



Aberdeen *Group*

Manufacturing Transparency

Turning Visibility into Value

December 2005



Executive Summary

For many years, manufacturers have sought transparency into production information, processes, and resources. Since the first manufacturing resource planning (MRP) systems were introduced three decades ago, many enterprises have considered the factory floor a “black hole.” Very simply, work orders and materials entered the plant at one end and, much later, finished products exited at the other. As enterprises invested in enterprise resource planning (ERP) systems, the prevailing thought was that they would eventually improve visibility into manufacturing. The ability to unlock the operational data that would empower plant managers and executives to make informed, timely decisions has eluded many companies until relatively recently. However, a new generation of MES (manufacturing execution systems) and manufacturing intelligence systems is enabling the collection, presentation, and analysis of critical, real-time data to decision makers throughout the enterprise and the supply chain.

Key Business Value Findings

Best-in-class manufacturers that have automated and integrated factory floor systems over time are better positioned to tackle challenges such as customizing products, providing rapid customer response, and improving operational performance than their poorer performing counterparts are. While the majority of process manufacturers focus on integrating DCS (distributed control systems), SPC (statistical process control), and LIMS (laboratory information management systems) with traditional and new-generation MES, more than half of best-in-class discrete manufacturers are leveraging emerging manufacturing intelligence systems to directly access real-time data from factory floor systems and deliver results to target users. Representing characteristics of process and discrete manufacturers, consumer products manufacturers are most interested in combining customer-focused metrics and real-time factory and plant-floor performance data into “actionable” dashboards.

Implications and Analysis

Empowering decision makers to proactively, rather than reactively, manage operations enables them to diligently control costs, improve customer and regulatory responsiveness, and quickly analyze unexpected situations and evaluate opportunities. To ensure considered and consistent responses throughout the company, corporate strategy must be well communicated and aligned with operational metrics and continuous improvement programs. Manufacturers also require technology solutions that enable the aggregation of data from throughout manufacturing and present it in context and in conjunction with KPIs (key performance indicators) to multiple target audiences. Best-in-class manufacturers are leveraging emerging technologies and industry standards to reduce costs, improve flexibility, and leverage new opportunities.

Competitive Framework Key

The Aberdeen Competitive Framework places enterprises into these three practice and performance levels:

Laggards (30%) — practices that are significantly behind the average of the industry

Industry Average (50%) — practices that represent the average or norm

Best in Class (20%) — practices that are the best employed and significantly superior to the industry average



Recommendations for Action

Based on survey participants' responses, Aberdeen has divided manufacturers into three categories according to our Competitive Framework: *Industry Average* (practices that represent the average or norm), *Best in Class* (those whose practices exceed those of Industry Average firms), and *Laggard* (those whose practices lag those of the Industry Average). Here are our recommendations for each group:

- **Laggards:** Eliminate competitive disadvantage by completing integration efforts from the factory floor systems up through the enterprise. Become more customer-focused by leveraging value-stream mapping and other modeling tools to streamline and standardize processes. Empower operators and supervisors on the plant floor by providing visual work instructions.
- **Industry average:** Stay diligently focused on cost-cutting efforts, empower plant managers and executives with intelligent dashboards, and make strides against the competition by simplifying processes with next-generation technologies.
- **Best in class:** Prepare to grow the business by deploying Lean and Six Sigma to all plants and contract manufacturing partners. Close the decision-making loops on the factory floor, among enterprise decision makers, and in the boardroom by leveraging real-time information frameworks, analytical tools, and technology-enabled dashboards.



Table of Contents

Executive Summary	i
Key Business Value Findings.....	i
Implications and Analysis	i
Recommendations for Action	ii
<i>Chapter One: Issue at Hand</i>	1
Multiple Systems Point to a Lack of Integration	1
Execution and Visibility Solutions	2
<i>Chapter Two: Key Business Value Findings</i>	4
What Are the Best in Class Doing Differently?	4
High Priority: Visualization and Analytics	6
A Business Case for Technology: Improved Asset Utilization	6
Stacking Up Against the Competition.....	8
<i>Chapter Three: Implications & Analysis</i>	9
Align Metrics to Communicate Strategy.....	9
Laggards: Complete Integration and Process Simplification.....	10
Consider Next-Generation Technologies	11
Tyson Foods Streamlines Operations	12
Ralco Industries Standardizes Production.....	13
Rexam Production Lines Never Go Down.....	13
Improved Visibility at Dow Corning.....	14
Increase Focus on Technology Standards.....	14
Improve Performance Over Time.....	15
Pressures, Actions, Capabilities, Enablers (PACE).....	16
<i>Chapter Four: Recommendations for Action</i>	18
Laggard Steps to Success.....	18
Industry Average Steps to Success	19
Best in Class Next Steps	19
Author Profile	20
<i>Appendix A: Research Methodology</i>	21
<i>Appendix B: Related Aberdeen Research & Tools</i>	22



Table of Contents

About AberdeenGroup23



Figures

Figure 1: Manufacturers’ Challenges to Achieving Visibility..... 2

Figure 2: Strategic Actions by Best-in-Class Companies 5

Figure 3: Most Important Capabilities by Industry Sector 5

Figure 4: Visualization and Analytics 7

Figure 5: Companies with More Than 10% Improved Asset Utilization 7

Figure 6: Key Performance Metrics 10

Figure 7: Laggards Have Unfinished Business 11

Figure 8: Technology Capabilities Having the Biggest Impact by Industry..... 12

Figure 9: Longevity of — and Plans for — Performance Improvement Programs... 16

Tables

Table 1: Aberdeen Competitive Framework..... 8

Table 2: PACE (Pressures, Actions, Capabilities, Enablers)..... 17



Chapter One: Issue at Hand

Key Takeaways

- About half of all respondents in our latest survey report that ERP investments have not delivered the visibility into factory floor data or provided the control over operations that buyers anticipated.
- More than half of manufacturers surveyed lack the ability to provide a unified view of plant or factory floor information.
- Traditional point solutions are being phased out by next-generation MES solutions with sophisticated toolsets that provide information frameworks, support production modeling, and enable real-time event monitoring and response.

Demanding customers, ruthless competitors, and bottom-line results are driving enterprises to develop capabilities that enable rapid response to demand and unexpected conditions, both externally and internally. Manufacturers must be prepared to intelligently assess any number of conditions and deliver informed responses in as close to “real time” as possible. This requires visibility to resources, processes, and transactions, and the ability to contextualize the data, consider the implications of multiple responses, and implement corrective actions or other processes.

