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Accelerate Business Performance Gains with Manufacturing Execution Systems

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Manufacturing companies are under extreme pressure not only to maintain but to improve their business performance. Publicly traded companies must show profit and revenue gains on a regular basis, and all manufacturers, whether public or private, are pushing to remain competitive and gain market share. Companies that choose to continue manufacturing products – rather than outsourcing production – are under constant scrutiny as to whether they can gain a healthy return on those expensive plant assets.

To meet this pressure, manufacturers across the industrialized world have consistently improved productivity. In all sixteen countries reviewed by the U.S. Department of Labor, output per labor hour rose and total hours dropped from 2004 to 2005. This trend is not

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new; tracking those same 16 countries from 1979 to 2005, every country reports 2%-5% increases in the rate of change of output per hour between 1979 and 2005.¹

There are many reasons for this, but continuous improvement programs and better use of technology are major factors. Companies have instituted Six Sigma, Lean Manufacturing, Demand Flow and Total

Quality Management programs. Research shows that manufacturing companies making the greatest increases in performance use plant-level information technology to complement these strategies.

Specifically, a series of studies by Industry Directions and others have shown that companies using manufacturing execution systems (MES) are more likely to perform well or improve their performance more rapidly than others. MES is an integrated plantwide system that monitors, records, and guides production activities. The gains by MES users are not only on operations metrics. Based on this research, MES appears to be a key factor for manufacturers to improve financial performance.

Research Results: MES Boosts Business Performance

Four Industry Directions studies all show significantly better performance or accelerated

What is MES?

Manufacturing Enterprise Solutions Association International (MESA) defines MES:

“A Manufacturing Execution System (MES) is a dynamic information system that drives effective execution of manufacturing operations. Using current and accurate data, MES guides, triggers, and reports on plant activities as events occur...from point of order release into manufacturing to point of product delivery into finished goods...MES provides mission-critical information about production activities across the enterprise and supply chain via bi-directional communications.”

performance increases for manufacturers using MES compared to their peers without a plantwide information system. The agreed-on definition of MES is in the box at left, “What is MES?” The exact breadth and scope of the system in use by research survey respondents to achieve the basic objective in the definition may vary. The benefits and boost in performance these systems provide, however, is consistent across multiple studies over multiple years.

¹ U.S. Department of Labor, Bureau of Labor Statistics “International Comparisons of Manufacturing Productivity and Unit Labor Cost Trends 2005, Revised” released February 22, 2007 <http://www.bls.gov/news.release/prod4.nr0.htm>



MESA Study: MES Use Ties to Financial Performance

In 2006, Industry Directions worked with the Manufacturing Enterprise Solutions Association

(MESA) to conduct a research program called Metrics that Matter. The public report from this research² examines both business or financial performance metrics as well as manufacturing or operations metrics. Respondents included information on what they measure, how they measure these things, and the level of performance increases they have logged against those metrics.

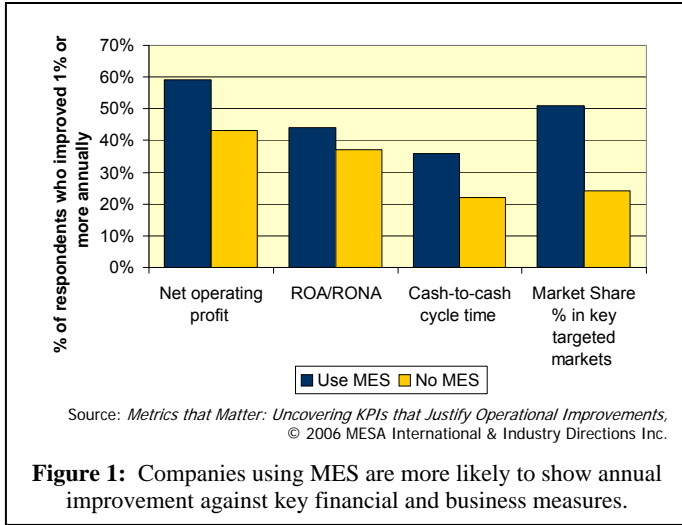


Figure 1: Companies using MES are more likely to show annual improvement against key financial and business measures.

The companies using MES in this study were more likely to have improved on a range of business and financial metrics. Figure 1 shows this in terms of net operating profit, return on assets or return on net assets, cash-to-cash cycle time, and market share.

