



Microsoft®

Plant Floor Visibility



R e l e a s i n g y o u r p o t e n t i a l

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Logica is a leading IT and business services company, employing 39,000 people across 36 countries. It provides business consulting, systems integration, and IT and business process outsourcing services. Logica works closely with its customers to release their potential - enabling change that increases their efficiency, accelerates growth and manages risk. It applies its deep industry knowledge, technical excellence and global delivery expertise to help its customers build leadership positions in their markets. Logica is listed on both the London Stock Exchange and Euronext (Amsterdam) (LSE: LOG; Euronext: LOG). More information is available at www.logica.com.

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1. The Business value of Plant Floor Visibility

Industrial manufacturers face many challenges related to the execution of their manufacturing operations: typically logistical optimisation, cost cutting, and strengthening the position in the supply chain. Moreover, manufacturers must control the quality of their products and processes, and, sometimes provide evidence of these controls, as required by government regulations.

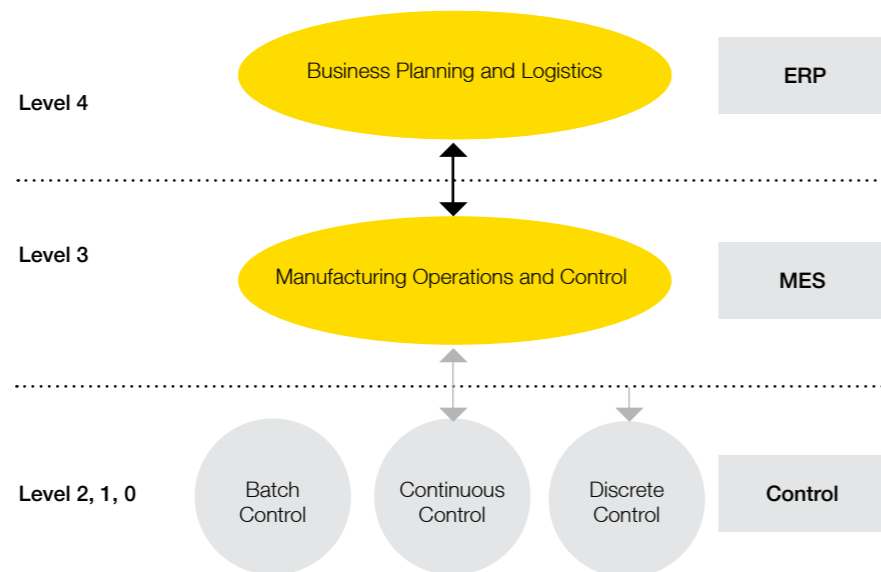
To handle these challenges in the manufacturing environment, specific IT systems are required: close to execution of the operations, able to handle near real-time information, and able to work with information from and to many other IT systems and installations.

Manufacturing execution systems (MES) are built to do exactly this, with functionality to support shop floor operation and integration facilities for the connection to planning systems and the actual machine controls on the shop floor.

Well considered integration of MES in the organisation's IT landscape offers Plant Floor Visibility: top-down and near real-time insight in status and performance of the operation.

In this whitepaper, chapter 2 is about the business drivers for plant floor visibility. Chapter 3 provides an introduction into the IT aspects of MES, building up plant floor visibility, and chapter 4 is about the technology that enables plant floor visibility.

ISA-95 Functional Hierarchy and Plant Floor Visibility



2. Business Drivers for Plant Floor Visibility

Three main business drivers are discussed in this chapter:

- Support of performance improvement initiatives: when MES systems are in place and there is actual information available on performance and quality, it becomes a lot easier to focus on improvement of operations and to support improvement initiatives.
- Collaborative manufacturing, where the timely and adequate anticipation of events in the supply chain is required to maintain competitiveness in the supply chain. This requires near real-time information, and handling of event management that crosses the functions of various systems.
- Compliance with regulations, meaning that the manufacturing process itself is (by customer or by law) required to show evidence of the quality (conformance to spec), both for the process and the delivered product.

2.1 Support of Performance Improvement Initiatives

According to a 2004 Industry Directions study, MES supports performance improvement initiatives. The study looked at about 100 plants in the United States, in different industries, and with different types of operations. The results of the study show that the extensive use of MES systems has benefits such as improvements in productivity and process, and better employee performance.

The researchers of the study conclude that the use of MES systems gives a company the possibility to feed process data to various internal and external partners.

