



Metrics that Matter: Uncovering KPIs that Justify Operational Improvements

Conducted by



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Executive Summary: Metrics that Matter

Metrics matter in business performance. The better the company’s system for metrics, the more their operations performance improves, and the more their business and financial performance improves.

The quality of a metrics system is dependent on how fast data is gathered, how well metrics are linked, how rapidly results are displayed to the operators and supervisors who can take action, and how compressed the latency is between business metrics and the operations activities that caused them. Plant dashboards,

manufacturing execution systems (MES) and automated data collection can help speed all of these elements.

To come to these conclusions, MESA International teamed up with Industry Directions and a set of MESA sponsor members to uncover which operational KPIs help justify improvements. We conducted an on-line survey of 135 manufacturers representing a wide range of industries, manufacturing process modes and operating conditions. Out of these respondents, we identified a subgroup of *Business Movers* – defined as those who improved performance notably on an annual average basis over the past three years. These improvements could be either broad (by over 1% on six of 11 business metrics in the survey) or dramatic (by over 10% on at least one business metric on the survey). All who improved less dramatically, we refer to as *Others*.

Business Movers also represent current best practices in performance metrics and have achieved good operational results (see Figure 1). Clearly, operational improvements can result in sound business and financial performance improvements.

Characteristics of <i>Business Movers</i>	
Definition: Level of Business Improvement	Improved over 10% on one or improved over 1% on six of 11 business/finance metrics in survey
Metrics Capability	<i>Business Movers</i> Difference
Operations and business metrics effectively linked	67% more likely to be at least somewhat effective (65% vs. 39%)
Metrics data collection automation	50% more likely to have fully automated (15% vs. 10%)
Timeliness of displaying KPIs to operators whose activities they reflect	Over 2.5 times as likely to display results to operations in 24 hours or less (46% vs. 18%)
Latency between business metrics and operations that caused results	43% more likely to have weekly or 24 hours latency (50% vs. 35%), less likely quarterly or annually (10% vs. 16%)
Use of MES & operations dashboards	33% use MES vs. 25% of others; 33% use dashboards vs. 17%
Results	<i>Business Movers</i> Edge
Know what they measure for business	Over six times less likely to answer “don’t know what metrics are in use”
ROI on applications	31% of applications achieved ROI in under two years vs. 11% for others
Improvements against operations KPIs	Over 2.75 times as likely to improve over 10% on at least one operations KPI or over 1% on 10 operations KPIs (83% vs. 22%)
Outstanding or medium improvements in:	
Quality	62% more likely (73% vs. 43%)
Customer service	Over 3.5X more likely (61% vs. 17%)
Throughput	65% more likely (61% vs. 37%)
Flexibility	Over 2.4X more likely (51% vs. 21%)
Compliance	Twice as likely (50% vs. 24%)
Asset Utilization	57% more likely (44% vs. 28%)
Inventory	32% more likely (41% vs. 31%)
Figure 1: Respondents that improved over 10% on at least one business or financial metric or over 1% on 6 of 11 business metrics had better metrics systems and greater operations improvements as well.	

A lesson from Industry Leaders we interviewed by telephone is that manufacturers cannot and should not measure everything. For this survey, we reduced the scope of metrics to 19 operations and 11 financial metrics. Industry Leaders indicate the key is to focus employees on just a few metrics within their scope of control. If those areas begin to improve reliably, it's time to identify new metrics. The few metrics that matter may also change as business strategies and conditions change.

Another challenge this research highlights is creating a performance metrics system that does not negatively impact productivity. Manually recording data, re-keying data into a spreadsheet and manually calculating results can all be too time-consuming to be effective. At that point it becomes a tradeoff between productive activity and measuring results.

Automating data collection and the calculation and display of metrics should logically help resolve that dilemma. Based on the *Business Movers* results and the rapid ROI of MES, this appears to be the case. Companies using MES and plant dashboards are more likely than others to have improved significantly against both business and operations metrics, illustrating how these plant systems can support sound, speedy and efficient metrics systems.

Metrics by themselves don't improve performance; taking action to improve against the metrics does. Plant systems can provide rapid data collection, aggregation and display. They can also support root cause analysis, alert those who can alter the situation or feed metrics from a dashboard into the MES system to guide operators, supervisors or technicians to tweak the process. Those who have sound metrics systems are more likely to speed and support their performance measurement processes with IT systems as well as sound practices.

Perhaps the most telling responses to this survey are the areas in which respondents answered, "don't know." A notable portion of the respondents did not know what metrics their companies use at either the operations or finance levels. The majority responded that they don't know how much they have improved against metrics at each level. While some may feel their job does not require it, this may be an outdated notion. As shown by our phone interviews and the *Business Movers* data, informed employees make the most improvements.

Performance metrics tell the story of a company's or an operation's progress. A sound system of metrics that matter can truly propel business success. If you don't know whether you have an effective metrics framework, you probably don't. Watch out for your competitors in the *Business Movers* group. If they continue to improve at their current rate, they will likely overtake the market before competitors know what hit them.

Study Origins

The mission of Manufacturing Enterprise Solutions Association International (MESA) is to promote the exchange of best practices, strategies and innovation in managing manufacturing operations, manufacturing quality and in achieving plant floor execution excellence. Two areas of concern that have emerged for many MESA end user members are:

- 1) How their production improvement efforts impact financial performance.
- 2) How to justify investments in software applications that are designed to enable process and operational improvement.

This research project grew out of those needs. It is rooted in the MESA Metrics Committee, which was formed in 2005 to meet membership demand. The committee originally searched the market for available benchmark data on performance metrics and the performance improvements that could be expected from plant investments. The committee discovered that only a few documents were available that pointed to best-practice metrics and levels of expected improvement but that these documents were not publicly available. At that point, the committee asked independent analyst firm Industry Directions to create a research program that could begin to fill that need.

Industry Directions agreed to develop such a program and solicited funding sponsorship from individual MESA solution provider members. Along with MESA, these sponsors developed a list of key concepts to include in the scope of this foundational research and how to best approach the manufacturing community. Each of the representatives and companies involved has deep expertise in plant operations, operations metrics, plant dashboards and software, and they worked together to develop a program that would truly increase the market's understanding of how to improve performance.

This report on the findings of our research is one of two deliverables of a major research project undertaken during 2006. We also developed a guidebook for managers and practitioners that introduces metrics issues and concepts, and illustrates how to develop a framework, how to construct meaningful metrics and how to justify investments in operations systems and improvements.

This 2006 Metrics that Matter project is a foundational study that we expect will spawn further study and discussion. MESA International is planning for its members to carry this work forward in working groups. Metrics really *do* matter,

and MESA is committed to supporting its members in discovering and sharing best practices and moving industry knowledge forward.

Methodology & Response Demographics

Methodology

We used an on-line survey as the main method for gathering quantitative input from the manufacturing industry about its use of metrics and software systems to support manufacturing control and improvement. Our questions centered on what the

Metrics that Matter Research Team

Analyst Team – Industry Directions plus independent consultant David Caruso devised and conducted on-line and telephone surveys, gathered and analyzed data and wrote this report.

Industry Council – MESA end-user members prompted and guided the study team, vetted on-line and telephone surveys and reviewed this report and the *Guidebook & Framework*.

Industry Leaders – Respondents with good results who participated in telephone interviews provided thoughts that appear throughout this document.

MESA Metrics Committee – This committee drove the concept for original research on operations metrics. A committee member reviewed this report and the *Guidebook*.

Sponsors – Solution providers funded and guided the research based on their field experience; consultants from these companies co-wrote the *Guidebook* with the analyst team and other key contributors.

research and sponsor teams believed would be most useful and revealing in a foundational survey.

A group of MESA end user manufacturing members – the “Industry Council” – guided the development of the survey. (See box, “Metrics that Matter Research Team”).

The on-line survey gathered respondents’ views on:

- Which metrics they use at both the operations and finance levels.
- Which major areas of operations are most critical and most improved.
- Degree of improvement against operations and financial metrics.
- Effectiveness of the links between operations metrics and financial metrics.
- Timeliness of data in and out of operations measurements.

- Latency between financial metrics and the operations activities that caused that performance.
- The software in use and the source or style of system that provides each function.
- ROI on software.
- Whether current dashboards are actionable.

The research for this report was conducted in the spring and summer of 2006 by independent industry analyst firm Industry Directions. Simultaneously, we conducted

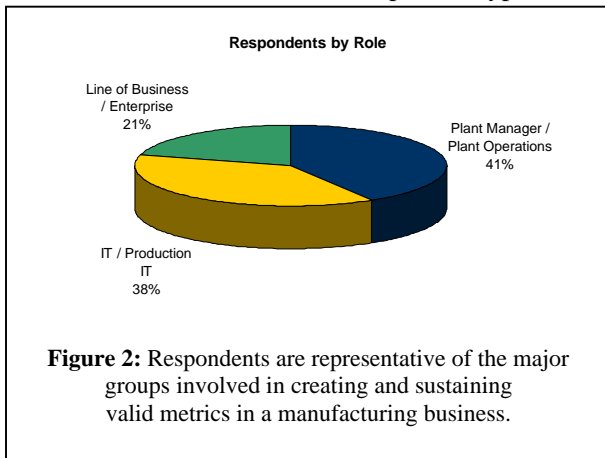
a set of 16 telephone interviews with “Industry Leaders” in a variety of segments. Industry Leaders are respondents to the survey who exhibited good performance improvements against metrics and were willing to speak with us about their experiences and views. Their comments appear throughout this report in light blue boxes. These interviews focused on:

- Aligning metrics with business strategy.
- Providing graphical displays for operators and business executives to visualize performance.
- Ensuring that metrics make sense in the particular production environment.
- Consistency of metrics across plants for effective enterprise comparisons.
- Impediments to effective metrics and how to overcome them.
- How metrics and systems can drive appropriate behavior.

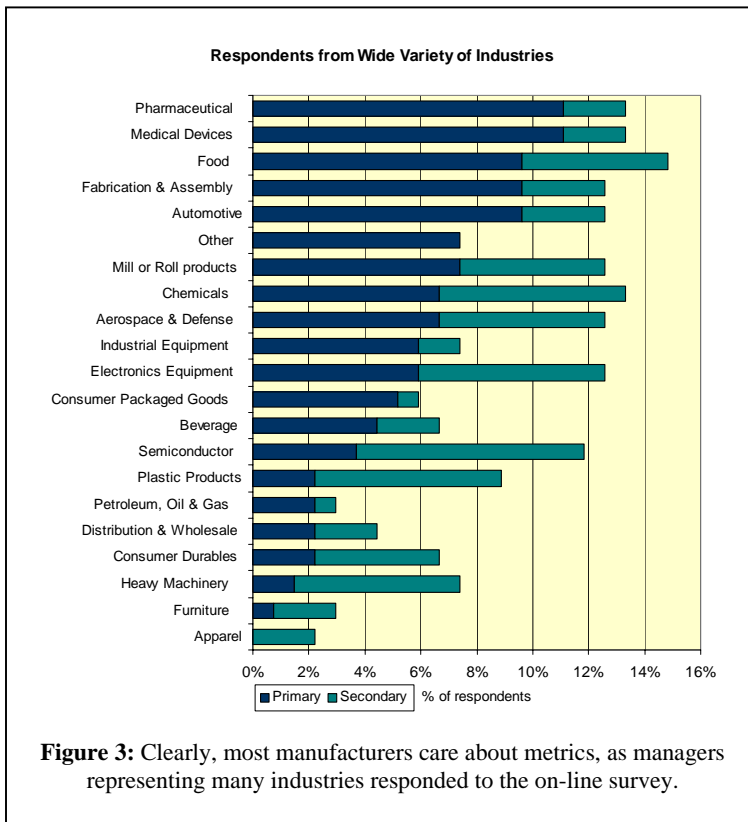
As with the on-line survey, the Industry Council reviewed the telephone survey script and question set before the research team initiated these calls. Interviewees were selected from on-line survey respondents who indicated a willingness to participate in a more in-depth interview and who had developed interesting practices or significant improvements. Independent consultant David Caruso was one of the research team members who conducted many of the telephone interviews.

Response

For the on-line survey, we received 151 valid responses. Of that group, 135 were from end-user manufacturing or distribution companies. This group of 135 is represented in the charts, graphs and statistics throughout this report. While the other 16 – mostly consultants, solution providers and integrators – may have had valid views, they were not included to ensure accurate industry representation. Among the 135 included in the analysis, there was an excellent distribution across roles, industries, process types, mix and size.

