CHOOSING THE RIGHT MES VENDOR TO ACHIEVE MANUFACTURING EXCELLENCE: A VENDOR COMPARISON

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OVERVIEW

Manufacturing execution systems (MES) that can be integrated with SCM, PLM and ERP applications provide the visibility, control, and synchronization to enable manufacturing transformation and excellence. Manufacturer’s today have many MES vendors and platforms to choose from. This paper profiles three leading software solution providers and discusses the important features and capabilities that manufacturers should consider if they want to obtain the best possible competitive advantage, create high quality products, and ensure the optimal customer satisfaction required for success in current global market conditions.

MANUFACTURERS FACE GROWING COMPLEXITY AND MULTIPLE BUSINESS CHALLENGES

In today’s highly competitive, global economy manufacturers are challenged by multiple business priorities and conflicting demands for limited resources. To successfully meet these challenges global manufacturers must respond faster than their competitors to local and global market shifts as well as to changing regulatory and customer demands. At the same time they need to remain focused on customer needs while providing consistent product quality across a geographically dispersed supply chain.

It is difficult to achieve these goals when existing manufacturing solutions and processes are not robust or flexible enough to meet shorter product life cycles, or cannot help companies capitalize on new or emerging market opportunities. Without a unified and agile platform with real time manufacturing capabilities, manufacturers struggle to fulfill customer orders on time, improve and coordinate manufacturing operations, eliminate supply chain bottlenecks, and rapidly respond to unpredictable customer fulfillment needs.

Furthermore manufacturing processes and IT systems are growing increasingly more complicated and sophisticated making it harder to achieve both success and excellence in manufacturing. Most global manufacturers have multiple plants each of which may have dissimilar equipment or different generations of equipment, various types or degrees of automation, SCADA and HMI systems, different PLC vendors, and different suppliers. It is quite common for different shop floors to have a variety of manufacturing execution software solutions which are not fully integrated with the business or other shop floor systems. Changes to processes...
in these environments often entails custom coding for each site which increases costs, risks, as well as the time to get changes into production and get product to customers. It also makes it exceedingly difficult to keep inventories to a minimum or to respond quickly when customer demands change or unplanned events occur. Modifying something as simple as changing the frequency of sampling on the line, or moving production when equipment fails on the shop floor can quickly wreak havoc resulting in inventory imbalances, delayed production, cost overruns, regulatory violations, poor quality, or unhappy customers.

MES BUSINESS BENEFITS AND KEY FEATURES AND CAPABILITIES TO CONSIDER

Manufacturing execution systems (MES) perform a strategic role in enabling global manufacturers to reduce complexity and achieve the flexibility needed to meet business and financial goals and respond to the demands of global markets. MES enforces manufacturing governance to attain standardized product and processes that allow manufacturers to achieve quality goals, and meet regulatory demands. It manages and monitors work in process on the factory floor to improve productivity and reduce the time required to produce a product. MES tracks all manufacturing information in real time and enables sharing of best practices to accelerate value across the enterprise while lowering total cost of ownership (TCO). Fundamentally MES reduces plant variances ensuring manufacturers can produce the right product—one that is both competitive and of high quality—in a timely manner, in the right quantity, for the budgeted cost.

The MES solution that is best suited for the specific needs of global manufacturers is one that accommodates the organization’s response-to-event time requirements across a globally synchronized enterprise. It must cost effectively meet the following business criteria:

- Improves manufacturing processes and quality
- Reduces IT involvement and lowers costs
- Easily supports multiple plants located in multiple cities, countries, and/or continents
- Integrates with other existing mission critical manufacturing and business systems
- Readily and rapidly adapts to planned and unscheduled changes in the production cycles within the business
- Supports shorter production cycles

Additional criteria to consider during the selection process:

- Endorsed by other manufacturers in similar industries
- Developed and supported by a vendor with the proven ability to deliver what has been promised and support the product during and after its implementation
- Flexible enough to support a proof of concept demo ensuring that the vendor can quickly deliver the specific capabilities the
manufacturer requires with minimal customization

The significance of each of these criteria and the key benefits they provide to manufacturers are described in more detail in subsequent sections of this paper.