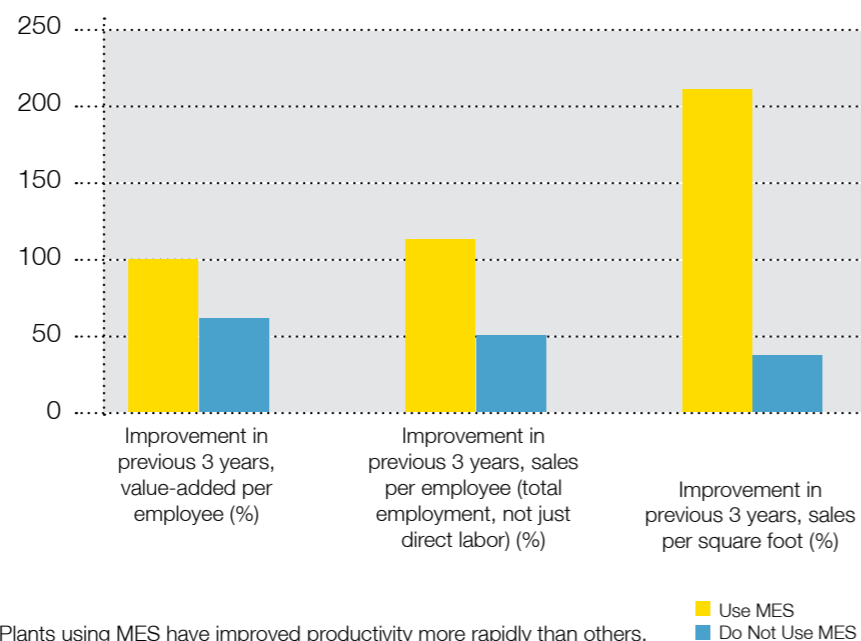
Recipients of the data include:

- Customers (shipping time confirmation)
- Distribution (replenishment expectations)
- Service providers (retail details and actual cost)
- Government regulations (compliance records)
- Manufacturing department (specs and best practices)
- Research and development department (test and pilot run results)
- Suppliers (performance scorecards)

This illustrates where MES systems add value and enable plant floor visibility.

¹ Julie Fraser, Industry Directions & Rockwell Automation 2004 study, 'MES performance advantage: Best of the Best Use MES'

Productivity has improved more dramatically in plants using MES



Plants using MES have improved productivity more rapidly than others.

- 70% greater by value-add per employee
- Over two times greater by sales per employee
- More than six times greater by sales per square foot

2.2 Collaborative Manufacturing

Manufacturers are realising more and more that they have to compete as supply chains instead of as individual companies. They also realise that production is a key element for keeping customer service levels high. In a supply chain, each plant is just one element, acting as customer for certain materials or sub-assemblies and supplying others.

In order to remain competitive, manufacturers have to collaborate with many others, such as customers, distributors, material and product suppliers, and contractors. However, effective synchronisation of activities among all these 'partners' is required.

The Manufacturing Enterprise Solutions Association (MESA) defines² collaborative manufacturing as: "A strategy by which all appropriate individuals and organisations - both internal and external to the legal enterprise - work together." The primary goal of this strategy is to improve the supply chain processes and provide adequate information for better decisions.

MES systems have to provide real-time insight into plant operations for buyers in procurement, customer service and sales representatives, distribution and logistics managers, as well as their traditional users inside the plant. MES systems also have to deliver information outside the company.

2 'Collaboration Manufacturing Explained', MESA White Paper #09 (see www.mesa.org)

As high stock levels and high work-in-progress amounts are responsible for a lot of cost in the supply chain, the pressure is on to deliver a lean supply chain, keep stock levels low and get maximum results from manufacturing operations.

This is where plant floor visibility offers real-time insight into operations, for example actual stock levels, the status of a batch in production, and the actual order status or delivery status at any point in time.

Moreover, organisations should have plant floor visibility so they can directly respond to events in the supply chain that could include the following scenarios:

A batch in production is tested and the result is not up to specification:

- It should be checked whether the customer delivery can be made with alternative batches.
- The production department should ask: Will rework solve the problem?
- The production batch should be assessed: Can it be used for other purposes?
- The sales department should consider: Must the customer be informed?
- The planning department should consider: Is a new production order necessary?

Production equipment goes down; production stops:

- The technical department should be notified to start a repair order.
- The equipment failure should be checked with the technical maintenance stock: Are spare parts available or must they be purchased?
- The planning department should consider: What are the consequences for planning?

2.3 Validation and Regulatory Compliance

In the last few decades, government regulations have increased considerably in the areas of environmental and quality requirements. This has led to an increase in information requirements for product and process in various industries, particularly in the pharmaceuticals, and food and beverage industries.