The financial gains likely came because companies using MES were more likely to have improved on operational metrics that aligned with their strategy as well. Those using MES were more than twice as likely to have improved upside planned vs. emergency maintenance, energy

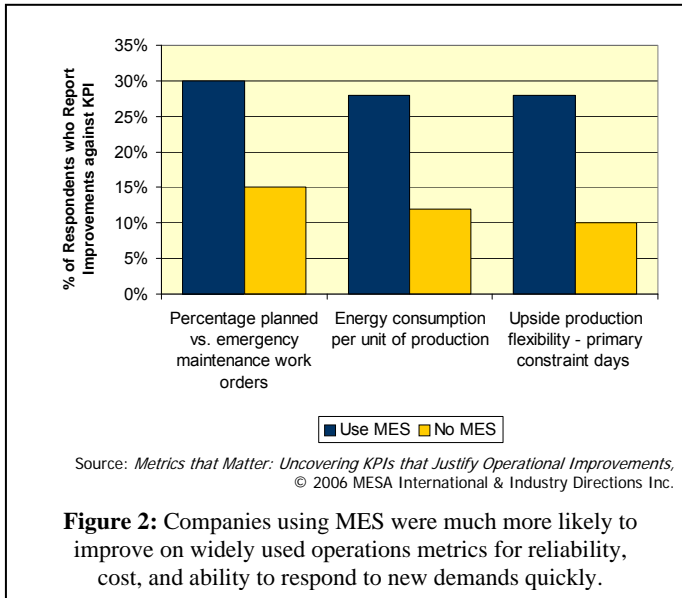


Figure 2: Companies using MES were much more likely to improve on widely used operations metrics for reliability, cost, and ability to respond to new demands quickly.

consumption, and upside production flexibility, as shown in Figure 2. Other areas where those using MES were significantly more likely to have improved include overtime, WIP and total inventory, first-pass yield, and process capability (or the ability of the process to consistently turn out quality product, often denoted as CpK). The next major section describes how MES fosters this type of success.

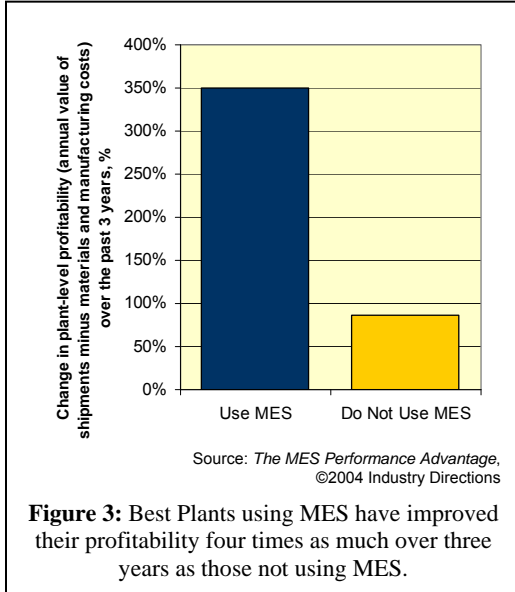
² Metrics that Matter: Uncovering KPIs that Justify Operational Improvements © 2006, MESA International and Industry Directions Inc.



Earlier Studies Consistently Show MES Value

A series of earlier studies conducted by Industry Directions explored the performance differential between plants using MES and others. These were based on the *Industry Week Best Plants* database of winners and finalists of this prestigious North American award.

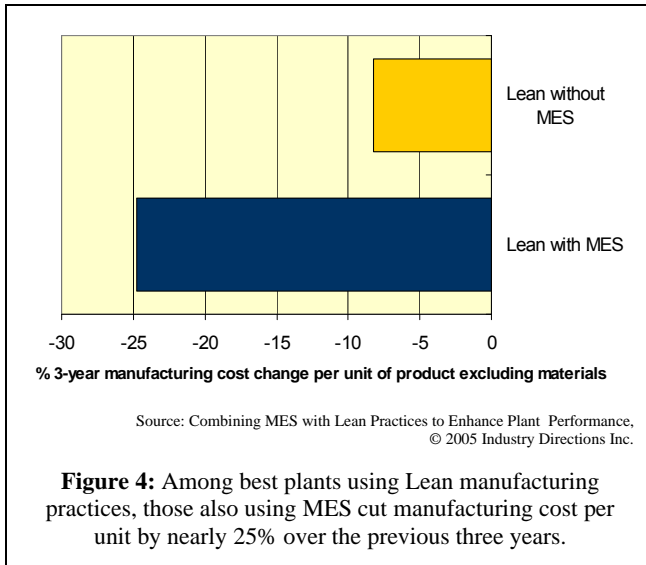
The first study³ was a simple comparison between Best Plants using MES and those not using MES. The most striking data point was that plants using MES improved profitability by four times as much as others, as shown in Figure 3.



