



Aberdeen *Group*

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Manufacturing Flexibility

Synchronizing the Shop Floor and Supply Chain

January 2007



Executive Summary

Manufacturing flexibility, for the purpose of this study, is defined by Aberdeen as the convergence of supply chain visibility, production capacity, and dynamic decision making. The Aberdeen Group has also identified three key performance indicators (KPI): on time delivery, finished goods inventory, and manufacturing cycle time, these KPI are used to measure the success enjoyed by manufacturers that integrate and improve upon the above three business capabilities.

Key Business Value Findings

The top three strategic actions being implemented by manufacturers to improve flexibility are measuring operational metrics, controlling inventory costs, and improving dynamic decision making. When viewed as an overall coherent strategy this can be categorized as a “measure, control, and improve” strategy, which is a common approach in the continual improvement and Lean manufacturing space. Manufacturers should utilize this approach when attempting to improve flexibility; it plays an important role in the analysis and recommendations.

Implications & Analysis

By analyzing the technology strategies of the Best in Class, two major areas of technology utilization are identified as precursors to Best in Class performance. First, improving production process capabilities is a determining factor in operational performance. Manufacturers have successfully improved this by implementing open architecture automation systems and improving the configurability of MES (Manufacturing Execution Systems), ERP (Enterprise Resource Planning), and APS (Advanced Planning and Scheduling) solutions. Manufacturers have also achieved Best in Class performance by improving dynamic decision making. This improvement has been accomplished by incorporating supply chain visibility and modeling capabilities into the APS optimization engines.

Recommendations for Action

- Utilize either ERP or MES to measure on time delivery, finished goods inventory, and manufacturing cycle time performance. Gauge the success of manufacturing flexibility by the aggregate performance of these metrics.
- Manufacturers should utilize open architecture automation systems. Best in Class manufacturers are over 3 times more likely to have implemented open architecture automation systems.
- Manufacturers should incorporate supply chain and production constraint visibility into APS solutions and utilize APS solutions for dynamic decision making. Best in Class manufacturers are 35% more likely than other manufacturers to have accomplished this.

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Chapter One: Issue at Hand

Key Takeaways

- Reducing inventory costs and shrinking lead times are the main market pressures driving manufacturing flexibility initiatives today, both of which limit manufacturers' ability to buffer against demand uncertainty.
- Increasing demand uncertainty is an additional market pressure driving manufacturers today, which increases the need of manufacturers to successfully buffer against demand uncertainty.
- Plant floor automation, execution system configurability, demand visibility, production constraint visibility, and dynamic decision -making all contribute to the success of manufacturing flexibility initiatives.

The scope and definition of manufacturing flexibility can vary across particular initiatives, but is generally broad and technology dependent. The typical aim of these initiatives is to reduce the costs associated with buffering demand uncertainty, while still improving overall customer delivery performance. There are three main aspects of the manufacturing process that will be examined in this report: production capabilities, supply chain visibility, and dynamic decision making. In the context of this report, Aberdeen defines manufacturing flexibility as the convergence of these three aspects of the manufacturing process and any improvement in manufacturing flexibility will encompass an improvement in one or more of these aspects of the manufacturing process.

Production Capabilities

For the purpose of this report, production capabilities refer to the plant floor automation and execution capabilities that are available to manufacturers. The main areas of interest in regards to production capabilities are ISA-88 compliance, the implementation of open architecture automation systems and the configurability of enterprise applications. Increasing the level of ISA-88 compliance and implementing open architecture automation systems will improve production capabilities in two ways, first by increasing the plug and play capabilities of new hardware and second by increasing the configurability of current automation systems and hardware. The other aspect of production capabilities, configurability of MES (Manufacturing Executions Systems), ERP (Enterprise Resource Planning), and APS (Advanced Planning and Scheduling), is relatively self explanatory. If execution systems facilitate multiple production setups and quick changeovers the production capacity of a given set of assets increases.

ISA-88 is an international standard helping manufacturers produce in a flexible way. It provides standards, models, and terminology for defining the control requirements in a manufacturing environment.



Supply Chain Visibility

Timely visibility into customer demand and raw material availability are both critical components of manufacturing flexibility and will both be analyzed in this report. Raw

material availability is closely related to production capabilities. The ability to quickly alter hardware and execution system setups is wasted without an accurate picture of the available raw materials necessary for the adjustment. Demand visibility is also similarly related to production capabilities. The ability to alter hardware setups and execution system configurations will also be wasted if there is visibility into customer demand is not available and more specifically if real time changes in customer demand are not available.

Dynamic Decision-Making

Dynamic decision making occurs when production capabilities and supply chain visibility converge. The degree to which manufacturers incorporate the different components of these will in large part determine the degree to which dynamic decision making can occur. The success of dynamic decision making is also, in part, determined by the metrics optimized and the specific optimization tools utilized. These metrics and tools include production constraint modeling, KPI optimization, financial impact analysis, and Lean manufacturing scheduling, which can include level loading, ConWIP, or tact time, among others. The use of such optimization is the way in which the convergence of production capabilities, supply chain visibility, and dynamic decision-making is achieved.