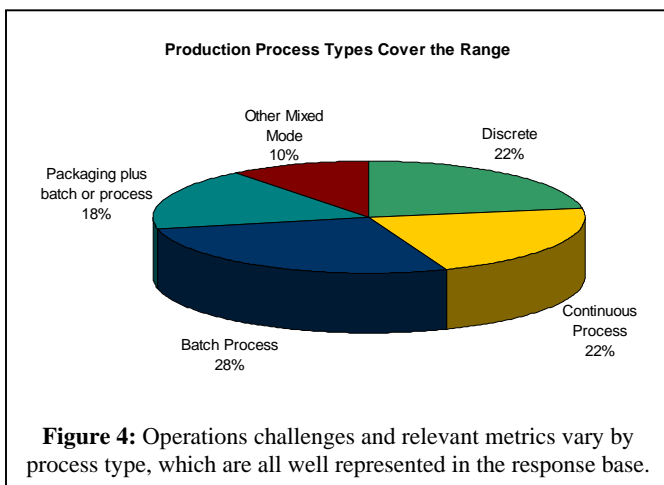


One of the challenges in ensuring that a company uses metrics that matter is the need for several groups to be involved: operations or plant management (including quality, engineering, maintenance); information technology (IT), finance and accounting and lines of business (LOB). The largest portion of our respondents is from the plant and IT groups, which are MESA’s main end user member constituents (see Figure 2).

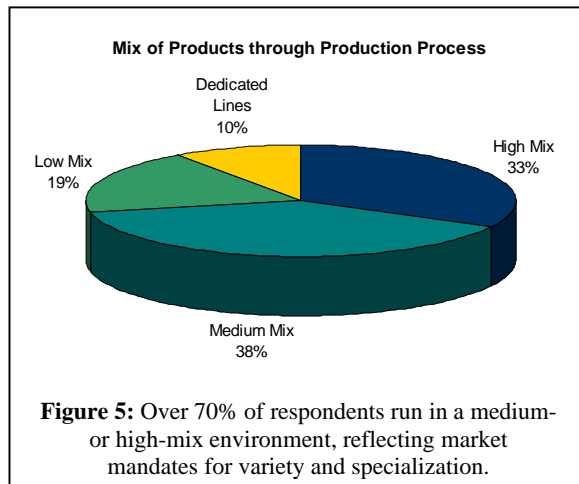


We also gathered responses from every major industry segment included in our list of possibilities (see Figure 3). Respondents chose the industry label that best described their site’s primary product and industry. They could also indicate secondary industries in which their company participates. Each industry individually had too small of a response base to provide statistically valid information from their responses, but it is significant to note that all of these major industries are represented by study respondents.

To determine if there is continuity in terms of need and execution, we grouped companies with similar production processes and challenges together for analysis by asking respondents to select a description of their production process. Respondents to the on-line survey encompass all the major process types specified in the survey, including batch, continuous, discrete, packaging plus batch or continuous and other mixed mode (see Figure 4).



There is another factor that can impact metrics and a plant’s ability to perform well against them, which is the number of specific products and product mix through the plant. One-third of the respondents’ plants process over 200 but less than 1,000 stock keeping units (SKUs), while 21% process more than 1,000 SKUs. At the low end of the spectrum, 29% process 25 to 200 SKUs through their plant, and 17% process fewer than 25 SKUs through the facility.



As a result, the mix through these plants – which we allowed the respondents to define for themselves – is overwhelmingly high to medium (see Figure 5). Higher mix requires more changeover time, often more materials and more equipment calibration time. These plant environments are also more susceptible to error. For this reason, the metrics for low-mix plants may not be valid for higher-mix facilities. Only 10% have dedicated lines that can be tuned to run a single product at top efficiency.

The last demographic difference is revenue of the company, location or division to which the respondent's answers pertain. Respondents are nearly evenly divided among those over \$2B, those under \$500M and those between \$500M and \$2B. Since we did not require them to answer for an entire enterprise, the responses broken down by size don't necessarily point to differences between companies in different size ranges. Some of the responses from small locations could represent just one plant of a large enterprise.

Metrics: Assessing Viability

The Institute for Supply Management shows that manufacturing factory activity in the U.S. has been growing every month for the past four years. Manufacturing growth in the EU and Japan has also been strong recently, according to JP Morgan. Yet, reading the popular press, you might think that the first-world industrialized nations are pulling out of manufacturing. Part of the reason for that is that manufacturing often looks as if it's not healthy or even viable in financial terms.

Offshoring and outsourcing can shrink the value of the asset base, thus improving return on net asset results. These practices may also allow the company and its most experienced employees to focus on higher value-added work, serve global markets more effectively and lower production costs. Other impacts of offshoring and outsourcing are not so positive. Long lead times generally mean an increase in inventory; long distances increase freight costs; certain locations are prone to political upheaval or natural disasters; and the difficulties of management and knowledge transfer

One Industry Leader who had been a plant manager at a facility being phased out in favor of outsourcing reports, *"The company did not make this decision with a total lifecycle view. As the company went from manufacturing to buying products, it was cheaper, but they also sold them for less. Their cost objectives were achieved, but profit and sales went down."*

may result in lower quality, less advance visibility and an increase in risk.

Some financial metrics are pulling manufacturing into lower-cost regions for outsourcing and offshoring, while other supply chain and operations metrics are keeping companies in their home markets or even bringing outsourced production back in-house.

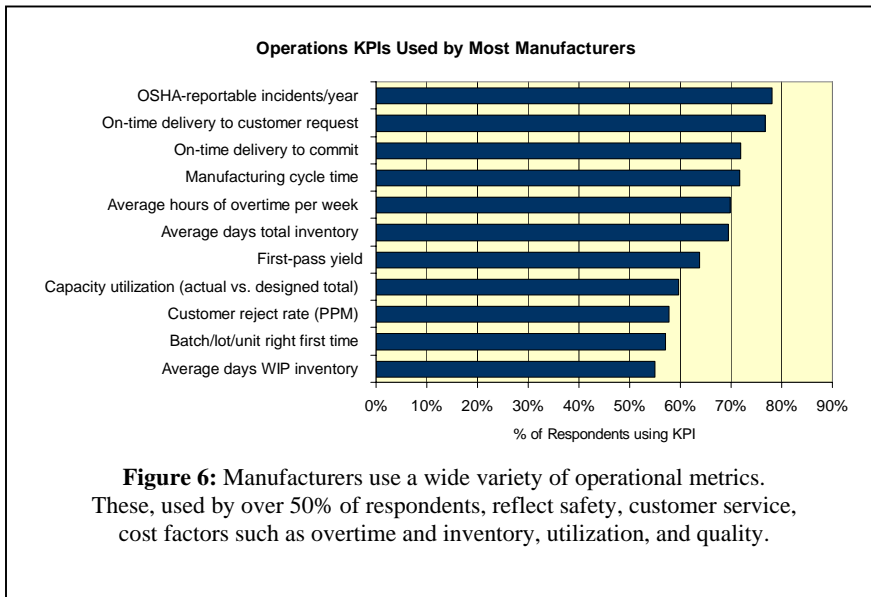
This is just one top-level example of trade-offs between metrics. In this case, improving the core metrics by which companies are measured financially can lead down paths that make other metrics look worse. Operational metrics are often in conflict with financial or business metrics.

Despite the conflicts, metrics *do* matter. Metrics are the foundation of assessing the viability of a company and each of its facilities. The key is to understand which metrics matter to the ongoing success of each company and each location. This study looks at both plant-level metrics and business or financial-level metrics.

"About 120 KPIs are reported, and of those, a handful is important," says an engineering department manager in one metrics-driven Industry Leader company.

There are at least as many plant-level or operational metrics as there are production facilities in the world. Our on-line survey specifically looked at the use of 19 operational metrics and nine financial metrics in the manufacturing companies

surveyed. This dramatically simplified view does not necessarily represent the diversity of measurements used in the industry. However, it does provide a view into the use and improvement against some common metrics. Clearly, each company may have more than two levels of metrics. In the ideal world, each level will focus on just a few true indicators of performance to critical success factors (CSFs).



Operations KPIs

For this survey, we presented respondents with 19 operations key performance indicators (KPIs). Of the KPIs in the survey, 11 are in use by more than half of the respondents (see Figure 6). The other eight are OEE, CpK, scrap/rework as %

Sometimes delivery metrics conflict, according to one Industry Leader. *“If a single order includes both standard products with fast lead times and others with longer lead times because of material procurement, which metric takes precedence: due date compliance or ship complete? Some customers may want ship complete, and others will prefer velocity on part of the order and get the rest when we can ship it.”*

of sales, toxic waste reduction, planned vs. emergency maintenance, energy consumption per unit produced, warranty costs and upside production flexibility.

The most widely used KPI in this survey is related to safety compliance. This is not surprising, since every manufacturer in the U.S. is required to comply with regulations from the Occupational Safety and Health

Administration (OSHA) and report accidents or safety incidents. Discrete manufacturers are the only group in which less than 70% report tracking this metric. We are not sure why this is true, but it may be that the regulatory compliance group has more distance from the operation than in process operations.

Significantly, two of the top three operational metrics concern on-time delivery: On-time delivery to customer request and On-time delivery to commit. A larger proportion of this group measures delivery to request as the more important metric. This trend demonstrates the growing sophistication of manufacturers’ supply chain management efforts – and the increased clout customers carry. In fact, 70% or more of every process type track on-time delivery to request.

The next most commonly used metric after on-time delivery is manufacturing cycle time, an indicator of ability to respond rapidly to changes and maximize plant throughput. To achieve a short cycle time, companies must not only design

processes well, but create effective schedules, ensure high quality, maximize yields, minimize changeover and downtime, and keep materials moving through the process. Since so many aspects must work well to achieve and sustain it, cycle time is an excellent plant performance metric.

Next, overtime and inventory are cost factors that directly affect financial results. Capacity utilization generally reflects the return on assets challenge that manufacturers face – it can be useful, but it may also work against low inventories. A metric that less than half of the respondents use – but that is still quite common

OEE – The Standard KPI for Some

For years, OEE has been a bellwether of performance for manufacturing managers in capacity constrained and process industries. OEE stands for Overall Equipment Effectiveness, and essentially it’s a measure of three machinery-based factors: availability, performance, and quality. In today’s implementations, OEE gathers uptime/downtime counts from the automation equipment and product performance data from the quality system, then correlates this with information from production schedules. Because of its holistic view, many managers feel that OEE is the best tool for managing operations in the context of cost- and efficiency-focused manufacturing.

While machine and asset-intensive industries have used this metric for quite some time, now managers in discrete industries are adopting it in a slightly modified version: by making it less equipment specific and introducing labor and assembly operations, OEE becomes more plant-wide in its view now, representing Overall Factory Effectiveness. With a manufacturing schedule that is accurate for customer demand, this metric in many ways becomes a measure for best achieving the conversion of manufacturing investment to margin dollars.

in equipment-intensive process industries – is overall equipment effectiveness (OEE). (See box, “OEE – The Standard KPI for Some”).

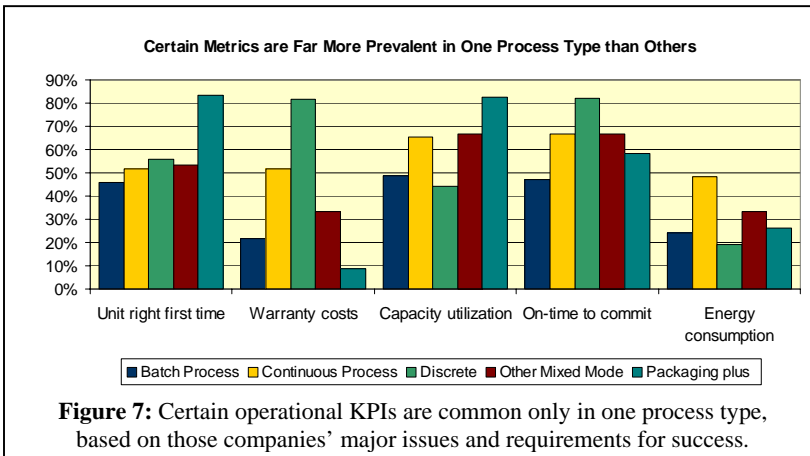
The other three most commonly used KPIs are quality-related. These include first-pass yield and batch/lot/unit right first time, both of which judge how reliably the process output results in good product. The third is customer reject rate, which measures the quality problems a customer actually detects. As we will see later,

“Targets must be responsive as conditions change so I can tell whether I am performing in an optimal manner to the benefit of the company,” says one IT Project Manager.

quality is a critical aspect to success; we suspect that various companies may use slightly different quality metrics or different terminology than in the survey in some cases.

What Operations Metrics Matter

What metrics actually matter to an operation depends on strategy, industry segment, process type and production and market conditions. It’s important to note that metrics should not remain static. As a business changes, the metrics that are most relevant to achieving success are likely to change, as well.



While on-time delivery, safety and manufacturing cycle time are high on everyone’s list, other metrics are common only in certain types of industries (see Figure 7). For example, 83% of batch plus packaging facilities measure batch/lot/unit right first

time, while less than 60% report using that metric in any other segment. Similarly, most mixed-mode facilities measure overtime. About half of continuous process plants track energy consumption per unit of production, but a minority of others. Discrete is more likely to track warranty costs and on-time delivery to commit.