Other areas where Best Plants using MES performed better included greater productivity improvement, larger reductions in overall costs and energy use, and greater cycle time reductions. All of this occurred in plants that had higher employee turnover, a higher percentage of new products in the mix, and more customer last-minute changes to orders. Despite all of these challenges, new employees in plants using MES required less training, and all employees required less classroom training.

The next two studies used a more recent Best Plants database to study the same effect of using MES, but in specific groups that also use Lean manufacturing or Six Sigma practices. Using this same methodology of splitting the Best Plants award winners and finalists into two groups, these studies again show accelerated performance

improvement for those using MES in conjunction with either Lean or Six Sigma.



Lean with MES

While Lean purists might insist that the plant needs no software, the results of this study⁴ suggest it does improve overall results. One of the tenants of Lean is just-in-time (JIT) materials delivery to keep inventories low; those in this study using MES had on average 30% greater inventory decreases than others at raw, finished goods, and total inventory.

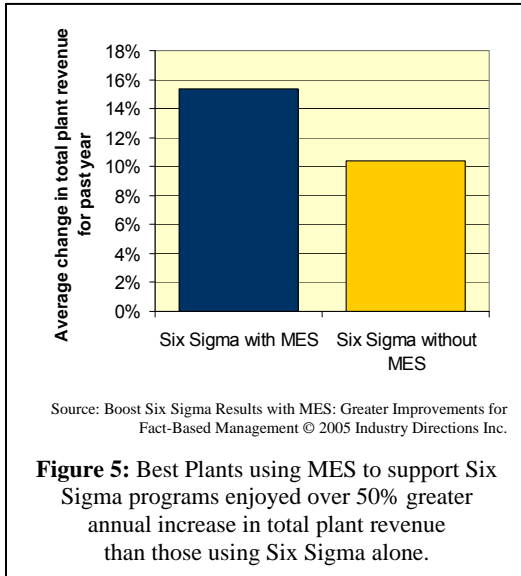
In addition, Lean best plants using MES reduced their manufacturing costs more as well. As shown in Figure 4, the average for plants using MES was a 74% larger cost reduction per unit than Lean best plants not using MES. The Best Plants with MES achieved outcomes most plants only dream of: 25% manufacturing unit cost reduction.

³ *The MES Performance Advantage: Best of the Best Plants Use MES*, ©2004 Industry Directions
⁴ *Combining MES with Lean Practices to Enhance Plant Performance*, © 2005 Industry Directions



Six Sigma and MES

A similar study⁵ examined results of best plants using Six Sigma methods to support process improvement. Plants using MES together with Six Sigma improved cycle times, yield, and productivity more while reducing energy and overall manufacturing costs more dramatically.



Overall revenue increased nearly 50% more over the previous year for the plants using MES together with Six Sigma, as shown in Figure 5. Combined with their greater cost reductions, this led to plants with MES and Six Sigma programs increasing profitability nearly four times as much as those using Six Sigma without MES.

Continuous Improvement

A major theme of all three of these Best Plants studies is continuous improvement. Many of the results were viewed in terms of annual improvements over three years. Those with MES gained more on nearly every metric over time.