Multiple Systems Point to a Lack of Integration

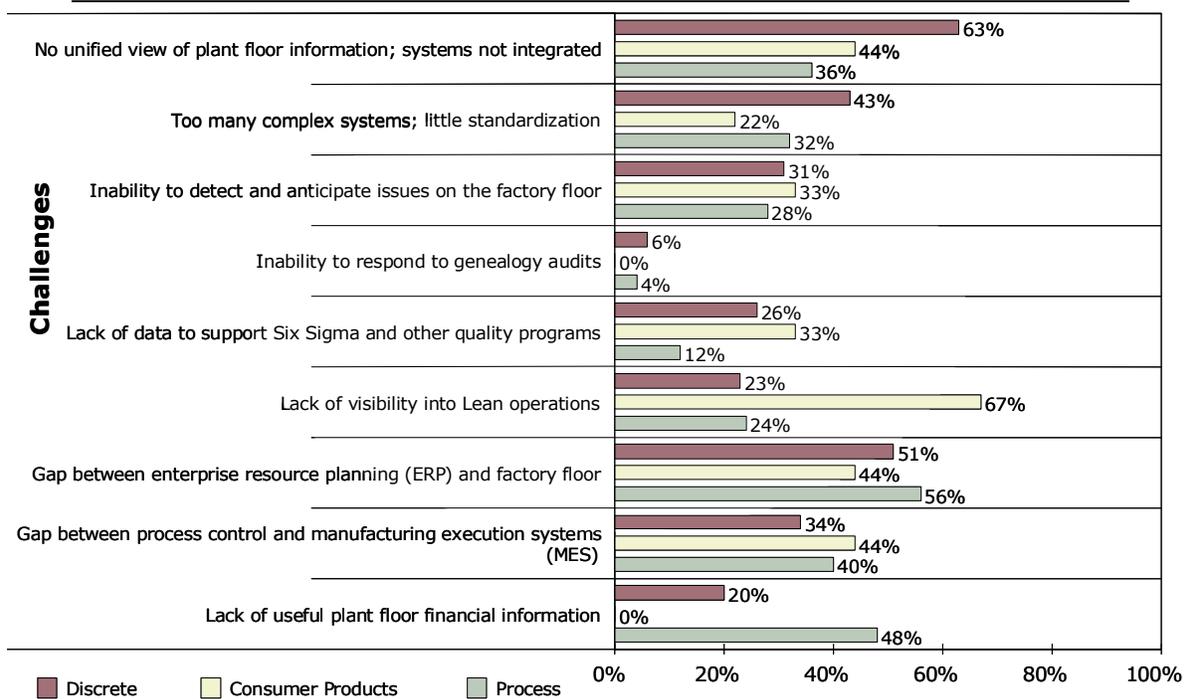
Over the past decade, manufacturers invested in ERP with the expectation that it would eventually provide visibility into production. But study participants cited disparate data sources, a lack of cohesiveness among plants and floor systems, and a lack of integration with ERP systems as top barriers to achieving visibility into the factory floor (Figure 1). For those that still rely on semi-automated or manual processes for data collection, acquiring accurate data on daily tasks such as material usage, step completion, quality test results, and other simple tasks can be error prone and slow.

Although all sectors report the lack of a holistic view into manufacturing, further analysis of the data shows variations between industries. For instance, most consumer products companies cite the inability to access Lean operational information as their primary concern, while discrete manufacturers say the inability to consolidate disparate plant floor information is their key issue. More than half of process manufacturers still suffer with the long-standing gap between ERP and the plant floor.

For more than half (63%) of *discrete manufacturers*, collecting, normalizing, and managing data from across manufacturing — from inventory records, data historians, and other factory floor devices — remain the top challenge. Specialized systems, incompatible technology, and the complexities and costs associated with integration have held back achievement of this goal.



Figure 1: Manufacturers' Challenges to Achieving Visibility



Source: AberdeenGroup, December 2005

Consumer products companies report that their top challenge is a lack of visibility into Lean operations (67%). Today, most Lean initiatives are still operated manually. But to deploy these programs into other plants and facilities, specific processes should be automated and integrated into other areas of manufacturing, the enterprise, and to customers and suppliers. (See *Best Practices in Lean: The Momentum Builds*, June 2005)

Process manufacturers report the gap between ERP and the factory floor as their top challenge. ERP typically generates orders for the shop floor on a monthly or weekly basis. Normal production “glitches,” such as unavailable or inferior batches of raw material, equipment operating below target performance, or unplanned recipe adjustments, are not reported back to ERP but will impact resource availability for planned orders.

Execution and Visibility Solutions

Two decades ago, MES appeared well positioned to bridge the gap between ERP and factory floor systems. However, manufacturers’ lack of investments in non-Y2K projects, coupled with unfavorable economic conditions, conspired to put investments in MES and connectivity solutions on the back burner until relatively recently. As a result, demand has built up over time and the need for execution and visibility solutions has never been higher. As external forces conspired to drive manufacturers to dramatically increase performance and flexibility while driving down costs, there have been many accomplishments on the technology front that manufacturers should benefit from.



New-generation manufacturing execution systems tend to have broader solution footprints, are easier to integrate and less expensive to maintain than previous-generation solutions. The MES manages work orders throughout production, combining materials, equipment specifications, labor requirements, and direct connections with DCSes (distributed control systems), PLCs (programmable logic controllers), LIMSes (laboratory information systems) into each target production step. The new generation MES leverages business process models, business rules, workflow technology, web services, service-oriented architectures (SOA), libraries of manufacturing component applications, and industry standards to drive and interactively manage production. Real-time factory floor data is collected from various automation and test systems, aggregated and contextualized, and often displayed on dashboards relative to continuous improvement program metrics. Stakeholders have real-time transparency into operations and the ability to make and implement important decisions, thus “closing the loop” relative to manufacturing operations.

Companies that have not embraced MES (e.g. continuous processes, simple products) can collect data directly from the factory floor *with new-generation manufacturing intelligence solutions*. These solutions gather production and performance data directly from automation and test systems (e.g. throughput, quality, and scrap), often aggregating and contextualizing this information for target recipients. Manufacturing intelligence solutions leverage web services, SOA, and graphical toolkits to rationalize information and present vital, real-time dashboards within the context of KPIs.

PACE Key — For a more detailed description see Appendix A

Aberdeen applies a methodology to benchmark research that evaluates the business pressures, actions, capabilities, and enablers (PACE) that indicate corporate behavior in specific business processes. These terms are defined as follows:

Pressures — external forces that impact an organization’s market position, competitiveness, or business operations

Actions — the strategic approaches an organization takes in response to industry pressures

Capabilities — the business process competencies required to execute corporate strategy

Enablers — the key functionality of technology solutions required to support the organization’s enabling business practices



Chapter Two: Key Business Value Findings

Key Takeaways

- Best-in-class enterprises are outpacing the competition by standardizing best practices: Discrete manufacturers focus on real-time dashboards, process manufacturers on plant floor integration, and consumer products companies on work process standardization.
- More than half of all manufacturers are leveraging visual work instructions and a third are delivering analytic capabilities to the executive suite.
- All enterprises reporting significant improvement in asset utilization have “closed the loop” with systems that anticipate change and take timely, corrective action to minimize impact.

Best-in-class enterprises have taken cost-cutting measures, demanding customers, and globalization in stride. They have prevailed by remaining focused on customer satisfaction, bottom-line results, and operational excellence. Over time, these companies have reengineered business processes and deployed best practices across manufacturing. Additionally, technology is enabling leaders to proactively manage operations, respond intelligently to customer requirements, and deliver value.

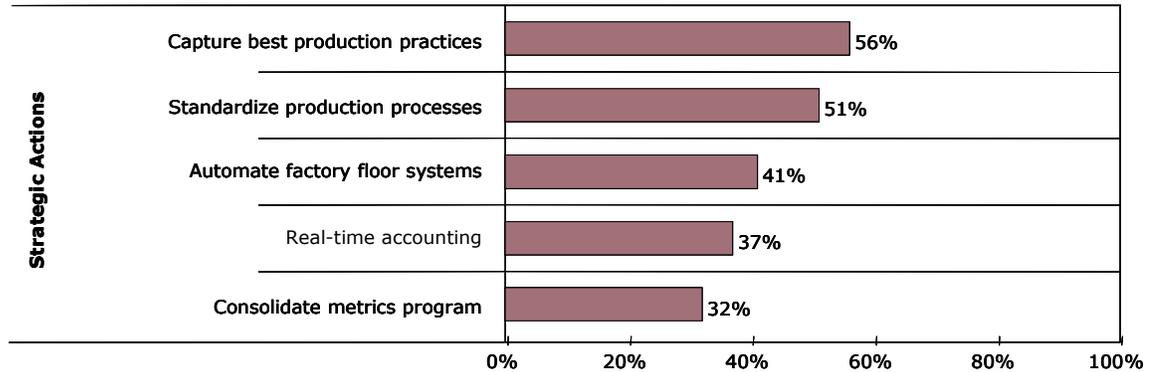
What Are the Best in Class Doing Differently?