FDA 21 CFR part 11

One of the most well known regulations is imposed by the American Food and Drugs Administration (FDA). Since August 20 1997, working under FDA regulations means organisations must comply with 21 CFR part 11. In 1999, the FDA announced they would pay special attention to compliance with this code during audits. They expect companies to have a statement containing their current compliance state and a roadmap of how the company will implement complete compliance. 21 CFR part 11 is also about electronic records and electronic signatures. Any combination of text, graphics, data, audio, pictorial, or other information representation in digital form that is created, modified, maintained, archived, retrieved, or distributed under any records requirements set forth in FDA regulations is submitted to this code. The purpose of this code is to create the opportunity for the FDA and the pharmaceutical industry to improve operational efficiencies, to reduce risks and to reduce paperwork. It will also force companies to improve the integrity of data in existing systems.

Process Analytical Technology (PAT)

PAT is becoming more and more an issue because of the new FDA approach to good manufacturing processes for the 21st century.

PAT focuses on how the industry should improve business (time, quality, and money) using state of the art technology. The FDA defines PAT as: "A system for designing, analysing, and controlling manufacturing through timely measurements (i.e. during processing) of critical quality and performance attributes of raw and in-process materials and processes with the goal of ensuring final product quality." It also specifically mentions the role that MES can play.

The goal of PAT is to release products whenever all process parameters stay within a certain bandwidth. As the process is well understood, the result (read: quality) can be predicted based on these parameters instead of months of investigation and animal tests.

Bioterrorism Act (USA) and General Food Law (EU)

In the field of food safety, visibility and traceability are of primary importance. Similar to the Public Health Security and Bioterrorism Preparedness and Response Act (Bioterrorism Act) in the United States, the European General Food Law, officially effective in 2005, states that each supplier must know the origin of products from the previous link in the chain and the destination in the next link. In addition, retailers accept responsibility for food safety and often impose additional traceability requirements on suppliers.

The consideration given to return logistics (packaging, whether reusable or not) has also increased due to environmental concerns. The need for information throughout the chain and the desire for product traceability mean that radio frequency identification (RFID) technology is increasingly being considered.

Sarbanes Oxley

Prompted by large corporate scandals such as Enron and WorldCom, the Sarbanes-Oxley Act of 2002 applies to companies listed on U.S. stock exchanges. The act's main parts consist of a set of criminal and civil penalties for securities violations, auditor independence or certification of internal auditor work by external auditors, and increased publication of financial information relevant for investors. In order to become compliant, many companies install software to provide security and electronic paper trails.

3. IT Aspects of Plant Floor Visibility

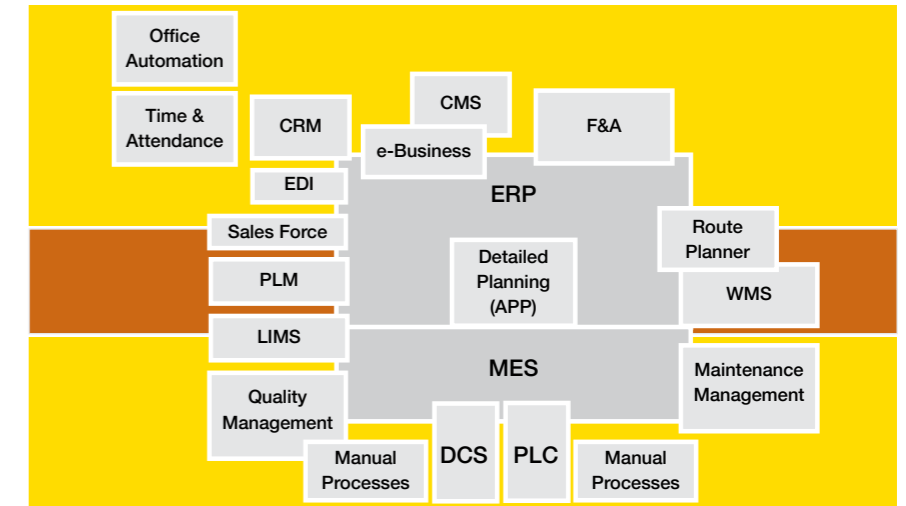
3.1 Systems Landscape and Integration

To support business processes in a manufacturing company, many different IT systems are needed, with many different functionalities. These include:

- Enterprise resource planning (ERP) for finance and logistics processes
- MES Systems for sales support, including customer relationship management (CRM)
- Systems for product data management (PDM)
- Quality control and laboratory information management systems (LIMS)
- Central reporting
- Maintenance management

The challenge for IT management is to find the right systems to cover all relevant spots in the landscape, to make the right connections to share information, and to effectively support the business and manage the systems landscape.