These findings provide further evidence to

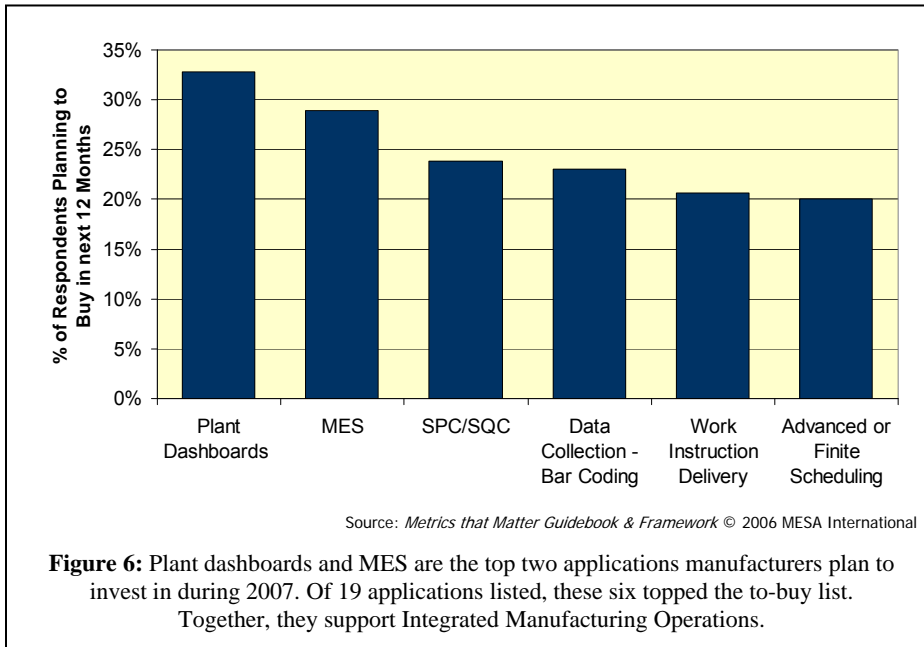
Plants using MES improved profitability by four times as much as others.

support the 2003 AMR study on MES benefits that showed an average payback on MES of 12 months, based on hard benefits from improved operations. That study showed that benefits increase to three to ten times the initial investment. Maximum benefits, they found, come from combining MES with other systems and strategies.

How MES Fosters Success

Despite these findings, plantwide integrated versions of MES remain an exception, not the norm for manufacturers. In the MESA Metrics study – a population that has far greater representation of MES use than most plants – less than one-third of respondents reported wide use of MES. Why is this? The great productivity gains in manufacturing plants may have masked the need for integrated information systems across the plant. In addition, MES is not well understood and the functions required are not consistent from one industry segment to another. Global competition, greater regulatory requirements, and ever more demanding customers are changing that picture. In the MESA Metrics study, the top two applications that companies are planning to invest in are plant dashboards and MES, as Figure 6 shows. The group of six together form a solid foundation for integrated manufacturing operations.

⁵ *Boosting Six Sigma Results with MES: Greater Improvements for Fact-Based Management*, © 2005 Industry Directions Inc.



This desire to buy these applications is not surprising, since the plant floor is one of the few “black holes” in many companies’ IT architectures. Information goes in, but because most plants do not have an integrated, up-to-date plant floor system, accurate and timely data has no reliable and automated way to flow back into the enterprise. The explosion in the number of product

variations most manufacturers produce also increases pressure to have automated information flows. People simply can’t keep up.

In the MESA Metrics study respondents provided information on how critical seven major aspects of an operation are and how much they have improved in those areas. In order of importance, the seven areas are: quality, customer service, throughput, asset utilization, compliance, flexibility, and inventory. We will review how MES improves each of these, explain the results with Lean and Six Sigma programs, and review innovation.

Quality

MES systems not only measure and record product and process quality, they help ensure employees follow best business practices that ensure higher quality. For discrete assembly industries, plant software should support best practices not only in production but also in test, repair, non-conformance handling, corrective and preventative action (CAPA), and returns processing. Through real-time visibility into the plant, MES can identify quality problems faster, thus reducing the cost of quality significantly. Their tracking capabilities also lower liability and warranty risk. Some advanced systems include non-conformance tracking, CAPA and some form of statistical quality analysis as well.

Customer Service

The visibility that MES provides into current operations allows customer service representatives to provide accurate order status information to customers when they call. The detailed view of order and operations status will help assess whether:

- It’s possible to meet an accelerated ship date
- A new design or supplier is causing or solving quality or process problems



- Last-minute configuration changes can be made based on what work is already complete for the order

Many companies using MES have found that this customer-service capability helps win customers during the sales cycle and keep them loyal.

Throughput

Simply having full visibility to the status of work on the plant floor can help accelerate throughput, since bottlenecks and resource shortages are more readily apparent. By having the latest version of work instructions and process plans at employees' fingertips, MES also facilitates best practices

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to keep throughput high. Automatic work dispatching may help, and some advanced systems also provide finite scheduling capabilities to better ensure sequences that will maximize total plant output.

Asset Utilization

The optimized sequence of work from MES that includes finite scheduling is particularly adept at ensuring high asset utilization. Some of these systems can manage changeovers to minimize downtime and maximize utilization as well as assigning work to the best work centers. Another factor in asset utilization is that maintenance staff can review MES data on products and processes to perform preventative maintenance, avoiding the disruptions of unscheduled downtime. Companies may achieve higher return on assets based on both cost reductions and throughput increases.