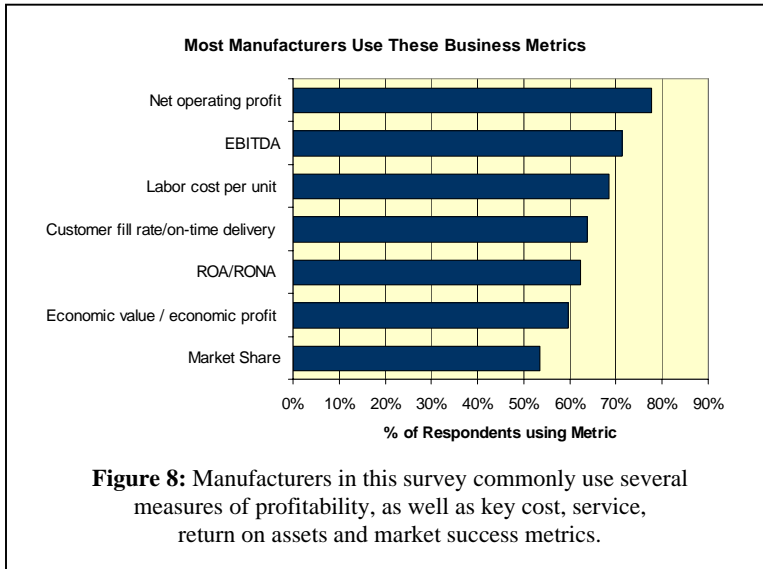
The Industry Leaders who participated in our telephone interviews indicated that it was important to have as few metrics as possible and review them frequently. Nearly all reported that some metrics are critical for achieving a

One Industry Leader reports, “As we see certain trends, we’ll be looking for root causes, which may lead us to use new KPIs.”

certain set of improvements or results for a certain period of time and may lose relevance after that. New challenges and a new focus can re-energize continuous improvement programs.

Financial & Business Metrics

Top-level financial metrics are largely dictated by regulated reporting requirements in the region of the company headquarters. In the U.S., these reporting metrics and means of measuring them are usually called generally accepted accounting practices (GAAP). That means certain income sheet and balance statement metrics are consistent across all public companies in a region or country.



How manufacturers measure their own financial and business success beyond the regulated accounting metrics is somewhat consistent (see Figure 8). The most commonly used business metrics relate to profitability or earnings, labor costs, customer delivery, return on assets and market share.

Naturally, profitability is the key to any company's

ongoing success. Net operating profit is a critical measure, as is earnings before interest, taxes, depreciation and amortization (EBITDA). Likewise, quite a few companies use an economic value or economic profit measure. Economic value-added measures the after-tax cash flow generated by a business minus the cost of the capital it has deployed to generate that cash flow. This is in some ways a more accurate view of real profit. Economic profit is usually defined as the total revenue minus opportunity cost or total operating cost.

"We are starting to see that by having KPIs such as OEE, we can see what our biggest Pareto of downtime is and go into our ERP system, slice and dice info in our BI system and translate operational KPIs into financial KPIs," says one Industry Leader.

Productivity measures such as revenue per employee, value-added per employee and revenue per square foot were not common among the survey respondents. All of these ranked at under 40%, despite the interest in labor costs per unit.

Improving Against the Metrics

Of course, metrics in and of themselves do not improve performance. They measure performance and indicate where changes may be needed to remain competitive. The important thing is how much plants have improved against the

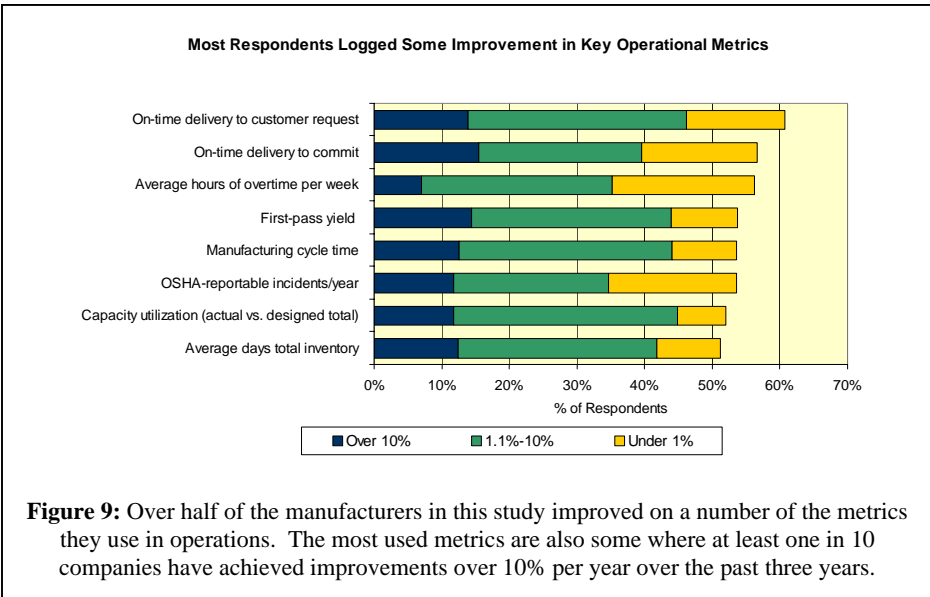
“Dashboards must show metrics that you CAN act on and react to right away. You won’t change inventory turns in a day, and ROI would not be actionable, so why look at that on my dashboard?” says one Industry Leader.

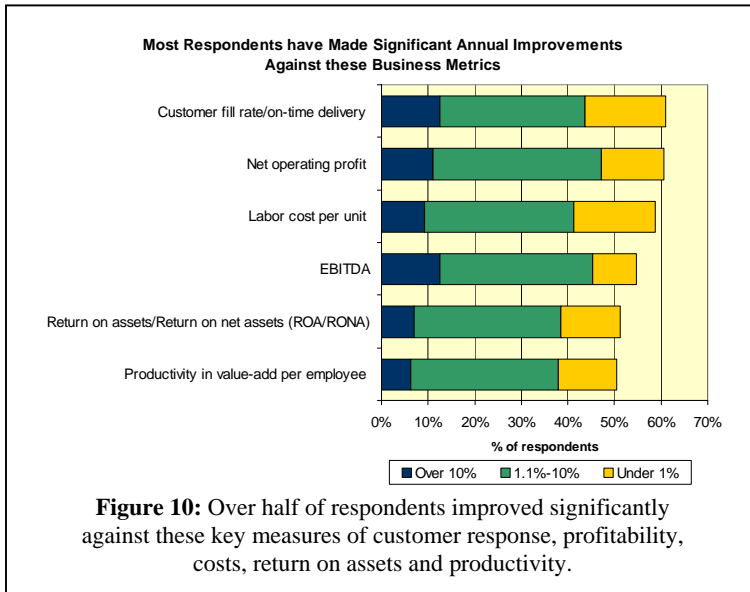
operational and business metrics they use. To smooth out business volatility, these responses are based on average improvements over the past three years.

The concept behind metrics is that if you measure something and show employees their performance, they will be motivated to improve along that line. Particularly with operational metrics where the levers to accelerate performance can be more apparent, it appears that in this group of manufacturers who responded, many are improving what they measure. For example, customer on-time delivery metrics are widely tracked, and also logged the most significant improvements on average over three years. (See Figure 9.)

Not only did larger portions of the response base improve against on-time delivery metrics, a significant portion improved over 10% on an annual basis. More than 10% improved over 10% per year in delivering on-time to customer request. This illustrates just how quickly the performance bar is rising for manufacturers as customers become more demanding and have easier access to a variety of manufacturing suppliers.

In fact, just over half of the respondents improved performance significantly on the group of 19 operations KPIs used in the survey. Of the 135 total respondents, 68 improved by 10% on at least one measure or improved by over 1% on more than half of the measures (at least 10). Within that group, about half improved performance by 10% or more annually against at least three of the metrics listed.



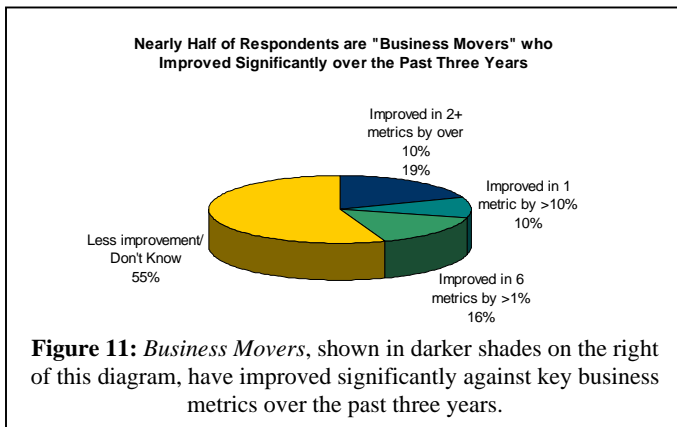


On the financial side, there is a similar group of metrics against which most of the respondents reported improvement (see Figure 10). Again, customer service was the number one area for improvement, followed closely by net operating profits and labor cost per unit. These improvements can transform a manufacturer into a market leader or shareholder favorite. Consider particularly that these are average improvements over the past three years.

Significant business gains were slightly less common than significant operational gains. Since the group of business metrics was about half the size of the group of operations metrics in the survey, the improvement criteria are similar. The group we will refer to as *Business Movers* are those who improved the most dramatically, defined by either improving over 10% on at least one business metric or improving over 1% on six different metrics of the 11 included in the survey (see Figure 11).

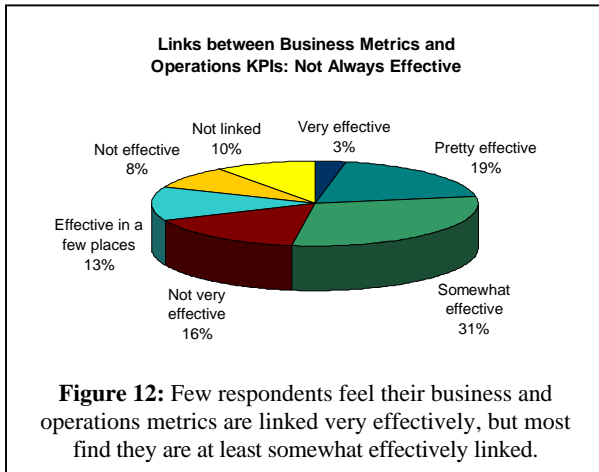
This group of *Business Movers* presents a considerable challenge to their competitors. Whether they are lowering costs, increasing customer service or getting a greater return from their assets, these businesses are increasing profitability more rapidly than others. Profit is both the top indicator and a major driver of ongoing business success. Growing profits allow the company to reinvest to continue and accelerate improvements, and they keep shareholders happy. We will discuss key characteristics of this group of rapidly improving companies in

the section, A Profile of the *Business Movers*.



Linking Business and Operational Metrics

To achieve maximum business performance, it's important to align or link operations KPIs to financial metrics. The concept is for business strategy to drive business and



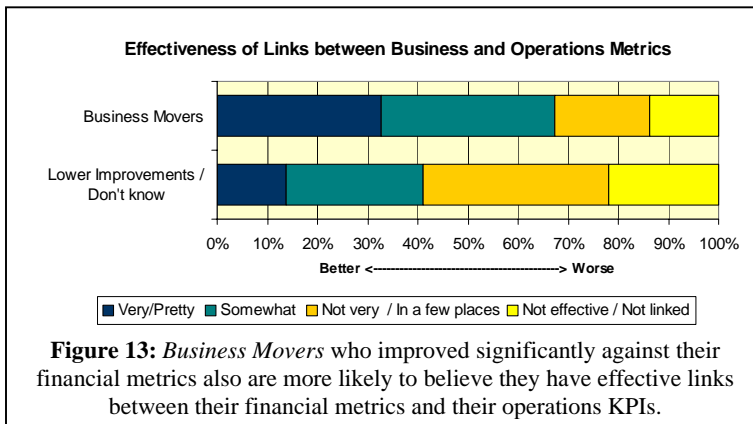
financial metrics, and for those metrics to link into operations metrics, since the activities in operations naturally drive business results. At best, the links between various levels or sets of metrics are logical relationships and not formal algorithmic links. Yet the logic must be clear for employees to align their activities and expectations effectively.

While the concept is straightforward and most manufacturers understand it, achieving

"Our success sharing bonus is tied primarily to our profitability," says one Industry Leader. "If we make a few extra percent, everybody would share an additional amount in their bonus. We have charts all over the plant on how we are doing against that goal. That makes it more real to people on line and maintenance technicians."

the state of well-linked metrics is not common (see Figure 12). About half of the respondents believe there is at least a somewhat effective link between their operational and financial metrics. But it's possible that some of the respondents who report that they are doing a good job with metrics simply understand how much more progress there is to make.