Best-in-class companies are achieving profitability and gaining market share in an increasingly competitive environment. According to this research study, more than half of the respondents representing best-in-class enterprises are capturing best practices and standardizing production processes (Figure 2). These actions presume the use of technology systems to help enforce standard work processes; and the ability to analyze and compare performance results (e.g., productivity, throughput, quality) across production lines and plants.

While prudent investments in manufacturing technology have helped the best in class achieve this status, the time has come for average performers and laggards to consider similar investments. At one time, investments in automation, integration, and MES seemed prohibitively expensive to many companies. However, times have changed. Today, the risk of *not* having the ability to “sense and respond” to customers, regulatory agencies, and unforeseen events is too high. Additionally, the costs associated with implementing new-generation solutions relative to previous generations are lower due to emerging technologies, simpler integration schemes due to the adoption of industry standards by many vendors, and, if appropriate, the ability to license “software as a service.”



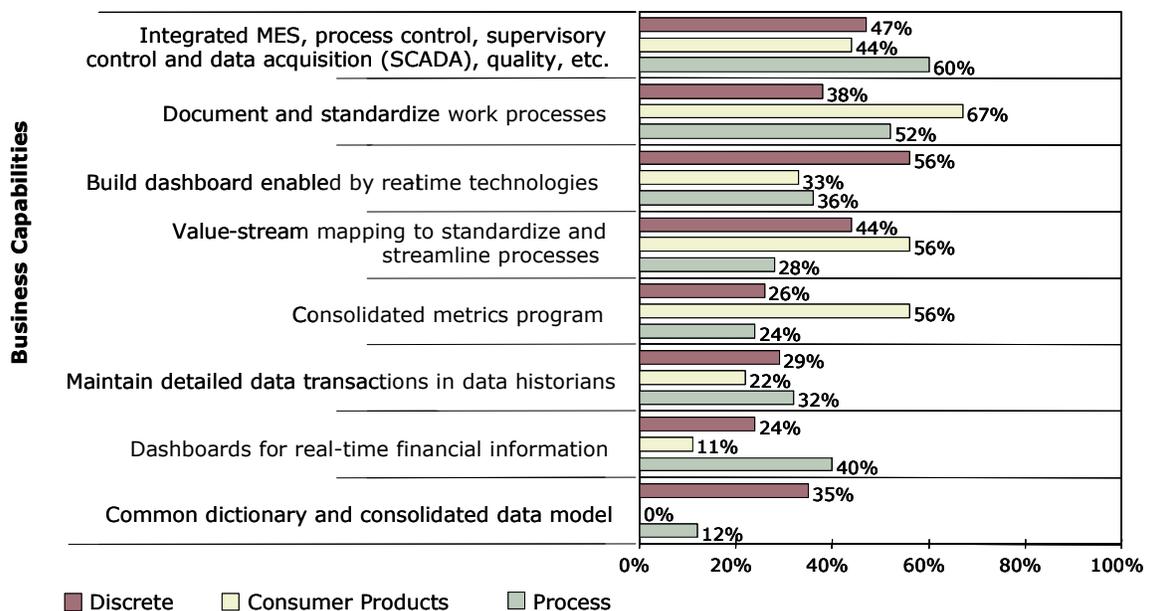
Figure 2: Strategic Actions by Best-in-Class Companies



Source: **AberdeenGroup**, December 2005

As part of the survey process, we asked participants to identify business capabilities that delivered the biggest benefits (Figure 3). *Consumer products* manufacturers registered a higher degree of enthusiasm for targeted, forward-thinking initiatives than process and discrete representatives did. The top priority reported by consumer products companies (67%) is documenting and standardizing work processes across factories and plants. Standardization of processes will result in cutting costs and, more importantly, improved flexibility by potentially creating interchangeable processes and lines.

Figure 3: Most Important Capabilities by Industry Sector



Source: **AberdeenGroup**, December 2005

Consumer-oriented manufacturers are twice as engaged in value-stream mapping as process manufacturers are (56% vs. 28%); they are on the front line with retailers, many of whom are demanding next-day delivery. By nature, business process modeling (aka, value stream mapping projects) starts with customer requirements and works back to the



supplier. As these companies become more customer-focused, their metrics programs will follow, which helps explain why twice as many consumer products manufacturers are consolidating their metrics programs than the other two sectors (56% vs. 26% and 24%) are.

The top priority for *discrete manufacturers* is building real-time dashboards using manufacturing intelligence solutions. It's interesting to note that more than half are trying to address the lack of integration with dashboards, while one-third are focusing on building common dictionaries and consolidated data models to address this issue.

Process manufacturers still focus largely on integrating plant floor systems. They report being less concerned with building dashboards than integrating process control systems (36% vs. 60%), and less interested in value stream mapping (28% vs. 44% and 56%) than either the discrete or process sectors. However, as consumer requirements ripple back to traditional process manufacturers (e.g., food and beverage, specialty chemical), sector interest in these technologies should pick up considerably within the next year or two.

Regardless of whether manufacturers leverage MES or manufacturing intelligence solutions to collect data, the top priority remains contextualizing and delivering information effectively to target audiences.

High Priority: Visualization and Analytics

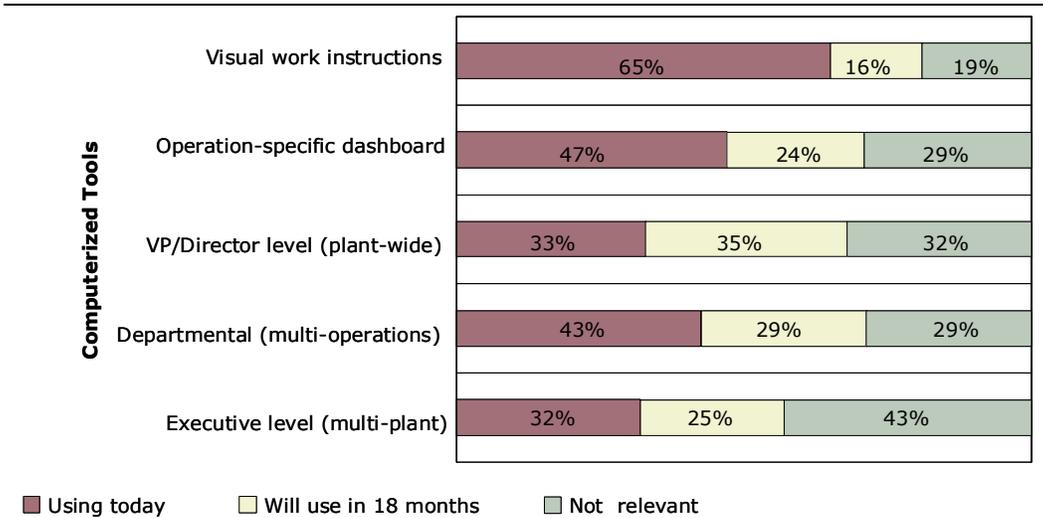
Historically, manufacturing technology systems have provided more visual interest than back-office systems have. In fact, process control systems have boasted colorful displays for two decades, and control rooms have provided plant managers the ability to see the status of equipment and work-in-process from one location for as many years. So it's not surprising that 65% of manufacturers (Figure 4) surveyed report relying on visual work instructions (e.g., work procedures, drawings, priority lists) to enhance workforce performance, while close to half (47%) are using operation-specific dashboards (e.g., quality testing, equipment monitoring, work assignments) to interactively manage operations.

