2013-2014

MANUFACTURING METRICS THAT REALLY MATTER
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SECTION 1

Research Objectives & Overview
The manufacturing industries are experiencing a bit of a renaissance these days. As shifts continue to occur in the global economic landscape around labor and energy costs, supply and demand preferences, regulatory considerations, and new applications of automation and information technologies, we are seeing a resurgence of manufacturing excellence across both established and emerging regions of the world.

Core to new levels of excellence is a keen focus on continuous improvement programs that go after business and manufacturing process improvements – supported by the collaborative efforts of people and smart technologies. Also, these sayings are absolutely true, “you cannot improve what you do not measure,” and “what gets measured gets done.” Therefore, effective metrics approaches continue to be key to manufacturing excellence.

The focus of this MESA Metrics research, conducted by LNS Research, was to understand the business impacts of metric programs and Key Performance Indicators (KPIs) that are being utilized across a wide range of manufacturing industries. With so many different metrics that are possible, it is important for organizations to choose the right metrics approaches that align to their business and manufacturing processes to help drive improvements in their organizations.

**Research Objectives & Overview**

**FINDING ANSWERS & INSIGHTS**

- Which metrics are being used to best understand manufacturing performance and opportunity areas for improvement?
- How does my company’s performance improvements compare to industry?
- How do we connect operational metrics to financial metrics?
- How can technology help support and impact metrics programs and performance?
- Which metrics are being utilized as part of role-based dashboards?
- How frequently should these metrics be measured and utilized?
- What are some of the best practices I can learn from market leaders?
Research Methodology

This 2013-2014 MESA Metrics research survey was conducted in partnership between MESA International and LNS Research from October 2013 through February 2014. MESA International is a global not-for-profit industry association of manufacturers, producers, industry leaders, and solution providers. LNS Research is a technology research firm focused on operational excellence in the industrial space.

A comprehensive online survey was created and conducted by LNS Research with the assistance of the MESA Metrics Working Group, along with an industry advisory team with members from Aditya Birla, Volvo, and Whirlpool, and also with inputs from the following leading companies that were sponsors of the 2013-2014 MESA Metrics research project: Epicor, InfinityQS, Plex Systems, Rockwell Automation and Schneider Electric (Invensys).

Data analysis and research report creation was done by LNS Research and reviewed by the MESA Metrics Working Group. Valuable insights came from this team approach, given that this is the fifth generation of MESA Metrics That Matter research that has been conducted every two years. The goal was to collectively understand and present new results in context to where the industry has come from, based on previous survey results.

As part of the data analysis, a number of market leading performers in financial and operational metrics were identified, and the research team is able to share some of their specific case study information. As the graphs indicate, 214 survey respondents from a mix of manufacturing industries, company sizes, and geographies contributed to this year’s research. Typical titles of respondents were plant managers, operations managers, manufacturing IT leaders, engineering and quality leaders, and continuous improvement team leaders.

KEY OBSERVATION:
66% of survey respondents were knowledgeable about financial and/or operational metrics improvements in their organizations and able to provide specific metric performance data.
Scope of Metrics Information Provided

Survey respondents were asked about the scope of the annual improvement information they were providing. We can see that across all 28 metrics (Overall), that the largest percentage (42%) were providing Corporate/Company-Wide information. The next most popular level of information that was provided was at the Business Unit and Plant levels – at 27% each. Production Line level information was typically provided – at 3%.

Looking at the subset of Financial and Operational metric categories, there were some additional insights that can be uncovered from these responses. For Financial metrics, almost half (49%) of respondents indicated that they were providing Corporate level information, and Plant level Financial metrics were only provided 19% of the time.

Operational metric inputs were dominated by Plant level (36%) and Corporate level (35%) information, followed by Business Unit level information, at 23%.

**KEY OBSERVATION:**
The data indicates that most Operational metrics programs are reviewing a combination of individual Plant level metrics rolling up to a Corporate view. Also, most Financial metrics programs are reviewing Corporate and Business Unit level metrics. Note that some Machine and Line level metrics are required in order to aggregate into Plant level metrics, as well as to support detailed operator actions.
SECTION 2

Improvements in Financial & Operational Metrics
Improvements in Financial & Operational Metrics

Based on the most utilized metrics from previous surveys, 28 different financial and operational metrics were included in this year’s survey. All respondents were also asked about their specific performance levels for three critical metrics – % of On Time Complete Shipments (OTCS), Overall Equipment Effectiveness (OEE), and % of successful New Product Introductions (NPIs). It is important to note that these three metrics are multi-disciplinary in nature and not fully under the control of the manufacturing operation.

The additional 25 metrics were grouped into the eight categories indicated by the dials in this figure, and respondents were asked for year-on-year % performance improvements for each of the metrics within each category. Only those who knew their performance improvements for the specific categories were included and evaluated further.

The dials indicate the average annual performance improvement for that category of metrics. The graph to the right also shows these same categories of metrics and which were most relied upon to manage operations.

There were very impressive levels of improvements being made by respondents, and these results may provide some inspiration for others on what is achievable. In the previous Metrics That Matter survey, the analysis looked at companies that improved metrics by 10% or more versus all others.

**Average Manufacturing Performance Improvements from 2012-2013**

**KEY OBSERVATION:**
Manufacturers continue to make great strides as this new survey shows that the overall average for those who provided metrics was consistently 10% or above for most metric categories.
This level of annual performance improvement is unlikely to be occurring across the entirety of the manufacturing industries.
Most of the respondents that took this survey are also engaged in continuous improvement activities for manufacturing excellence. In fact, 85% currently have formal process improvement programs in place, such as Lean, Six Sigma, ISO 9000/9001, etc. Therefore, many of the learnings that this report explores can be considered best industry practices.