When operational metrics are not in tune with business goals and metrics, the possibilities for conflict and working at cross-purposes are great. Naturally, when parties are pulling in opposite directions, each group has diminished ability to improve on their own set of metrics. The on-line survey also shows this effect (see Figure 13). A much greater portion of the *Business Movers* who improved



significantly feel their metrics are at least somewhat effectively linked (65%) than the group that improved less (39%). The point is, companies need to link business and operations metrics effectively to ensure that improvement against a KPI will make a difference in business success.

The Business – IT – Operations Disconnect

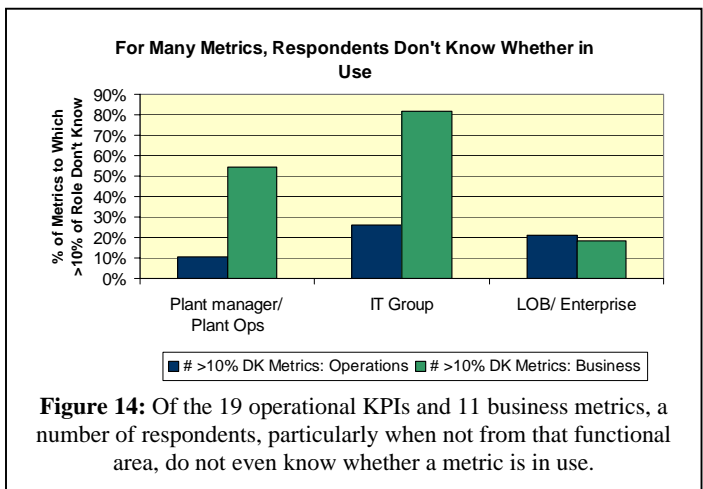
Manufacturers need to assemble a multi-discipline team to establish a system of metrics that links strategy to financial success and to operations improvements.

“The trick is to break out of the siloed thinking,” said one IT Industry Leader who was befuddled by financial metrics. “I work on our SPC program in manufacturing, and the same principles could be applied to the business. People tend to get locked into budget that way. They worry: am I ahead or behind today?”

Employees from plants and operations must work with the accounting team to understand one another’s goals and how they might link. IT also needs to be part of the team to create ways for metrics data to be gathered, aggregated, disseminated and displayed appropriately.

Unfortunately, in many companies these three groups do not have a good view into one another’s worlds. Since respondents to the survey are from different companies, it’s somewhat misleading to make comparisons among answers to specific questions. However, taking an aggregate view shows that most finance groups have a fairly good idea of the metrics in use

(see Figure 14). However, while plant operations respondents know what operations KPIs are used, many are not aware of business KPIs. Meanwhile, IT respondents were less knowledgeable than the other groups about what metrics are in use in general.

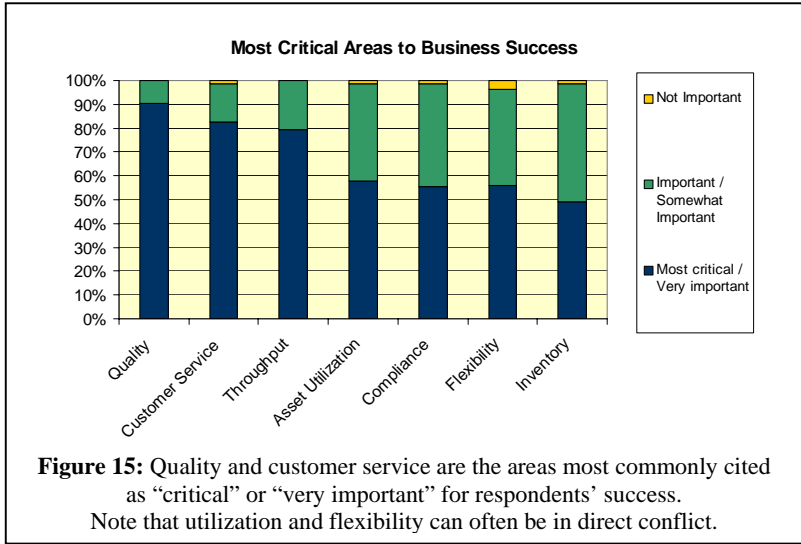


As we discuss later in this report, what you don’t know can hurt you. Clearly, in building the team to align and link metrics, all three of

these groups will need to be educated about what the other groups measure. This education process sometimes uncovers metrics that are in conflict – either at different levels or in different areas of the plant. For example, capacity utilization may look bad when responding to the objective of achieving customer fill rates for a wide variety of products through a single plant. In short, “don’t know” can be a detrimental answer to your ability to improve overall business performance.

Improving What Matters

Metrics ideally focus on measuring performance in areas that matter most to the company’s success. Since the operations KPIs and even financial metrics cover a wide range of topics, some will carry more weight than others. A variety of issues may make a major difference in the health of a company, based on its industry segment, process type and approach to competing in the market.



Critical vs. Improved Areas of the Operation

Beyond the questions on which KPIs are in use and the degree to which companies have improved against those measures, the survey included a somewhat simpler question about what matters most to manufacturers by major area of metrics (see

Figure 15). The areas we covered include quality, throughput, asset utilization, inventory, customer service, compliance and flexibility. Respondents could rate each area as critical, very important, important, somewhat important or not important.

Quality and customer service were almost universally cited as “critical” in any industry or segment. Quality – when achieved at the source through low-variation processes – drives improvements in costs, inventory needs and throughput. It is also a foundation for brand reputation, which impacts revenues by allowing

premium prices and increasing customer loyalty.

Quality ranks as the most critical factor for every production mode, but in packaging plus process or other mixed mode, customer service is essentially equal in importance to respondents, based on the average of their responses. Customer service is, of course, the other cornerstone for customer satisfaction and loyalty, rated as a close second to quality for most respondents.

Correlating customer experience in the field to in-plant product and process quality is an important exercise that leaders are undertaking (see box, “Field Experience Drives Operations Metrics Design”). Throughput is a major driver

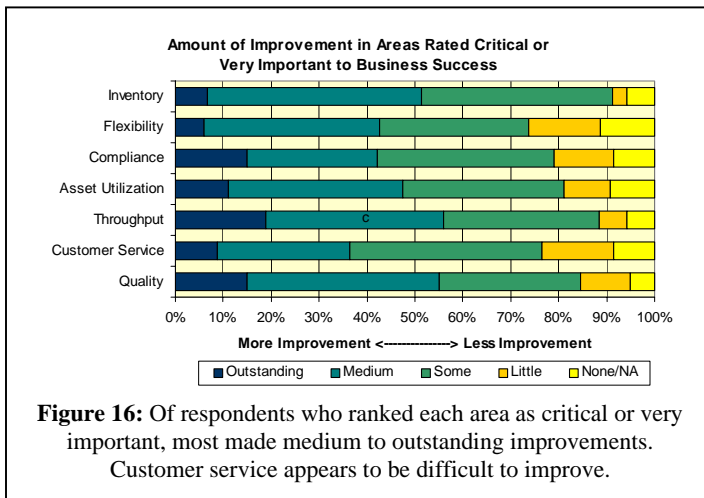
Field Experience Drives Operations Metrics Design

“Cost and quality go hand in hand” is the mantra for nearly every manufacturer we surveyed. Now, leading manufacturers are starting to close the loop between product quality in the factory and the customer experience.

Many companies are working on tying field performance back to materials and production activities in the plant. Measuring out-of box failures, return rates and the cost of warranty and repairs is becoming more of a priority – especially for pharmaceutical, medical device, electronics and automotive manufacturers.

While the specific metrics vary by product and supply chain, an overarching need is to weave this into MES systems and the metrics strategy. This means they need to ensure that the required data is collected and assembled in the appropriate context. Context enables analysts to correlate field incidents to in-house quality data to determine the root cause of failure and take appropriate preventative actions.

In many cases, our interviewees said this exercise had the side benefit of causing the company to revisit its metrics strategy. They set out to understand: What do these metrics tell us, and do we need to design different tests that provide better insight into the products’ performance?



of profitability for many plants and particularly for continuous process industries, for which it places second in average ranking by importance.

For the same seven areas, respondents reported which aspects of their operations are seeing the most improvement. As we would expect, some of the most dramatic improvements are in quality, which also ranks as the most critical to

the company’s success. Figure 16 shows improvement levels only for those who rated each area as critical or very important to achieving the company’s top business goals. The areas are shown in order of overall ranking of “critical” or “very important” by the total response base.

“We need to provide a diagnostic to each metric so we can see what are we doing right and what can we improve on,” one Industry Leader says. “With that repository of information, we know where our pain points are and what the value is if we make an investment.”

Throughput has seen the largest percentage of outstanding improvement, and part of that might be driven by the need to increase volume as the economy improves. Customer service, which is also very important, appears far more difficult to improve – partly because so many elements are involved and potentially because customers are ever more demanding.

Inventory is a major focus, and a larger portion of respondents achieved at least some improvement on that front as a result. However, with increased volatility, mix and global uncertainty, outstanding inventory reductions are very rare.

The *Business Movers* who improved significantly on business metrics were much more likely to see medium to outstanding gains in these seven major areas (see

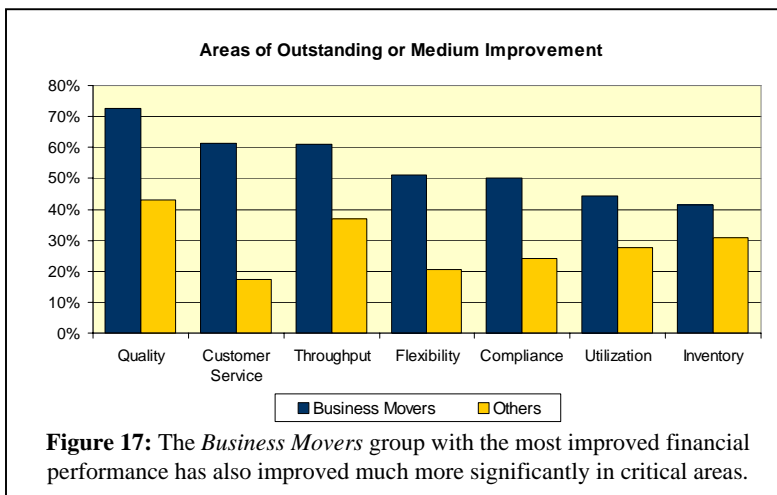


Figure 17). Their most significant improvements were in the same areas that the total group rated as most important to their business success. The correlation between areas critical to the business and those most improved is also better among this group.

What You Don't Know Can Hurt You

As W. Edwards Deming said, you can't measure what you can't see, and you can't improve what you can't measure. Put another way, those who don't know, can't improve – and if someone else is improving while you are not, the health of the business may suffer.

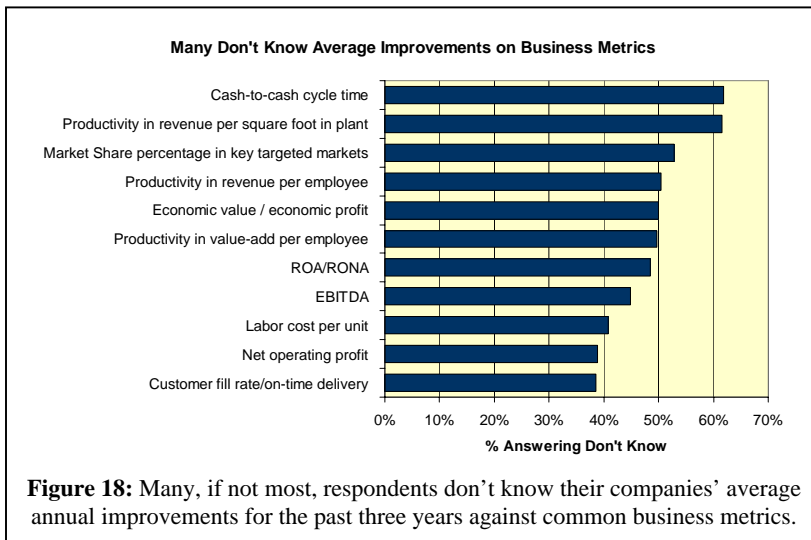
One small company Industry Leader says, "When I came here in the 1970s, nobody was looking at the efficiency of the line, so I started registering just the number of potential vs. actual units per hour and put it on the board so everyone could see it. In their curiosity, they saw issues and quickly got it up by 15%."

There are several ways in which respondents might not know how they are doing – one is simply not knowing what metrics are important and how much the company is improving against them. Another is not knowing about performance issues in time to do anything about them. Manufacturers struggle with both of these.

Don't Know: Deadly Answer?

While everyone who responded to the survey is clearly interested in the topic of metrics, perhaps the most interesting finding is how many respondents did not know how much they improved against each metric listed. Some did not even know which metrics their company considers to be important to track.

When respondents were asked to rate the importance of various metrics, three areas out of the 19 being tracked in the survey garnered over 10% "don't know" responses. These three are relatively industry-specific: warranty costs, energy consumption per unit of production and upside production flexibility. Beyond those three, at least 5%, chose "don't know" as to the use and importance of another six operations KPIs.