PACE Key — For more detailed description see Appendix A

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

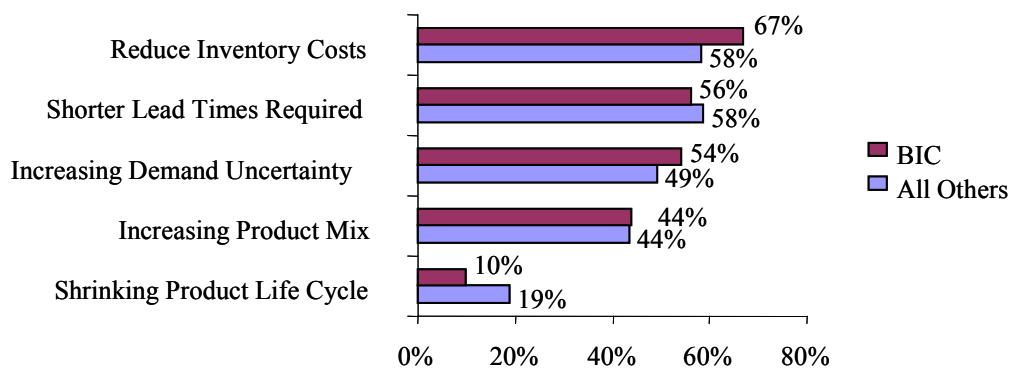
Pressures — external forces that impact an organization’s market position, competitiveness, or business operations

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

Figure 1: Market Pressures Driving Manufacturing Flexibility Initiatives



Source: AberdeenGroup, December 2006



Addressing Market Pressures

The number one market pressure driving manufacturing flexibility initiatives for manufacturers today is reducing inventory costs. This is followed by shrinking lead times and increasing demand uncertainty. Although these are all market pressures manufacturers' face; the above ordinal ranking does not necessarily reflect the dynamics between the three.

Two of the above three market pressures play crucial roles in the manufacturers' arsenal to effectively buffer against uncertain demand. The main buffers that manufacturers have to mitigate the risks associated with demand uncertainty are increasing inventory levels, decreasing lead times, or increasing capacity. This does not bode well for customer delivery performance. The market is pressuring manufacturers to reduce the cost of inventory, i.e. reduce inventory levels, and in doing so manufacturers will reduce the ability to respond to changes in demand. Manufacturers are also being pressured by shorter lead times; implying customers are demanding shorter order to delivery times, which can be achieved only in two ways: either by increasing inventory levels, which is not desirable, (see above pressure) or by improving some aspect of manufacturing flexibility.

The final market pressure faced by manufacturers is increasing demand uncertainty, which only amplifies the problem. Not only is the market pressuring manufacturers to reduce the use of buffers mitigating the risks associated with uncertain demand, but the uncertainty of demand itself is increasing. This leaves manufacturers with very few options.

In the face of increasing demand uncertainty and the pressure to reduce the use of demand uncertainty buffers, the only strategy left is to improve performance by improving manufacturing flexibility. The remainder of this report will explore the strategies manufacturers are currently employing to improve manufacturing flexibility, the subsequent operational performance enjoyed, and the technology being utilized to facilitate these strategies and operational performance improvements.

"We are piloting Infor's APS solution for several reasons. Due to the dynamic nature of our process we need to increase the granularity with which we can view our raw materials and scheduling process. There are currently conflicting views on how to optimize the production plan across multiple production lines and product setups; consequently we need an optimization engine that can formalize this process. Our current ERP implementation does not effectively address these issues."

Anonymous
Engineering Manager
Food and Beverage Manufacturer



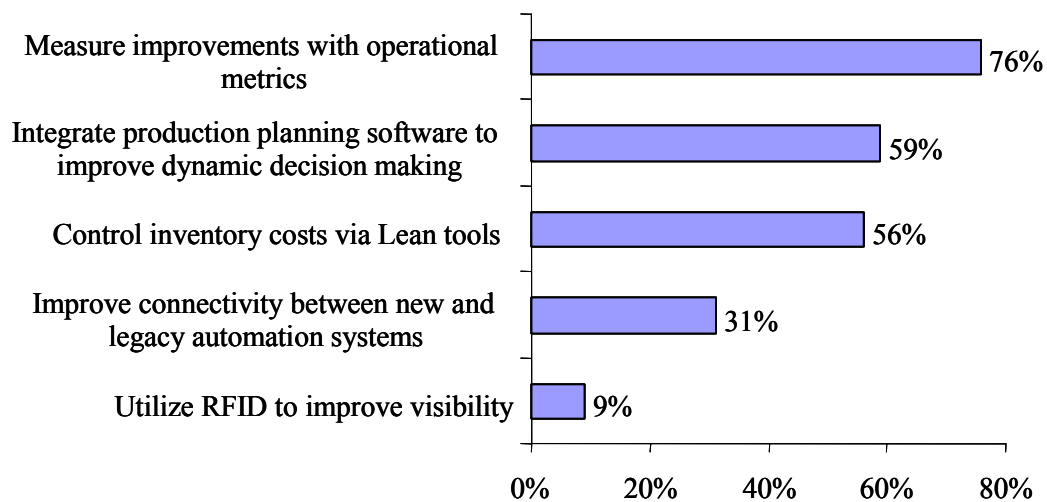
Chapter Two: Key Business Value Findings

Key Takeaways

- The top three strategic actions manufacturers are taking to improve manufacturing flexibility are measuring operational metrics, improving dynamic decision making, and controlling inventory costs.
- These three separate actions can be described by an overall strategy, “Measure, Control, and Improve”. This strategy should be utilized when improving manufacturing flexibility.
- The key challenges surrounding this strategy all involve a lack of technology; improving decision making, measuring operational metrics and increasing supply chain visibility are all best accomplished with technology implementations.

The need for manufacturers to improve manufacturing flexibility is apparent; the market is pressuring manufacturers to both improve customer responsiveness and reduce the cost of demand uncertainty buffers at the same time. However, the best practices that manufacturers are currently leveraging to improving manufacturing flexibility are not necessarily apparent. When asked, 76% of manufacturers are attempting to improve manufacturing flexibility by measuring operational metrics, 59% are integrating production planning software to improve dynamic decision making, and 56% are attempting to control inventory costs through Lean manufacturing tools. When all three of these strategic actions are viewed as a coherent strategy, a plan of action begins to surface: “Measure, Control, and Improve.”