**Types of Manufacturing Metrics Relied on for Managing Operations**

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial</td>
<td>69%</td>
</tr>
<tr>
<td>Quality</td>
<td>62%</td>
</tr>
<tr>
<td>Efficiency</td>
<td>53%</td>
</tr>
<tr>
<td>Inventory</td>
<td>52%</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>43%</td>
</tr>
<tr>
<td>Maintenance</td>
<td>28%</td>
</tr>
<tr>
<td>Compliance</td>
<td>27%</td>
</tr>
<tr>
<td>Innovation</td>
<td>15%</td>
</tr>
</tbody>
</table>

![Image of performance improvements](image-url)
Improvements in Financial Metrics

This section takes a closer look at what is behind these categories of average annual performance improvements, starting with the Financial metrics.

The graph shows the average improvements for each of 10 individual Financial/Business oriented metrics, and below is a brief description/definition of each:

- **Total Cost Per Unit Excluding Materials** – A measure of all potentially controllable manufacturing costs that go into the production of a given manufactured unit, item, or volume.

- **Customer Fill Rate/On-Time Delivery/Perfect Order Percentage** – This metric is the percentage of times that customers receive the entirety of their ordered manufactured goods, to the correct specifications, and delivered at the expected time. This metric is very often utilized by business management as it is of top concern to customers and has a strong correlation to overall financial performance. It is also known as On Time Complete Shipments (OTCS).

**KEY OBSERVATIONS:**

The survey showed that the average OTCS was 87.6%.

The top performers achieved OTCS of 95% or better and this represented 21% of the respondents. Top performers’ solutions are explored later in this eBook.

- **Net Profit Margin** – Measures the financial profitability for all investors/shareholders/debt holders, either before or after taxes, for a manufacturing plant or business unit.

- **Manufacturing Cost as a Percentage of Revenue** – A ratio of total manufacturing costs to the overall revenues produced by a manufacturing plant or business unit.

- **EBITDA** – Stands for Earnings Before Interest, Taxes, Depreciation, and Amortization. This is a calculation of a business unit or company’s earnings prior to having any interest payments, tax, depreciation, and amortization subtracted for any final accounting of income and expenses. EBITDA is typically used as top-level indication of the current operational profitability of a business.

- **Revenue Per Employee** – A measure of how much revenue is generated by a plant, business unit, or company, divided by the number of employees. A financial measure of productivity.

- **Cash To Cash Cycle Time** – The duration between the purchase of a manufacturing plant or business unit’s inventory, and the collection of payments/accounts receivable for the sale of products that utilize that inventory – typically measured in days.

- **Return On Net Assets (RONA)** – A measure of financial performance calculated by dividing the net income from a manufacturing plant or business unit by the value of fixed assets and working capital deployed.

- **Average Unit Contribution Margin** – This metric is calculated as a ratio of the profit margin that is generated by a manufacturing plant or business unit divided into a given unit or volume of production.

- **Energy Cost Per Unit** – A measure of the cost of energy (electricity, steam, oil, gas, etc.) required to produce a specific unit or volume of production.

**Types of Manufacturing Metrics Relied on for Managing Operations**
Improvements in Operational Metrics – Inventory, Innovation, and Responsiveness

These graphs show the details behind average annual improvements for the Inventory, Innovation, and Responsiveness categories of Operational metrics. Below is a brief description/definition of each:

- **WIP Inventory/Turns** – A commonly used ratio calculation to measure the efficient use of inventory materials. It is calculated by dividing the cost of goods sold by the average inventory used to produce those goods. This was the only metric used in the Inventory category.

- **Engineering Change Order Cycle Time** – A measure of how rapidly design changes or modifications to existing products can be implemented all the way through documentation processes and volume production.

Even though Engineering Change Order Cycle Time was the only metric surveyed for annual improvements in the Innovation category, the % of successful NPIs is also a key measure of a manufacturing company’s ability to innovate.

**KEY OBSERVATION:**
Based on the survey results, the average % of successful NPIs was 71.5%. Therefore, introducing new, ever more complex products to market is an imperfect science. The top 7% performers achieved 90% or greater successful NPIs. Solutions used by these top performers will be explored later.

- **Manufacturing Cycle Time** – Measures the speed or time taken for manufacturing to produce a given product from the time the order is released to production to finished goods.

- **Time to Make Changeovers** – Measures the speed or time taken to switch a manufacturing line or plant from making one product over to making a different product.

**2012 to 2013 Average Improvements - Inventory Metric**

<table>
<thead>
<tr>
<th>WIP INVENTORY TURNS</th>
<th>15.0%</th>
</tr>
</thead>
</table>

**2012 to 2013 Average Improvements - Innovation Metric**

<table>
<thead>
<tr>
<th>ENGINEERING CHANGE ORDER CYCLE TIME</th>
<th>7.8%</th>
</tr>
</thead>
</table>

**2012 to 2013 Average Improvements - Responsiveness Metrics**

<table>
<thead>
<tr>
<th>MANUFACTURING CYCLE TIME</th>
<th>10.7%</th>
</tr>
</thead>
<tbody>
<tr>
<td>REDUCING TIME TO MAKE CHANGEOVERS</td>
<td>9.3%</td>
</tr>
</tbody>
</table>
Improvements in Operational Metrics – Efficiency and Quality

These graphs show the details behind average annual improvements for the Efficiency and Quality categories of Operational metrics. Below is a brief description/definition of each:

- **Production Output/Throughput** – Measures how much product is being produced on a machine, line, unit, or plant over a specified period of time.
- **Production/Schedule Attainment** – A measure of what percentage of time a target level of production is attained within a specified schedule of time.
- **Capacity Utilization** – Indicates how much of the total manufacturing output capacity is being utilized at a given point in time.

### 2012 to 2013 Average Improvements - Efficiency Metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Improvement 2012-2013 Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased Production/Throughput</td>
<td>17.6%</td>
</tr>
<tr>
<td>Production/ScheduleAttainment</td>
<td>17.3%</td>
</tr>
<tr>
<td>Increased Capacity Utilization</td>
<td>16.1%</td>
</tr>
</tbody>
</table>

In addition to these three efficiency oriented metrics, OEE is another related and popular metric that contains multiple dimensions.