Knowledge of financial metrics was even less widespread. Of the 11 financial metrics, five had over 10% "don't know" responses: cash-to-cash cycle time, economic profit/value, EBITDA, productivity per square foot and market share. Many – and on some metrics, most – respondents don't actually know how much

“Implementing new metrics systems almost borders on a religious debate,” says one Industry Leader. “Do you understand your business enough to believe these activities will add value? You don’t know what you don’t know.”

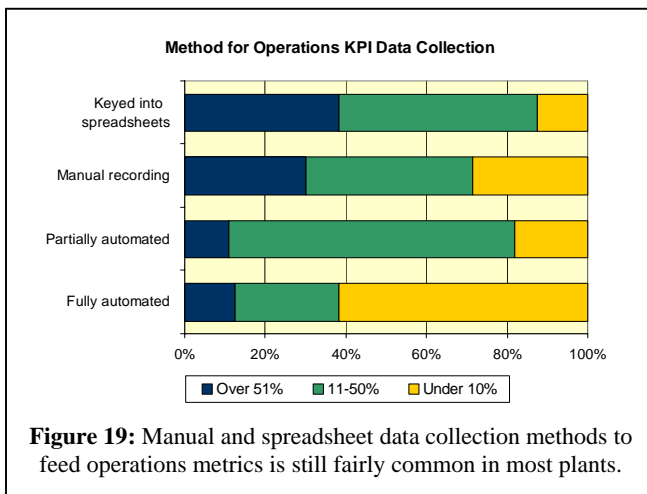
they improved against business metrics, even when they do know which ones are important (see Figure 18). Some of the Industry Leaders we interviewed said that financial performance can be a great motivator.

The number of respondents who don’t know improvement levels against operations KPIs is similar. For some of the less-used metrics such as warranty costs and overtime hours, over 70% of respondents simply don’t know how much they have improved. Like the financial metrics, at least 39% selected “don’t know” on every metric. So plant employees are addressing the issue of the day, whether it’s critical to overall performance or not.

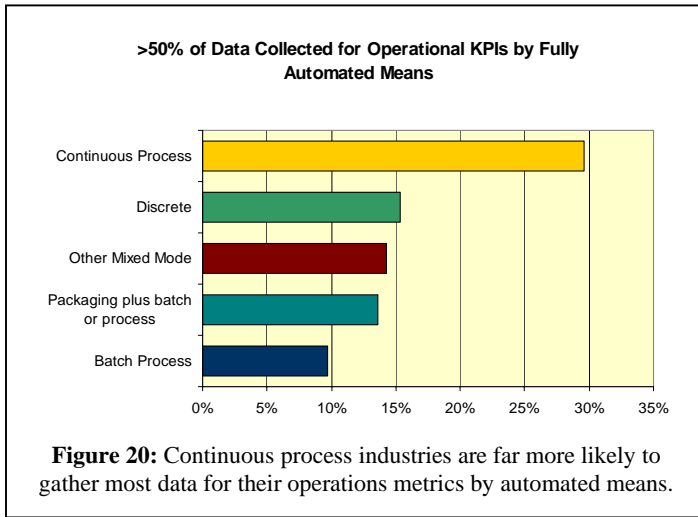
It’s increasingly important for management to know how their business is doing; Sarbanes-Oxley requires it for U.S. public companies. However, if employees don’t see performance metrics, they cannot provide accurate reporting – much less advance notice – to executives. Companies need integrated systems within the plant to see how they are performing, and they need these systems between plant and enterprise systems to stay aligned. Companies need to implement operations performance management systems that inform a broader swath of employees about results and also feed enterprise performance management systems far more effectively.

Speed & Latency of Metrics & Delivery

Time is of the essence. In many cases, even if respondents do know what metrics their companies use and how much they have improved against them, they may not know in time to take action and change the outcome. That is mainly a question of speed of data collection and metrics displays – as well as the latency between operations occurring and being measured.



One of the key questions around operations metrics in particular is how the data is collected. Traditional data collection methods of handwriting and keying data from instruments into spreadsheets can introduce not only errors but also time lags into performance data. Among our respondents, a large portion still manually enters data into spreadsheets (see Figure 19). Clearly, there is quite a mix of methods in most plants. Yet over



60% of respondents report that they gather less than 10% of the data collected for their operations metrics in a fully automated way

The big exception to this rule is continuous process industries (see Figure 20). With their highly automated and instrumented processes, many process plants can, in fact, gather much of the data for their operations metrics without human intervention. Very few other industries are currently in a

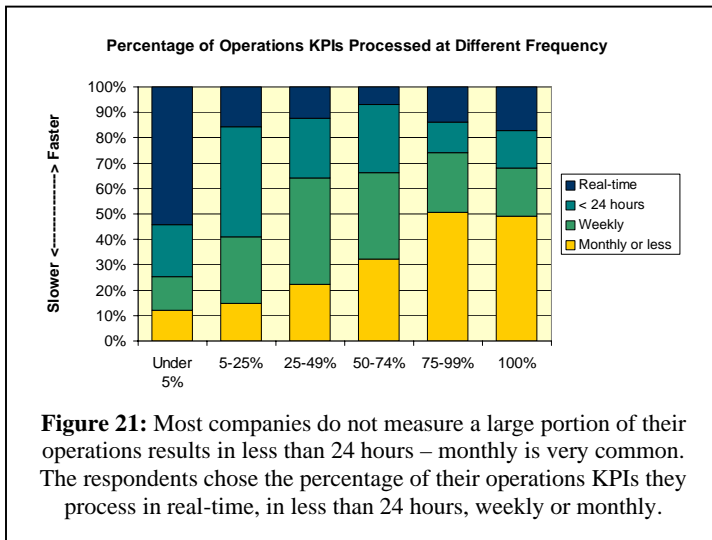
position to do so, based on the data output capabilities of their control systems and the state of integration between controls and business information systems. Few can gather and aggregate data into information for metrics use without human intervention.

One Industry Leader with a dashboard system says, "We leverage the PLC data now, so when we have a problem in the plant, we can identify it in hours, not weeks. I think that data is also valuable on a daily basis, not just when something goes wrong."

In many plants, operations staff members conduct a meeting at the beginning of each shift to ensure everyone is aware of status and current top priority issues. However, many respondents report that they don't process operations KPIs frequently enough to feed daily reviews effectively

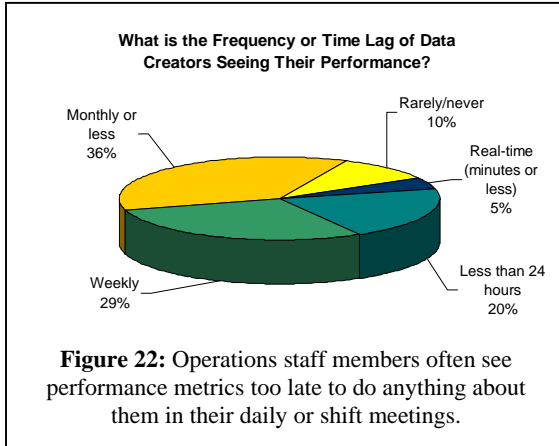
(see Figure 21). This does not mean operators don't have alerts and alarms that help guide their activity, but it's harder for them to tell which problems are impacting the areas of performance they care most about.

Again, continuous process industries are most likely to measure more than half of their operational KPIs in real-time.



The 38% of process industry respondents represents more than twice the proportion as the next industry, discrete, at 15%. So being instrumented for automated data collection appears to be a foundation for providing operations metrics in real-time.

Given that operations metrics are not processed very frequently in many plants, it follows logically that the operations staff whose



actions cause that performance do not see metrics immediately, which can negatively impact performance (see Figure 22).

Nearly two-thirds only see operations metrics on a weekly or monthly basis, and one in 10 report that those whose activities are being measured rarely or never see the results of their efforts. Since so much data is collected semi-manually and keyed into spreadsheets or other systems, this time lag is not surprising. Automating data

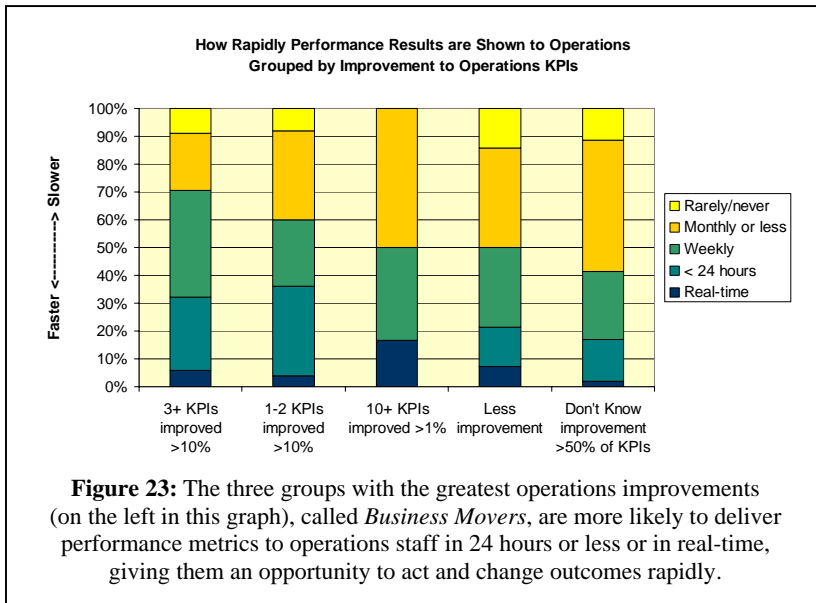
collection and metrics aggregation and display could really improve this lagtime picture – and companies’ performance.

In this research base, a much larger portion of the respondents who improved performance on at least one operations KPI by 10% display those performance

“We have real-time data. So if a measurement drops below a pre-set threshold, we have an alarm and an e-mail is sent out,” says one Industry Leader. “If that happens in another plant without MES, they could build many more with the same defect. Here, parts go on hold immediately and the problem is solved.”

results to operations staff in 24 hours or less (see Figure 23). We did not ask them to define the mechanism for display, but it’s apparent that most do not have an operations dashboard but are using reports and spreadsheets that might come in e-mail or be posted on the wall. While one-third of respondents in the two groups in Figure 25 who improved at least 10% on one operations KPI display metrics to operations within 24 hours, another significant group displays performance weekly.

The third group, which improved more modestly but against a wide range of KPIs,



actually has the largest portion of real-time display of performance. (The top three groups together are considered *Business Movers* in this report, and they are profiled as a group in a later section.) Their broad improvement illustrates the power of having metrics displayed so that the appropriate people can take action to improve performance, resulting in broad-based

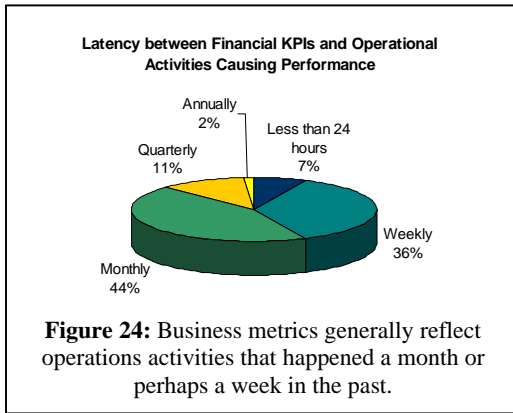


Figure 24: Business metrics generally reflect operations activities that happened a month or perhaps a week in the past.

gains. Over half of those *Others* who improved less dramatically or don't know how much they improved display performance results to operations staff monthly or less frequently.

If a rapid view into their performance allows operations personnel to act more effectively and improve, it might be useful to see the financial impact rapidly as well. This will allow everyone to prioritize activities to meet financial goals, both at the operations and business levels of activity.

While there is no algorithmic link between operational and financial metrics, the relationship is clear: activities in operations are a major driver of financial results. Looking at the latency of financial KPIs in reflecting the operations activities that caused that performance, most companies have a monthly or weekly cycle (see Figure 24). This is not very surprising, given that most companies report financial

performance only quarterly. As companies need to control performance more closely, we expect to see more get to weekly and even more frequent latency between activities and financial metrics.

"We differentiate by giving our people business information, so when they are looking at plant floor KPIs, they will know how much their plant is costing and how much revenue it's making," one IT manager in a mill reports.

The correlation between speed and improvement levels illustrates a similar effect on the operations side. The *Business Movers* who improved the most have shorter latency between financial metrics and operations that they reflect. Over half of *Business Movers* have weekly or less latency between financial metrics and operations, in contrast to one-third of others who do (see Figure 25). We will discuss this further in the next section, which profiles *Business Movers*.