Figure 2: Strategic Actions to Improve Manufacturing Flexibility



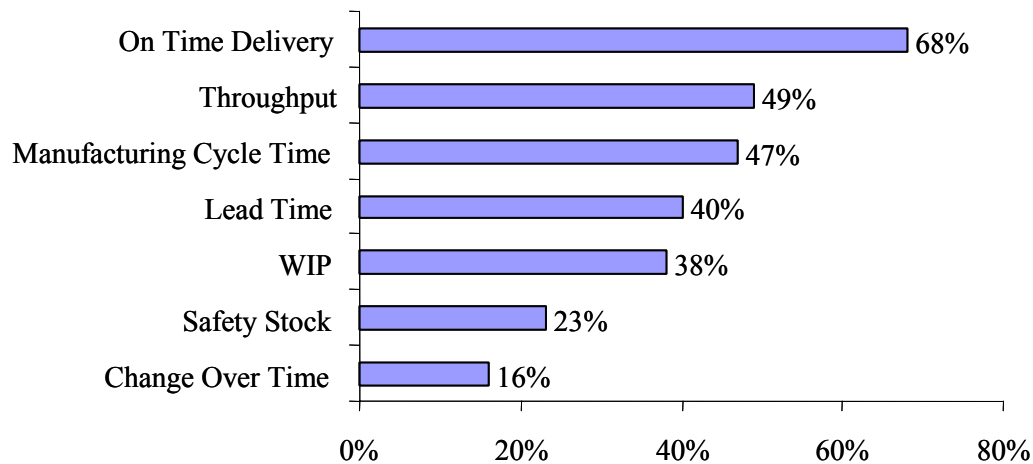
Source: [AberdeenGroup](#), December 2006



Measure, Control, and Improve

The strategic actions identified by the surveyed manufacturers encompass a broad based strategy that embraces many of the key ideas behind Lean manufacturing and continuous improvement. The process starts with both identifying and measuring the proper metrics to improve performance. It is often the case that manufacturers receive the most substantial and immediate benefit just from this first step. Many times, just giving visibility to performance will facilitate improvement.

Figure 3: Share of Manufacturers Measuring Specific Metrics



Source: **AberdeenGroup**, December 2006

The second piece of the strategy is implementing tools that help control key metrics, in this case inventory costs. It is often the case that without Lean manufacturing tools and Lean scheduling policies in place WIP (work in process) inventories and finished goods inventories can explode. Tools like Kanban will limit the level of inventory at any given point in the production process and tools like Heijunka will level load the total amount of work in process at any given time in the production process.

The final piece of the puzzle is implementing and integrating a technology solution that facilitates both the measurement and control of key performance indicators. The purpose of such an integrated technology solution is to give timely visibility to the necessary decision makers in order to institute dynamic decision-making. Once this leap is made, optimal in-process adjustments to the production plan can be made based upon production capacity constraints, raw material availability, and changes in demand.

“We have implemented Activplant on our shop floor and integrated Activplant with both our Rockwell and Siemens PLC. We utilize the data collected: i.e. machine fault, down time code, first time through, and mean time to repair among about 15 others, to better equip or Lean and Six Sigma initiatives.”

Anonymous
IT Portfolio Manager
Auto Manufacturer



Challenges and Responses

As with all improvement initiatives, challenges will arise, be confronted, and finally resolved. The top three challenges identified by surveyed manufacturers are closely aligned to the strategic actions identified above. 70% of manufacturers report that conflicting views on how to optimize production planning is a challenge inhibiting the implementation of manufacturing flexibility initiatives. This is followed by 60% of surveyed manufacturers reporting that a lack of visibility into the supply chain and production capabilities is a challenge, followed by 49% stating that operational metrics not being measured is a challenge.

As with the strategic actions, there is a relationship between the top three challenges faced by manufacturers. Namely, it is of very little surprise that there exists conflicting views of how to optimize production planning considering the number two and three challenges are a lack of visibility and measurement of operational metrics. Clearly, optimization of production planning is dependent upon both visibility and key performance indicator measurement. Without these being implemented optimization is infeasible and the result is often confusion among practitioners.

The responses to these challenges begin to highlight how technology can be utilized in a manufacturing flexibility initiative. The challenges of optimization and visibility are both being addressed with technology solutions. ERP, APS, constraint modeling software, and MES are all viable technology options for improving the ability to optimize decision-making and create visibility into production capabilities respectively. The remainder of this benchmark report will examine the specific functionality and implementation strategies that Best in Class manufacturers are employing.

"We have been utilizing Synchrono's Adaptive Manufacturing Solution for approximately two years. We use the solution for both job shop sequencing and balancing the release of work orders. We have raw material visibility through our ERP solution and Synchrono is directly integrated with customer demand. Since the implementation we have seen a 27% reduction in cycle time, a WIP reduction from 32 to 21 million dollars, and a 60% reduction in the average number of days late for order delivery."

