Pursuing Manufacturing Excellence through Real-time Performance Management and Continuous Improvement

Executive Summary ................................................................. 3
Manufacturing Excellence ......................................................... 5
Today’s Challenges .................................................................... 6
Real-time Performance Management .......................................... 8
Synchronized Manufacturing Operations ................................. 13
Realizing Manufacturing Excellence .......................................... 15
Summary .................................................................................. 16
About the Author:

Greg Gorbach: As ARC’s Vice President, Collaborative Manufacturing and Architecture, Greg Gorbach is a thought leader in Collaborative Manufacturing and provides clients in a number of manufacturing vertical markets with strategic advice in dealing with boundary-crossing business processes. Greg’s primary areas of focus are Collaborative Manufacturing, Production Management, Business Process Management, Manufacturing Performance Services, and the synchronization of plant systems with CRM, ERP, PLM, Supply Chain and other business systems. He brings over twenty years of hands-on experience to ARC, with direct experience within manufacturing organizations, as well as extensive experience with suppliers to manufacturers.

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Executive Summary

Manufacturers are feeling new pressure on their operations coming from many directions. Dynamic market needs, increased compliance requirements, more distributed manufacturing operations, rapid product innovation, Lean manufacturing, and the approaching transition to new IT technology all manifest themselves on the plant floor and throughout the enterprise - and often lead to pleas for new technology solutions. Integration and data utilization are the two key issues to address in order to improve responsiveness and performance.

Many manufacturing companies recognize that improving corporate performance demands better synchronization with the plant floor. For too long, manufacturing has been isolated. Most of the important production data has not been easily accessible, and is therefore not very useful in improving performance. Today, however, feasible solutions are available to drive excellence in manufacturing performance through better manufacturing intelligence and integration.

Real-time Performance Management (RPM) solutions acquire manufacturing data in real-time, establish the operating context for that data, and ensure that it is stored in a manner that makes it accessible at later times for a variety of uses. RPM facilitates the visibility of this real-time manufacturing data to users throughout the enterprise, and includes tools for enhanced decision support and role-based display of performance against operating metrics. Event-based triggers notify all who should be informed when important or unforeseen events take place. These solutions help companies achieve a higher level of manufacturing excellence by allowing them to better leverage their detailed manufacturing information.

In many companies, it falls to IT to envision new business possibilities in concert with the technologies needed to realize them. At the same time, the
usual job of reducing the cost of doing business through increased efficiency and productivity cannot be ignored. This paper outlines how modern solutions can support both strategies at the same time.

<table>
<thead>
<tr>
<th>Sample Business Challenges</th>
<th>Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid demand growth is outstripping production capacity; need better efficiency to keep acceptable customer service levels</td>
<td>Drive efficiency to world-class levels; for example, from 60% to 85% by better utilizing manufacturing data</td>
</tr>
<tr>
<td>Manufacturing to high quality standards; need to reduce the “cost of quality” and improve productivity</td>
<td>Achieve significant improvement in First Pass Yield and OEE by improving visibility of quality data</td>
</tr>
<tr>
<td>Increase competitive advantage by driving down production costs and COGS</td>
<td>Reduce operation costs through increased yield and efficiency; reduce material waste; avoid expensive peak outsourcing of manufacturing and distribution by improving utilization of existing plant and facilities</td>
</tr>
<tr>
<td>Rework/repair level is too high. With weekly or daily quality reports, a large amount of defective product can be manufactured and possibly shipped before problems are recognized. Significantly impacts productivity.</td>
<td>Eliminate or significantly reduce data latency; alert appropriate personnel in real-time about defect events.</td>
</tr>
<tr>
<td>Need to continuously improve margins and cost structure in core businesses to fund product development and growth in new markets</td>
<td>Reduce operation costs through increased yield and efficiency</td>
</tr>
<tr>
<td>We want to improve our competitive position through innovation. In order to get to the next level, need creative solutions and improvements to the manufacturing process.</td>
<td>Reduce or eliminate non-value added work to free up time for innovation by providing data and analysis tools. Provide broad information visibility and analytics to spark innovative ideas.</td>
</tr>
<tr>
<td>Our Balanced Scorecard methodology needs information from sources outside our ERP system</td>
<td>Provide real-time manufacturing performance information to corporate performance systems.</td>
</tr>
<tr>
<td>Our Six Sigma methodology has become ingrained in our culture, but our Six Sigma Control Plans have a limited value because they exist as a spreadsheet or Word document and are difficult to adhere to.</td>
<td>Automate the Six Sigma Control Plans and provide real-time, exception-based notifications to owners so they can take immediate action.</td>
</tr>
<tr>
<td>To maintain and improve responsiveness and customer satisfaction, Plant operations needs to be better integrated with business systems and the supply chain</td>
<td>Increase data utilization: move from data collection, to performance visibility and analytics, to closed-loop business scenario deployment</td>
</tr>
</tbody>
</table>