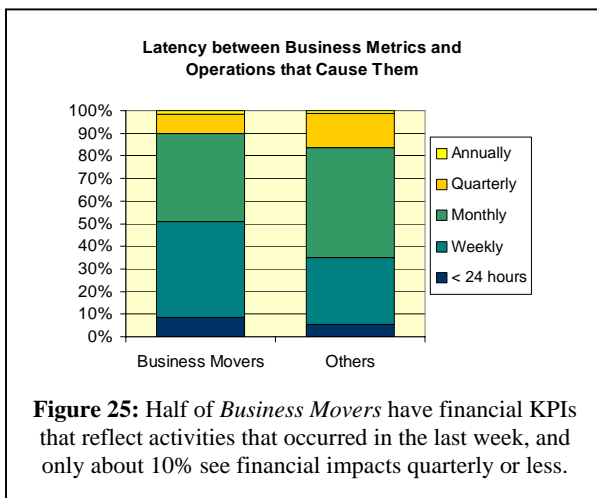


Figure 25: Half of *Business Movers* have financial KPIs that reflect activities that occurred in the last week, and only about 10% see financial impacts quarterly or less.

In short, the companies that know the most about their performance – whether operations or business – improve the most.

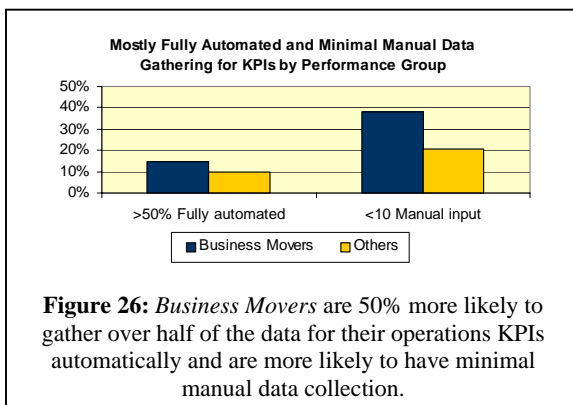
Those who know less improve less. Given that there are likely to be these rapidly improving companies among a field of competitors, companies that cannot see their performance issues rapidly will suffer.

A Profile of the *Business Movers*: Model for Success

The *Business Movers* group that improved most dramatically against financial metrics shows some distinct characteristics that impact their success. We defined this group as those who either improved at least 10% against one or more of the financial metrics or those who improved by over 1% on over half of those financial metrics, on average, over the past three years. As shown in Figure 11, these *Business Movers* compose 45% of the response base to this survey. While these companies are grouped by financial performance improvements, they also improved more dramatically on more of the operations KPIs in the study.

So these companies are not necessarily the leaders in their markets, but they have moved the performance needle for their business faster than others.

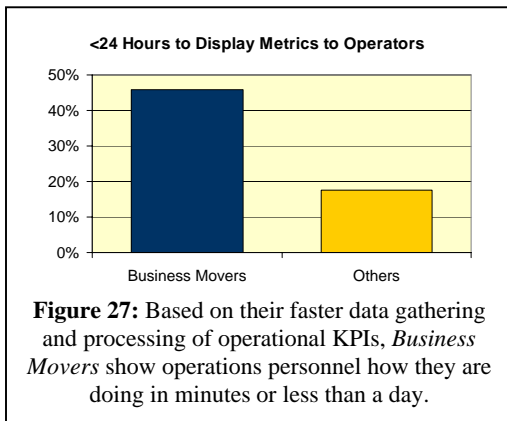
How are they different? They are more agile, more effectively linked, know more



about their metrics and improvement levels, have improved more against operations as well as finance metrics, improve what matters most, and are more likely to use key operations software such as MES and operations dashboards. Figure 1 in the executive overview outlines some of the differences between these companies and the others in our response base.

Differentiators of *Business Movers*

1. Speed. The latency period is shorter between operations and the financial metrics for *Business Movers*. (see Figure 25). *Business Movers* are also much more likely to process at least half of their operational KPIs in real-time (22% vs. 12% for others) or in less than 24 hours (29% vs. 17% for others). They can do this in



part because they are more likely to gather data for operations KPIs in a fully automated rather than a manual way (see Figure 26), which can speed the process of analyzing and displaying KPIs.

As a result of that core speed, these *Business Movers* are also more than two and a half times more likely to display performance results to their operations staff in 24 hours or less (see Figure 27). Based on their automated data collection and speed of processing these operations KPIs, they are able to

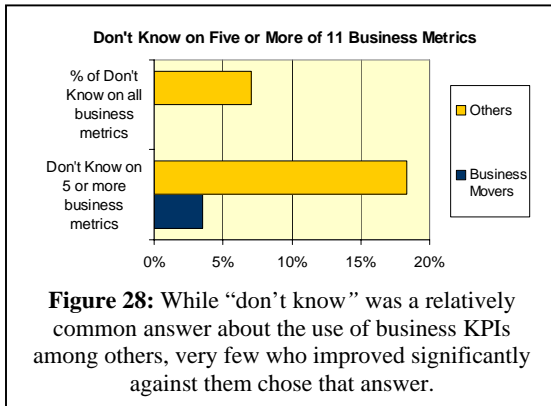


Figure 28: While “don’t know” was a relatively common answer about the use of business KPIs among others, very few who improved significantly against them chose that answer.

show employees the results of their actions quickly. Logically, this should improve the companies’ ability to improve both operational and financial performance.

2. Linked Metrics. Clearly, for improvements in operations to make a difference in financial performance, it helps to have logical linkages or relationships between metrics at the operations and business levels. Figure 13 shows that *Business Movers* are more than twice as likely as

their counterparts – 32% compared with others, at 13% – to believe that their operations and financial metrics are linked well. *Business Movers* are less likely to report the links between their financial and operations metrics as not effective or that their metrics are not linked (13% vs. 21% for others). The stronger links appear in terms of stronger operations improvements and – by the definition of this group – greater financial improvements as well.

3. Know the Score. The *Business Movers* know what their business KPIs are (see Figure 28). The portion of *Business Movers* who answered “don’t know” on five or more questions was only 4%, compared with over 25% for the others. The *Business Movers* are also more likely to know what operational KPIs the company uses and their improvement against them.

4. Operations Gainers. The *Business Movers* were overwhelmingly more likely to improve on the operational metrics in the survey, as well (see Figure 29). It is apparent that improving operations does improve financial performance – particularly when the metrics are relatively well linked. They are also more likely to focus on first-pass yield and less likely to focus on overtime than *Others*.

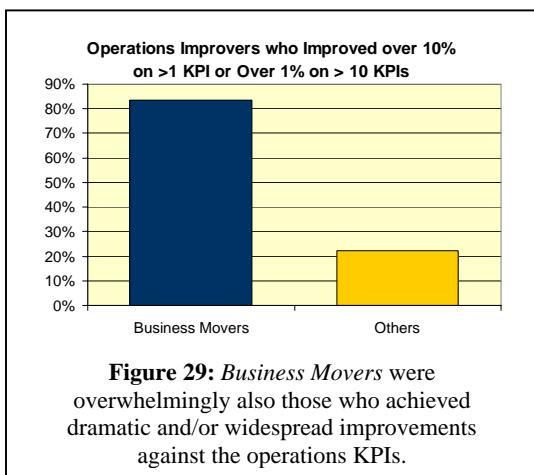
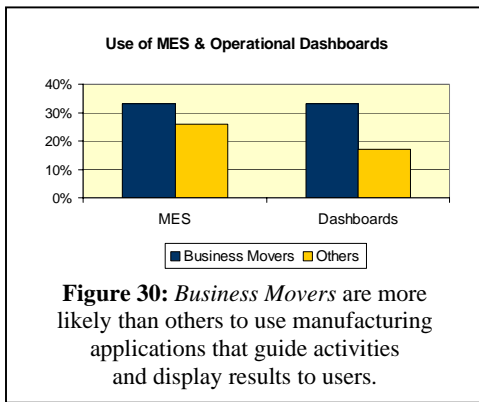


Figure 29: *Business Movers* were overwhelmingly also those who achieved dramatic and/or widespread improvements against the operations KPIs.

5. Focused on what Matters. More *Business Movers* improved dramatically in every major area of the survey (see Figure 17). They significantly improved on the most critical areas of quality, customer service and throughput. The *Business Movers* also increased flexibility and compliance.

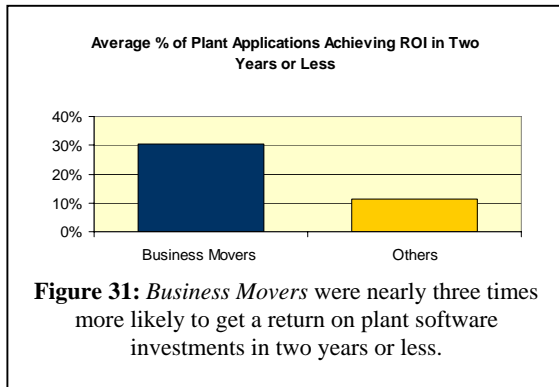
- While flexibility was rated as “very important” or “critical” by only slightly over 50% of the total group, it clearly delivers benefits in responsiveness and ability to manage innovation and market fluctuations or shifts.



- Compliance may initially be intended for cost avoidance, but for it to be cost-effective, it entails improvements in process reliability and visibility of results. This environment can improve performance quality, throughput and costs.

6. Applications Users. The *Business Movers* are more likely to use MES and operational dashboards than others (see Figure 30). In our telephone interviews with Industry Leaders, the importance of displaying metrics

to plant personnel came through loud and clear. One said, “Dashboards must be designed for the purpose of the person who needs it.” (See box, “Dashboards – Presentation Vehicle of Choice” in the IT Solutions Matter to Performance section.)



7. ROI. *Business Movers* were also more likely to gain a return on their investments in plant systems more rapidly (see Figure 31). It would appear that one more thing these companies do right is implement critical process improvements and the software to sustain them.

IT Solutions Matter to Performance

Experience shows that processes often require some type of software application functionality to support and sustain best practices. It is those best practice processes that result in good operational and financial performance. To test this thesis, the survey included questions on the respondents’ use of information technology (IT) and, specifically, a range of software applications that are commonly used in manufacturing.

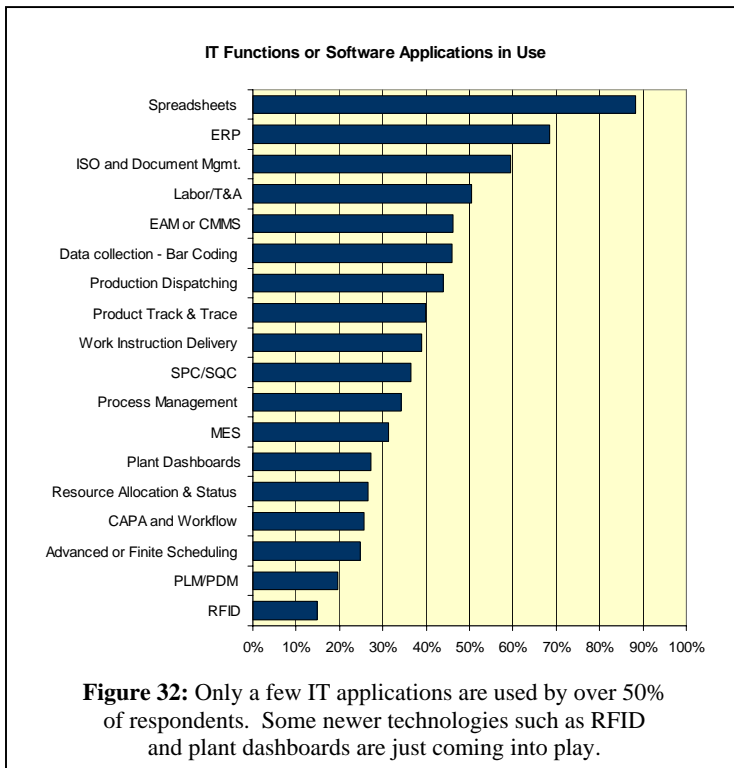
Software Functions in Use

Naturally, the number of functional areas for the use of software in manufacturing is vast. The list in this survey includes:

- Data collection, both bar code and radio frequency identification (RFID), that feeds needed data to calculate metrics.

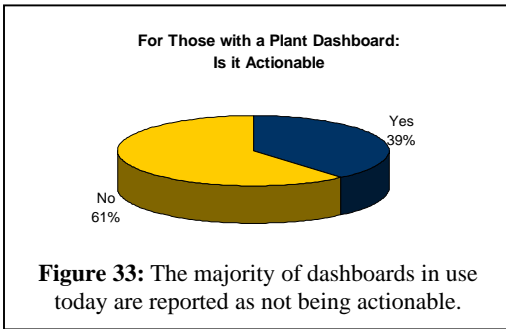
- Plant dashboards that contextualize, analyze and display metrics, which are sometimes also called operational performance management (OPM) or manufacturing intelligence (MI).
- Three quality-oriented systems: statistical process control/statistical quality control (SPC/SQC), ISO and document management to comply with quality and other certifications of process repeatability, and corrective and preventative action (CAPA) with workflow.
- Track and trace, process management, work instruction delivery, resource allocation and status, dispatching, finite scheduling and labor management, which are major functions that may be available in an MES system, as well as MES itself.
- Enterprise asset management (EAM) or computerized maintenance management (CMMS).
- Two enterprise applications that often have use on the plant floor or integration with the plant floor: enterprise resources planning (ERP) and product lifecycle management or product data management (PLM/PDM).
- Spreadsheets.