Dimitri Youllakaris
Vice President Global Business Improvement & Information Systems
Timet



Table 1: Manufacturing Flexibility Challenges and Responses

Challenges	% Selected	Responses to Challenges	% Selected
1. Conflicting views of how to optimize production planning decision-making.	70%	1. Utilize constraint modeling software for shop floor capabilities.	57%
2. Lack of visibility into demand and shop floor capabilities.	60%	2. Utilize a MES solution to measure success by operational metrics.	56%
3. Operational metrics are not measured.	49%	3. Utilize a MES solution that's configured to multiple production setups.	56%
4. Enterprise and production planning applications are not integrated.	38%	4. Integrate disparate software solutions.	50%
5. Shop floor is limited by the configurability of MES.	31%	5. Implement RFID technology to increase visibility.	18%
6. New hardware and legacy automation systems can't communicate.	19%	6. Increase ISA-88 compliance of legacy automation systems.	9%

Source: **Aberdeen Group**, December 2006



Chapter Three: Implications & Analysis

Key Takeaways

- Manufacturers will be evaluated with a weighted average across three KPI: on time delivery, finished goods inventory levels, and manufacturing cycle time.
- Best in Class manufacturers are over three times as likely to have automation systems that utilize an open architecture and over twice as likely to have enterprise applications that are configurable to changes in the production process than other manufacturers.
- Best in Class manufacturers are more likely to have raw material visibility, demand visibility, and production constraint modeling incorporated into APS solutions and are 35% more likely to utilize this in dynamic decision making than other manufacturers.

For the purpose of this report Aberdeen has evaluated manufacturers using a weighted average across three KPI. The three key performance indicators being considered include: on time delivery, finished goods inventory levels, and manufacturing cycle time. Absolute performance is considered for on time delivery and finished goods inventory only, while improvement is considered for all three.

This competitive framework will be utilized throughout the benchmark to establish the connections between operational performance and technology utilization. Specifically, the technology functionality and operational approaches that are adopted by Best in Class manufacturers at a higher rate than Industry Average and Industry Laggard firms are considered technologic precursors to Best in Class performance. It is through this analysis that recommendations will be made to manufacturers still striving to become Best in Class; these precursors to improvement in operational performance should be viewed as the logical next-steps for technology adoption plans.

Competitive Framework Key

The Aberdeen Competitive Framework defines enterprises as falling into one of the three following levels of performance:

Industry Laggards — bottom 30% of performers.

Industry Average —middle 50% of performers.

Best in Class — top 20% of performers.

On Time Delivery

On time delivery is a commonly measured operational metric that gives a clear picture of overall customer delivery performance. In fact, 68% of surveyed manufacturers indicated that on time delivery was a “top three” operational metric for measuring overall success. On time delivery was chosen as a component of the competitive framework because of its broad acceptance by manufacturers as an indicator of success and because of its relationship with demand visibility, dynamic decision making, and operational performance. Any deficiencies in the above aspects of manufacturing flexibility will be reflected as poor performance for on time delivery. If demand visibility, production constraint visibility, or dynamic decision making falters it will translate into unfeasible order delivery time commitments and subsequent on time delivery misses.



Figure 4: On Time Delivery - Absolute

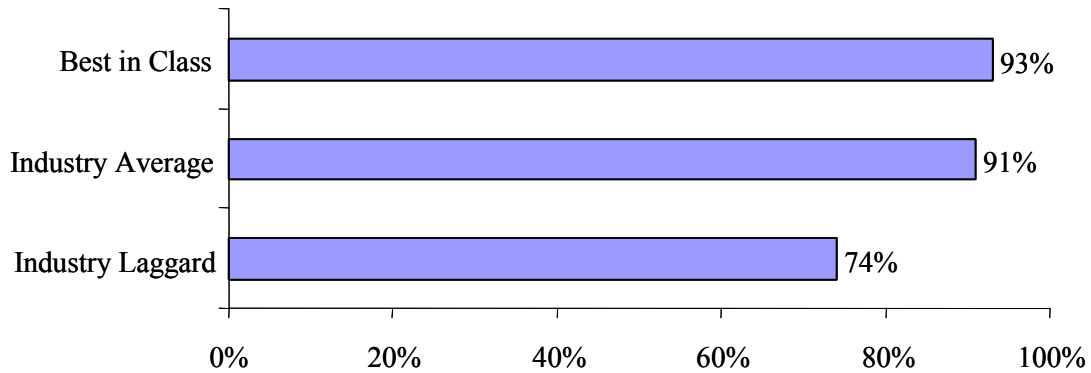
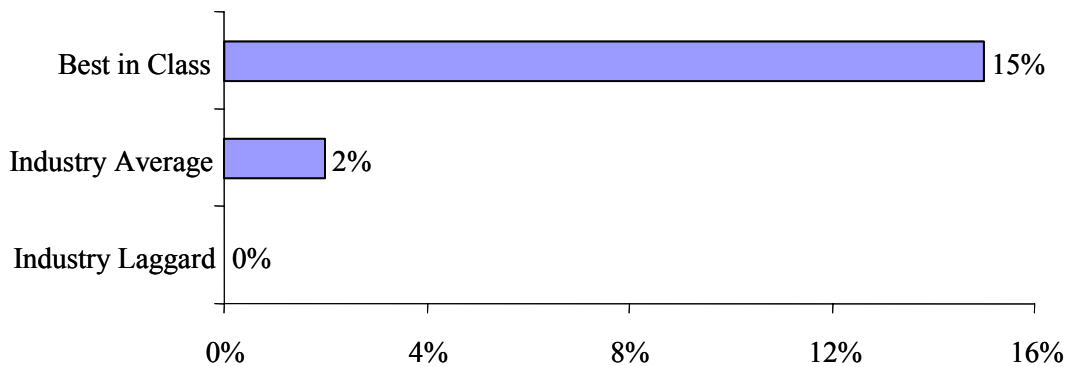


Figure 5: On Time Delivery – Improvement



Source: **AberdeenGroup**, December 2006

Finished Goods Inventory

Finished goods inventory is the second component of the competitive framework and is a crucial tool in manufacturers’ repertoire for buffering against uncertainty. However, as discussed earlier, it is not without cost and many manufacturers today, (56%) are attempting to reduce finished goods inventory levels.