Table 1: Today’s Business Challenges Require Strategies Based on Better Utilization of Manufacturing Data. These are Real Examples from Manufacturers in a Variety of Industries Who Have Embarked on RPM Projects
Manufacturing Excellence

Pursuing excellence in manufacturing operations is second nature for Adaptive Manufacturers. Comparable to ARC’s Collaborative Manufacturing Management, Adaptive Manufacturing is SAP’s vision for how companies participate in an ecosystem or business network, are able to leverage the network’s cumulative ability to plan and anticipate demand and supply, execute plans efficiently and effectively, sense meaningful events in real-time, and respond to and learn from ever-changing business conditions.

Manufacturers participating in an adaptive business network remain flexible, resourceful, and profitable in a constantly changing environment. At the same time, they can meet the increasing demands of consumers who expect high-quality, personalized products designed in ever-shortening time windows and attract new customers and sales based on the ability to meet those changing consumer needs. In time, the network helps to reduce costs by streamlining processes and focusing them on what each participating company does best. It also allows all participants to collaborate dynamically with their partners to produce new and innovative products and services.

Participating in an adaptive business network requires a significant shift in the way manufacturers view their business and trading partners. It requires moving from traditional, often adversarial supplier and customer relationships, to true collaborative partnerships based on standardized business processes and measurement systems. It also requires manufacturers to ensure that operations are synchronized with business dynamics and are focused on driving manufacturing performance excellence in order to ensure profitability, flexibility, and quality [Table 1].

Manufacturing Excellence is, therefore, a critical aspect of adaptive manufacturing. Excellent performance is characterized by the ability to react quickly to changing marketplace conditions, to dynamically reflect these changes in production targets, and to efficiently and reliably achieve these targets. It also requires ongoing cost reductions and quality improvement.

In order to achieve manufacturing excellence, manufacturers need to manage based on real-time performance information. Grounded in operations, Real-time Performance Management (RPM) encompasses the processes, methodologies, metrics, systems, and information needed to measure and manage the performance of a manufacturing organization. RPM places particular
emphasis on: acquiring and using real-time, plant level, performance and operating data; providing actionable intelligence based on analytics, event triggers, and visibility; KPI support; and, integration to business systems. RPM provides the real-time plant level information needed by the planning and financial reporting/analysis functions of Corporate Performance Management systems.

Today’s Challenges

Manufacturing organizations are directly feeling new pressure on their operations and it comes from many directions simultaneously. Dynamic market requirements, increased compliance needs, more distributed manufacturing operations, rapid product innovation, Lean manufacturing, and the approaching transition to new IT technology all manifest themselves on the plant floor. Too often, the symptoms go unrecognized. For example, it may be that supervisors are in a constant state of firefighting, or spending more and more time expediting. This can be related to shorter delivery promise windows, faster turnaround, and more customer status inquiries. The situation is exacerbated when plant personnel are not immediately informed about manufacturing exceptions, because small perturbations have a much larger impact when the system is running under pressure [Table 3].