- **OEE** – A multiplier of Availability x Performance x Quality, and can be used to indicate the overall effectiveness of a piece of production equipment or an entire production line.

### KEY OBSERVATIONS:

The survey showed that the average OEE was 70.7.

The top performers achieved an OEE of 80 or better, representing 11% of the of the respondents. Solutions used by these top performers will be explored later.

- **Customer Rejects/Return Material Authorizations/Returns** – A measure of how many times customers reject products or request returns of products based on receipt of a bad or out-of-specification product.
- **Supplier Quality Incoming** – A measure of the percentage of good quality materials coming into the manufacturing process from a given supplier.
- **First Pass Yield** – Indicates a percentage of products that are manufactured correctly and to specifications the first time through the manufacturing process, without scrap or rework.

### 2012 to 2013 Average Improvements - Quality Metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Improvement 2012-2013 Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Rejects/RMA/Returns</td>
<td>15.0%</td>
</tr>
<tr>
<td>Supplier Quality Incoming</td>
<td>13.3%</td>
</tr>
<tr>
<td>First Pass Yield</td>
<td>12.9%</td>
</tr>
</tbody>
</table>

0.0%  2.0%  4.0%  6.0%  8.0%  10.0%  12.0%  14.0%  16.0%
These graphs show the details behind average annual improvements for the Maintenance and Compliance categories of Operational metrics. Below is a brief description/definition of each:

- **Downtime in Proportion to Operating Time** – This ratio of downtime to operating time is a direct indicator of asset availability for production.

- **Planned Versus Emergency Maintenance Work Orders** – This ratio metric is an indicator of how often scheduled maintenance takes place, versus more disruptive/un-planned maintenance.

- **Reportable Environmental Incidents** – A measure of the number of health and safety incidents that were recorded as occurring over a specified period of time.

- **Non-Compliance Events** – A measure of the number of times a plant or facility operated outside the guidelines of normal regulatory compliance rules over a specified period. These non-compliances need to be fully documented as to the specific non-compliance time, reasons, and resolutions.

- **Reportable Health and Safety Incidents** – A measure of the number of health and safety incidents that were either actual incidents or near misses that were recorded as occurring over a specified period of time.
Impact of Changing Manufacturing Business Conditions

In order to further understand shifts in the manufacturing business landscape, a multiple choice question was asked that was consistent with previous Metrics That Matter surveys, “Please indicate if your business has undergone any of the following shifts over the past 18 months.” The graph shows the results by indicating the % of respondents that experienced specific business shifts.

As global and regional manufacturing goes through continual changes, the job of manufacturing businesses is more challenging than ever. Therefore, there were some specific metric improvement correlations based on these changing business conditions.

KEY OBSERVATIONS:

The number of product variants/SKUs has increased to 71% of respondents over the last survey, which was 62%. This indicates a greater level of challenges in getting new products to market along with the need for increased flexibility within manufacturing operations.

Those who improved the % of successful NPIs appear to also be doing a better job at OTCS, at an average annual improvement of 19.1% versus an overall annual OTCS improvement average of 12.5%. This makes sense, given that effective management of new product processes would carry forward into ongoing customer deliveries.

Those who introduced more complex products appeared to have a more difficult time managing Inventory turns, with an average annual improvement of only 4.1% versus an overall annual improvement average of 7.8%. This also made sense, since carrying larger inventory buffers can make up for unplanned or unexpected activities that can be associated with complex products.
SECTION 3

Key Relationships Between Operational and Financial Metrics
Key Relationships Between Operational and Financial Metrics

There should be no surprise that one of the key relationships that was uncovered in this year’s survey was positive correlations between average annual Operational metric improvements or Operational metric performance, and improvements in average annual Financial metrics. This has been true in every MESA Metrics Survey since 2006. It stands to reason that the converse is also true. Those who had lower Operational metrics or improvement percentages also had lower Financial metric improvements.

KEY OBSERVATIONS:
Average annual Financial improvements were 8.6%; however, top Operational metric performers did significantly better:

SUCCESSFUL NPIs
Those with Successful NPIs of 90% or better (7% of respondents) had average annual Financial improvements of 16%.

They also had 32% annual improvements in Customer Fill Rate/On Time Delivery/Perfect Order versus an average of 12.5% overall.

Additionally, they had 17% annual improvements in RONA versus an average of 6% overall.

Lastly, they also had 14% annual improvements in Average Unit Contribution Margin versus an average of 5% overall.

WIP/INVENTORY
Those with annual Inventory WIP Improvements of 10% or better (7% of respondents) had average annual Financial improvements of 12%.

EFFICIENCY
Those who had top annual improvements in Efficiency metrics such as Increased Production Throughput/Output by 10% or more, or Increased Capacity Utilization by 10% or more, or Improved Schedule Attainment by 10% or more (10% of Respondents for each) had average Financial improvements of 14%.

Conversely, those who did not improve any of these same Efficiency metrics by 10% or more (17-19% of respondents) only had average annual Financial improvements of 6%.

Those who increased Production Throughput/Output by 10% or more also had 15% annual improvements in Cash to Cash Cycle Time versus an average of 7.9% overall.

Additionally, those who increased Capacity Utilization by 10% or more had 24% annual improvements in Net Profit Margin % versus an average of 10.4% overall.

OEE
Those with OEE of 80 or better (11% of Respondents) had average Financial improvements of 14%.

They also had 20% annual improvements in Revenue per Employee/Productivity versus an average of 8% overall.
More Relationships Between Operational and Financial Metrics

**RESPONSIVENESS**

Those who had top improvements in Responsiveness and improved Manufacturing Cycle Time by 10% or more (7% of respondents), had average Financial improvements of 14%.

Those who had top improvements in improved Manufacturing Cycle Time by 10% or more also had 22% annual improvements in Manufacturing Costs as a % of Revenue versus an average of 10.2% overall.