Better-performing companies have introduced dashboards (regardless of data collection strategy) to stakeholders throughout the company. One-third of the research participants report that VP/director-level executives in their companies are using dashboards (e.g., actual vs. planned productivity, views of individual plant and line operations, along with analytic tools that facilitate analysis) while slightly more than another third will implement executive dashboards within the next 18 months.

A Business Case for Technology: Improved Asset Utilization

The data gathered throughout this study demonstrates a quantitative linkage between meeting performance objectives and successful deployment of technology. To demonstrate how metrics and technology can drive positive performance results, this section characterizes the organizations that reported significant gains (more than 10%) in asset utilization within the last 18 months.

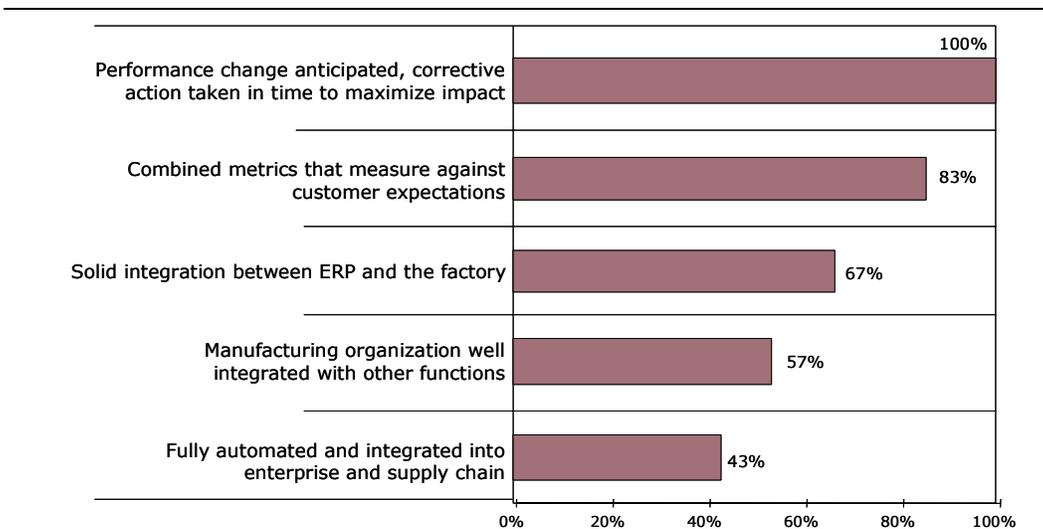
Figure 4: Visualization and Analytics



Source: **AberdeenGroup**, December 2005

All of these companies are leveraging technology to proactively anticipate and take corrective action in close to real-time (Figure 5). These firms have implemented and integrated systems to sense, detect, and respond to changes in their environments; for instance, beneficiaries might include an operator monitoring a quality problem, a supervisor reassigning orders to another line due to an equipment problem, or a maintenance manager being called to repair a failing piece of equipment.

Figure 5: Companies with More Than 10% Improved Asset Utilization



Source: **AberdeenGroup**, December 2005

A second important common characteristic is that 83% of these companies have extended their metrics programs beyond manufacturing and linked into their customers. Establishing joint goals requires customer collaboration, including joint planning and periodic performance reviews. While asset utilization is not linked directly to customer satisfaction, these firms demonstrate yet another tangible reason to become customer-focused.



Third, 67% of the companies that have achieved significant gains in asset utilization report that they have solid integration links between ERP and the factory floor. These ROI-oriented manufacturers have made the provision of visibility into factory floor data a priority, enabling managers and executives to participate in operational decision-making.

Stacking Up Against the Competition

Aberdeen has developed a competitive framework that helps determine success factors for Laggard, Industry Average, and Best-in-Class performers. Survey respondents were evaluated on five criteria: process, organization, knowledge, technology, and performance measurement. Table 1 lets you see how your organization stacks up.

Table 1: Aberdeen Competitive Framework

Process	Laggards	Industry Average	Best in Class
Process	Manufacturing processes are either manual or partially automated	Manufacturing processes are at least partially automated; some degree of integration	Manufacturing processes are fully automated and integrated into enterprise and supply chain functions
Organization	Fragmented functional departments throughout manufacturing; little interaction	Manufacturing organized as a single function, with regular coordination between functions	Manufacturing organization well integrated with other functions, such as engineering and finance
Knowledge	Performance change known well after the fact, not in time for any corrective action	Performance change known immediately after it has occurred; local corrective action undertaken	Performance change anticipated before it occurs, corrective action taken in time to minimize impact
Technology	Gap between ERP and the factory floor closed with manual and spreadsheet solutions	Basic exchange of data between ERP and the factory	Solid integration between ERP and the factory
Performance Measurement	Plant is measured on unit cost and throughput	Some measurement programs in place	Comprehensive metrics that measure against customer expectations

Source: [AberdeenGroup](#), December 2005



Chapter Three: Implications & Analysis

Key Takeaways

- Better-performing companies have successfully aligned metrics and continuous improvement programs to reflect well-articulated customer-facing strategies.
- Laggards have placed themselves at a competitive disadvantage due to a lack of focus and investment in technology. The time is now to automate, integrate, and simplify systems.
- Next-generation technology solutions: What's hot and what's not?

Successful manufacturers are proactively managing their businesses. They're collecting data from the factory floor and presenting it in context and at appropriate levels of detail to executives, supervisors, and operators who are empowered to act on behalf of the customer and the enterprise. This chapter outlines a five-part strategy for companies interested in creating transparency into manufacturing and turning this information into value:

- Align metrics to communicate strategy;
- Complete integration and process simplification;
- Consider next-generation technologies;
- Increase focus on industry standards; and
- Improve performance over time.