Compliance

Government regulations now reach beyond aerospace, defense and medical products. Automotive, electronics and every discrete industry using electronics must track and trace products through all levels of the bill of material (BOM) throughout their lifecycles to comply with regulations such as TREAD, ELV, RoHS, and WEEE.

MES includes genealogy and performance management functions that help ensure compliance is streamlined, and the extensive data collection mandated is relatively automated. The cost of compliance with MES is radically lower than with paper systems. Better yet, MES can help manufacturers benefit from the need to comply. For example, the data returned through customer complaints and end-of-life products can shed light on ways to improve product quality and lifespan. Also, tracking capabilities linking all components to final assemblies by serial number greatly reduces the scope of warranty and recall costs by pinpointing only those units likely to be affected by a problem. Thus a manufacturer can limit the action to only a few customers, rather than recalling or quarantining all units of a product.

Flexibility

One of the major drivers of business success for manufacturers is their ability to produce exactly what customers want, when they want it. Tight customer specifications and delivery requirements make this increasingly difficult. MES provides the ability to switch smoothly from one product to another by automatically showing operators work in priority sequence with all of the background they need. Plants with significantly expanded product lines will find that the plantwide information system supports both product variety and responsiveness.

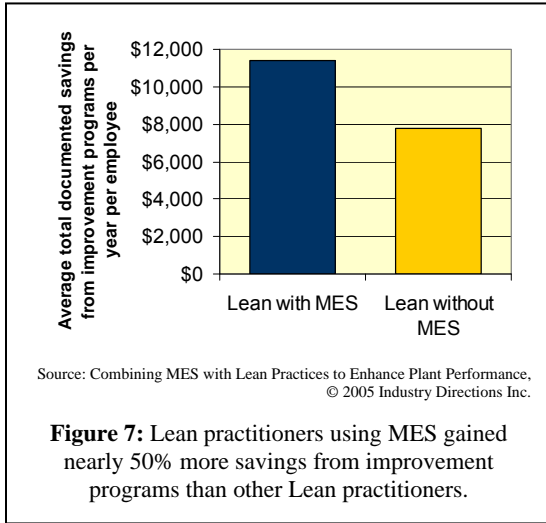


Figure 7: Lean practitioners using MES gained nearly 50% more savings from improvement programs than other Lean practitioners.

Inventory

In many companies, in-process inventory is worth literally millions of dollars. MES tracks inventory from incoming receipt and inspection through every manufacturing process – both value adding and movement. Should a batch of materials not meet specification, MES data can alert inventory management immediately so they can re-order. The complete visibility will show where inventory buffers are too large or too small for smooth and low-cost production.

Lean

Using MES to support Lean results in far greater profitability and revenue. This is the result of greater productivity, higher quality output, lower costs and better confidence to undertake just-in-time delivery from suppliers and to customers. As Figure 7 shows, the savings from improvement programs was nearly 50% greater in Lean plants using MES. This is because the MES supports operators with instructions for standard work, and relieves them of much of the burden of regulatory and customer compliance tracking.

Six Sigma

Using statistics and a focused methodology, companies can improve nearly any type of process. MES supports every stage of the Define-Measure-Analyze-Improve-Control (DMAIC) process. One of the largest challenges Six Sigma practitioners face is finding reliable sources of data in sufficient granularity to support root cause analysis and root cause identification. For in-plant processes, MES can automatically collect and store data from many processes at a level of detail that would bring ERP to its knees.

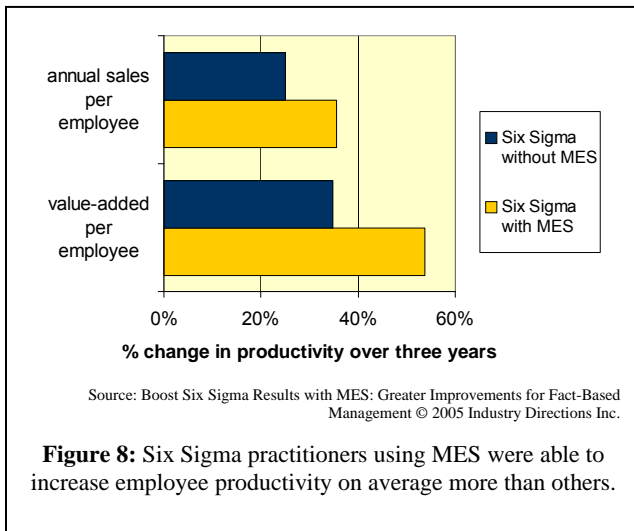


Figure 8: Six Sigma practitioners using MES were able to increase employee productivity on average more than others.