**Improving Manufacturing Processes and Reducing Costs**

Manufacturing costs can be significantly reduced through more efficient and flexible manufacturing processes. This requires MES functions that support fast and uncomplicated configuration of business processes. For instance, the ability of MES to automatically link business processes such as production, quality, warehouse and labor is vital to reducing time and labor costs. Automatically rendering the right user interfaces, in the right language, for shop floor operators and being able to easily change these as often as necessary is essential for any global manufacturer. Moreover these activities should minimize additional IT or local support personnel costs.

MES systems that utilize a Service Oriented Architecture (SOA) in addition to Business Process Management (BPM) offer an adaptive manufacturing platform that eliminates the need for one-off systems to perform quick fixes to any sudden changes in processes. This simplifies the process of changing processes and introducing and deploying new solutions to multiple plants around the world and to establish globally standardized manufacturing processes. It also delivers the benefits of higher quality, better compliance, and agility while enabling continuous process improvement.

MES platforms should provide complete work-in-process tracking that can be viewed and monitored across multiple sites into the supply chain and by subcontractors. A system that contains event alert and dashboard features provides decision makers with greater visibility into all manufacturing operations. This gives decision makers more control over manufacturing capabilities and processes. Plant managers and supervisors can see problems before they become critical, and take action such as rescheduling, shifting production to a different plant, or other similar proactive steps.

**Improving Inventory Management, Reducing Costs and Eliminating Bottlenecks**

Effective inventory management is crucial to reducing inventory costs and manufacturing bottlenecks and problems. Global manufacturers need real-time, accurate, and detailed inventory tracking information available to the right people, at the right time, so informed decisions can be made about capacity management and balancing production. It needs to be able to trace materials, processes, employees, equipment and storage locations as well as support tracking technologies such as RFID. An effective inventory management system should support multiple inventory processes such as cross docking, consignment or vendor managed inventory, and postponement strategies.

An MES system with these capabilities
helps manufacturers improve the flow of materials. It offers visibility over, control into, and synchronization of material with production to improve manufacturing efficiency while reducing inventory carrying costs. This provides three distinct benefits: First, it enables a wide variety of inventory management and replenishment models including Kanban, Just-In-Time manufacturing and Just-In-Sequence to support advanced Pull-based material flow. This ensures that the required part or material is available when the production is ready to be run, reducing bottlenecks by preventing starving the production line. Second, it facilitates the introduction of new products by eliminating delays and potential conformance issues due to excess line side inventory. And third, it allows companies to control and improve the quality of what is produced because every step of the process is traceable and visible.

**Maintaining Good Quality as Product Cycles Get Shorter**

Competitive advantage goes hand in hand with high quality and striving for excellence in manufacturing processes to keep customers satisfied. One way to ensure this occurs is through a uniform environment that supports decision making across all plants—no matter where they are located. MES is most useful when it links a factory’s physical production assets with enterprise software suites including Enterprise Resource Planning systems (ERP) and Production Lifecycle Management systems (PLM). This gives the business more visibility into key indicators that are happening in the manufacturing process and allows them to respond more rapidly to changing conditions and unplanned events that arise. It is important to note that best results are achieved when the solution is seamless with bi-directional integration with corporate business applications, manufacturing operations processes, and essential data from engineering systems and other applications. This allows managers to capture shop floor costs for things like downtime, retooling, etc.

As global market cycle times become shorter, companies are pressed to produce products faster. Therefore the ability to link all the information relevant to the manufacturing process together with seamless, just-in-time processes, contributes to supply chain agility as well as better and more consistent customer order fulfillment. This increases customer satisfaction because quality products are delivered on time or can come to the market ahead of the competition.

**Simplifying and Reducing the Costs of Changes and Upgrades**

The existence of different manufacturing execution systems in each shop floor location is a common contributor to cost overruns,
inconsistent product quality and delays in many manufacturing companies. When this situation exists, making a change to an existing process or adding a new process can be very expensive, labor intensive, and time-consuming. It almost always entails IT involvement and frequently requires custom coding at each plant before the change can be fully implemented across a global organization. These problems are further compounded when the change requires multiple disparate systems to interoperate with each other or communicate with existing ERP or other business systems. In these cases the time required to make the change can prevent the company from quickly responding to a new requirement or reacting fast enough to take advantage of a new opportunity or changing market conditions.