In other cases, operators may be missing their performance targets and are unable to meet continuous process improvement goals. Business and plant managers may be missing their budgets more frequently. Perhaps variations in manufacturing performance across shifts, lines and plants are inexplicably widening. These may all be signs that things are beginning to slip because people are no longer able to effectively monitor, measure, analyze, control and improve key performance indicators (KPIs) against targets.

<table>
<thead>
<tr>
<th>Role</th>
<th>Performance Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line/ machine operator</td>
<td>How am I performing against my production targets? How am I performing against my peers?  How can I make more given pay-for-performance model?</td>
</tr>
<tr>
<td>Production Supervisor</td>
<td>Which orders have been impacted by the asset failure? Which lines are currently available? Which line is the most efficient for this order?</td>
</tr>
<tr>
<td>Plant Manager</td>
<td>What is my actual cost of production versus budget? What are my best and worst performing assets? What is my Overall Equipment Effectiveness (OEE)? How can I analyze, isolate and improve on OEE variances?</td>
</tr>
<tr>
<td>VP Operations or Supply Chain</td>
<td>Can I fulfill an order profitably against current inventory? Which assets are currently available for a rush order? Which is the most efficient plant to produce this product? Which underperforming assets can we rationalize?</td>
</tr>
</tbody>
</table>

Table 2: RPM Provides Information to Support Manufacturing Excellence
as the pace increases. Managers cannot get the information they need to measure and control actual production costs against targets, and supervisors waste time accessing and searching through multiple systems for needed data.

In mid-size and larger manufacturing enterprises, the problems are compounded by the need to assess and improve performance across multiple, production lines/equipment, and databases.

<table>
<thead>
<tr>
<th>Production Data Issues</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key data is in Excel spreadsheets, clipboards, applications, production lines/equipment, and databases</td>
<td>Collect key data electronically and make it widely available throughout the organization</td>
</tr>
<tr>
<td>Plant production data needed by ERP is manually collected, often re-entered, and manually transferred from spreadsheet to spreadsheet as it moves from plant data sources to the ERP system</td>
<td>Automatically collect and transfer plant data needed by ERP</td>
</tr>
<tr>
<td>It is very difficult to get information that is in different departments. Different systems/applications, conventions, business cycles, and the like complicate the collection and rationalization of data</td>
<td>Collect and contextualize data from all departments electronically in real-time and make it widely available throughout the organization</td>
</tr>
<tr>
<td>It is difficult, time-consuming, and costly to interpret the data and prepare graphs/charts/reports that help identify problems and root causes</td>
<td>Speed analysis and minimize cost by leveraging solutions that provide graphical display, drilldown, and analytical tools.</td>
</tr>
<tr>
<td>Shop floor technicians enter some data via three, four, or five ERP screens. This is too time-consuming and is prone to errors.</td>
<td>Provide a simplified “front” screen for ERP data entry.</td>
</tr>
<tr>
<td>We’ve gotten good at collecting lots of data – but our needs have matured and we need to integrate that data with other areas.</td>
<td>Provide a unified, consistent view of data; visualization and analysis tools, and robust integration.</td>
</tr>
<tr>
<td>Our schedule is on a big whiteboard</td>
<td>Electronic schedule with extensive visibility, linked to real-time performance data.</td>
</tr>
<tr>
<td>We have to respond to customer Quality Notifications, even though the issues may not end up being traceable to our products (because a number of materials come into play simultaneously downstream in our customer’s manufacturing processes). It can take 5-7 days to pull together the data needed to satisfy the customer</td>
<td>Dramatically reduce the burden of research to answer customer quality and production inquiries. Collect and contextualize data from all departments electronically in real-time and make it widely available throughout the organization. Speed analysis and minimize cost by leveraging solutions that provide graphical display, drilldown, and analytical tools.</td>
</tr>
</tbody>
</table>

Table 3: A Sampling of Typical Issues Manufacturers Encounter When Production Data is Underutilized
possibly globally distributed, facilities and business units. Without accurate and timely asset-to-asset and plant-to-plant comparison data, this is difficult and impractical.

To address these challenges, manufacturers need solutions that allow them to see and use real-time information from operations. They need solutions that facilitate excellent manufacturing performance and enterprise-wide process synchronization.