The relationship between finished goods inventory and manufacturing flexibility involves finished goods inventory’s relationship with on time delivery and production capacity. It is impossible to improve finished goods inventory while keeping on time delivery constant without improving some

“Utilizing Lawson’s M3 solution with supply chain visibility and bottleneck constraint planning capabilities we have greatly improved system performance. We have made significant improvements to our WIP while maintaining finished good inventory levels and on time delivery performance”

Chuck Keeley
 President
 CGR Products, Inc.



aspect manufacturing flexibility, i.e. production capacity. If finished goods inventory levels are reduced, a manufacturers' ability to respond to changes in demand is diminished. This implies that supply chain visibility, production capabilities, or dynamic decision making must improve in order to improve overall system responsiveness; otherwise on time delivery performance will suffer.

Figure 6: Finished Goods Inventory - Absolute

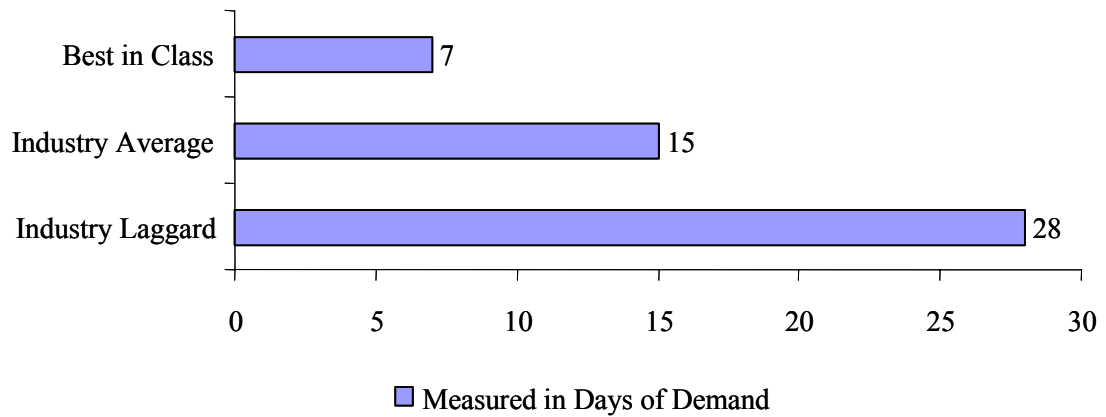
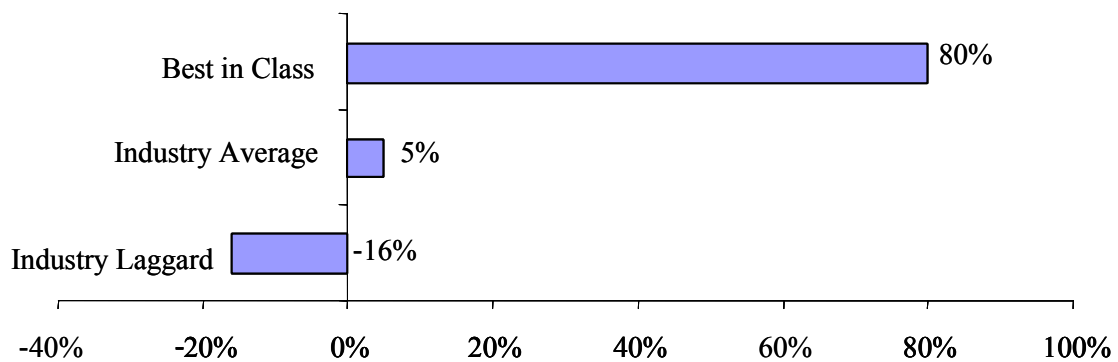


Figure 7: Finished Goods Inventory - Improvement



Source: [AberdeenGroup](#), December 2006



Cycle Time

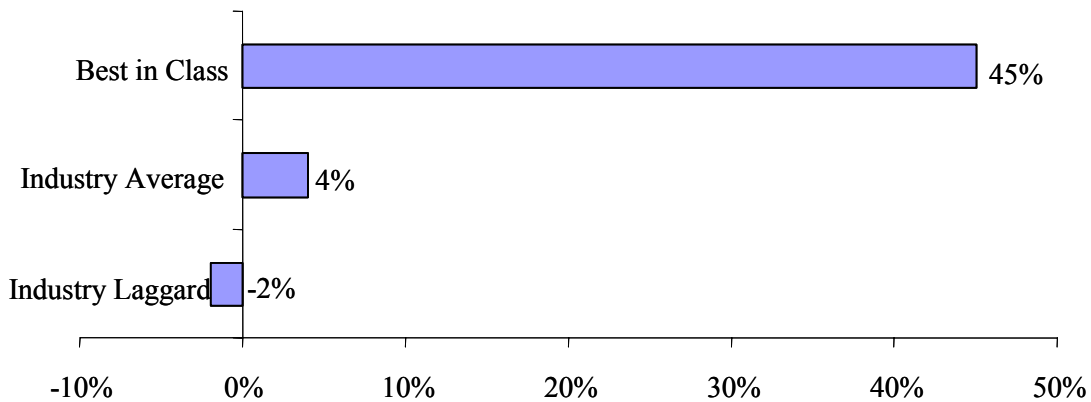
The final component of the competitive framework is manufacturing cycle time. Only improvement and not absolute performance is considered in the weighted average calculation for the competitive framework. This is the only aspect considered because of the large range in absolute cycle times across industries and modes of manufacturing.