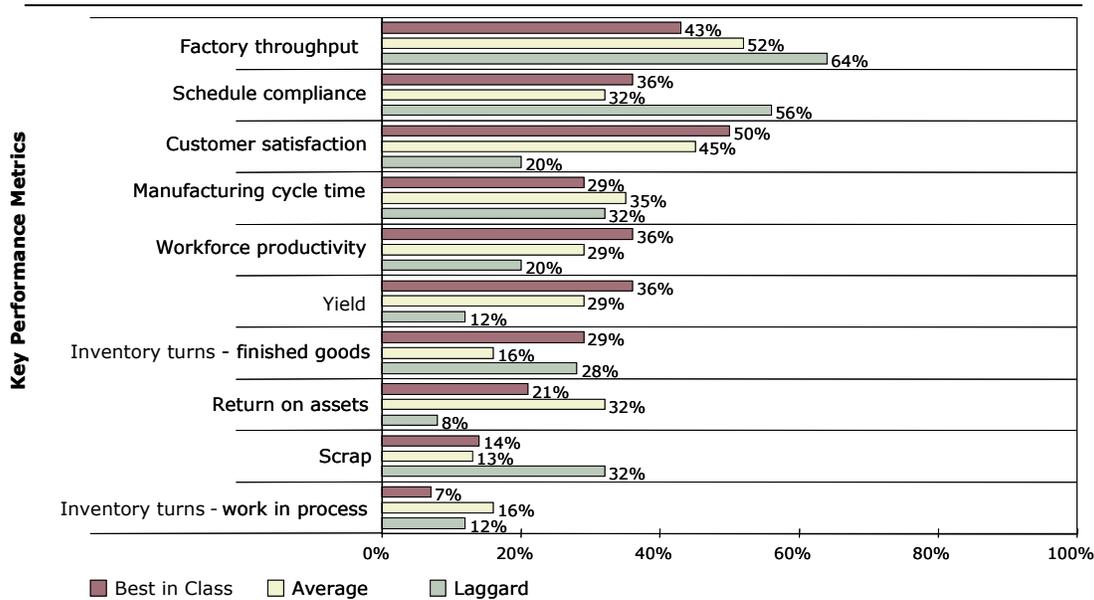
Align Metrics to Communicate Strategy

A successful strategy describes how a corporation intends to create value for its customers and stakeholders. Better-performing enterprises represent their strategies by setting quantifiable goals and implementing continuous improvement programs to achieve profitability and long-term growth. Figure 6 shows which metrics enterprises, operating at various performance levels, are monitoring to achieve corporate performance goals.

According to this data, best-in-class companies are more focused on customer satisfaction, workforce productivity, and yield. These metrics are forward-thinking and altruistic, and lend themselves to be communicated in a way that “enrolls” people to participate. Skilled delivery should demonstrate to each employee how he or she can contribute toward helping the enterprise achieve its goals. Appropriate communication, rewards programs, and management of positive metrics will help the organization focus on moving from making decisions based solely on internal information to making decisions that put the best interests of the customer and the overall company front and center.



Figure 6: Key Performance Metrics



Source: AberdeenGroup, December 2005

Conversely, it's interesting to note that the poorest performing companies are more focused on factory throughput (64%), schedule compliance (56%), and scrap (32%) than their better-performing counterparts are. Our findings indicate that the best in class are half as interested in scrap (what's wrong) but 2.5 times more interested in yield (what's right) than the laggards are. Another telling sign relative to performance: Customer satisfaction is less than half as important to laggards as it is to the best in class (20% vs. 50%). Finally, laggards are considerably more interested in factory throughput than better-performing companies (43% vs. 64%) which are more concerned with customer satisfaction.

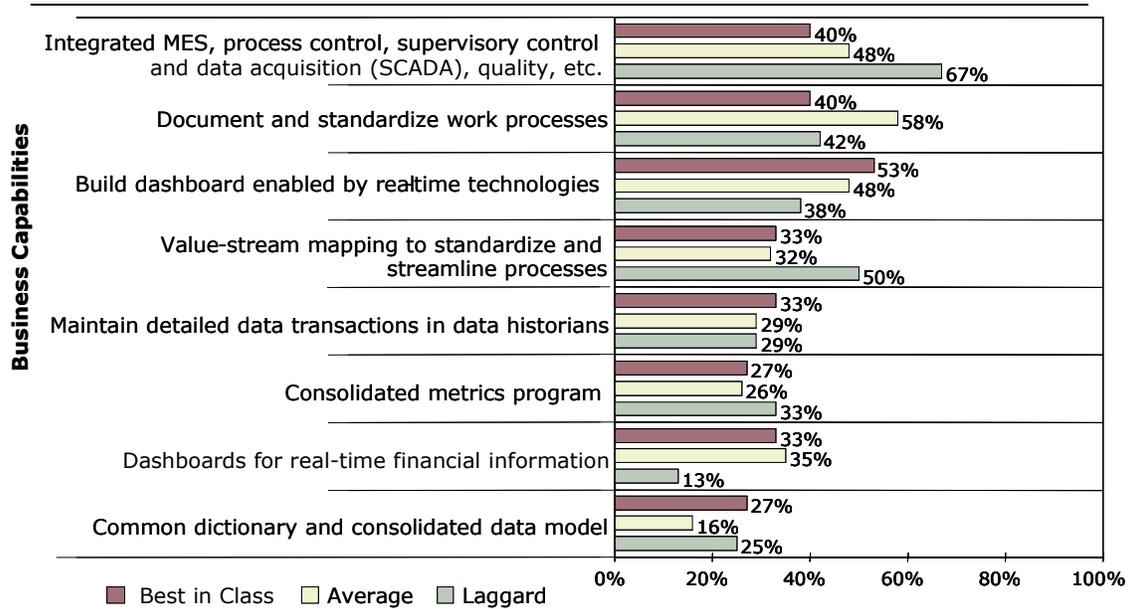
Laggards: Complete Integration and Process Simplification

In spite of the ups and downs of the manufacturing market, better-performing companies have managed to automate and integrate their manufacturing systems over time. While previous integration provided competitive advantage for early adopters, the lack of modern technology systems in day-to-day operations puts poorer-performing manufacturers at a competitive disadvantage. The lack of automation makes it difficult to identify and control costs while building in the flexible processes that facilitate rapid response to customer mandates and new market conditions.

To demonstrate this point, Figure 7 shows that 67% of laggards have yet to integrate their factory and plant floor systems. Because these companies have not linked individual steps and processes, each task operates independently, perhaps optimizing individual steps, but not optimizing manufacturing overall. This lack of technology also means that these companies are not equipped with the ability to automatically sense or anticipate upstream issues and opportunities.



Figure 7: Laggards Have Unfinished Business



Source: **AberdeenGroup**, December 2005

Consider Next-Generation Technologies

We asked participants to identify the technological capabilities that would deliver the biggest impact to their organizations (Figure 8). Across all three sectors, integrated real-time systems that sense, detect, and respond to factory floor issues received the highest combined priority, indicating that more than half of the survey participants recognize the important role technology plays in enabling them to manage their operations more proactively.

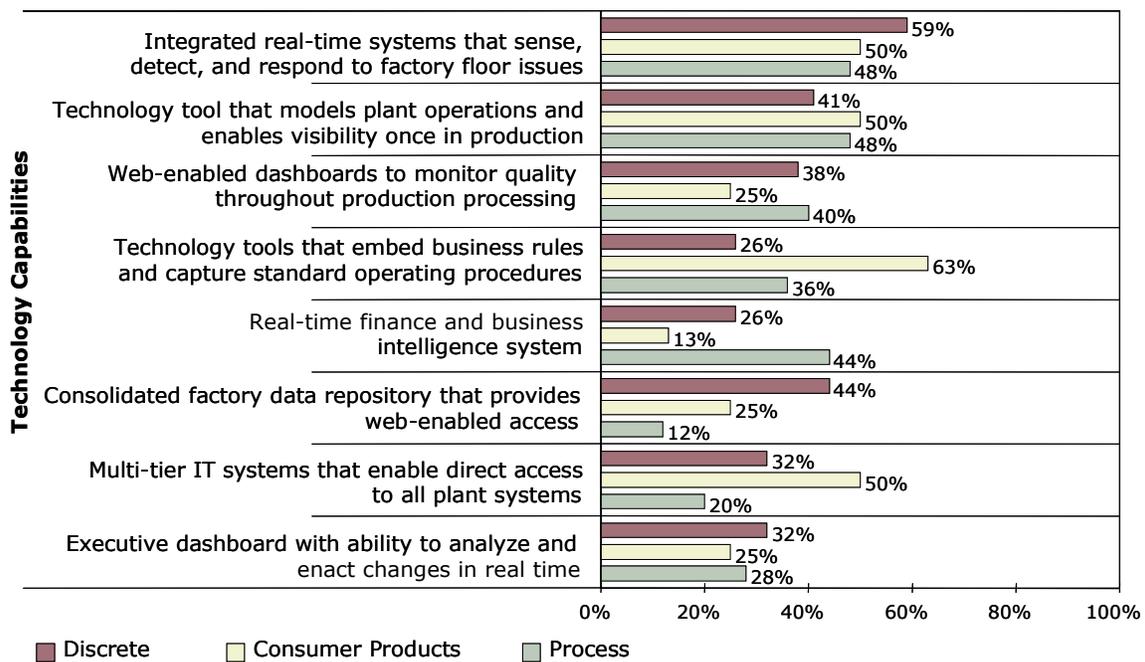
The second highest overall ranking in terms of high-impact technology solutions is a technology tool that models plant operations and enables visibility into production. Value stream mapping (VSM), business process modeling (BPM), and production modeling can all be supported by similar modeling tools that enable the user to visualize steps and “drag and drop” icons representing materials, operating instructions, information, etc., using a graphical user interface (GUI). VSM is the technique prescribed as a cornerstone for Lean and Six Sigma initiatives to simplify tasks and eliminate non-value-added activities.