Another challenge for many improvement programs is backsliding. Once the Six Sigma process develops better processes, the question becomes how to maintain those. The MES guides operators based on best practice processes as process sheets are updated. The Six Sigma practitioners in our Best Plants study using MES showed greater improvement in employee productivity than other Six Sigma plants, as shown in Figure 8.

Innovation

Product proliferation, frequent upgrades and short lifecycles are facts of life. All of this is great for sales and marketing, but a major challenge for manufacturing operations. With MES, people do not need to strain to remember specific issues for each configuration, since the system stores data on the entire



product line in its latest configurations. Further, MES can provide a complete genealogy for every product, with multi-level serial number tracking as well as other relevant production information such as any reworked subassemblies or test irregularities. This fills in the critical as-built piece of a Product Lifecycle Management (PLM) strategy. It can also feed design for manufacturability information back to engineering.

Global Gains with Integrated Manufacturing Operations

Companies are increasingly realizing the need to integrate manufacturing plants into their overall information flow. Production is at the center of the supply chain, the product lifecycle and the value-add for which customers are willing to pay. Diverse product lines lead to complex production operations. Companies can no longer afford to run this asset-intensive part of their business with spreadsheets, paper, and the knowledge of a few key personnel who may be nearing retirement.

Integrated manufacturing operations must be the goal. This reaches beyond what traditional MES has done. It means operations, scheduling, manufacturing engineering and quality

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personnel all work from consistent and timely data in a coordinated fashion. Increasingly it also means gaining visibility and control across multiple plants and even across the supply chain and to outsourced partners.

This move toward enterprise-wide MES is relatively recent, but is taking hold as more manufacturers roll out greater functionality to more facilities. This allows companies to hold plants accountable and spread best practices. Fortunately, as business needs have grown, MES applications have matured to be not only multi-site, but also broader in functionality to better integrate all manufacturing operations. To manage the complexity, today's systems are also more robust, flexible, configurable, and performance-oriented.

One example of a solution that supports integrated manufacturing operations is from Visiprise. It clearly is an enterprise system, since it is designed for multi-plant, multi-enterprise and multi-tier implementation. Visiprise supports integrated manufacturing operations with a wide range of functions, including materials and operations visibility, product and materials track and trace,

operator guidance, engineering change management, advanced process planning, production scheduling, project management, quality, CAPA, returns and repair management.

The race to implement MES is on. It is a system that not only provides visibility into the performance of those assets and the products they produce – but also delivers improved performance. Studies consistently show that companies using MES improve profits more rapidly from both sides of the equation. They cut costs and also increase revenue and market share more dramatically – even in combination with Lean initiatives – as shown in

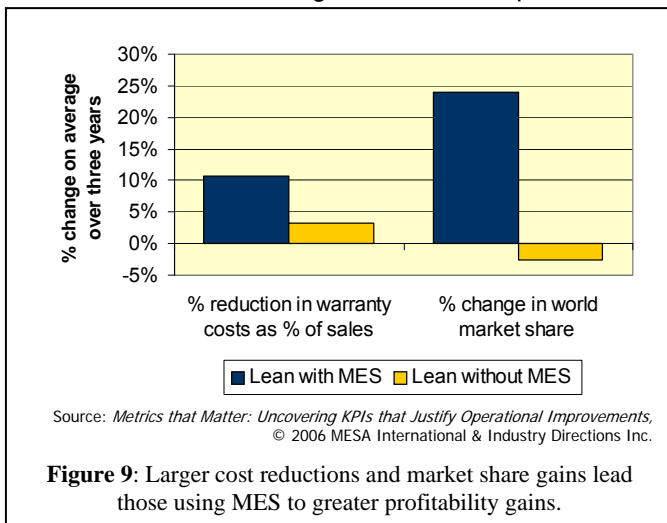




Figure 9. MES is proven to cut operational costs and increase the ability to capitalize on revenue opportunities.

For discrete manufacturing to remain a viable industry worldwide, executives must grasp the opportunity to radically improve business performance. Improvement lies in creating integrated manufacturing operations and ensuring plant operations stay in tune with the rest of the enterprise. Those who do not improve consistently will soon be outperformed by the increasing base of companies using MES and related applications.



About Cambashi

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