

KPIs Made Easy

Behind the data walls and executive dashboards, metrics increasingly link to real-time, plant-floor data. Do you know enough about key performance indicators (KPIs) and manufacturing execution systems (MES) to invest in efficient process improvements?

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Process control is hip. Manufacturing line optimization is cool. Everybody from the CEO down wants a piece of it. And judging by the clamor around video walls, information portals, and executive dashboards, everyone wants to visualize control to drive performance.

Globalization and pressure on companies to compete at the most fundamental level of operational excellence means everyone is looking at the factory, the mill, or the plant more closely. The challenge is whether control engineering can master the strategic role implicit in this level of scrutiny.

What's strategic in the role can be summed up in three letters: K-P-I. Key performance indicators are measures of success or compliance, and the industry is rife with talk of them. Industry analysts, organizations, and enterprises are deep in exploration and analysis of how to define, create, calculate, and disseminate KPIs. And control engineers need to understand them,

so they can help in meaningful ways.

"Control engineers can no longer afford to be satisfied with a controller's performance by viewing how straight the lines on the control chart are," says John Snodgrass, process control engineer for Chemtura Corp.'s Morgantown, WV, specialty chemical plant.

"In today's market, with today's technology, typical operators aren't typical anymore. They don't just turn valves. Control engineers shouldn't be typical either," says Snodgrass. "They should be looking at the information they have and trying to determine what they can do make product more efficiently. If they don't, it won't be long before there won't be a business anymore."

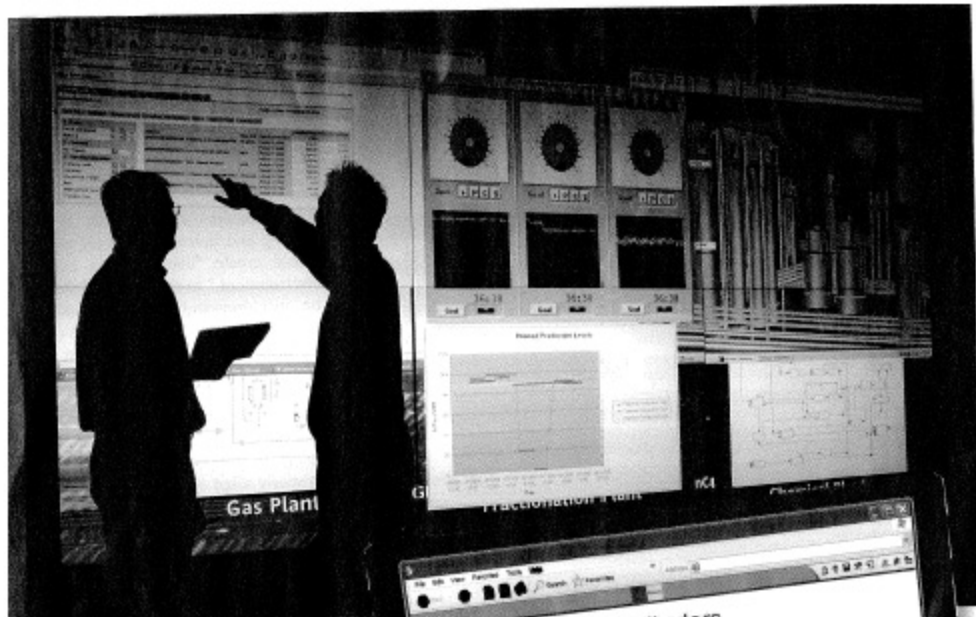
MESA International, a trade organization constellated around manufacturing execution systems (MES), has actively investigated KPIs since early last year. In October 2006, it published an initial report on its efforts called "Metrics That Matter: Uncovering KPIs that Justify Operational Improvements."

But MESA concedes it's just scratched the surface of a very complex issue. Consequently, MESA working groups are delving deeper still, particularly into the labyrinthine linkages between KPIs at different business levels within organizations. A common thread is the control layer of a plant, where the data that feeds many KPIs is generated. Another common element is MES. That's where aggregation of the data and context typically happens before it's passed up to enterprise systems and their dashboard and video wall

KPIs in action

Performance measurement is not static: it evolves as performance issues vary, as the market strategy changes, as technologies and the means to measure and record performance evolves over time. Sources of KPIs that others are using include research from MESA, AMR, and Aberdeen. Here are specific recommendations from users.

- "We manufacture 50,000 custom parts every day.... The KPIs we've focused on initially are public facing ones—cycle times and gross margins."
- "We operate in a tightly regulated industry, which determines which KPIs you must track and trend in your operations. After that, we're looking at: first-pass yields, are we staying capable, is preventive maintenance effective, [and] are we preventing breakdowns."
- "Corporate division headquarters set up the specific KPIs they wanted us to use."
- "We put no more than four [KPIs] in front of an operator at any time."
- "Our company has determined as an organization that there are four process areas that the enterprise needs to focus on. These include: financial; process excellence; quality; and environmental health, safety and security. Everything cascades down from those."
- "At the operator level, we use the real-time accounting measurement of cost-per-batch. With that an operator can drive down costs and keep quality high. The next layer up doesn't want to see the cost of everything, but [wants instead] variance-to-budget of production, or variance-to-budget from department to department. It's all based on the same data that flows up."



outputs that executive management sees.

