Plant Floor Visibility: Getting More from Your Plant Floor

Connected Experiences for Consumer Goods
Delivering Value Today, Driving Innovation for the Future
Introduction

Flexibility, visibility, and foresight are the primary drivers of success for manufacturing plants. This is what enables them to cut costs while adhering to increasing compliance standards, boosting overall performance, and delivering more and better-quality products in less time. In light of the fact that offshore manufacturing is on the rise, regulatory scrutiny is intensifying, Web-based commerce is rapidly growing, and integrating sustainability measures into processes and practices is becoming more important than ever before, manufacturers need more ways to remain nimble. In short, they need to be able to connect dots and centralize ideas to accelerate profitability.

The growth of multifaceted global supply chains, for example, has made it more difficult than ever to bridge the physical distance between enterprise-level decision making and plant floor execution systems. Employees are working in varying time horizons, performing dozens or hundreds of activities, and the amount of data emerging from plants is increasing exponentially. As a result, today's manufacturers often lack the start-to-finish, enterprise-wide view of operations that is critical for making intelligent decisions at the right time on the plant floor.

For operations managers, achieving manufacturing excellence requires increasing real-time data analyses that do not affect lead time or require additional resources. They need to find ways to make existing assets do more, reduce product variations and machinery failure to reduce costly rebatch processes, and meet increasing bottom-line and regulatory pressures. In essence, manufacturers need to find the “hidden plant” and leverage this understanding to increase efficiency. This paper reveals how operations managers can capture accurate demand data, ensure continuity of production and product integrity, and maximize visibility across each end of the production spectrum with standards-compliant tools that enable proactive, collaborative, and productive operations across global channels.

Key Components of Operational Excellence

In today’s challenging economy, true operational excellence can help your business reach a leadership position in the market, but maintaining this level can be frustratingly elusive. Operational excellence requires that your people be able to gather, analyze, and respond to vast amounts of production-related data in a short time. The goal is to create a flexible and agile manufacturing operation that can adapt and respond to changes in the business, processes, supply chain partners, products, and markets.

How is this possible? First, by integrating evolving technologies into current systems that help improve asset management and label tracking with accurate measures and indicators—whether leading versus lagging, or detailed versus segregated. Next, by establishing an improved platform for collaboration that enables people to share ideas and better respond to challenges. Finally, by gaining better insights from analytics that support and enable smarter decisions.
Overcoming Operational Challenges

Both generic and brand manufacturers face a number of challenges, such as lower growth rates, marginal profits, and declining consumer loyalty to a particular brand. And these challenges can become more complex as retailer mandates (for example, Wal-Mart’s recent decision to require Eco-Labels from its suppliers\(^1\)) and government regulations increase. To flourish in this landscape, several manufacturers are reaching for partners to support product innovation and supply chain innovation. The following sections highlight the major challenges that partnerships such as these can address.

**Increasing Operations Flexibility**

A major concern for Product Lifecycle Managers (PLMs) is finding a way to reduce safety stock levels while maintaining consistent—and optimal—customer service levels. With a flexible operations platform, manufacturers can produce smaller lots with shorter lead times, and gain a huge competitive advantage as a result. In other words, PLMs can leverage increased operations flexibility to promise delivery of an item/Stock Keeping Unit (SKU) in 24 hours or less, rather than forecasting delivery out three days.

The following figure shows how Type “A” businesses achieve higher performance over Type “B” businesses by making smaller lots with shorter lead times when SKU-level consumption triggers replenishment signals.

![Diagram showing inventory and consumption over time, comparing Type B (Bigger Lot, Longer Lead Time) and Type A (Smaller Lot, Shorter Lead Time).]

**Figure 1: Packaging Operations Flexibility**

\(^1\) *Wall Street Journal*, “Wal-Mart to Assign New Green Ratings,” July 7, 2009
Responding to Heightened Regulatory Requirements and Sustainability Concerns

It is estimated that in the last five years, nearly 10,000 regulations have been created by federal and industrial entities. At the same time, consumers and regulatory bodies are increasingly concerned with green and sustainability issues. For plant managers, adapting to these heightened standards with the push toward sustainable practices requires them to reduce the carbon footprint of manufactured goods, reduce or reuse basic materials, and aggressively monitor power profiles to comply with emission controls of environmental pollutants—all while shrinking costs and improving efficiencies.