**QUALITY**

Those who had top annual improvements in Quality metrics such as Improved First Pass Yield by 5% or more, or Increased Supplier Quality Incoming by 5% or more, or Reduced Customer Rejects by 5% or more (10-11% of respondents for each) had average Financial improvements of 14%.

Conversely, those who did not improve any of these same Quality metrics by 5% or more (21-22% of respondents) only had average annual Financial improvements of 6%.

Those who had top improvements in Supplier Quality Incoming of 5% or more also improved Total Cost Per Unit – Excluding Materials by 24% versus an average of 13.1% overall.
SECTION 4

Key Relationships Between Metrics and Software Use
Key Relationships Between Metrics and Software Use

One of the key relationships that was uncovered in this year’s survey was the correlations between average annual metric improvements and/or market leading metric performance and the use of software technologies in support of these improvements.

The graph shows the categories of manufacturing software that are either currently implemented, planned within one year, or not planned by survey respondents.

Reflecting on changes in adoption of these technologies since the last survey, there are some interesting trends that were uncovered.

**KEY OBSERVATIONS:**

The most deployed applications by all respondents were Enterprise Resource Planning (ERP); Planning, Scheduling & Dispatching; Quality Management; Document Management; Data Historians; Manufacturing Execution Systems (MES); and Asset Management Software.

In comparison to previous Metrics That Matter survey respondents, companies had more manufacturing software applications implemented. Key examples include ERP, which grew from 67% to 74% adopted, Data Historians, which grew from 39% to 42%, and MES, which grew from 35% to 40%.

There were many more, as well as much stronger (up to 2x) correlations between the use of software technologies and improvements in Financial and Operational metrics in this year’s survey.
The next key correlation to discuss is average annual improvements in Net Profit Margin.

**KEY OBSERVATIONS:**

The average annual Net Profit Margin improvement for those who DID NOT use ERP software was only 2% versus 10.4% for all respondents.

Average annual improvement in Net Profit Margin was 19.4% for users of a Comprehensive Suite of Manufacturing Operations Management (MOM) software versus 10.4% for all respondents.

ERP systems are clearly a fundamental tool of most manufacturers today. ERP systems are the most adopted software application for many good reasons. They enable consistent business and financial practices and typically contain the master data for customers and products alike. They also perform the overall manufacturing resource planning of what will be produced, when, and where.

When survey respondents referred to a Comprehensive Suite of MOM software, they were indicating a combination of real-time, in-process management software tools that included combinations of MES, OI/EMI, Quality Management, Document Management, Workflow, Asset Management, etc. Sometimes these capabilities are all available in a single, pre-integrated software package, and other times it takes a suite of real-time applications to cover all required functionality. It certainly stands to reason that companies that have a comprehensive set of real-time process management applications in place would have their processes and quality in control for greater profitability.
The next key set of financial correlations was related to average annual improvements to OTCS.

**KEY OBSERVATIONS:**

Average OTCS performance was 87.6%—with the top 21% of respondents having OTCS of 95% or better.

Average annual improvement in OTCS was 22.0% for users of MES software versus 12.5% for all respondents.

Average annual improvement in OTCS was 19.1% for users of Product Lifecycle Management (PLM) software versus 12.5% for all respondents.

Average annual improvement in OTCS was 20.4% for users of Quality Management software versus 12.5% for all respondents. Conversely, the average annual OTCS improvement for those who DID NOT use Quality Management software was only 7% versus 12.5% for all respondents.

Those who use Quality Management software had an average OTCS of 91.0%, and those who DID NOT use Quality Management software only averaged 85.2%.

**Quality Management Software Use and Average % OTCS**

The top manufacturing applications used by companies that had OTCS of 95% or better are shown in the graph. When looking at the top performers that had OTCS of 95% or better, ERP; Quality Management; Planning, Scheduling & Dispatching; MES; PLM; and Asset Management are the top applications used by this group.

The percentage of use of these applications by this group is in line with data from all respondents; however, the role that these applications can play in OTCS related initiatives will be explored further.

It has been established that ERP is fundamental to managing and planning production on behalf of customers. The use of Quality Management software to ensure consistent in-process quality as well as the handling of non-conformances can also be key to ensuring customer deliveries are being met. Planning, Scheduling & Dispatching software is often utilized at both the enterprise level and at the plant level of organizations to deal with the dynamics of supply and demand and ensure that the best possible plans are being put into action to meet customer deliveries. MES ensures production procedures happen according to those plans and Asset Management systems can help ensure that equipment and other production assets are properly maintained and available.

PLM systems have traditionally been used by engineering organizations to assist with managing new product designs into production. However, more and more, these systems are integrating with real-time plant workflows and bi-directional information from MES and Quality Management applications in order to speed time-to-market for engineering changes, while receiving direct feedback on production issues and quality in order to improve future designs.
Key Relationships Between Operational Metrics and Software Use

The following are key relationships identified between Innovation and Efficiency related Operational metrics.

KEY OBSERVATIONS:
Average % of Successful NPIs was 71.5%, while the top 7% of respondents had 90% or better.

Those who use ERP software had an average of 75.4% Successful NPIs, and those who DID NOT use ERP software only averaged 59.9%.

Those who use Quality Management software had an average OTCS of 91.0%, and those who DID NOT use Quality Management software only averaged 85.2%.

ERP Software Use and the Average % of Successful NPIs

The top manufacturing applications used by companies that had NPI success rates of 95% or better are shown in the graph below. ERP; Planning, Scheduling & Dispatching; and Document Management use was significantly higher than that of all survey respondents.

Going beyond ERP, it makes sense that effective use of the below set manufacturing applications could also be contributing to the successful lifecycle of new product introductions, as these collectively support both the business planning and the manufacturing reality dimensions.

Applications Used by Companies with OTCS of 95% or Better
**KEY OBSERVATIONS:**

Average OEE was 70.7, while the top 11% of respondents had OEE of 80 or better.