MES systems should enforce consistent KPI standards such as OEE for every location ensuring that each plant measures performance accurately and in the same way. Real-time information needs to be rolled up to the business level where executives can make timely decisions and take immediate action. When MES incorporates a robust KPI engine, common KPI definitions and calculations can be shared, enabling manufacturers to easily compare the performance of each plant.

**CONSIDERING APRISO, SAP, AND SIEMENS**

There are many MES vendors and products to choose from. The remainder of this paper focuses on three global leaders: Apriso, SAP, and Siemens. Of these, Apriso is the only dedicated MES vendor. SAP and Siemens both provide a variety of products that address the scope of the manufacturing operational value-chain, from ERP, PLM, design, simulation, production, etc.—of which, one or more components comprise their MES platforms.

**Apriso**

**Company Background:**

Apriso Corporation was founded in 1992 and is headquartered in Long Beach, Calif., with regional offices throughout Asia, Europe and Latin America. The software company has more than 200 customers with services deployed in 40+ countries. Apriso is the only vendor in this group focused exclusively on MES. They have become a global presence, both directly and through business partners delivering Apriso’s adaptive operations execution solutions for manufacturing: adaptive manufacturing, lean material flow, lean manufacturing, enterprise quality management, maintenance management, time and
labor tracking and manufacturing process intelligence.

**Vertical markets:** Apriso has demonstrated an ability to facilitate fast, low cost, global, multi-site deployments worldwide serving the aerospace and defense, automotive, medical device, life sciences, packaging, technology and electronics, consumer goods, clean technology, and industrial equipment industries.

**Product overview:** Apriso’s platform is built using Business Process Management on a Service Oriented Architecture (SOA). Apriso’s FlexNet manufacturing operations management solution was developed through years of customer engagements and has been selected by leading manufacturers around the world for its unique combination of visibility, control, and ability to synchronize operations across manufacturing and into the supply chain. FlexNet enables all plants to run as a coordinated network to support Lean adaptive manufacturing, and reduce complexity—tasks that can’t be accomplished by companies that take a plant-centric approach to manufacturing solutions. FlexNet breaks down the traditional silos of manufacturing processes and systems with its broad functional coverage supporting ISA-95 and MESA-11 standards. This makes it possible for manufacturers to view and respond in real time to all events in all locations across the organization. With a unified data model (UDM) and broad manufacturing platform Apriso delivers business value, reduces complexity, and helps lower IT costs.

Manufacturers have achieved continued brand integrity and regulatory compliance using the BPM capabilities of FlexNet to standardize and enforce operating procedures. Native BPM combined with its unified data model UDM enables the creation of unified processes covering a broad scope of functionality linked to a common data, and process model, this unified way of accessing data results in lower cost and inherently integrated functionality. Additionally, FlexNet centrally manages business processes and deploys them to the field without coding and without compiling new software or restarting servers at each site. These capabilities support continuous improvement while enforcing process standardization and site specific extensions.

Business processes and standardized workflows can be configured and changed with minimal IT involvement. Manufacturers can establish and test the effectiveness of repeatable processes and then quickly deploy the processes to multiple plants around the world. As production ramps up, interlocking traceability and real-time integration feeds process results back to both engineering and business systems. This implementation of closed loop manufacturing processes between operations and engineering design applications enables faster and more successful introduction of new products.

**SAP**

**Company background**

Founded in 1972 and headquartered in Walldorf, Germany, SAP is among the world’s largest business software companies. SAP
has more than 95,000 ERP customers in over 120 countries and its MES solutions are used in a variety of manufacturing environments. With its acquisitions of companies such as Visiprise, a specialized MES applications vendor, Lighthammer, and other software investments in recent years, SAP has been aggressively pursuing its goal of creating and selling a complete plant manufacturing intelligence and management solution.

**Vertical markets:** The SAP ME solutions services industry-leading, global customers in discrete manufacturing industries including high tech, aerospace and defense, automotive and medical device.