This is a daunting challenge, but one that can be overcome by gaining real-time visibility into product quality and purity. Rather than analyzing historical reports that aggregate information days or weeks after events have occurred, operations managers can respond to issues when they arise through real-time data reporting.

Moving from Silos of Information to Centralized Communication

Plant floor optimization centers on fostering optimal performance of people, plant assets, business processes, and workflow. However, in a global infrastructure in which outsourcing is increasingly the norm, there are vast distances between manufacturing operations and corporate headquarters. A lack of near-real-time visibility across all ends of production leads to fragmented communication and delayed response to production-critical issues.

Ensuring optimization requires a central platform where accurate, up-to-date information from all sources is aggregated and made accessible to end users. More than that, operations managers can leverage advanced mobile technologies to give users instant access to important information, such as lapses in performance or equipment downtime—whether they are working on the plant floor or out in the field.

Fostering Interoperability for Manufacturing Excellence

For years, the overarching need of businesses has been to link their business applications with plant floor execution systems. While this began as Material Requirements Planning (MRP), which focused on improvements to visibility of inventory, materials utilization, and the quote-to-cash cycle, the needs of manufacturers are expanding as the walls between corporate issues and manufacturing operations crumble or erode completely. Managing a global network requires extracting accurate consumer demand data to empower smart decision making at the right time, and continuity of production to ensure optimal performance and efficiency.

With the tools available today, manufacturing companies can grasp a holistic view of plant floor operations, from consumer demand, through asset performance, to actual materials usage and production quality—essential drivers to succeed in a global business community.
Integrating a New Technology Platform to Achieve Better Results

Effective peer-to-peer collaboration among operations personnel and across corporate groups, engineers, partners, and customers is crucial to fostering an open dialog and an active exchange of ideas. With a centralized “think tank,” manufacturers can hone in on consumer demands, operations challenges, and productivity issues. Secure, manageable technologies that are built with collaboration and enterprise requirements in mind—and that seamlessly integrate with existing technologies—are essential ingredients in helping manufacturers drive innovative processes while minimizing expenses.

When applied, these technologies provide manufacturers with manageable ways to:

- **Establish common views to achieve common goals.**
  Efficient and intelligent decision making hinges on integrating systems and applications, providing operations and systems visibility, and improving the end user experience so that each worker can make timely decisions that improve productivity. Finding context in this interconnected matrix requires a way to aggregate and filter data while simplifying the end user experience.

- **Increase visibility with a central platform.**
  A central platform provides an accessible view where areas of improvement can be easily identified by each end user. Advanced performance options, such as Enterprise Manufacturing Intelligence (EMI), can establish Key Performance Indicators (KPIs) by role/function, to provide “leading edge” indicators on operations that can be translated into tangible performance metrics, and that are customizable to meet corporate standards while reflecting the corporation’s goals.

**Making Smarter Business Decisions with Near-Real-Time Insights and Visibility**

Success in manufacturing requires access to near-real-time information on disparate processes. Making timely decisions can prevent lag time and help managers address lapses in performance, address equipment downtime, and quickly identify areas that require operational improvements. As business operations expand beyond the desktop, mobile connectivity can ensure that data is available anytime, anywhere for faster, more intelligent decision making that can help manufacturers gain a competitive edge.

**Continuous Improvement: A Packaging Example**

For a given service level, increasing operational flexibility and moving toward higher inventory turns (and higher margins) require managing a number of variables and finding the right technology to support operational processes. More often than not, high-performance organizations create a role or team charged with improving operational efficiencies. These groups are responsible for a number of continuous improvement initiatives, all of which aim at improving productivity while respecting regulatory compliance.
In a typical “kaizen” initiative, people look at a number of variables that affect a process. The following figure shows the process to fulfill a manufacturing work order.