Those who use Quality Management software had an average OEE of 73.5, and those who DID NOT use Quality Management software only averaged 67.7.

The top manufacturing applications used by companies that had OEE of 80 or better are shown in the graph below. The percentage of use of these applications by this group is in line with what the data showed for all respondents.

Since driving higher OEE requires a combination of ensuring production uptime and availability, along with ensuring consistent high quality, it was no surprise to see that high OEE performers are using ERP and Planning, Scheduling & Dispatching on the planning and management side, along with Quality Management, MES, and MOM to support both the quality and production dimensions.

### Quality Management Software Use and Average OEE

<table>
<thead>
<tr>
<th>Using Quality Management software</th>
<th>Average OEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>73.5</td>
</tr>
<tr>
<td>No</td>
<td>67.7</td>
</tr>
</tbody>
</table>

### Applications Used by Companies with OTCS of 80 or Better

- **ERP**: 67%
- **Planning, Scheduling & Dispatching**: 67%
- **Quality Management**: 58%
- **Document Management**: 54%
- **Asset Management**: 50%
- **MES**: 46%
- **Comprehensive MOM suite**: 42%
The following are the key observations between Compliance related Operational metrics.

**KEY OBSERVATIONS:**

Average annual improvement in Reportable Health & Safety Incidences was 23.8% for users of Quality Management software versus 17.1% overall. Conversely, the average annual improvement in Reportable Health & Safety Incidences for those who DID NOT use either Document Management or Quality Management software was only 6%.

Average annual improvement in Reportable Environmental Incidences was 27.6% for users of Quality Management software versus 19.9% overall. Average annual improvement in Reportable Environmental Incidences was 23.9% for users of Document Management software versus 19.9% overall. Conversely, the average annual improvement in Reportable Environmental Incidences for those who DID NOT use either Document Management or Quality Management software was only 7%.

Average annual improvement in the Number of Non-Compliance Events was 24.6% for users of Document Management software versus 18.5% overall. Conversely, the average annual improvement in the Number of Non-Compliance Events for those who DID NOT use either Document Management or Quality Management software was only 7%.

These key observations make a strong case for the powerful combination of Document Management and Quality Management applications in support of compliance initiatives.

All of these initiatives require diligent monitoring and documentation of procedures as well as enforcement to specified actions surrounding any type of incident – whether the incident is related to Health & Safety, Environmental, or Industry Regulations. Document Management software solutions capture and track the lifecycle of documents such that only the most up-to-date and valid document is in use and only authorized personnel can access or modify documents. They also support team collaboration around documentation. Given that documented proof is required in support of compliance activities, Document Management is a natural supporting fit.

It is also clear that today’s Quality Management software solutions are being used not only to focus on ensuring that quality procedures are being followed, but also compliance related procedures as well. All related actions are enforced and recorded in these systems. And most of them include a Document Management capability and/or can work directly with a separate Document Management system.
SECTION 5

Role-Based Performance Dashboards
Role-Based Performance Dashboards

As part of corporate-wide and manufacturing metrics programs, companies have been on a path over the last decade to bring greater visibility of key performance indicators to their employees so they can take decisive improvement actions. As part of these initiatives, there have been many lessons learned, including how to do this “right,” with “right” meaning:

- Ensuring that the only the right/appropriate/correct information is presented
- Delivering this right information only to those individuals who need it, such that people are not distracted or overloaded with informational noise
- Delivering this right information in the right/timely fashion, so people have what they need to take action while there is still time to impact a situation
- Ensuring that the right information is delivered in context with the right/correct rationale, so that people are clear about why they are receiving the information and what they need to do about it
- Ensuring that the right actions are being taken and the right processes and procedures are being followed for a given situation

A number of these “right” things are addressed by today’s performance dashboard software applications. Some of these applications are intended to be more enterprise/business focused, such as Business Intelligence (BI) dashboards. Others are more directly focused on manufacturing operations, such as OI/EMI. In addition, there is some blending/integration of business and manufacturing operations information on dashboards seen in the marketplace.

One goal of this year’s survey was to understand how the use of dashboards continues to evolve in relation to the previous survey. And more specifically, to understand how people were tailoring dashboards to suit specific roles, as well as to look at the timeliness of role-based information. Related to this is the associated automated versus manual data capture, and the dashboard technologies and functionality being deployed in support of metrics programs.

KEY OBSERVATION:
Operational dashboard use did not change from an overall usage perspective (38%) from respondents of the previous Metrics That Matter survey. However, there were a number of shifts in how they are being used and these will be explored further in this section.
Operations Use of Performance Dashboards

As part of the survey, respondents were asked about the timeliness of information being delivered on performance dashboards that are currently in use in support of the needs of a wide number of manufacturing organization roles. Responses are organized into three groupings – Operators & Supervisors, Technical Staff, and Management.

The graph shows the existing timeliness/frequency of performance dashboard information for different levels of Operators, as well as Supervisors.

**KEY OBSERVATIONS:**

Operators and Supervisors are seeing more performance information in real-time than respondents of the previous Metrics That Matter survey. In the previous survey, the percentage was approximately 17%, and this is now up to 26% of Machine Level Operators seeing their performance information in real-time, and 19% of Line/Area Level operators are as well.

Seeing performance information within a shift has increased from the previous survey average of approximately 13% for Line/Area and Plant Level Operators to 15% in this new survey.

Plant Level Operators and Supervisors appear to be the sweet spot for using high frequency performance dashboard information in manufacturing operations.

The overall trend is toward faster visibility of performance metrics for manufacturing operations.
Technical Staff Use of Performance Dashboards

The graph on this page shows the existing timeliness/frequency of performance dashboard information for different manufacturing technical roles, including Maintenance, Engineering, Process Improvement, IT/Business Analysts, and Quality personnel.

The graph shows that daily information is most typical for use by technical staff. Maintenance and IT/Business Analysts are not using performance dashboard information as much as other roles that are more reliant, such as Quality, Process Improvement, and Engineering.