Cycle time plays its role in manufacturing flexibility as a measurement of process velocity and is part of a dynamic relationship between both on time delivery and finished goods inventory. Continuing with the arguments used earlier, improving on time delivery, while reducing finished goods inventory levels, can only be accomplished by improving system performance or capacity. To accomplish this, manufacturers must improve either: supply chain visibility, production capabilities, or dynamic decision making. Unfortunately, these are not commonly measured metrics; but cycle time is; if any of the aforementioned factors improve, it will be reflected in reduced cycle times.

“In the late 1990’s we improved our competitive standing by coordinating both our business processes along with our ERP implementation. This put ourselves in the position to aggressively promote Lean and Six Sigma across our business unit. Utilizing SAP in conjunction with our Lean and Six Sigma programs we have seen significant improvements to both our product cost and cycle time performance.”

Frederick Musco
 Director of Information Technology
 Lockheed Martin Electronic Systems

Figure 8: Manufacturing Cycle Time - Improvement



Source: **AberdeenGroup**, December 2006



The Path to Best in Class Performance

Now that it is clear what level of operational performance constitutes a Best in Class manufacturer, the specific technology characteristics that are common to these manufacturers will be identified. Hardware and automation system configurability, enterprise application configurability, APS capabilities, the use of financial modeling to optimize operational metrics, and finally dynamic decision making will all be benchmarked. In each case both the operational benefits and technology utilized will be presented.

Automation System and Application Configurability

One of the ways Best in Class manufacturers differentiate is by increasing the configurability of production processes; this includes hardware, automation system, and enterprise application configurability. In order to respond to changes in demand, manufacturers must have the ability to respond on the shop floor and quickly change production line setups, execution system setups, and enterprise application setups.

Open architecture automation systems can facilitate “plug-and-play” capabilities with new hardware and legacy automation systems. MES, ERP, and APS configurability includes the ability to quickly execute changes in SKUs running on specific production assets or facilitate changes in the bill of materials as raw material availability changes. It also includes the ability to adjust modeling, Lean scheduling, and optimization capabilities as production setups change. Improving the ability of a given set of production assets to deal with changes in demand, while reducing finished goods inventory levels and continue to improve customer delivery performance all rely heavily on the configurability of the assets; as the following results will show.

Figure 9: Configurability of Hardware and automation systems

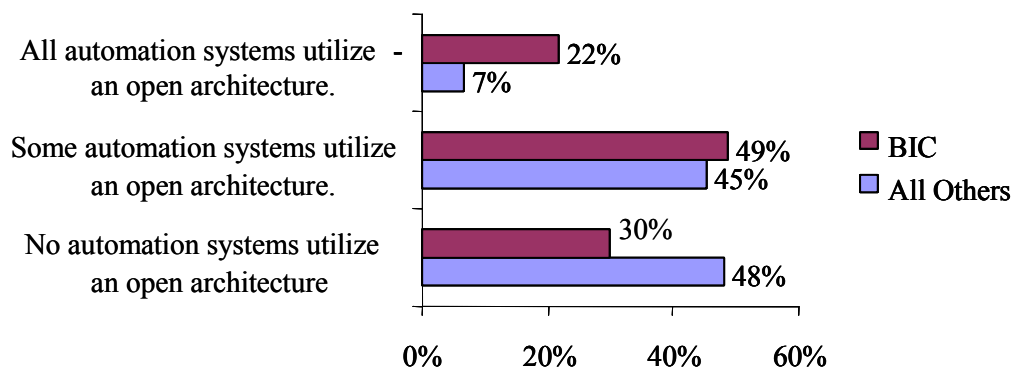
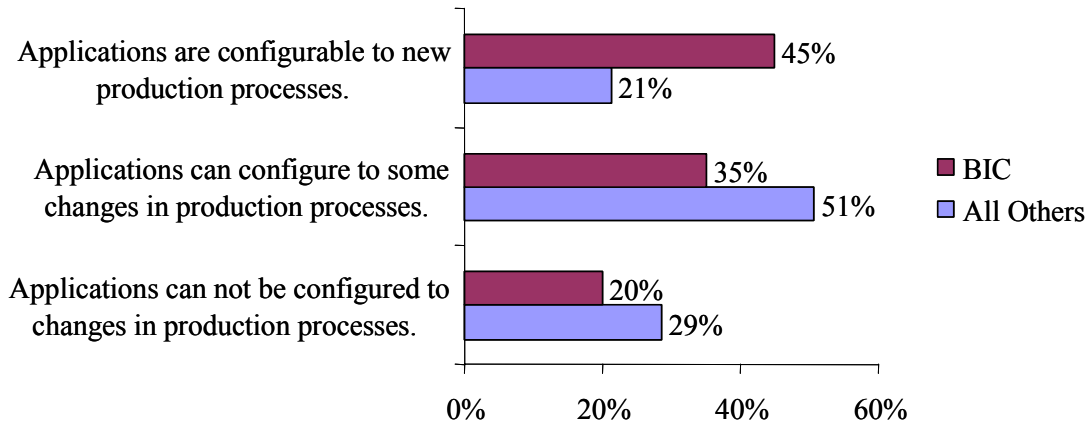




Figure 10: Configurability of Enterprise and Execution Applications



Source: **AberdeenGroup**, December 2006

Advanced Planning and Scheduling

Another way Best in Class manufacturers are differentiated is by the functionality of APS applications and how these applications are utilized in dynamic decision making. APS is typically implemented as either an ERP extension or standalone best-of-breed application. However, the differentiator for Best in Class manufacturers is the specific functionality of the application, not its method of delivery. Some common functionality found in APS solutions are demand visibility, raw material visibility, and production constraints and bottleneck modeling.