**Real-time Performance Management**

Real-time Performance Management (RPM) is a term that describes all of the processes, metrics, techniques, and systems needed to measure and manage the performance of a manufacturing organization. RPM is primarily focused at the plant level but has significant touchpoints within the business systems. It complements and extends Corporate Performance Management systems [Figure 2] [Table 4].

RPM solutions acquire manufacturing data in real-time, establish the operating context for that data, and ensure that it is stored in a manner that makes it accessible at later times for a variety of uses. RPM facilitates the visibility of real-time manufacturing data to users throughout the enterprise, and includes tools for enhanced decision support and role-based display of performance against operating metrics. Event-based triggers are also provided to notify all who should be informed when important or unforeseen events take place. These solutions help companies achieve a higher level of manufacturing excellence by allowing them to better leverage their detailed manufacturing information.

Another important role for RPM solutions is to synchronize the plant floor with increasingly dynamic business operations. This includes providing enterprise-wide visibility of manufacturing data, including certain operating data, compliance information originating in the plant, and capacity and cost data. Information needs to flow in both directions, to support work planning and deployment as well as plant floor visibility of selected financial information for plant floor metrics. As the need to use manufacturing data matures, business processes become more automated, and closed loop scenarios begin...
to operate between business systems and plant systems. RPM solutions provide the real-time manufacturing data, information, analysis, and synchronization needed to operate at a high level of manufacturing excellence, while supporting the corporation in excellent overall business performance.

It is important to distinguish real-time solutions from solutions that provide information on a daily or weekly basis. Real-time solutions make information “actionable” at the point in time when it has the greatest potential impact. This can mean the difference between one or two items and a whole day’s worth of out-of-spec product taking up space, waiting for disposition as scrap or rework while the customer awaits delivery of their orders. Real-time solutions create ROI by exposing business opportunities that might otherwise be lost.

In today’s competitive environment, “Manufacturing Excellence” represents far more than just making the machines and personnel in the plant effective.

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Table 4: RPM Complements and Extends Corporate Performance Management

<table>
<thead>
<tr>
<th>Function</th>
<th>CPM</th>
<th>RPM</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>Strategic Planning, Sales Planning, etc.</td>
<td>Provide Real-time Mfg data for Corporate Planning Activities</td>
<td>Strategic planning, sales planning, expense planning, and risk analysis. Establish data, process, and policy requirements. Budgeting, modeling, planning, forecasting.</td>
</tr>
<tr>
<td>Financial Reporting &amp; Analysis</td>
<td>General Ledger, A/R, A/P, &amp; other financial analyses; Consolidation</td>
<td>Financial component of plant metrics; Compliance info from plant</td>
<td>Multi-jurisdiction, reports, financial feed to metrics; provide compliance info to financial systems/executives.</td>
</tr>
<tr>
<td>Intelligence/Decision Support</td>
<td>BI/Decision Support</td>
<td>MI/Decision Support</td>
<td>Performance indicators, reporting, analysis, dashboards, queries, alerts, notification, event/activity management</td>
</tr>
<tr>
<td>Metrics/Scorecarding</td>
<td>Corporate Metrics Management</td>
<td>Production KPIs, Real-time OpX Data</td>
<td>Metrics mgt, Planning-based metrics, Reporting, etc. Establish targets, link metrics to underlying data, maintain and show relationships among metrics; drive Continuous Improvement initiatives</td>
</tr>
<tr>
<td>Real-time Manufacturing Information</td>
<td>n/a</td>
<td>Real-time Manufacturing Information</td>
<td>Manufacturing data acquisition, contextualization, processing, storage</td>
</tr>
<tr>
<td>Business Integration</td>
<td>n/a</td>
<td>Business Integration</td>
<td>Closed loop business process integration; enterprise-wide visibility of mfg data; Plant visibility of selected financial info for metrics</td>
</tr>
</tbody>
</table>

(CPM) Corporate Performance Management

(RPM) Real-time Performance Management

CPM is an umbrella term that describes all of the processes, techniques, metrics, and systems needed to measure and manage the performance of an organization. RPM extends this to real-time manufacturing information.
Adaptive Manufacturers respond proactively to unforeseen events, exceptions, and increasingly rapid changes in demand and supply. The manner in which that manufacturer utilizes plant floor data determines their ability to do this effectively. Historically, some data is gathered manually and other data accumulates in isolated plant systems. Data gathered in this manner may serve as a historical record, but is essentially unavailable for use in daily operations or for continuous improvement programs.