It was not surprising to see that in general, Technical Staff are less engaged in using performance dashboards than Plant Level Operators or Supervisors according to the survey, showing that more of the Technical Staff rarely/never use them. Operations have more opportunities to make day-to-day impacts on performance.
Management Use of Performance Dashboards

The graph on this page shows the existing timeliness/frequency of performance dashboard information for different management roles, including C-Level Executives, Business Unit Managers, Plant Managers and Operations Managers.

KEY OBSERVATIONS:

Management roles are not seeing as much performance information in real-time as other roles (5% to 12% of managers are depending on role/level).

However, a good portion of management roles are seeing performance information within a day or sooner (27% to 65% are depending on role/level).

Operations Managers are in the highest category of seeing/utilizing performance information within one day or sooner at 65%, and this is almost double when compared to the last Metrics That Matter survey.

This indicates a stronger engagement and involvement of Operations Managers in the overall manufacturing performance management process.
The State of Data Collection for Metrics

Another section of the survey asked where companies were on their journey towards more automated data collection techniques in support of their manufacturing performance metric programs.

The graphs show the spectrum of manual to automated data collection in three different views. The first is overall/across both the Financial and Operational metrics. The second view is just for the Financial metrics and the third is just Operational metrics. The goal was to see if there were differences in the levels of information automation for these groupings.

**KEY OBSERVATIONS:**

The graphs show there is more automated data collection occurring for Operational metrics than Financial metrics, whereby a total of 67% have Operational metrics that are partially or fully automated versus a total of 60% for Financial.

There were no significant movements seen in going to fully automated data collection methodologies, when compared to respondents from the previous Metrics That Matter survey. Progress in this area appears to be a longer journey in spite of the fact that the amount of available manufacturing information is rapidly increasing as more intelligent devices and systems are being deployed.
The next area that was explored in relation to role-based performance dashboards was the specific functionality that has been deployed to date.

Some of the functionalities go to the heart of delivering on the needs that were discussed earlier as being “right.”

The graph indicates that most Operational Dashboards cover a single plant – at 69%. However, 43% of respondents also indicated that their dashboards are covering multiple plants. Multiple selections were allowed in the survey.

At 57%, most have purely electronic/visual displays. It is relatively common to be able to drill down on dashboard displays to get to root causes and more detailed information at 40%, while 35% have the capability to proactively alert users based on conditions/rules.

A recorded 40% have Operations performance information rolling up to Enterprise dashboards/scorecards. This is consistent with the trend described earlier towards more high frequency engagement by Operations Management in plant performance activities.

**KEY OBSERVATIONS:**

In comparison to respondents of the previous Metrics That Matter study, only 31% had dashboards that could escalate/alert based on rules, versus 35% in this new study.

Previously, only 30% rolled up to an enterprise scorecard; now it is 40% on average. This indicates further sophistication in the use of dashboards, along with higher transparency of manufacturing information going up the enterprise.
The last area of exploration in relation to role-based performance dashboards was to understand the different software technologies and packages that are being utilized.

The graph clearly shows that there is a broad range of manufacturing and business applications being utilized to support metrics programs with visual performance dashboards.

**KEY OBSERVATIONS:**

There is no clear single approach/package being used, and many companies are using multiple different software applications to meet their overall needs.

The percentage of companies using the performance dashboard functionality provided with MOM/MES and Quality Management software packages appears to be higher than the portion of companies using the ERP based performance dashboards.

This can be concluded from comparing the percentages of manufacturing software deployed by survey respondents (in Section 4), versus the associated use of the operational dashboards of those same software packages. For example, ERP is the most used manufacturing software application at 74%, but ERP operational dashboard use is only 31%. 
SECTION 6

Anticipated Impacts of Emerging Technologies
Anticipated Impacts of Emerging Technologies

There are a number of rapidly emerging technologies that are already having a significant impact on manufacturing performance management approaches. These include cloud, mobile, and big data technologies, and an important research goal was to understand where and how these emerging technologies will be utilized in manufacturing company’s futures.

CLOUD-BASED SOFTWARE

IT communities have rapidly embraced cloud-based software applications due to lower total lifecycle costs. Initial capital expenditures on hardware, licensing fees, and updates can comparatively make traditional software delivery mechanisms more costly and time consuming. Cloud-based “software as a service” delivery outsources the hardware and software support for the user, is faster and easier to deploy, updates automatically, and allows for nearly unlimited storage space.

Though many business leaders still have reservations about the cloud for manufacturing applications, the space is advancing rapidly to address major concerns around connectivity and security, as well as other issues, while making the benefits of cloud adoption too attractive to ignore. In a separate LNS Research vendor survey, 50% of manufacturing software providers were found to be already offering some cloud-based offerings, and over 90% of were investing in cloud capabilities for future products.

Performance information applications such as Data Historians and OI/EMI are good examples of cloud-based software in use today with little reservation, since they do not directly control production. There are also cloud-based ERP and MES offerings that are available and proven in manufacturing.

The graph shows the expectations of survey respondents for the impact of cloud-based software in their operations.

While 37% are still unsure, the lower total cost of ownership message is well understood at 39%, along with unburdening the IT organization at 37%. Users are anticipating greater speeds of implementation (29%), as well as making it easier to aggregate performance information across multiple plants/facilities in the future (24%).
Anticipated Impacts of Mobile Technologies

The use of Mobile devices and applications has removed the restrictions of needing to be on-site to access performance and other production information. Mobile devices have the potential to enable workers from across every level of the enterprise to access the performance and decision support information applicable to their respective roles.

Virtually all of the manufacturing software providers have some mobile application(s) available, and with more on the way.

The graph shows the roles that are expected to benefit from mobile technologies, along with the extent of use expected – ranging from performance information to being able to perform the majority of their job functions using a mobile device.