**Product overview:** SAP continues to market what it calls a “perfect plant” solution through integrating, managing, and coordinating manufacturing execution systems with other essential manufacturing applications such as planning, workflow, data collection, process tracking, analysis, financial planning, etc. SAP’s products and marketing messages highlight the company’s goal to display, aggregate, analyze and present data about the manufacturing life cycle that is relevant to multiple levels of stakeholders throughout an organization.

SAP continues to work towards integrating its acquisitions and applications across numerous industries and incorporating industry-specific functionality. Investments have been made to fold these acquisitions into the NetWeaver stack though in some cases at the expense of providing new functionality planned on their roadmap. Today, SAP MII provides data integration, information delivery, and analytics and leverages new and existing SAP ERP implementations. SAP MII, when used in conjunction with SAP ME, serves as SAP’s MES platform providing data integration, information delivery, and analytics connecting shop floor systems and business operations. All data affecting manufacturing including information about orders, materials, equipment status, costs, and product quality, etc. is visible in near real time while leveraging SAP’s infrastructure stack. SAP’s plant centric manufacturing implementations are closely tied to SAP ECC functionality and SAP products help manufacturers achieve full control throughout the entire manufacturing life cycle. Together these products provide a set of integrated MES and manufacturing applications, reporting, analysis and management capabilities that require minimal changes to operations and procedures.

**Siemens**

**Company background**

Siemens, a global leader in electronics and electrical engineering, was founded in 1847. The company employs 405,000 employees in 190 countries, and more than 60,000 people throughout all 50 states and Puerto Rico. Siemens’s acquisitions of Orsi Automazione, Compex, IndX, UGS’s Unicam, and Elan Software, have been incorporated into and become integral modules of the Siemens SIMATIC IT product line.

**Vertical markets:** Siemens operates mainly in the industrial, energy, and healthcare sectors. Today, Siemens primarily services the
needs of process oriented and highly automated industries such as oil and gas, chemical, and food and beverage industries. It is also selling solutions that address the discrete manufacturing needs of automotive and aerospace companies.

**Product overview:** Siemens SIMATIC IT is a suite of MES solutions utilizing a cross-plant open architecture for enforcing value-driven strategies and performance measurement connecting manufacturing operations with the rest of the enterprise. Siemens' collaboration and integration technologies allow manufacturers to link to their disparate systems. SIMATIC IT improves efficiency, flexibility and visibility across the shop floor. It channels the information needed for manufacturers to improve strategic decision making abilities and refine their manufacturing business plans. It supports distributed manufacturing operations and its plant-centric implementations are closely tied to the Siemens' automation layer.

SIMATIC IT relies on specific industry libraries that are customized by key customers in each industry. Once applied on top of the MES platform, the libraries deliver a customized, industry specific solution. Siemens SIMATIC IT consists of several modules: Production Suite organizes and integrates the manufacturing process; Intelligence Suite performs real time data monitoring and historical data collection; R&D Suite addresses sourcing, supplier management, requirements, formula/recipe management, etc.; and SIMATIC IT Interspec enables Siemens to support end users across process industries, allowing them to transfer specifications, recipes and formulations into the manufacturing environment.

Siemens recently introduced key strategic initiatives to help its customers speed up new product introductions and product releases. SIMATIC IT’s production modeling and workflow functions accelerate and facilitate design capability. The product interfaces with Siemens Teamcenter PLM applications and facilitates the collection, tracking and reporting of accurate and unified manufacturing performance data delivering essential manufacturing intelligence.

**ADDITIONAL CONSIDERATIONS FOR SELECTING THE RIGHT VENDOR**

Global companies with multi-plant implementations require defined, repeatable processes that minimize the use of labor, material, time and equipment. MES solutions let manufacturers innovate and execute upon that innovation and deliver high quality products to market well ahead of their competitors. They easily and quickly facilitate changes and propagate processes across multiple plant sites as the need arises while eliminating manufacturing bottlenecks, improving inventory management, and interfacing seamlessly with key manufacturing business applications. It is important to undertake a thorough and objective evaluation of the importance of each of the criteria identified in this document. The decision to use an MES system from a dedicated provider like Apriso or to use MES components that are part of an extended ERP system, or full automation
suite of products, depends on many factors including budget, required response time, risks, benefits, and capabilities of each MES provider, and more.