Many manufacturers are beginning to use systems to collect and contextualize plant data and make it visible to a variety of users. The availability of real-time information aids in operational decision-making and the organization reaps benefits in the form of efficiency and yield improvements, OEE, and the like. Analytical tools extend the ability to make better decisions. Adding event-triggered alerts reduces the reaction time for changes, failures, opportunities, and problems, and can significantly improve overall performance. Responses to certain alerts can be preordained and enforced by workflow solutions, further enhancing performance.

Organizations can reap even greater gains when workflow or business process management tools are used to synchronize business processes across departments and operations and between business and plant floor systems. Solutions for this level of synchronization can also typically support multiple plants with a normalized view of performance across disparate systems. At the highest level, organizations can leverage the plant data/information to

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**Fig 3: Manufacturing Excellence Depends Upon the Robust Use of Manufacturing Data**
support the use of tools for modeling new business processes and the change management process for implementing them.

**Greater Than the Sum of the Parts**

As RPM is rolled out beyond the original pilot implementation, higher levels of benefits are obtained. Since RPM “snaps on” to existing systems, instead of replacing or replicating them, an extended deployment can proceed at a rapid pace. In addition, RPM is an approach that supports all categories of metrics such as Assets, Quality, Manufacturing, and Cost, and therefore a single solution can deliver performance benefits in all of these areas. When a significant portion of one plant’s operations are involved [Figure 4], that plant sees better performance as well as better service to its customers. As RPM is extended to multiple plants and the bulk of the enterprise, business managers at all levels are empowered to make better decisions based on a unified view of the distributed real-time manufacturing data. This can lead to a quantum change in performance for any manufacturing enterprise. Each plant has the information necessary to optimize its efforts in support of enterprise priorities. Regional and corporate managers have accurate information feeding their planning, allocation, risk management, and report-
ing systems. The enterprise as a whole becomes much more adaptive, and able to compete in previously unreachable areas.

Real-time Manufacturing Data and Continuous Improvement

A common use of RPM is to provide data for the Measure phase of Six Sigma DMAIC processes. This can be implemented as data that appears in a quality dashboard. Leading manufacturers take this a step further. Instead of trying to manage the Control phase with plans drawn up in Microsoft Word or Excel documents, they use RPM to automate the control plans and notify process owners in real time about events or exceptions so that they can immediately take action. This approach can have a huge impact in the effectiveness of existing Six Sigma programs. Linking performance against metrics with Continuous Improvement speeds the improvement cycle, which creates more awareness of the value of RPM at other locations, as well as a functional baseline so new installations can be deployed more quickly.

SAP xMII

SAP xMII connects to a wide variety of plant systems and data sources, such as MES, DCS, HMI, Plant Historians, Laboratory systems, Maintenance systems, and other data sources [Figure 5]. It establishes the production context for data from these systems and makes the information visible to users and available to other applications. It also provides analytical tools to aid in decision-making and integration services to facilitate connectivity to business systems.

SAP xMII collects and contextualizes plant data and make it visible to a variety of users. It supports optimal decision making by providing “unified” real-time information and analytical tools. Event-triggered alerts speed reactions, problem identification, and problem resolution. It provides workflow-based responses, which can be configured for certain alerts. SAP xMII’s in-
Integration capability includes synchronizing business processes across departments and operations and between business and plant floor systems. It scales to support multiple plants with a normalized view of performance across disparate systems. SAP xMII plant data/information is readily available to inform tools for modeling new business processes and the change management process for implementing them.