Figure 8 also shows that *consumer product companies* are at least twice as interested in technology tools that embed business rules and capture operating procedures than either discrete or process (63% vs. 26% and 36%) manufacturers. Because these manufacturers tend to be under more pressure to respond rapidly to their customers, leveraging these technology tools helps automate many routine tasks and decision-making responsibilities.

This study also revealed that more consumer products companies recognize the value of multi-tier IT systems that enable direct access to all plant systems than their counterparts (50% vs. 32% and 20%). Multi-tier IT systems would enable, for example, an offsite decision maker to investigate the performance of individual production lines in specific facilities, or a regulatory agent to access full product genealogy (details of materials, lots, processes, test results, etc.) by “drilling down” into required data.



Figure 8: Technology Capabilities Having the Biggest Impact by Industry



Source: AberdeenGroup, December 2005

Tyson Foods Streamlines Operations

Under pressure from its competition, Tyson Foods pursued “The Perfect Order” strategy. Its goal was to deliver the highest quality product at the lowest possible cost. Challenges included delivering actionable information to production supervisors, integrating thousands of PLCs and supervisory control systems, creating end-to-end business processes from the front office to the loading dock, and establishing standards so that the resulting solution could be rolled out to additional plants.

The Tyson project team began by using value stream mapping techniques to document and model its 19 major process flows, and the 103,000 tasks and activities that supported them on a weekly basis. Evaluating each step in terms of the value it added, more than 20,000 steps were eliminated (from 22,000 to 220), bringing the 103,000 steps down by two-thirds to 30,000. As these end-to-end processes were streamlined, the IT team was establishing data and integration standards, using the ISA-95 framework in preparation for integrating thousands of PLCs and supervisory systems across the plant floor.

Once the processes were aligned and plant-level integration strategies defined, Tyson proceeded to evaluate the MES capabilities of multiple vendors. Its goals included leveraging ERP data to drive plant production, pegging customer orders to work-in-process, providing visibility into operations, reporting on production and testing data relative to KPIs, and finally, providing the real-time information decision makers need to respond rapidly to unexpected production issues and “opportunities.”

Tyson selected the SIMANTEC IT framework from Siemens as its MES solution. The project team began by modeling its newly streamlined production environment, using the



Siemens toolkit, including business rules capabilities and standard library components to create the basic structures for major processes. Legacy systems and real-time control were also integrated into the solution. Today, Tyson manufacturing decision makers receive 38% of their information in real-time vs. zero prior to MES. Time-critical data, decision support tools, and most importantly, the ability to enact change are made available via dashboards to decision makers throughout manufacturing.

Ralco Industries Standardizes Production

Ralco Industries has been providing metal stamping and manufacturing assembly services to its automotive and non-automotive customers since 1970. Because the company is more adept at delivering quality parts and components “just-in-time” to meet customer manufacturing schedules, it is growing faster than its competitors. The need to consistently adhere to industry standards and customer requirements motivated Ralco to invest in an integrated technology solution. Plexus online, the on-demand manufacturing information solution, has enabled Ralco to integrate engineering and manufacturing systems, thus providing plant managers and operators with visibility into materials and operations. Plexus online also helps provide assurance that standard operating procedures are enforced. The electronic communication of work instructions also ensures that setups are performed rapidly, consistently, and leave no room for operator variation. Throughout production, the integration of operator instructions, process step procedures, and PLC equipment help ensure that tough in-process quality standards are met. As a result, the scrap rate has gone down from 3% to less than 1% and OEE (overall equipment effectiveness) has gone up dramatically.

Rexam Production Lines Never Go Down

Over the past few years, Rexam has outpaced the competition to become the world’s leading provider of quality beverage packaging products to the consumer products industry. During a major supply chain reengineering effort in 1997, Rexam cast a critical eye on the performance of its more than 40 global manufacturing plants. CIO Paul Martin presented a strong case for the company to raise its focus on operational excellence throughout manufacturing. In the middle of its global SAP rollout, Rexam determined that its high-speed production lines were mission critical and that aggressive plans should be established to avoid having even one line fail unexpectedly.

Its focus on operational efficiency (OE) helped drive the manufacturing agenda. As part of its OE program, Rexam established tougher standards for quality, committed to providing real-time visibility to decision makers throughout the company, and focused on keeping high-speed lines up and running around the globe.

To accomplish these goals, Rexam initiated its bottoms-up integration program first. It leveraged Acumence’s Plant Analytic Server to capture real-time performance data, synchronize the management of production processes, and deliver operator instructions through an intelligent technology platform. Today, Rexam is able to compare production data to predetermined operational KPIs (e.g., production efficiency, spoilage) in real-time. As soon as results trend off spec, early warning alerts are sent to appropriate operators and maintenance managers so corrective action can be taken immediately.

As Rexam rolled out its SAP manufacturing and maintenance systems, it recognized the need to aggregate factory floor systems into a plant-wide, and later a company-wide data model that could be used as a basis for executive reporting. By synchronizing SAP data elements with the Plant Analytic Server, plant managers and vice presidents are able to



view plant-wide operations through the SAP portal and to “drill down” into real-time data as required.

Today Rexam produces more than 50 billion cans per year, which equates to 2,000 to 2,200 cans per minute through nine or 10 automated processes. Prior to 1997, equipment often operated until it failed. When equipment is running in degraded mode, action is taken automatically. As a result, the company has saved \$3 million per year in maintenance costs. Today Rexam operates a single instance of the SAP maintenance solution across manufacturing and has standardized on Acumence solutions across all its plants.

Improved Visibility at Dow Corning

A primary driver for Dow Corning over the past several years is assuring 25,000 customers that its silicon-based products are safe. From a manufacturing systems perspective, the company has had a major initiative underway to collect and aggregate quality data from across ERP, LIMS, and quality systems onto a common information framework. Over the past few years, the spreadsheets that were previously used to store production data have been replaced with SAP’s xMII (x-app manufacturing Integration and Intelligence) solution.

At Dow Corning, xMII enables decision makers to access customer and product related quality data regardless of where it resides or what format it is stored in; relevant data is collected and aggregated into the xMMI information framework. SAP Portals leverage this real-time data to display production and financial data relative to established KPIs. At Dow, when anomalies are discovered, managers are empowered to ‘drill down’ on issues to discover causes and effects, to analyze detailed data, and respond accordingly.