Predictably, nearly all of the respondents use spreadsheets (see Figure 32). While not a very appropriate tool to ensure that everyone has a “single version of the



truth,” nor in fact to enable data consistency, spreadsheets are highly versatile tools that continue to supplement other software applications.

Nearly 70% report using ERP, as well. The only other two applications in use by more than half of respondents are ISO and document management and labor management (which may represent time and attendance or certification management or both). ERP and ISO document management are involved in compliance, and labor management may also factor into compliance.



Dashboards & MES

Most manufacturers have a long way to go to fully support all of their plant business processes effectively. Many of them realize that, and plan to purchase applications in the next 12 months. **The most commonly cited application that respondents plan to purchase is plant dashboards (33%), followed closely by MES (29%).** Since the

Business Movers use MES and dashboards more frequently than others, it may be useful to examine those investments.

Dashboards can be a critical component of sustaining a sound metrics strategy. (See box, “Dashboards – The Presentation Vehicle of Choice.”) Just because a company has a plant dashboard does not necessarily mean that it can quickly take action on it, however. Most dashboards in use at this point are not actionable (see Figure 33). The two action categories we gave as examples are:

Dashboards – The Presentation Vehicle of Choice

In a desire to make metrics the driver of corporate and manufacturing performance, many firms are adopting dashboards. By definition, dashboards are a simple and graphical way to make KPIs visible to the organization – often tailored for every level of the organization. Often characterized as scorecards, dashboards are developed as an integral component of a comprehensive performance management strategy.

“To be truly effective, metrics must be graphic” said one of our interviewees. His point? Everyone can understand the data and take action based on what they see. A quick glance at a trend-oriented graphic gives powerful insights to performance and adds the ability to provide comparisons of multiple data sources and the dimension of time.

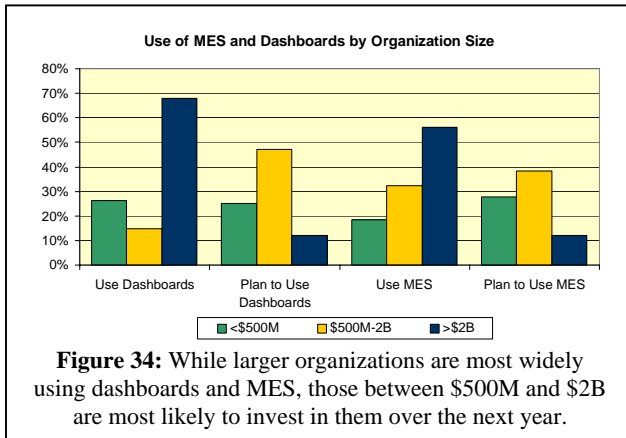
Beyond ease-of-use, many survey participants saw the dashboard as the method for gaining corporate-wide visibility. One driver for using a dashboard is measuring and comparing different plants. For one firm, it did more than enable them to establish benchmarks for performance – manufacturing managers use the dashboards as collaborative diagnostics. In this way, they help lower-performing plants leapfrog the learning process to better quality or higher output.

Some key characteristics of dashboards:

- Role-oriented – designed specifically for each level and job role.
- Highly graphic – dashboards that show trending can be key to establishing an early warning or predictive capability.
- A tool for policy deployment – The dashboards enable executives and metrics designers to consider the type of behavior they are striving to achieve. Done well, dashboards enable manufacturers to institutionalize goals and objectives up and down the organization. A side benefit for IT managers is that the dashboards act as a driver for MES standardization.

- Can you drill down into the KPIs to find root causes or likely areas causing problems?
- Can you alert someone when performance drops?

Plant dashboards are a reasonably new technology, but unlike many enterprise performance management systems, nearly 40% of those who have a plant dashboard installed can take action as a result. Whether by root cause analysis, alerts to those who can alter the situation, or having the dashboard connected into the system guiding operations, full leverage comes from taking action on metrics.



This is where MES comes into play. Many of the functions listed can be provided by an MES system, including, in some cases, dashboards. MES is the system that provides a plantwide context for operational data. It goes beyond data collection to provide guidance and work instructions to operators, to track materials and products, and to ensure that operations do not proceed when the established process has not been followed.

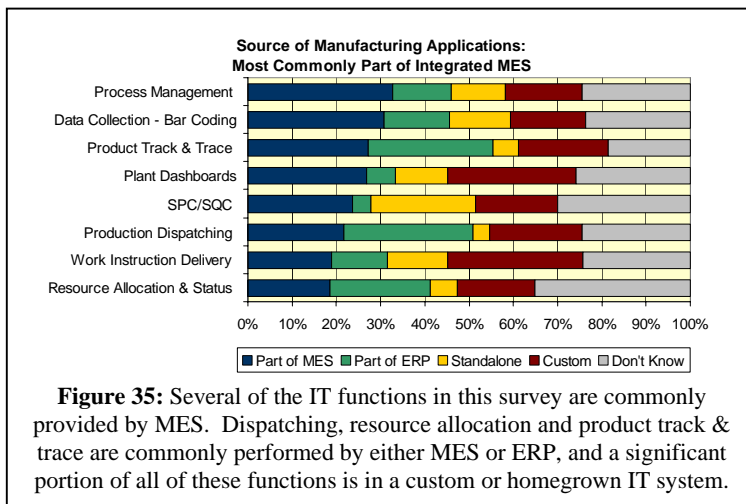
Like ERP, MES is generally understood to be a suite of functional modules that play together to enhance overall plant – and thus business – performance. In continuous process industries, the distributed control system vendor often provides critical MES functions. Most other industries will look to a pure software provider for those plant floor functions.

“With MES, when a question comes up from an executive, I go to the MES administrator and ask her for the dashboard,” says one Industry Leader. “She sets it up in about 10 minutes and sends an e-mail. The executive can just log onto the MES and he sees the data himself.”

In our response base, the larger organizations are much more likely to use plant dashboards and MES today (see Figure 34). This is a common situation; larger organizations generally have the funding to adopt earlier. However, an interesting fact is that responding organizations between \$500M and \$2B are

most likely to be planning on buying MES and dashboards in the next 12 months.

In a competitive landscape, it’s increasingly clear that those who have plant dashboards and MES are more likely to know what’s happening in plant operations and improve their business performance rapidly.



Source of Functions

Respondents to the survey use a wide range of software types to perform plant floor functions (see Figure 35). Many of the functions in the survey are potentially very different among respondents, since the same function may be part of an ERP, an integrated MES, a stand-alone commercial system that provides that function (or

a small set of functions) or a homegrown or custom-built system.

The most commonly used functions in integrated MES (on the left in Figure 35) are process management, data collection (which can feed a dashboard) and product track and trace. These, along with dispatching, work instruction delivery and resource allocation and status are some of the most common core functions of MES and the most widely applicable across industry segments and process types.

Product track and trace – critical for compliance and warranty/recall cost reduction in many industries – is provided by ERP nearly as often as by MES (in the left two segments of Figure 35). While some enterprise systems can perform this capability

“There was talk of implementing some MES capabilities in our ERP system, but it’s not detailed enough for what we want to do,” reports one Industry Leader.

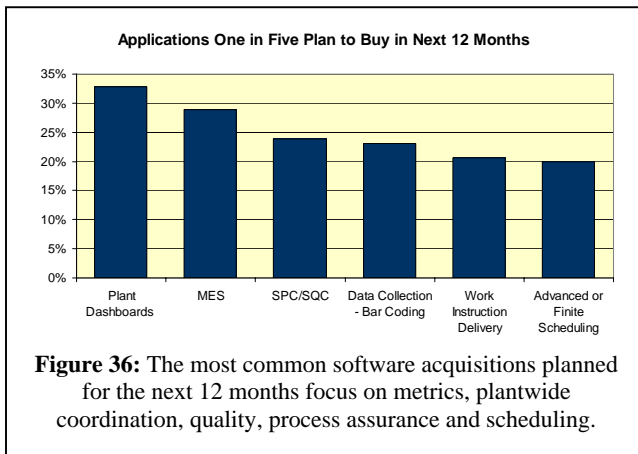
effectively isolated from the plant floor, these systems then require a separate data collection architecture to help drive the plant’s performance.

Production dispatching is another function commonly provided by ERP among our respondents. Again, it may be effective, but ERP systems often don’t have the detail of routing and the operations model to ensure order dispatching (or scheduling, which commonly is performed by the ERP system in this response base) is feasible for plant personnel to follow.

Software Purchasing Plans

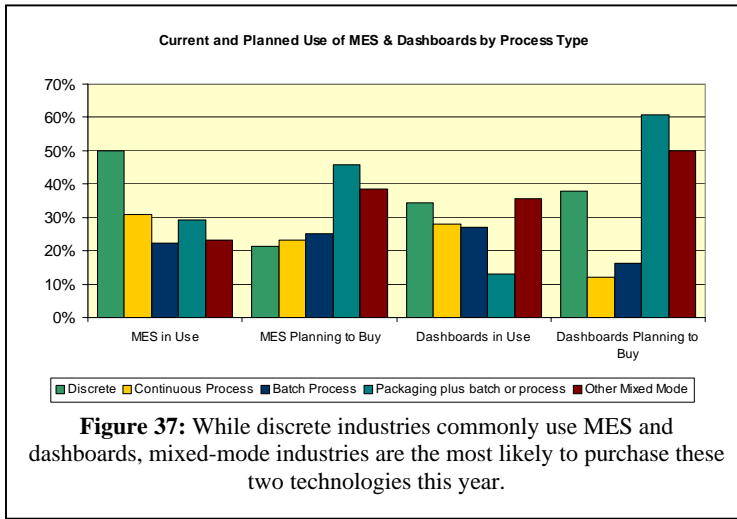
To get a feel for what software manufacturers are planning to invest in, we also asked about purchasing plans for the next 12 months. Not too surprisingly, their

plans are focused primarily on applications not already widely in use. One exception to this is data collection, which is fairly widely deployed and also in many companies’ plans.



The No. 1 most common software system that respondents plan to buy this year is plant dashboards, at 33% of respondents, followed closely by MES at 29% (see Figure 36). Dashboards are the core vehicle for calculating and displaying operations KPIs. MES can

sometimes provide a dashboard, but it is certainly a core source of plantwide data, with capabilities for overall plant coordination and control and process improvement. MES often includes work instruction delivery to ensure employees know what to work on when, particularly as products and methods change. The wide interest in SPC/SQC reflects the importance of quality. Automating data collection is key to a speedy and effective metrics framework. Scheduling is a



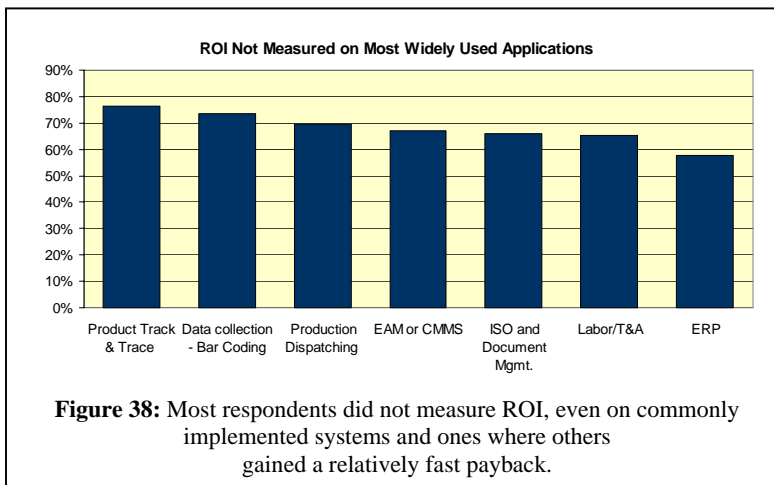
natural desire (though it has not gotten much press in the past few years), since many plants use schedule attainment as a core view of operations issues.

The plans for buying MES and dashboards – as well as their use – vary by process mode. The most likely to buy are mixed-mode industries, whether packaging or other types of mixed mode (see Figure 37).

Half of discrete industry respondents report that they have MES today, and over 20% are planning to buy it. Packaging industries are starting from a lower installed base, but many plan to implement both MES and plant dashboards. On dashboards, other mixed-mode industries are in the lead, and many more plan to buy. Clearly, this group of respondents will be ahead of the overall industry in implementing MES and plant dashboards if they follow through on those plans.

ROI on Systems

An obvious metrics-oriented question about software is: What is the payback or return on investment? Apparently, measuring systems results is not nearly as important to these respondents as measuring the success of their operations and their business. As with improvement against metrics, most respondents don't know what benefits they received from their IT systems investments.