**Synchronized Manufacturing Operations**

SAP xMII enables Adaptive Manufacturing to drive manufacturing excellence by synchronizing manufacturing operations with business systems to deliver “one version of the truth”. Without such a solution in place, bad decisions can be made due to out of date or wrong data, or because different plants or departments have different methods and algorithms for populating the data. At best, it wastes time to sort this all out, and delayed decisions lead to lost profits and lost opportunities. “One version of the truth” is not intended to imply that there must be a single data repository for all data. It refers to the unification of information, so that users in various roles have personalized views of different aspects of the same information at the same time. This unified view of manufacturing information is provided by the combination of **Manufacturing Intelligence** - a real-time analytics engine that aggregates and delivers unified visualization of events, alerts, KPIs, and decision support to production personnel and appropriate other parties through role-based Enterprise Portal dashboards - and **Manufacturing Integration** - a single, standards-compliant application enabling bi-directional SAP ERP connectivity into real-time plant floor applications to drive efficiency in enterprise business processes, whether in a single plant or across multiple plants, business units, and regions.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Services</td>
<td>Bi-directional data access, Metadata browsing, XML-based data abstraction, Connectors to external systems</td>
</tr>
<tr>
<td>Business Logic Services</td>
<td>Logic, Integration services, Notification services, Calculation and data transformation, Content creation</td>
</tr>
<tr>
<td>Visualization Services</td>
<td>Charts, Grids, tickers, UI controls, Dashboard components</td>
</tr>
<tr>
<td>Analytic Services</td>
<td>SPC/SQC (Six Sigma) analyses, Statistical and other mathematical analyses</td>
</tr>
<tr>
<td>Web Services</td>
<td>All services exposed as web services, Includes user-defined composite services</td>
</tr>
</tbody>
</table>

*Table 5: SAP xMII Core Functionality: Manufacturing Integration and Intelligence*
Early adopters have identified performance improvements primarily in the areas of yield, production output and Labor. Adverse events trigger quick responses, so the line runs better and with more uptime. More product is created faster (production) while less material is needed for a given output (yield). Labor savings come from three primary sources: Less labor is needed to clear out and dispose of bad product; a more efficient line can lead to reductions in contingent labor, such as extra workers who can jump in to fix problems, crank out additional work or support additional shifts; and, in many cases, a significant reduction in labor occurs as the need to manually collect, analyze, and chart data is eliminated.

**Whirlpool Corporation**

According to Ken Klein, Director of Global Development, Manufacturing at Whirlpool, “We deployed this as a series of projects, and our problem wasn’t finding the next project that could meet the bar in terms of ROI justification – we had many, many projects that passed that test, and we regularly saw returns on the order of 15-20 times investment. Our problem was prioritizing, selecting from among those projects the ones we could work on first to have the maximum impact on the organization’s performance.”

Founded in 1911, Whirlpool Corporation is the world’s leading manufacturer and marketer of home appliances. With annual sales of $13 billion USD, 68,000 employees, and nearly 50 manufacturing and technology centers around the globe, Whirlpool markets major brands such as Whirlpool, KitchenAid, Brastemp, Bauknecht, and Consul in more than 170 countries.

Whirlpool initially set out to improve their performance through better and more visible plant information. They replaced an assortment of local Visual Basic reports with a centralized, standardized, web-based data acquisition and visibility tool. The thin-client interface was easy to maintain, and allowed them to drive improved visualization on the plant floor and other parts of the organization.

SAP xMII enabled Whirlpool to collect First Pass Yield (FPY) data in real-time at various points in the assembly process, to capture downtime tracking data by category (such as changeover, setup, maintenance, manpower, etc.) for OEE calculations and interactive graphics such as waterfall charts of performance losses of a particular machine against 100% OEE, as well as global metrics captured manually across all regions and summarized at a global level. The real-time data, together with shopfloor and quality solutions, sup-
ported Whirlpool’s continuous improvement initiative, and the system also greatly simplified the plant maintenance users’ interactions with SAP PM.