![Process Diagram](image)

**Figure 2: Continuous Improvement**

For all the manufacturing and business processes involved, providing actors and stakeholders with actionable information is what separates leaders from laggers. In other words, leaders need actionable information, and the ability and foresight to apply corrective and preventive actions as abnormal events and incidents arise (CAPA system).

### Connecting Business Applications with Plant Floor Execution Systems

Software standards have improved to facilitate increased interoperability, and business standards are evolving to define the methodologies for integrating enterprise applications and plant floor automation systems, such as MES (Manufacturing Execution Systems). At first, this process was batch-oriented: as a lot finished production or materials were released to production, data was sent from the ERP to the plant floor systems, sending notification for subsequent order processing. But there were no fine points of iteration: plant floor scheduling was still left to the operations personnel, based on the daily demands and resource line status. Essentially, the walls between enterprise-level decision making and plant floor operations prevented streamlined interoperability, and thus hampered productivity.

The following figure depicts this process, showing the historical divide between business applications and plant floor execution systems.
Missing link: Manufacturing operations impact on results inventory, processes, order, resources, status, downtime, products, lab results, exceptions.

**Figure 3: Enterprise Applications Integrated with Manufacturing Operations**

With subsequent improvements, and with an active community of both ERP and MES vendors promoting interoperability, integration has reached a point where the plant has not just visibility of operations as they occur, but a holistic view and interoperability of the supply chain—from customer demand, through capacity planning and preventative maintenance, to final shipment affecting the quote-to-cash cycle. The result is that the status of the entire plant network is open: automatic systems—from PLCs to the DCS systems used for process control to the entire plant ecosystem (maintenance systems, execution systems, planning systems, and customer support systems)—are readily accessible. This additional visibility and integration of functionality helps reduce downtime and stoppages, and it also helps manufacturers better manage capacity, throughput, and responsiveness to customer demands.

The following sections present the key components that drive productivity through increased interoperability and visibility.

**Integrated Demand Planning**

Operations have been shifting from make-to-forecast inventories to make-to-order inventories. Being able to access customer demands requires up-to-date information that is visible across the entire spectrum of the plant floor—and on a global level. Synchronicity between top-line and bottom-line processes and technologies can help manufacturers better respond and adapt to customer needs.

**Capacity Planning**

With increased visibility, plant floor operators can get more out of their physical assets by better aligning inventory supply and resources to the output requirements. This enables profitable growth while maintaining lean inventories and quality levels of service.
Preventive Maintenance

Knowledge of physical asset capabilities is crucial in helping manufacturing managers determine competitiveness and profitability. Asset-related information was once compiled and analyzed in a silo that was separated from engineering, operations, and maintenance; however, this resulted in a disjointed view that prevented plant floor operators from responding to real-time information that indicated product inconsistencies, insufficient resource availability, or equipment failures. With increased visibility and collaboration, Asset Lifecycle Management (ALM) can be assessed and monitored from a common platform to help ensure consistency. Common asset information exemplifies platform needs, and manufacturers can maximize data rescue for operations and maintenance to eliminate the cost of poor-quality asset information.

Putting It All Together:
Building Enterprise Manufacturing Intelligence

More and more, businesses are seeing themselves as “information driven,” which has ratcheted up the importance of acquiring accurate information and opening up access channels to enable collaborative solutions development. The following sections highlight some of the enterprise production data sources involved in creating an accurate, holistic view of operations.

Production Data

Identifying critical data can help manufacturers establish informational foundation levels where they can create layered analyses and reports. Tracking and collecting accurate data enables manufacturers to understand lapses in production processes and implement solutions to streamline operations.

Production Quality

Maintaining consistent batch quality is crucial to keeping costs low and producing quality goods that customers demand. It is also imperative in adhering to heightened regulatory standards and aligning with green efforts toward sustainability. Real-time information on production quality empowers manufacturers to make proactive changes to production inefficiencies before problems arise.

Process Standards and Settings

Decreasing process variability helps maintain streamlined operations and more accurate compliance monitoring and reporting. With accurate data that reveals true process standards and settings in real time, manufacturers can assess the efficacy of each individual process to quickly address any inconsistencies in performance or output.