This time, it's because they did not measure ROI. The proportion of respondents that did not measure ROI ranges from 58% to 77%, depending on the application. However, some respondents answered this for applications they do not have. For example, of those with MES, 40% did not measure ROI, and for those with plant dashboards, 36%

did not measure ROI. However, even for the most commonly used applications, the vast majority did not measure ROI (see Figure 38).

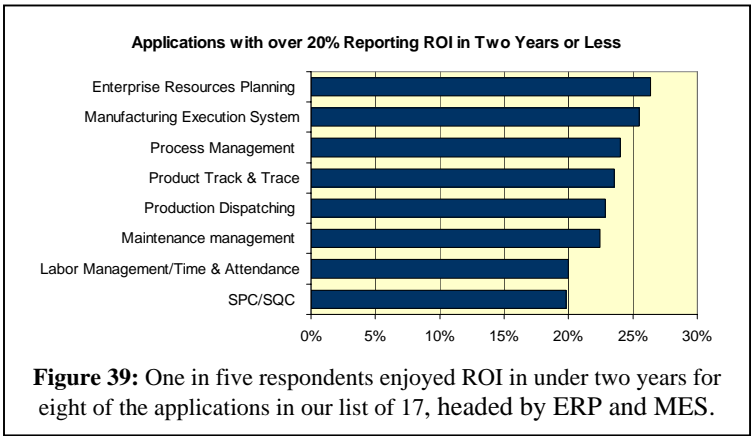
This study result points out another possible disconnect between operations, finance and IT on establishing and confirming ROI on software applications. While the capital expenditure processes require justification, it seems as if companies would be well served to take the time to establish a baseline before and measure ROI after

"It is impossible to do ROI on ERP. The baseline is not accurate enough, and we did not collect the data. We are able to do 10 times as many things, but the cost structure is not down," says one Industry Leader.

the system is in use. Clearly, operations needs a way to ensure its investment priorities are likely to improve business results, and knowing the impact of current systems can help do that. Systems ROI can also help set realistic expectations for systems costs and benefits during justification.

Most respondents appear to believe that system ROI is just not that valuable. However, performance improvement is. An appropriate IT-based metrics system can help calculate current state and improvement levels if implemented properly. Collecting and aggregating the data for those metrics, improving processes and sustaining those improvements requires appropriate IT systems. Yet it's difficult to separate the benefits of process improvement and the inevitable increase in awareness of critical issues from the other benefits of having a system. Measuring and gaining improvements in processes is clearly more important than calculating system ROI. However, based on the number of "don't know" responses to the metrics questions, many respondents are not clear on their improvements either.

Among those who did measure ROI, ERP and MES were the two systems most likely to provide a relatively fast payback when compared with other applications in our list (see Figure 39). It's possible that the broad, integrated nature of these suites of applications deliver a greater number of benefits than more isolated areas of functionality. These integrated, multi-function systems help correlate data with confidence to calculate metrics and put them in a meaningful context. ERP and MES are also normally evaluated and approved by a multi-discipline committee, so



many of the functional areas of the enterprise have had input into the purchase.

The next several application areas are also common MES functions: process management, product track and trace and production dispatching. These are all critical to the visibility and control of plant operations.

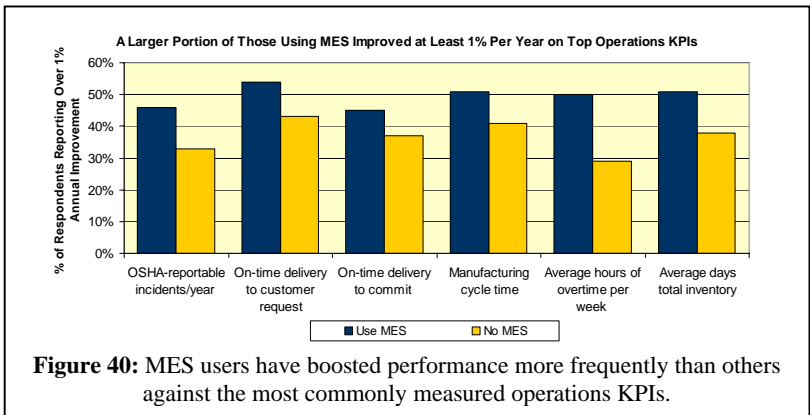
Systems can only perform well if the business processes they support are effective, incentives are aligned, and management is driving appropriate behavior. While a sound metrics system could provide some of the calculations affecting ROI of new systems investments, its clear that most manufacturers are not at that state.

Improvements More Likely for MES and Plant Dashboard Users

Even if companies did not measure ROI on their systems, it appears they may be getting it. Companies using plant dashboards and MES are more likely to be improving significantly against almost all of the metrics in the survey. As with the *Business Movers*, we considered improvement of at over 1% on average over the past three years to be significant improvement.

MES Users' Gains: On average, the group using MES is 31% more likely to have made significant improvements on the operations KPIs we list. Looking at some of the more dramatic areas:

- Twice the proportion of MES users has improved significantly in percentage planned vs. emergency maintenance work orders (30% vs. 15%).
- Nearly three times the percentage of MES users has improved in upside

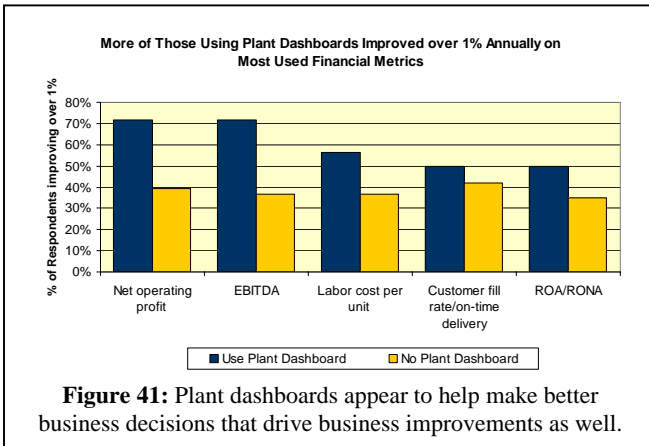


production flexibility to accommodate surges in demand (28% vs. 10%).

- Over twice the portion of MES users has decreased energy costs per unit of production by over 1% (28% vs. 12%).

While the differences are not all as dramatic, this improvement pattern holds for the most commonly measured operational KPIs as well. Figure 40 shows MES users vs. others for the top six most commonly used operations measures.

MES users are also 19% more likely, on average, to have made gains against business and financial metrics. Again, there are areas where the portion is much higher. For example, over half of those using MES gained more than 1% in market share – more than double the percentage of others, at 24%. Further, 37% of MES Users improved significantly in productivity per square foot and 36% improved



over 1% in cash-to-cash cycle time, compared with 22% making comparable gains against each measure of those not using MES.

Plant Dashboard Users Gains: Those using plant dashboards were 37% more likely, on average, to have improved against operations KPIs than others. The most dramatic areas are average days WIP inventory, at nearly 60% of those using a plant dashboard reporting

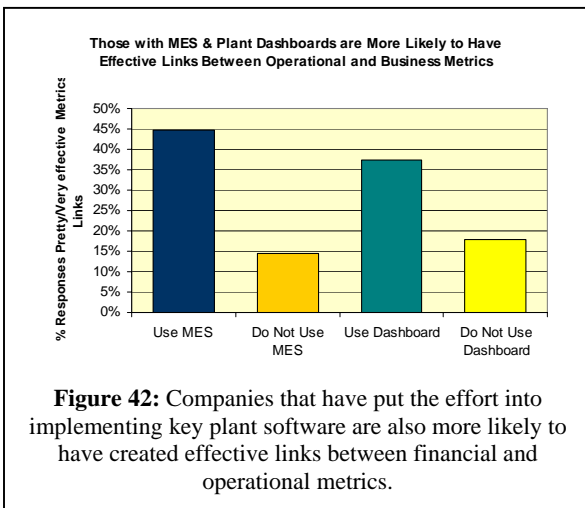
gains of over 1%, compared to less than 30% of others. Significant gains against upside production flexibility, first-pass yield, OSHA-reportable incidents and total inventory metrics were also at least 50% more likely in those using plant dashboards.

The differences are even clearer in improvements to business metrics. The proportion of those with plant dashboards making gains of over 1% on their financial metrics is 53% higher than for others, on average. Figure 41 shows the

One Industry Leader articulates a common theme: *“The mission of our dashboard is as a policy deployment system. A major issue is how people use these tools to change behavior.”*

differences for the most commonly measured business metrics. The likelihood of respondents using plant dashboards gaining significantly in cash-to-cash cycle times is also over twice that of the group not using these visualization tools (44% vs. 20%).

Given that success in improvement rests on a fast, effective system for metrics, it’s no surprise that those using MES and plant dashboards have achieved greater success. They supply the information required to see trends as they occur, to guide



both operators’ actions and managers’ decisions. MES can also guide processes in the plant to ensure best practices are followed that can lead to better, more reliable performance in the operation and the business.

It’s always difficult to attribute improvements to a single system or factor. We would add that those using MES and Plant Dashboards are also far more likely to have effectively linked metrics, as shown in Figure 42. The analysis process for justifying, purchasing and

implementing plant floor software can often create major benefits. We do not know whether these respondents developed the effective links between their operations and financial metrics as a result of their software projects. Those who realize how directly their operations performance impacts the business may be more prone to seek out appropriate plant software solutions. In any case, the correlations are clear.

Conclusions

Companies that know more about their operations, their metrics and their improvement levels are improving more dramatically than others. These *Business Movers* have a sound system for metrics. They link operations and

Future Focus for Manufacturing Metrics

What does the future hold for the development of meaningful metrics that enable higher performance? A number of respondents shared their thoughts on where they would like to see improvements in today's metrics:

- **Time-to-market and time-to-volume metrics.** Many firms now recognize that their ability to compete is based on new product introduction (NPI), which requires operational metrics beyond those that deal with steady-state production. New metrics must gauge the effectiveness and efficiency of prototyping, R&D to production efficiencies, production line and new technology start-ups in the plant.
- **Regulatory compliance.** Nearly every industry has new regulations that require compliance, so MES systems, dashboards and associated metrics now take on a more powerful role in ensuring compliance and collecting the necessary data for reporting purposes. New challenges are being brought forth by the emerging focus on "green" regulations, such as WEEE and RoHS, the Bioterrorism Act (for food safety) and – for those running paint lines – containing and reporting on Volatile Organic Compounds (VOC).
- **Complexity.** Several firms indicated that they would like to see some form of complexity analysis. These metrics would help them better understand the impact that high mix and many product variants creates in manufacturing and scheduling to pinpoint what actions to take to simplify operations and direct product engineering.
- **Predictive.** Not surprisingly, many interviewees spoke of the need to take their metrics program to the next level – predicting the future. These manufacturers are trying to determine which metrics can be used as (or transformed into) performance predictors. They want to understand how to manipulate or analyze the data to give advance warning on problems they may face. Done well, this would make many manufacturers significantly more agile – an important consideration in today's very lean supply chains.

finance metrics, speed data through the system, show operators results and use IT systems to support metrics efforts. They are positioned to be winning competitors because of better control of their operations, more visibility into their manufacturing and better aligned management – and they have improved business success the most. So metrics do matter.

Ignorance is not bliss – in fact, it can be deadly. Companies that have not realized the positive power of providing operations employees with feedback on the results of their action are missing a major opportunity to improve.

Since there are so many possible metrics, companies need to understand which metrics are most critical to their success. Armed with

that information, they must discover how frequently they need to collect which pieces of data and aggregate them into metrics for display so that employees can act on results, and in the process, improve the company's performance. The *MESA Metrics Guidebook and Framework* companion document explains this ongoing metrics review and design process.

Respondents to this study are striving to create metrics systems that will drive their company's ongoing performance. From the telephone interviews, we heard loud

"Now that we have MES, we can set rules for how to track trending. To be cost effective and competitive, we must become a predictive manufacturing environment," declares one Industry Leader.

and clear that everyone must buy in and get the data they need to act within the timeframe appropriate for their role. This behavioral change is critical to continuous improvement.

Clearly, there are more questions about metrics and justifying improvements than we could answer in this survey. Our interviews and surveys for this work indicate a need for metrics that show how to gain speed with new products, manage complexity and ensure regulatory compliance.

Predicting results is the next logical step for metrics. (See box, "Future Focus for Manufacturing Metrics"). In addition, companies want to measure their ability to innovate and introduce new products effectively, ensure regulatory compliance and make profitable tradeoffs in complexity of products and product lines. MESA looks forward to exploring these and other metrics issues with its members.

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Manufacturing Enterprise Solutions Association (MESA) International is a not-for-profit organization of manufacturers and information system providers focused on leveraging technology to achieve business goals. The organization is a community of manufacturing end-users, technology suppliers and consultants – focused on improving the flexibility and agility of manufacturing production. For more than a decade, MESA has been a premier venue for the manufacturing community to share and create unbiased information on the topic of solving business issues with technology. For more information about MESA, visit www.mesa.org.



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