**Realizing Manufacturing Excellence**

Performance is the measure of manufacturing excellence, but how should performance be measured? Unfortunately, no single measure is appropriate for every manufacturing enterprise. Small scale deployments may focus on OEE or cycle time, while enterprise-wide deployments require a complex set of coordinated metrics throughout various levels and regions. Metrics may be crafted around profitability, asset utilization, quality, headcount, customer satisfaction, and the like, but in the end, the performance measures currently relied upon by your company and your industry are likely to be the best metrics to use to begin leveraging your manufacturing data in new ways to achieve manufacturing excellence.

Improving the performance of the IT group can sometimes improve the performance of the entire enterprise. With real-time data, it becomes easy to prepare and distribute reports that were infeasible before. Armed with this information, managers, supervisors, and operators make better decisions and business performance improves. In many companies, the IT group has become increasingly burdened by supporting homegrown and legacy plant systems. An RPM solution can replace some of these applications, but a more powerful strategy is “front-ending” legacy applications. With this approach, RPM user interfaces mimic those of legacy applications so the introduction of RPM has little or no impact on the operators. Once it is in place, rationalization of the underlying systems can proceed at any desired pace without further impact. This in itself can justify many projects, based on improving IT productivity by reducing legacy applications support costs.

To be sure, plant operations can benefit directly - in terms of reductions in variable labor and overall production cost, together with increases in yield and production output. In addition, more productive use of capital equipment can enable manufacturers to avoid adding additional capital equipment in order to get more output. It can also reduce the need to contract out manufacturing during demand peaks.

Early adopters have reported dramatic changes in the effectiveness of their morning meetings, which set the tone for the rest of the day. Instead of
working from static, dated reports, manufacturing teams begin using the live RPM system at the daily meeting. Performance problems are spotted and addressed immediately, using the system to drill down to individual events and equipment to understand root causes. In some cases, Six Sigma or TPM leaders are given action items to conduct further analysis - again leveraging data from the live system.

**Summary**

Manufacturers recognize that they need IT solutions designed to improve performance in order to respond to dynamic market pressures, to become more flexible and adaptive, and to enhance competitive positioning. Real-time Performance Management (RPM) solutions acquire manufacturing data in real-time and synchronize the plant floor with increasingly dynamic business operations. These solutions drive excellence in manufacturing performance through better manufacturing intelligence and integration. They provide enterprise-wide visibility of manufacturing data, including key operating data, compliance information originating in the plant, and capacity and cost data. These systems are relatively light touch and minimal risk, because they leverage existing systems and do not require expensive rip-and-replace or replicate strategies. They are also relatively quick to deploy, so value is rapidly generated. Despite this, they can have a powerful impact in two ways: by contributing to reductions in the cost of doing business and increased productivity and efficiency, and by enabling new business processes or opportunities.

Because RPM is an approach that spans all categories of metrics such as Assets, Quality, Manufacturing, and Cost, a single solution can deliver performance benefits in all of these areas. When the measurement data for these metrics is linked to a continuous improvement program such as Six Sigma, the improvement cycle is accelerated and entire operations can rapidly move to higher levels of performance.

It is important to distinguish real-time solutions from solutions that provide information on a daily or weekly basis. Real-time solutions make information “actionable” at the point in time when it has the greatest potential impact. It can mean the difference between one or two items and a whole day’s worth of out-of-spec product taking up space, waiting for disposition
as scrap or rework while the customer goes waiting. Real-time solutions create ROI by exposing business opportunities that might otherwise be lost.

SAP xMII enables Adaptive Manufacturing by synchronizing manufacturing operations with business systems to deliver “one version of the truth” and driving manufacturing excellence. This unified view of manufacturing information is provided by the combination of **Manufacturing Intelligence** - a real-time analytics engine that aggregates and delivers *unified visualization* of events, alerts, KPIs, and decision support to production personnel and appropriate other parties through role-based Enterprise Portal dashboards - and **Manufacturing Integration** - a single, standards-compliant application enabling bidirectional SAP ERP connectivity with real-time plant floor applications to drive efficiency in enterprise business processes, whether in a single plant or across multiple plants, business units, and regions.