It is clear that this functionality is necessary for manufacturers to properly leverage the production process configurability discussed earlier. The degree to which manufacturers are able to utilize APS applications in dynamic decision making is a precursor to Best in Class performance. Again, the ability to optimally react to changes in demand helps utilize the production process configurability discussed above. Without properly utilizing APS functionality in dynamic decision making the benefits of production process configurability will largely go unrecognized. In addition, the overall adoption of manufacturers utilizing technology to model shop floor and supply chain constraints is still relatively low. Considering the correlation between the technology use and Best in Class performance, manufacturers not yet utilizing such technology should view implementation as low hanging fruit in the search for competitive advantage.

“Utilizing Waterloo Manufacturing Software’s APS solution we have increased customer order and raw material visibility. The benefits we have seen are decreased lead times, the reduction of raw material inventories and the ability to adjust production schedules on the fly. This was not possible using only our standard MRP solution.”

Linda Wilson
 Production Planner
 MM Kembla Tube & Fittings Ltd



Figure 11: Share of Manufacturers with Specific APS Functionality

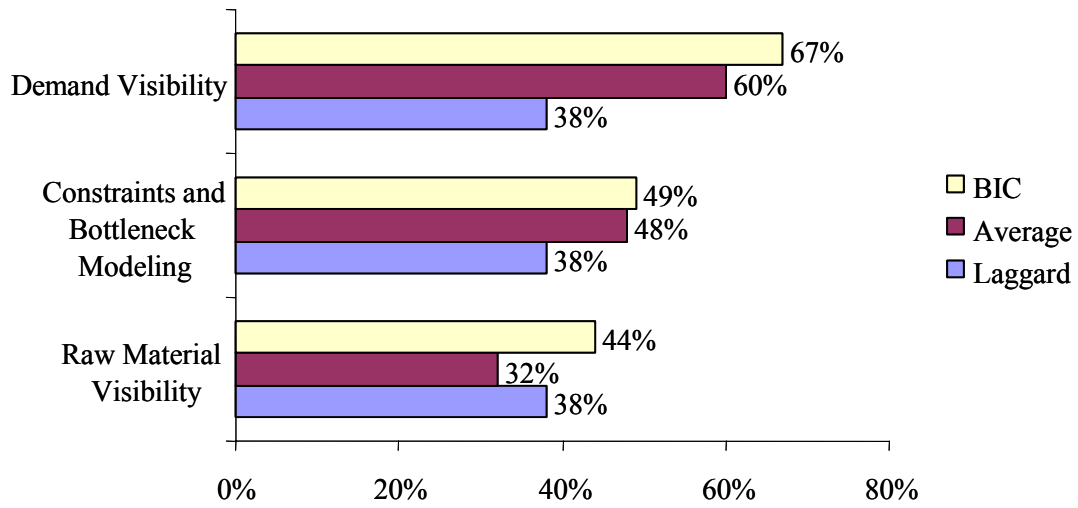
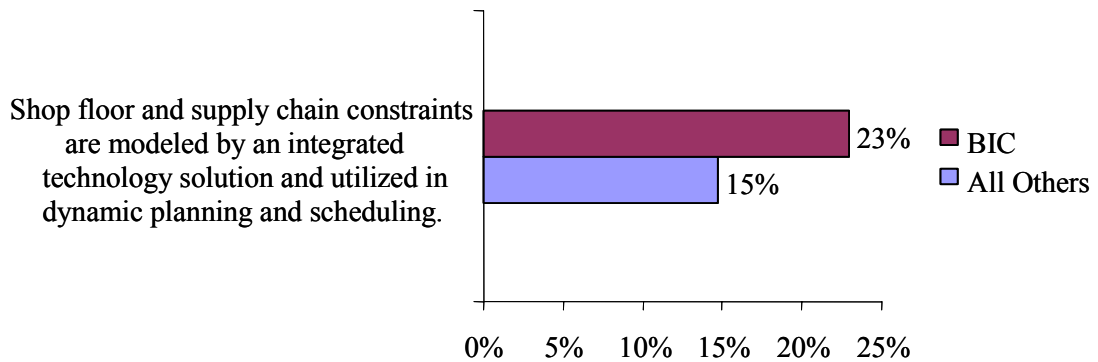


Figure 12: Share of Manufacturers with Dynamic Decision Making Capabilities



Source: [AberdeenGroup](#), December 2006



Chapter Four: Recommendations for Action

Key Takeaways

- Manufacturers must first understand the relationships between improving demand responsiveness, buffering against demand uncertainty, and manufacturing flexibility before any improvements can be realized.
- Central to improving demand responsiveness is improving supply chain visibility, production process capabilities, and dynamic decision making. ERP, MES, and APS solution are all technologies that must be utilized to improve performance in these areas.
- As manufacturing flexibility improves the need for demand uncertainty buffers decreases, this is a driving force behind need for optimization tools and dynamic decision making.

To properly implement the following recommendations it is crucial that manufacturers understand the dynamic relationships affecting the ability to manage changes in demand. There are two main tools that can be used to buffer against demand uncertainty; namely increasing finished good inventories and increasing order to delivery times. Manufacturers must also understand that these buffers are costly and the market is pressuring firms to reduce the use of these buffers while concurrently pressuring manufacturers to improve demand responsiveness. This may seem like an inherent contradiction, but it *is* possible to improve customer responsiveness without using buffers; which is accomplished by improving manufacturing flexibility and subsequently overall system performance.

Manufacturing flexibility, for the purpose of this study, is defined as the convergence of supply chain visibility, production process capabilities, and dynamic decision making. The key performance indicators used to gauge the success manufacturers enjoy by integrating these three are on time delivery, finished goods inventory, and manufacturing cycle time. Those manufacturers successfully improving all three of these metrics have truly improved overall manufacturing flexibility and the technology implementation and utilization strategies that these firms have used should be viewed as future steps for firms still attempting to achieve Best in Class status.