Plant Supervisors (54%) are the top users anticipated to have the ability to have everything they need to do their jobs in the palm of their hands. Plant Managers (53%) are anticipated to have the ability to manage performance in real-time from mobile devices.

Given that most Maintenance professionals have a need to be highly mobile, it was no surprise to see them at 47%, with all the information they need to do their jobs remotely.

Facilitating access to mobile information also holds the promise for an entirely paperless manufacturing environment for 35% of respondents.

Only 25% were unsure of how mobile technologies would impact manufacturing performance management, which implies that mobile applications in manufacturing are better understood than cloud-based software, which was at 37% “Don’t Know.”

<table>
<thead>
<tr>
<th>Impact of Mobile Technologies on Manufacturing Performance Management</th>
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<tbody>
<tr>
<td><strong>Plant supervisors having all the information they need to do their jobs on mobile devices</strong></td>
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<tr>
<td><strong>Plant managers have real-time performance information on mobile devices</strong></td>
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<tr>
<td><strong>Maintenance personnel having all the information they need to do their jobs on mobile devices</strong></td>
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<tr>
<td><strong>Executives have real-time performance information on mobile devices</strong></td>
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<td><strong>Quality personnel having all the information they need to do their jobs on mobile devices</strong></td>
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<td><strong>Technical personnel having all the information they need to do their jobs on mobile devices</strong></td>
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<tr>
<td><strong>Plant operators having all the information they need to do their jobs on mobile devices</strong></td>
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<tr>
<td><strong>Creating a completely paperless manufacturing environment</strong></td>
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<tr>
<td><strong>Engineering and manufacturing have same design and manufacturing information on mobile devices</strong></td>
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<tr>
<td><strong>All personnel have same design and manufacturing information on mobile devices</strong></td>
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<tr>
<td><strong>Don’t know</strong></td>
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<tr>
<td><strong>Sharing information with suppliers via mobile devices</strong></td>
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<td><strong>Sharing information with customers via mobile devices</strong></td>
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The last emerging technology impact we will explore is “big data.” The current buzz-term may be slightly misleading to some. Most manufacturers are quite accustomed to having “big,” or some might say huge amounts of data flowing throughout their organizations, but they have historically lacked the context that gives that data actionable meaning—giving birth to the phrase, “data rich, but information poor.”

And this is where the emerging technological capability referred to as big data is coming into play. The potential for previously unknown correlations to be discovered, and for informational silos to be broken down, is accelerating. But big data concepts are still both nascent and broad enough that nobody is entirely sure how they will play out in manufacturing, although the possibilities are potentially transformative.

The graph shows where survey respondents see this going. Given the importance of production, it is not surprising that better production/forecasting was the top response at 46%. Here, big data could operate in myriad ways, including identifying correlations between customer data, scheduling, and maintenance, which would have the potential to identify hidden patterns that could enable greater operational efficiency, better anticipate order lead times, shorten asset/machine downtimes, and make materials purchasing and WIP decisions more effectively.

Other top responses, such as being able to understand plant performance across multiple metrics (45% of responses), servicing and supporting customers faster (39%), and real-time alerts based on analyzing manufacturing data (38%) are in line with some of the important objectives and challenges that manufacturers are talking about today, such as finding ways to overcome informational silos/disparate data sources and maintaining/developing a more customer-driven organization.

It seems clear from these responses that manufacturers today are poised to have their personnel take advantage of big data analytics to attack some of their biggest and most important challenges and objectives. Reinforcing this, note that the top nine responses each has a response rate of over 30%. A mere 5-6% felt that big data would not have any future use or impact on their manufacturing performance improvement personnel.

**Anticipated Impacts of ‘Big Data’ Technologies**

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SECTION 7

Best Practices for Metrics Program Success
Best Practices for Metrics Program Success

One of the industry best practices that MESA and LNS Research see for metrics program success is to take the organization through a strategy decomposition and goal alignment process. By definition, company strategy needs to be a “top down” exercise, but the alignment of strategy, actions, and metrics as they relate to individual areas of the business, departments, and individuals is a cross-functional engagement exercise that ensures that employees can clearly see the relationships between their work efforts and their contributions toward strategy achievement.

The diagram shows an example of top level strategy, actions and measures, and how these need to be interpreted into more detailed, but aligned plans across a manufacturing enterprise.

Here are the key steps (further explained in the MESA Metrics Guidebook) to take in a Strategic Decomposition/Goal & Metric Alignment Process:

1. **Understand and Articulate Strategy:** Have a clear and universally understood manufacturing strategy that is in support of the corporate business strategy.

2. **Translate Strategy into Specific Goals:** Turn that strategy into specific goals for business groups and associated supply chains as well as plants, units, and production lines.

3. **Map Goals and Specific Metrics for Success:** Use a cross-functional team to map each detailed translation across the enterprise.

4. **Determine Key Performance Indicators:** Develop a set of manufacturing KPIs to measure progress toward goals.

5. **Establish Communication Procedures for KPIs:** Make sure the right information is getting to the right people in a timely manner.

6. **Set Processes for How to Act on KPI Information:** Determine best practices for individuals from the shop- to top-floor to interact with KPIs.

7. **Match Performance Incentives to Aligned Goals:** Reinforce the effectiveness of measuring KPIs by incentivizing progress.

When everyone across an organization is aligned with their respective individual, group, and company goals and metrics, and everyone has the information they need to do their jobs efficiently, truly great things can happen at an accelerated pace.

Source: Dr. Peter G. Martin
Getting Executives and Operations on the Same Page

One of the specific challenges that was discussed at length at the 2013 MESA “unConference” session on Metrics That Matter was the organizational and understanding related gaps that exist between executives and plant operations. “Business-speak” and “manufacturing-speak” are very different languages, and there was a sense that if executives could better understand “manufacturing-speak” and the potential impact that manufacturing can have on business success, then this two-way understanding could accelerate many more manufacturing initiatives to move forward.