KPIs and MBS are becoming critical elements to running a plant, because they're critical to running a business. And, in today's world, anyone not thinking about the business isn't as keyed in to business performance as they should be.

Engineering to money

"Everything a control engineer does eventually rolls up into money," says Jim Christian, product manager for Honeywell. "It's important to know how what you do contributes to the business. Stable operations translate into greater reliability and better throughput, longer catalyst and equipment life, and reduced use of chemicals. All are measurable."

One way for control engineers to think about KPIs is "to understand how what you do contributes to your company making money," says Christian. "What measurements do you need to track to know you're maximizing value?"

A vast, widely prevalent disconnect exists in most organizations today, at various levels of conceptual abstraction as well as within data flow linkages. "Many of our customers view KPI initiatives as an engineering exercise to collect data," says Claus Abildgren, marketing program manager for production and program development for Wonderware. "They don't understand the key needs of the business—what are the pieces of data that the rest of the business needs to make decisions."

The disconnect is from the bottom up and from the top down. This was revealed in the survey behind the report that MESA developed. "The big surprise for us was how few felt they

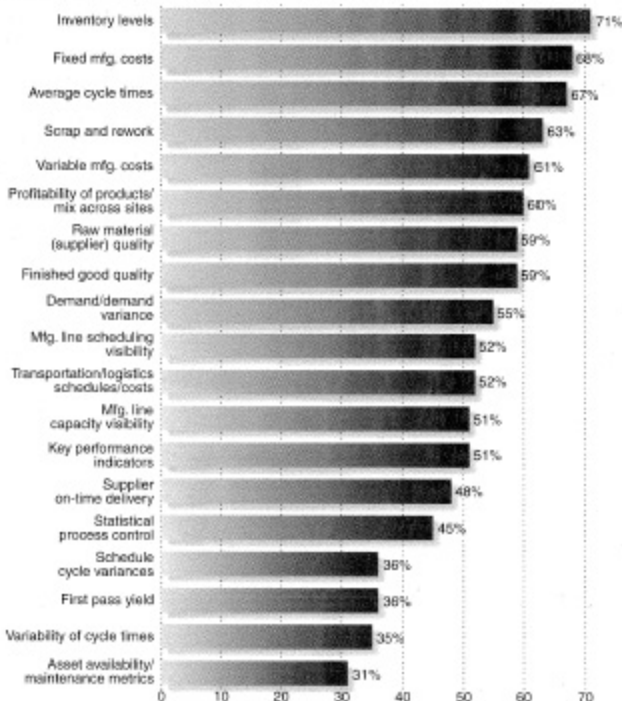
had a strong structure of linkage from financial goals and metrics down to the shop floor," says Julie Fraser, principal at Industry Directions, a Boston-area industry consultancy. Fraser was contracted to help drive the MESA "Metrics That Matter" project. "Only 3% of the companies we interviewed for the study said they had strong linkage. We didn't expect it to be huge, but we didn't expect it to be that small either."

Contributing to the problem is structural weaknesses in technology infrastructure—in other words, an inability to handle the vast number of applications and amounts of data now being generated. "AMR has worked with



Behind the flashy data walls and Web-enabled dashboards are metrics that comprise the models, charts, and graphs. Key performance indicators (KPIs) are measures of success or compliance to objectives. Source: *Invensys* (background) and *GE Fanuc* (foreground).

Common Manufacturing Metrics



Source: AMR Research, Manufacturing Metrics Survey, 2006

It's not trivial to construct metrics at one site, let alone across multiple sites, says Colin Masson, research director at AMR Research. Use of specific metrics varies, as shown by the percentages.

manufacturers who have over 5,000 point solutions [applications] in their portfolio," says Colin Masson, research director for supply networks operations for Boston-based AMR Research.

Under such circumstances, "it's not trivial to construct metrics at a single site, let alone across multiple sites. That's not even taking into consideration performance data composed of millions of readings a day and putting that into some business context that has meaning at a higher level," he says.

Growth of data models

Such a wealth of data possibilities is contributing to a growing emphasis on standardization of manufacturing data models that can establish commonality.

This desire for a comprehensive manufacturing model is one of the market drivers behind the surge in interest in MES, for models are core to functionality of this software. It's also what's prompted automation and human machine interface (HMI) vendors to invest in model-driven

integration infrastructures, such as Rockwell Automation's FactoryTalk, GE Fanuc's Proficy, and Invensys' Infusion platforms. These create "one common computing environment," in the words of Peter Martin, vice president of strategic ventures for Invensys.