Laggard Steps to Success

1. Study and understand the relationships between improving demand responsiveness, buffering against demand uncertainty, and manufacturing flexibility.
2. Perform a self assessment of current performance in supply chain visibility, production process capabilities, and dynamic decision making. Carefully note the utilization of technology in each.
3. Begin to utilize APS (either as a standalone or ERP extension) to model and optimize production planning. Consider implementing either Lean tools or financial modeling techniques when conducting this optimization.



4. Begin to improve the configurability of MES and automation systems, consider implementing open architecture for new and legacy automation systems. Utilize this additional configurability to improve current production capabilities.
5. Utilize either an MES or ERP solution to begin measuring KPI. Gauge the success of manufacturing flexibility initiatives by improvements in on time delivery, finished goods inventory, and manufacturing cycle time.

Industry Norm Steps to Success

1. Improve visibility into raw material availability, changes in demand, production process capabilities, and production bottlenecks. Integrate this data with APS applications and utilize it in dynamic decision making.
2. Evaluate the current mode of manufacturing and implement either financial modeling or Lean manufacturing tools to optimize production planning and dynamic decision making.
3. Continue the quest to improve production process capabilities by implementing open architecture automation systems and enterprise applications that can be configured for changes in production processes.
4. Gauge the success of manufacturing flexibility initiatives by on time delivery, finished good inventory levels, and manufacturing cycle time. Utilize either financial modeling or Lean scheduling optimization tools to continually optimize finished goods inventory levels and order to delivery times as supply chain visibility, production capabilities, and dynamic decision making improves.

Best in Class Next Steps

1. If not yet completed, integrate APS solutions not yet integrated with supply chain visibility and production process capabilities and utilize APS solutions in dynamic decision making and production planning optimization.
2. Continue to improve production process capabilities by improving the share of open architecture automation systems and the configurability of MES, ERP, and APS solutions.
3. Utilize financial modeling or Lean scheduling tools in the optimization process, to help materialize the full potential of the improvements to production process capabilities.
4. Ensure that the proper KPI are being measured. If not utilize either ERP or MES to do so. Remember that as manufacturing flexibility improves the level of demand buffer in the system must be continually optimized, utilize APS and either financial or Lean scheduling optimization tools to do so.

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Appendix A: Research Methodology

Between November and December 2006, Aberdeen Group surveyed more than 200 enterprises and supplemented this online survey effort with telephone interviews of select survey respondents.

Responding enterprises included the following:

- **Job title/function:** The research sample included respondents with the following job titles: procurement, supply chain, logistics executive or manager (57%); manufacturing/operations executive or manager (22%); IT manager (9%); CFO or other C-level officer (8%), and finance/accounting manager (4%).
- **Industry:** The research sample included respondents predominantly from manufacturing industries. Automotive manufacturers represented 22% of the sample, followed closely by high-tech manufacturers, which accounted for 20% of respondents. Manufacturers of metals and metal products (including industrial equipment) totaled 16% of respondents. Aerospace and defense manufacturers accounted for 10% of the sample. Other sectors responding included medical equipment, construction/engineering, and retail and distribution.
- **Geography:** Nearly all study respondents were from North America, including 92% from the U.S. alone. Remaining respondents were from the United Kingdom and the Asia-Pacific region.
- **Company size:** About 24% of respondents were from large enterprises (annual revenues above US\$1 billion); 37% were from midsize enterprises (annual revenues between \$50 million and \$1 billion); and 41% of respondents were from small businesses (annual revenues of \$50 million or less).

Solution providers recognized as sponsors of this report were solicited after the fact and had no substantive influence on the direction of *Manufacturing Flexibility Synchronizing the Shop Floor and Supply Chain*. Their sponsorship has made it possible for Aberdeen Group to make these findings available to readers at no charge.



Table 2: PACE Framework

PACE Key
<p>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:</p> <p><i>Pressures</i> — external forces that impact an organization’s market position, competitiveness, or business operations (e.g., economic, political and regulatory, technology, changing customer preferences, competitive)</p> <p><i>Actions</i> — the strategic approaches that an organization takes in response to industry pressures (e.g., align the corporate business model to leverage industry opportunities, such as product/service strategy, target markets, financial strategy, go-to-market, and sales strategy)</p> <p><i>Capabilities</i> — the business process competencies required to execute corporate strategy (e.g., skilled people, brand, market positioning, viable products/services, ecosystem partners, financing)</p> <p><i>Enablers</i> — the key functionality of technology solutions required to support the organization’s enabling business practices (e.g., development platform, applications, network connectivity, user interface, training and support, partner interfaces, data cleansing, and management)</p>

Table 3: Competitive Framework

Competitive Framework Key
<p>The Aberdeen Competitive Framework defines enterprises as falling into one of the three following levels of FIELD SERVICES practices and performance:</p> <p><i>Laggards</i> — Operational performance that encompasses the bottom 30% of manufacturers.</p> <p><i>Industry Average</i> — Operational performance that encompasses the middle 50% of manufacturers.</p> <p><i>Best in Class</i> — Operational performance that encompasses the top 20% of manufacturers.</p>

Source: **AberdeenGroup**, December 2006

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

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

- [The Manufacturing Intelligence Benchmark Report: Bridging the ERP and Shop Floor Divide](#)
- [Roadmap to Lean Success: Measurement and Control Benchmark Study](#)
- [The Supply Chain Visibility Roadmap](#)
- [On-Demand Manufacturing Planning and Scheduling](#)

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