Increase Focus on Technology Standards

Well aware of the media hype regarding Sarbanes Oxley, RFID, and RosettaNet, we asked manufacturers which regulatory requirements they were concerned about, which technologies were being deployed for compliance, and which industry standards were being considered in their operations and systems.

In terms of ***regulatory requirements***, the quality-focused ISO (International Organization for Standardization) initiative is the most mature and was cited by the majority of respondents as their top regulatory requirement. Second in priority, EU (European Union) quality and safety standards are driving manufacturers around the globe to establish tougher internal procedures. Additional responses included:

- ISO (9000, 13485, 14000, 14971) – 68% today, 11% in 18 months
- EU (European Union) Directives – 48% today, 7% in 18 months
- Sarbanes Oxley – 36% today, 12% in 18 months
- FDA (Federal Drug Administration) – 36% today, 12% in 18 months
- DoD (Department of Defense) – 18% today, 2% in 18 months

Many survey respondents are using ***key technologies*** in at least part of their operations:

- Barcodes used by 70% of respondents; 18% will use in 18 months;
- EDI used by 56%; 17% will use in 18 months;



- Web/Internet used by 52%; 18% will use in 18 months; and
- RFID used by 21% today; 25% will use in 18 months.

Although a good deal is written about *industry standards*, the actual deployment or understanding of these standards in the production environment was lower than expected:

- ISA95 (Instrument, Systems, Automation) – 20% using today; 13% will use in 18 months
- OAGIS (Open Applications Group Integration Specification) – 15% using today; 5% will use in 18 months
- RosettaNet (B-to-B commerce) – 8% using today, 4% will use in 18 months

Aberdeen recommends that manufacturers support existing standards organizations, encourage technology vendors to incorporate standards into their offerings, and leverage standards into existing manufacturing systems. As individual companies and as an industry, manufacturers should dedicate themselves to propagate standards to:

- Establish common terminology and processes;
- Define links and standards for integration;
- Enforce data and process standards in the organization;
- Lower integration expenses;
- Lower cost of ownership; and
- Protect technology investments.

Improve Performance Over Time

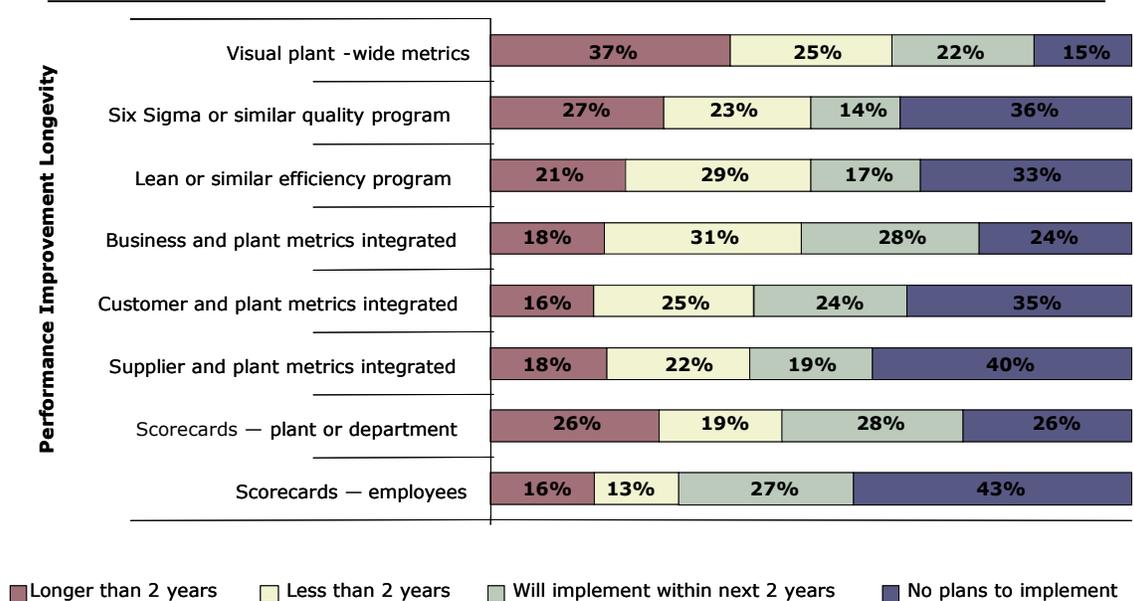
While metrics should be driven from the top down to align with corporate strategy, performance improvement programs are generally initiated at the operational level. According to this study, Six Sigma and Lean are the most common, and are in place or will be in place among more than half of respondents (Figure 9). This data also shows that three-quarters of respondents report that corporate and plant metrics are well integrated, which means that for the majority of companies, corporate strategy is being well communicated and delegated responsibly.

Integrating metrics with customers and suppliers demonstrates a focus on the end-to-end business process. About 40% have integrated these metrics already while another 24% to 28% of manufacturers plan to implement them within the next two years.

Communicating and “enrolling” employees and individuals into continuous improvement programs is a definitive step toward success. An impressive 85% of respondents either display plant-wide metrics visually or will do so within the next two years.



Figure 9: Longevity of — and Plans for — Performance Improvement Programs



Source: **AberdeenGroup**, December 2005

Pressures, Actions, Capabilities, Enablers (PACE)

There's a clear relationship between the pressures companies identify, the actions they take, and their subsequent competitive performance. All participants should examine their prioritized PACE selections and determine whether they can glean valuable perspectives by comparing their PACE selections with those of best-in-class companies. Table 2 shows the pressures, and prioritized actions, capabilities and enablers companies must embrace to move from industry norm to best in class.

PACE Key: For a more detailed description, see Appendix A

Aberdeen applies a methodology to benchmark research that evaluates the business pressures, actions, capabilities, and enablers (PACE) that indicate corporate behavior in specific business processes. These terms are defined as follows:

Pressures — external forces that impact an organization's market position, competitiveness, or business operations

Actions — the strategic approaches that an organization takes in response to industry pressures

Capabilities — the business process competencies required to execute corporate strategy

Enablers — the key functionality of technology solutions required to support the organization's enabling business practices



Table 2: PACE (Pressures, Actions, Capabilities, Enablers)

Priority	Pressures	Actions	Capabilities	Enablers
1	Executive visibility into production processes	Standardize and streamline production processes	Value stream mapping to standardize and streamline processes	Technology tool that models plant operations and enables visibility once in production
2	Improve product quality and reduce variability	Consolidate metrics program	Consolidated metrics program	Web-enabled dashboards to monitor quality throughout production processing
3	Proactively manage production	Automate and integrate factory floor systems	Integrated MES, process control, SCADA, quality, etc.	Integrated real-time systems that sense, detect, and respond to factory floor issues
4	Provide direct access to full product genealogy	Create full audit trail for all finished goods, assemblies, components	Maintain detailed data transactions in data historians	Multi-tier IT systems that enable direct access to all plant systems
5	Executive ability to implement changes as required	Create standard framework to unify systems	Build dashboard enabled by real-time technologies	Executive dashboard with ability to analyze and enact change in real-time
6	Leverage best practices into new facilities	Capture and manage best production practices	Document and standardize work processes	Technology tools that embed business rules and capture standard operating procedures
7	Enterprise-wide access to manufacturing orders, inventory, etc.	Identify target audiences and information requirements	Common language and consolidated data model	Portal or dashboard that enables executive view or drill-down into detailed manufacturing information across plants and business units

Source: **AberdeenGroup**, December 2005



Chapter Four: Recommendations for Action

Key Takeaways

- Laggard companies must complete factory floor integration efforts, become more customer focused, and empower operators and supervisors to make prompt decisions by delivering real-time technology solutions.
- Industry Average manufacturers should consider simplifying processes and systems with next-generation technologies, empowering plant managers and executives with technology-enabled dashboards, and remain diligently focused on cost-cutting efforts and continuous improvement initiatives.
- Best-in-Class companies should get ready to deploy Lean and Six Sigma to all plants and contract manufacturing partners, leverage real-time technologies to close the decision-making loop, and deliver manufacturing intelligence to the boardroom.