Materials Usage

Manufacturers need to be able to capture a cohesive, interconnected view of materials usage to maintain adequate inventories. Visibility into real-time materials usage can help manufacturers maintain lean inventories and keep costs to a minimum.
Material Yield Loss

Materials Requirement Planning (MRP) is driven by supply and demand. Small deviations in control processes can wreak havoc on material yield loss and interrupt supply-to-demand productivity. Thus, it is imperative that manufacturers have an up-to-date view of current lot production and stable, reliable control systems that prevent batch variations.

Equipment Performance

Variability in asset performance can cause costly stoppages and delays to plant floor production. Therefore, stable, reliable equipment is essential to quality output—and stable, reliable mechanisms for extracting this data are necessary for accurate assessment of equipment performance.

PM Attainment

With Predictive Maintenance (PM) attainment, manufacturers are equipped to perform proactive maintenance on equipment to prevent problems before they occur.

Advanced Planning and Scheduling

Acquiring accurate, up-to-date data and leveraging relevant analytics can help manufacturers streamline operations and deliver products at the right time to the right market.

Gaining Flexibility by Increasing Interoperability

As previously discussed, improvements to integration, coupled with an active community of ERP and MES vendors in collaboration, have promoted the interoperability of business applications to plant floor execution systems. By utilizing these technologies, plant floor operators can get more out of their existing assets and provide faster response to consumer needs, with integrated demand planning, leaner inventory maintenance with capacity planning, and facilitation of preventive maintenance to address problems in near-real time.

Increasing Production Efficiency with Real-Time Mobile Connectivity and Visibility

Improved RFID tracking and increased capabilities of mobile devices have made real-time production tracking across multi-enterprise views more accessible. With these mobile tools, manufacturing operators can both retrieve inventory and process data, as well as extract KPIs to make smarter decisions and quickly adapt to shifting marketplace demands, in near-real time.
Using Analytics to Extract Actionable Insights

Accessing real-time data is necessary for rapid responses to problems, opportunities, and customer needs. But raw data is not enough; to convert these sets of data into actionable knowledge, manufacturers need the right data, from the right sources, at the right time. Rather than compiling historical data and troubleshooting problems, manufacturers can respond to the speed of the marketplace with real-time, multilevel information such as the costs of goods sold, inventory levels, gross profit and revenue growth, capital expenses, and asset performance.

The Packaging Line V-Shape Speed Distribution

If all equipment is running smoothly, the average throughput of each machine will match the throughput of the bottleneck equipment. With a V-shape, this means that the downstream equipment and upstream equipment are sometimes idle.

- Each equipment control system will cause **upstream** machines to idle or be blocked (be switched off) while they wait for the equipment immediately after them to clear the conveyor between them.
- Each equipment control system will cause **downstream** machines to idle or be starved (be switched off) while they wait for the equipment immediately before them to fill the conveyor between them.

The V-shape thus means that upstream machines are designed with integrated build-back times, and that downstream machines, in turn, have starvation times built in. The following figure illustrates how the slowest equipment (the filler is the bottleneck, because it has the slowest rate) has the highest net rate. Note that the sole focus of the line crew should be aimed at increasing the actual net rate of the filler, because the line output will be constrained by the slowest equipment.

![Figure 4: Downstream Equipment Speed Distribution Profile](image-url)
Gaining Equipment Effectiveness/OEE Metric

As mentioned in the previous section, different functions need different measures to meet their respective goals and objectives. The following figure defines different measurement points.

![OEE Metric Components](image)

**Figure 5: OEE Metric Components**

Adding EMI to Your Plant Floor with Microsoft and Invensys Tools and Solutions

Incremental MES integration—adding capability iteratively—helps protect investments made in legacy systems, while gradually phasing new users into dynamic EMI environments. With three decades of experience in the manufacturing sector, Microsoft, together with its partner Invensys, is adept at understanding both manufacturing managers’ needs, and how to leverage and synthesize existing technologies with advanced tools and applications. Microsoft data management offerings have been used extensively in manufacturing over the years, helping manufacturers achieve operational excellence through visibility solutions that provide simple, integrated user interfaces. Through a powerful and versatile business intelligence platform, along with a strategic partnership, Microsoft and Invensys provide consistent, reliable, and scalable solutions that are necessary for the effective planning, collaboration, and global coordination that manufacturers need to thrive in today’s competitive marketplace.
The Microsoft Manufacturing Operations Visibility Pillars center on three main components: Integration, Analytics, and Collaboration. Microsoft also provides manufacturers with standards-compliant systems, cohesive data storage for the effective and efficient retrieval of information that is necessary for quick decision making, and customized dashboards that help end users execute timely, intelligent decisions. With flexible ad-hoc workflows that enhance and automate business processes, manufacturing managers can quickly adapt to changing marketplace conditions and realize supply chain—and overall performance—optimization.