Other factors driving interest in MES and KPIs are increasing product and manufacturing complexity and regulatory compliance needs. Align Technology manufactures a line of individually custom-designed orthodontic appliances used to properly align teeth. Orders are acquired at its Santa Clara, CA, headquarters, then transmitted to its facility in Costa Rica where clinical technicians create 3-D representations. These are then sent back to prescribing doctors for verification, before work orders are transmitted to the company's Mexico production facility.

Align Technology turned to MES to enable it to recover the detailed visibility of manual tracking that was lost when it implemented an enterprise resource planning (ERP) system. It uses Production Centre MES, a component of the Rockwell Automation FactoryTalk platform.

"We manufacture 50,000 custom parts every day—and every day it's a different 50,000," says Michael Henry, Align Technology CIO and vice president of information and technology. "The KPIs we've focused on initially are public facing ones—cycle times and gross margins."

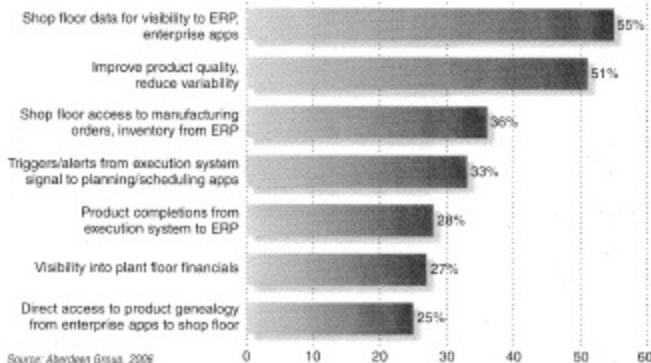
By providing greater visibility into the flow and status of work orders, MES was instrumental in attacking problems that had driven up cycle times and eaten into gross margins. Real-time visibility into the status of work orders in the geographically distributed process flow helped Align Technology identify bottlenecks and smooth the flow into a more seamless stream, from order acquisition to finishing and polishing at the end of the production line.

"Cycle times, which were two weeks, are down to five days. And gross margins that were 58% are now up to 69-70%," Henry says.

Regulation helps?

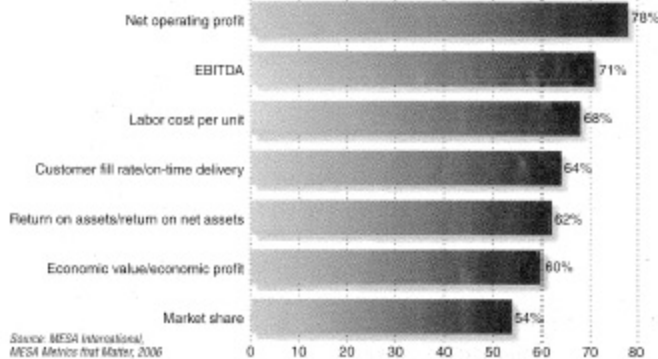
Business metrics such as cycle times and gross margins are relatively common. Determining which manufacturing metrics are critical to track can be more challenging—unless you're in a regulated industry. Utica, NY-based ConMed Corp., manufacturer of laparoscopic surgery products, patient support and other products, is bound by U.S. 21CFR Part 820 regulations outlining Good

Priorities for Bridging the Gap



Manufacturers are striving to relate KPIs used on the manufacturing floor to business metrics tracked in the executive suite.

Common Business Metrics



"The big surprise for us was how few felt they had a strong structure of linkage from financial goals and metrics down to the shop floor," says Julie Fraser, head of the MESA "Metrics That Matter" research.

Manufacturing Practices (GMP) for medical device manufacturers.

"We operate in a tightly regulated industry, which determines which KPIs you must track and trend in your operations. We have to validate the process to begin with to determine the variable data, such that when I set these indicators, and the numbers are being met, I know the process is stable," says Bill Wheatley, ConMed manager of manufacturing engineering.

"After that, we're looking at: first pass yields, are we staying capable, is preventive maintenance effective, [and] are we preventing break-

downs." Implementing MES was crucial to streamlining the process, Wheatley says. ConMed uses Visiprise MES.

How does a company determine which KPIs to use? Ideally, it's a top-down decision. "In concept, you want to take top-level goals and strategy and build out departmental metrics and link those all the way down," says Fraser of Industry Directions. "You want to take manufacturing metrics...right down to the machines."

Eliminating boundaries

The whole issue of KPIs is exceedingly complex and, as a "science," is still young and evolving. But progress being made is looping downward evermore inclusively into the domain of control engineering. As work in the field is revealing, everything is indeed interconnected.

"The traditional approach over the years has held that automation, MES, and IT are three individual layers," Martin says. "But it's an artificial separation. It's been necessary, he says, because past technology required that problems be segmented to deal with the unique requirements at each level.

As the technology evolves, "in time that separation is going away," Martin says. The push for KPIs linked from top floor to shop floor is driving the business case for that. And in the end, it truly is all about the business case.

That's what control engineers need to grasp and master. Forget the flashy data walls and Web-enabled dashboards. Focus instead on the metrics that feed those broadcasts. Your company's future will be increasingly dependent on converting control data into strategic intelligence. **ee**

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