SAP xMII connects to a wide variety of plant systems and data sources, such as MES, DCS, HMI, Plant Historians, Laboratory systems, Maintenance systems, and other data sources. It establishes the production context for data from these systems and makes the information visible to users and available to other applications. It also provides analytical tools to aid in decision-making and integration services to facilitate connectivity to business systems.

SAP xMII collects and contextualizes plant data and make it visible to a variety of users. It supports optimal decision making by providing “unified” real-time information and analytical tools. Event-triggered alerts speed reactions, problem identification, and problem resolution. It provides workflow-based responses, which can be configured for certain alerts. SAP xMII’s integration capability includes synchronizing business processes across departments and operations and between business and plant floor systems. It scales to support multiple plants [Figure 6] with a normalized view of performance across disparate systems. SAP xMII plant data/information is

<table>
<thead>
<tr>
<th>Category</th>
<th>Strategic Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate Performance</td>
<td>Real-time manufacturing data enhances corporate decision-making and aligns the plant floor with corporate initiatives</td>
</tr>
<tr>
<td>Competitive Advantage</td>
<td>Increase competitive advantage by driving down production costs and increasing flexibility and responsiveness</td>
</tr>
<tr>
<td>Continuous Improvement</td>
<td>Accelerate continuous improvement programs through increased data velocity and process automation</td>
</tr>
<tr>
<td>Quality</td>
<td>Reduce the Cost of Quality with real-time operating data to improve margins and fund product innovation</td>
</tr>
<tr>
<td>Capital Expense</td>
<td>Avoid capital expenditure and peak outsourcing through better utilization of existing assets</td>
</tr>
<tr>
<td>Adaptive Manufacturing</td>
<td>Real-time information and process automation enable increased flexibility and responsiveness to ecosystem changes</td>
</tr>
</tbody>
</table>

*Table 6: RPM Contributes to Strategic Enterprise Performance*
readily available to inform tools for modeling new business processes and the change management process for implementing them.

For too long, manufacturing has been isolated and most important production data has not been easily accessible. As manufacturing companies begin their push to improve responsiveness and performance, they will find what leading companies already know: Real-time Performance Management (RPM) solutions drive **excellence in manufacturing performance** through better manufacturing intelligence and integration.

![Fig 6: SAP xMII in a Multi-Plant Context](image)
Acronym Reference: For a complete list of industry acronyms, refer to our web page at www.arcweb.com/Community/terms/terms.htm

- **APS** Advanced Planning & Scheduling
- **B2B** Business-to-Business
- **BI** Business Intelligence
- **BPM** Business Process Management
- **CAGR** Compound Annual Growth Rate
- **CMM** Collaborative Manufacturing Management
- **COGS** Cost of Goods Sold
- **CPG** Consumer Packaged Goods
- **CPM** Corporate Performance Management
- **CRM** Customer Relationship Management
- **DCS** Distributed Control System
- **EAI** Enterprise Application Integration
- **EAM** Enterprise Asset Management
- **ERP** Enterprise Resource Planning
- **FPY** First-Pass Yield
- **HMI** Human Machine Interface
- **IT** Information Technology
- **KPI** Key Performance Indicator
- **MES** Manufacturing Execution System
- **MI** Manufacturing Intelligence
- **MRP** Materials Resource Planning
- **OpX** Operational Excellence
- **OEE** Operational Equipment Effectiveness
- **P2B** Plant-to-Business
- **P2D** Plant-to-Design
- **PLM** Product Lifecycle Management
- **RFID** Radio Frequency Identification
- **ROA** Return on Assets
- **ROI** Return on Investment
- **RPM** Real-time Performance Management
- **SCM** Supply Chain Management
- **SPC** Statistical Process Control
- **SQC** Statistical Quality Control
- **WMS** Warehouse Management System
- **XML** Extensible Markup Language

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ARC Advisory Group, Three Allied Drive, Dedham, MA 02026 USA
Tel: 781-471-1000, Fax: 781-471-1100, Email: info@ARCweb.com
Visit our web page at ARCweb.com