Driven by dynamic markets, Lean and Six Sigma initiatives, and emerging technologies, manufacturing enterprises are entering a new era of technology solutions. These solutions can help laggards overcome competitive barriers, or help industry average companies to reach the next plateau of performance, or enable the best in class to retain their leadership positions. The following actions should help spur necessary performance improvements.

Laggard Steps to Success

1. *Complete integration efforts.*
Make integration of factory and plant floor systems a high priority. Begin from the bottom up and leverage emerging industry and technology standards to integrate multiple control systems into an MES system or plant-wide database. Next, build critical integration links with ERP to enable visibility into operations by all levels of management throughout the company.
2. *Become customer-focused.*
Implement customer-focused business processes by leveraging initiatives such as Lean and Six Sigma, and methodologies such as value stream mapping to ensure employees and trading partners focus on the end-to-end business process. Also, enhance metrics programs to measure revised processes.
3. *Empower operators and supervisors.*
If you don't have computerized visual work instructions at each major step, make this a priority. Empower operators to interact with their assigned production process, thereby ensuring completion of each step and associated testing procedures prior to releasing to the next operator. Also, provide supervisors with transparency to all operations to ensure smooth flow and enable reprioritization as required.



Industry Average Steps to Success

- 1. Remain focused on cutting costs and improving responsiveness.*
If you're deploying Lean and Six Sigma, remain focused on monthly results and trends over time. After a couple of years, many programs lose momentum. If this happens, redouble efforts to improve performance. If you're reaching program goals but the impact on performance is not as strong as it once was, reevaluate corporate strategy in light of external customer or environmental changes.
- 2. Consider next-generation standards and technologies.*
As your company becomes more customer-focused, understand the critical role MES plays in being able to deliver quality and compliant products on time and within budget. Consider your current systems, as well as commercial solutions, and the potential benefits you can gain by leveraging ISA-95, OAGIS, and other standards along with newer lower-cost integration techniques.
- 3. Empower plant managers and global manufacturing executives.*
Deliver appropriate levels of plant and production information to plant managers and their executive managers. Enable decision makers to compare results across lines, from throughput to product quality to workforce productivity. Enable visualization of processes and provide the data and analytic tools to empower managers and executives to make informed decisions relative to resource assignment, demand, and unforeseen circumstances.

Best in Class Next Steps

- 1. Get ready to scale operations.*
Now is the time to scale successful Lean, Six Sigma, and other initiatives into other parts of the enterprise and the supply chain. This will require automation and integration of processes and information. In addition to enabling propagation of best practices, this is also an opportunity to capture work processes and other knowledge that will enable new workers to come up to speed quickly.
- 2. Close the loop with real-time “detect, sense, and respond” technologies.*
Now is the time to take advantage of business process modeling tools, service-oriented architectures, component applications, and the incorporation of ISA-95 standards into many leading technology solutions.
- 3. Deliver manufacturing intelligence to the boardroom.*
Harness manufacturing information and technology to provide executives with the information they need to make informed decisions. Provide summaries of this information and allow detailed drill-downs into data on products, facilities, processes, compliance, the workforce, and other manufacturing information.



Author Profile

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Jane Biddle leverages her more than 25 years of manufacturing, enterprise, supply chain, and international logistics expertise to lead Aberdeen research efforts in the global manufacturing sector. Through benchmarking studies, best practice reports, and tailored research projects, she remains focused on helping clients understand and anticipate the impact of business and technology on their organizations.

Jane has been at the forefront of technology since implementing MRP systems for Hewlett-Packard customers. This experience led her to become MRP/ERP product manager and industry solution manager for Hewlett-Packard's CIM marketing organization. In the mid-1990s, she established the manufacturing practice for Benchmarking Partners before she joined SAP to initiate and manage its Industry Centers of Expertise for the Americas. The solutions maps that were developed under her leadership are still core to the way SAP develops requirements and sells solutions. Prior to joining Aberdeen, Jane was an independent consultant providing strategic advisory services to technology and service providers in the supply chain and manufacturing sectors.

Jane is a frequent speaker at industry conferences and has published a number of articles. She also serves as APICS West Jersey president. Jane received her BS in Computer Science and MBA from Rivier College in Nashua, N.H., and maintains her APICS CPIM certification status.



Appendix A: Research Methodology

In July and August 2005, **AberdeenGroup** and *Control Engineering* examined the management procedures, experiences, and intentions of 75 manufacturing enterprises across the discrete sector (automotive, high tech, industrial equipment), process sector (chemical, food & beverage, pharmaceutical), and consumer products (consumer durables, consumer electronics, consumer packaging).

The survey and follow-up interviews were designed to determine the following:

- The opportunities manufacturers have today to leverage their manufacturing information in other parts of the enterprise or with supply chain partners;
- The business capabilities and technology enablers leading manufacturers are using to improve transparency into manufacturing; and
- The specific actions manufacturers can take to gain insight into manufacturing, and leverage this insight to deliver value to the customer and the enterprise.

This research included respondents with the following:

- **Department/function:** supply chain (36%), quality engineering (24%), supply chain, manufacturing (21%), customer service (12%), etc.
- **Job title:** vice president (33%), plant manager (33%), supervisor (33%), etc.
- **Industry:** The research sample included 52% respondents from discrete manufacturing industries, 36% from process, and 12% from consumer products.
- **Geography:** The respondents represent manufacturing facilities around the globe, including 59% in the U.S., 47% in Asia Pacific, 46% in Europe, 24% in South America, 11% in North America excluding the U.S. 12% in the Middle East, and 10% in South America.
- **Company size:** About 33% of respondents were from large enterprises (annual revenues above US \$1 billion); 35% were from mid-size enterprises (annual revenues between \$50 million and \$1 billion); and 32% of respondents were from small businesses (annual revenues of \$50 million or less).

Table 3: Relationship between PACE and Competitive Framework

PACE and Competitive Framework — How They Interact

Aberdeen research indicates that companies that identify the most impactful pressures and take the most transformational and effective actions are most likely to achieve superior performance. The level of competitive performance a company achieves is strongly determined by the PACE choices it makes and how well its decisions are executed.

Source: **AberdeenGroup**, December 2005



Appendix B: **Related Aberdeen Research & Tools**

Related Aberdeen research that forms a companion or reference to this report includes:

- *[Winning with Global Manufacturing Networks](#)* (September 2005)
- *[Best Practices in Lean: The Momentum Builds](#)* (June 2005)

Information on these and any other Aberdeen publications can be found at www.Aberdeen.com.



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- PRIORITIZE operational improvement areas to drive immediate, tangible value to their business
- LEVERAGE information technology for tangible business value.

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- CREATE DEMAND, by reaching the right level of executives in companies where their solutions can deliver differentiated results
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- EXPAND CUSTOMERS, by fortifying their value proposition with independent fact-based research and demonstrating installed base proof points

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