The following sections describe the plant floor solutions that Microsoft and Invensys have joined together to provide PLMs.

**Integrated Solutions for Increased Interoperability and Improved Asset Management**

Microsoft works with leading partners, such as Invensys Operations Management/Wonderware, to develop solutions that allow manufacturing operators to manage IT assets across geographic boundaries. This powerful partnership combines the capabilities of both Microsoft and Wonderware to provide end users with flexible, scalable solutions that integrate with existing technologies, and that ultimately help:

- Collect and aggregate data from disparate sources, including "real-time" events in the physical layer of the plant floor and overall supply chain.
- Foster a stronger development platform that allows customers and partners to build robust, scalable applications that interoperate with other assets in the enterprise value chain.
- Synthesize scalable platforms with familiar desktop technologies for easy access to real-time operations across the enterprise and plant floor.

**Real-Time Collaboration with Mobile Applications**

By mobilizing LOB (Line of Business) applications, manufacturing operators can give end users the flexibility and mobility they need to perform and collaborate across geographic boundaries and different business functions—whether working on the plant floor or out in the field. Microsoft and Invensys work together to provide you with collaboration tools that extend across networks and facilitate real-time conversations to help better manage manufacturing systems and operations.

**Actionable Insights with Aggregated Data and Powerful Analytics**

A simplified and efficient real-time data acquisition system that captures performance from all areas of the enterprise can help users understand operational efficiencies at the holistic level and ensure that every step of production is monitored. This information empowers manufacturers to deliver on customer promises, and produce and ship products within hours rather than days. The Microsoft/Invensys solution provides you with the following:

- Linked dashboards and scorecards that allow users to monitor data in real time and perform timely analyses of KPIs
- One centralized platform where all end users can access pertinent information to support their roles
Multiple methods for drilling into greater detail of performance trends, which gives users the flexibility to extrapolate the data they need to be proactive

An integrated environment with a single source of information, which allows users to immediately execute plant floor decisions after analyses

The Future of EMI

At present, the majority of manufacturers who have turned to Microsoft solutions are employing SharePoint® technologies together with existing applications. The next phase will consist of integrating Performance Point Server systems that give managers the ability to analyze business without IT involvement.

Analytics are becoming more “self-service” to reduce the dependency on IT organizations. This puts more BI power in the hands of the end user, while still maintaining a single version of the truth. Microsoft PowerPivot, for example, enables users to leverage familiar Microsoft Excel® tools and features to process massive amounts of information in seconds, and to use powerful analytic capabilities such as Data Analysis Expressions (DAX).

Knowledge management and social networking are used to capture information surrounding the structured manufacturing data. Microsoft SharePoint technologies provide a collaboration platform where users can share information—and respond to it—faster than before.

Event management is coming together with messaging platforms to drive “Communication-Enabled Business Processes.” This means that integrated notifications in manufacturing systems can help everyone understand what’s happening on the plant floor and drive proactive decisions.

Conclusion

Microsoft is committed to delivering next-generation manufacturing solutions that integrate with existing technologies to give manufacturers scalable, interoperable, and extensible platforms. Through collaborative partnerships with vendors such as Invensys Operations Management/Wonderware, Microsoft provides manufacturers with the tools they need to extend visibility across systems—and across borders—to foster the increased innovation and collaboration that’s necessary to adapt to evolving marketplace trends.

We look forward to supporting your efforts to achieve manufacturing excellence through increased visibility and collaboration. For more information, please visit www.microsoft.com/consumergoods or www.invensys.com.
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