Therefore, in addition to the specific Operational and Financial improvements that were uncovered in the survey, two related “attitude and approach” questions were asked. The first graph shows which categories of Operational metrics that executives already believe have the biggest impact on financials. The top four responses were Efficiency (33%), Quality (31%), Responsiveness (26%) and Inventory (21%), with 18% indicating that they didn’t know, and these responses represent the extent of the disconnect.

Next, respondents were asked about what approaches have been taken in the past to successfully bridge this gap by educating executives on manufacturing business improvement potential.

The graph shows that executive business review meetings were the top communication opportunity, at 40%. Next, at 35% was including manufacturing strategy as part of the overall business planning process. This is consistent with the Strategic Goal Alignment best practice discussed earlier.

Manufacturing performance dashboards and reporting came up in multiple responses, along with simple review meetings and plant tours.

MESA and LNS Research recommend that you consider employing a number of these approaches to get executives and operations on the same page. This will facilitate a greater two-way understanding of both challenges and opportunities and likely cut down on some frustrations.
SECTION 8

Case Study
CASE STUDY
Murata Power Solutions

Headquartered in Mansfield, MA, Murata Power Solutions is a leading global supplier of converters, power supplies, and related products. The company operates in a highly competitive industry—requiring rapid product development, stringent quality standards, and high customer responsiveness to both maintain and elevate its market position.

With a strong continuous improvement company culture to build from, the company has recently added Project Management (PM) software to its operations and integrated its formerly disparate MES system and reporting methods.

The addition of this PM software has fostered additional inter-departmental collaboration, and the company’s software initiatives around MES and Quality Management software have shown valuable operational correlations that have helped the company improve in several operational areas over the past year.

Murata has recorded significant annual performance improvement metrics, such as:

**Customer fill rate/on-time delivery:** Annual improvement of 80%, versus survey respondents’ annual improvement average of 12.5%.

**First Pass Yield:** Annual improvement of 50%, versus survey respondents’ annual improvement average of 12.9%.

**Supplier Quality Incoming:** Annual improvement of 25%, versus survey respondents’ annual improvement average of 13.3%.

Spurred on by the metrics improvements these initiatives have helped deliver, the company is moving forward with further integration of its MES and ERP systems, as well as intensifying efforts to speed its new product introduction process and reduce costs by incorporating FMEA (Failure Mode and Effects Analysis) initiatives into additional manufacturing phases - beginning with design. Additionally, the company is implementing a Six Sigma program at its main facility and selecting specific individuals for belt training in this program.
SECTION 9

Summary & Recommendations
Summary & Recommendations

To conclude, here is a summary of some key answers to questions posed in the introduction:

Q. Which metrics are being used to best understand manufacturing performance and opportunity areas for improvement?
A. The top 10 Financial metrics and top 18 Operational metrics are listed and highlighted in Section 2.

Q. How does my company’s performance improvements compare to industry?
A. You can compare with the average annual improvements achieved by others for metrics categories are shown in the dials. Additionally:

   - The average % of successful NPIs was 71.5% and the top performers averaged 90%.
   - The average OTCS was 87.6% and the top performers achieved 95% or better.
   - The average OEE was 70.7 and the top performers achieved 80 or better.

Q. How do we connect operational metrics to financial metrics?
A. There were many positive correlations between average annual Operational metric improvements or Operational metric performance, and improvements in average annual Financial metrics highlighted in Section 3. Average annual Financial improvements were 8.6%; however, top Operational metric performers did significantly better. Examples follow.

Average Manufacturing Performance Improvements from 2012-2013

SUCCESSFUL NPIs
Those with Successful NPIs of 90% or better had average annual Financial improvements of 16%.

WIP/INVENTORY
Those with annual Inventory WIP Improvements of 10% or better had average annual Financial improvements of 12%.

OEE
Those with OEE of 80 or better had average Financial improvements of 14%.

RESPONSIVENESS
Those who improved Manufacturing Cycle Time by 10% or more had average Financial improvements of 14%.

QUALITY
Those who had top annual improvements in Quality metrics such as Improved First Pass Yield by 5% or more, or Increased Supplier Quality Incoming by 5% or more, or Reduced Customer Rejects by 5% or more, all had average Financial improvements of 14%.
Summary & Recommendations (Continued)

Q. How can technology help support and impact metrics programs and Financial performance?

A. The most deployed applications by all respondents were ERP; Planning, Scheduling & Dispatching; Quality Management; Data Historians; and MES. Additionally:

Average improvement in Total Cost Per Unit Excluding Materials was 24.1% for users of OI/EMI software, and 22.5% for users of MES software versus 13.1% overall.

Average improvement in Net Profit Margin was 19.4% for users of a Comprehensive Suite of MOM software versus 10.4% overall.

Average improvement in OTCS was 22.0% for users of MES software, and 20.4% for users of Quality Management software, and 19.1% for users of PLM software versus 12.5% overall.

Q. Which metrics are being utilized as part of role-based dashboards and how frequently should these metrics be measured and utilized?

A. The top 10 Financial and top 18 Operational metrics that are being utilized by respondents are detailed in Section 2. Most Operational metrics programs are looking at a combination of individual Plant level metrics rolling up to a Corporate view. Most Financial metrics programs are looking at Corporate and Business Unit level metrics. The overall trend is toward faster visibility of performance metrics for manufacturing operations. Examples follow.

26% of Machine Level Operators and 19% of Line/Area Level Operators are seeing their performance information in real-time.

15% of Line/Area and Plant Level Operators are seeing performance information within a shift.

Q. What are some of the best practices I can learn from market leaders?

A. One of the industry best practices that MESA and LNS Research see for metrics program success is to take the organization through a strategy decomposition and goal alignment process (Section 7) to ensure that the right metrics are being applied and evaluated across the business. This is one focus of the MESA Metrics Guidebook. Also, helping executives and manufacturing personnel to better understand each other and the potential impact that manufacturing can have on business success can accelerate many more manufacturing initiatives in the future.
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