REVIEWING THE ADVANTAGES AND CHALLENGES IN COMPLEX DISCRETE MANUFACTURING

**Apriso**

Apriso addresses the needs of many industries, but its solutions are particularly well suited for complex, discrete manufacturing scenarios. Apriso provides a dedicated, full featured MES platform that delivers a complete, real-time view into the manufacturing operations of the company and its suppliers. Apriso’s MES platform lets manufacturers actively deploy and manage processes and best practices in a single flexible plant or across all facilities. Unlike SAP and Siemens, Apriso does not provide a full suite of other complementary systems as part of its portfolio. However, this helps Apriso avoid the overlapping functionality and conflicts of data mastering in both SAP and Siemens. In addition Apriso synchronizes FlexNet with ERP and PLM master data and provides operational data. FlexNet was designed and architected to complement and enhance business systems. FlexNet is modular and expands or contracts to “fill these white spaces”. Furthermore FlexNet’s wide footprint is another strategic differentiator for Apriso that simplifies integration with the shop floor by unifying plant floor operations. A wider footprint means fewer plant systems and fewer interfaces yielding lower cost of acquisition and ownership and enabling cross-functional processes. It also enables enhanced and comprehensive “interlocking” traceability, which results in better root-cause analysis (RCA) as well as greater flexibility for continuous improvement.

**SAP**

SAP’s ERP-based approach delivers enterprise-class support for manufacturing processes. However deploying ERP to the shop floor is not always sufficient for complex manufacturing environments particularly when manufacturers require highly flexible, real-time production systems capable of delivering the level of operations intelligence and operations process management they require. Due to SAP’s multiple, loosely coupled products and product complexity, making and deploying a change to any one process is often expensive and time consuming, especially if extensive modifications or configurations are also required. In these situations, manufacturers may not be able to attain immediate business value from their systems until the work is completed. In some large global manufacturing companies it has taken SAP 18 months or longer to implement its solutions at a new site before it was able to take that factory live. A frequent cause of delays has been the high level of customization that is done at many SAP customer sites. This can also negatively impact future upgrades and increase total cost of ownership (TCO). Making changes to one or more sites often involves custom coding and requires support
staff with multiple skill sets. Furthermore, SAP customers have to be running newer versions of NetWeaver, ECC, and MII in order to take advantage of marketed capabilities. This often means customers have to manage multiple NetWeaver servers in the plant.

**Siemens**

Siemens does well in providing a smarter automation and process control layer to support sustainability goals and basic traceability requirements. Best suited in batch- and margin-sensitive continuous process environments, where the goal is optimization and constant fine-tuning of existing assets through tighter integrations between IT and production automation equipment. However, Siemens customers may be challenged to support complex discrete operations with high requirements for traceability and genealogy. Furthermore, Siemens may be constrained when supporting just-in-sequence operations or operations where tight synchronization between material management and production is required. SIMATIC IT’s complexity and historical evolution through a series of acquisitions means that necessary changes to manufacturing processes frequently require custom coding. Manufacturers should carefully examine the level of integration between products and ensure that their needs are actually met. The product suite has somewhat limited ability to support certain types of global implementations and does not easily integrate with SAP and other enterprise business systems.

**CONCLUSION**

Ultimately, the MES solution best suited for large global organizations will be the one that can maximize manufacturing performance and asset utilization through central coordination, centralized vision of plant operations, and an ability to facilitate rapid decision making as well as fast reconfiguration of production operations. Apriso, with its MES best of breed FlexNet platform delivers a continuous process improvement approach to manufacturing enabling the distribution of best practices developed in one site to other plants. It also enables a solution to be deployed quickly and uniformly across multiple sites, and enables all plants to run as a coordinated network.

SAP and Siemens deliver the benefits of large scale, global resources in terms of a portfolio of various manufacturing operations products, services, and support and may be able to leverage existing investments and license agreements. The scope and breadth of the manufacturing operations features and functionality provided by both Siemens and SAP are of interest to manufacturers requiring various levels of customization and integration capabilities for multiple plants, but frequently are not as flexible, efficient, or cost effective as a dedicated MES solution for many global and/or multi-plant deployments.