Systems Landscape



The place of MES in this landscape is between the actual real-time controls that move the equipment on the shop floor and the ERP-side where logistics and finance are managed.

MES systems overlap with other systems that should be considered. See the table below, which shows potential overlaps of MES with other systems in the IT landscape.

Overlap of MES with	Aspects
ERP	<ul style="list-style-type: none"> - Finance and Controlling - Human Resources - Order Control - Purchase - Capacity Planning - Distribution Requirements Planning - Distribution - Master Planning - Material Requirements Planning
LIMS	<ul style="list-style-type: none"> - Quality Control - Test Results - Test Planning - Instrumental Interfaces - Lab Samples
Electronic Batch Record (EBR) and System Control and Data Acquisition (SCADA)	<ul style="list-style-type: none"> - Batch Creation and Approval - Batch History - Operator Instructions - Data Collection - Visualisation
Statistical Quality Control & Statistical Process Control, (SQC/SPC)	<ul style="list-style-type: none"> - Operator Instructions - Data Collection - Visualisation
Programmable Logic Controller (PLC)	<ul style="list-style-type: none"> - Operator Instructions - Data Collection - Visualisation - Process Data History - Machine Interfaces

3.2 Standards for integration

The World Batch Forum (WBF)³, a worldwide, non-commercial organisation dedicated to the advancement of batch process manufacturing, has released new versions of its two XML-based mark-up languages for implementing the ANSI/ISA-88 and ANSI/ISA-95⁴ standards and their international counterparts IEC-61512 and IEC/ISO-62264 respectively.

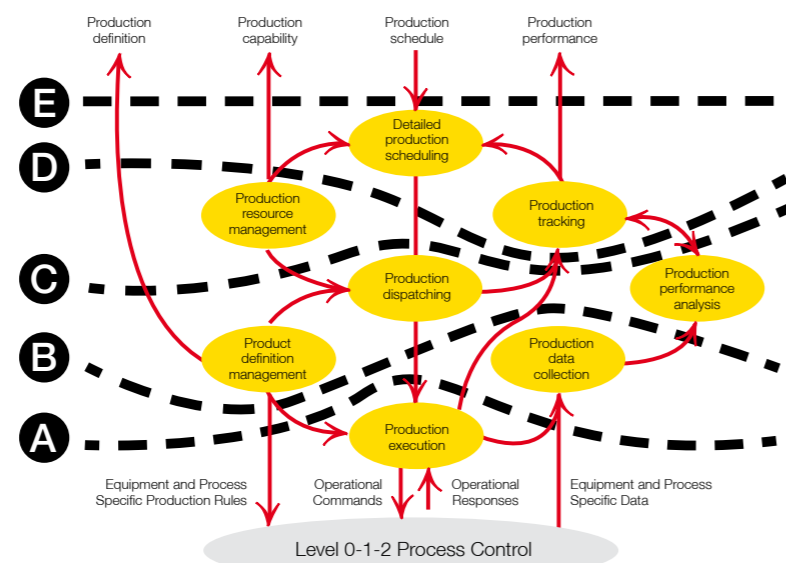
Enhancements in the WBF's Batch to Manufacturing Mark-up Languages (B2MML) and Batch Mark-up Language (BatchML) include greater compatibility with popular programming tools and improved ease of use in a number of areas.

Many companies have adopted the WBF schemas since 2002, when the organisation released the initial versions of BatchML and B2MML. The languages, which were developed by committee members representing approximately a dozen leading manufacturing companies and automation system suppliers, are intended to streamline and simplify batch recipe development and ERP to MES data integration. Because they are based on industry standards, including XML, they represent a simple, straightforward way to integrate systems from multiple vendors.

The ANSI/ISA-88 standard defines terminology specific to batch control systems, a standard data structure batch control language, and a standard batch control architecture. The ANSI/ISA-95 standard establishes common terminology for the description and understanding of manufacturing information in an enterprise. It also defines the information exchange between the manufacturing control functions and other enterprise functions, including data models and exchange definitions.

A large collection of activities is defined in this standard, because the boundary between what is done by ERP-level (level 4) personnel and by MES-level (level 3) operations (production, maintenance, quality, and inventory) is not invariant. One can distinguish the scope of required responsibilities, the scope of the actual responsibilities, and the scope related to the areas of technical integration.

Different Boundaries of Responsibility⁴



³ See: www.wbf.org

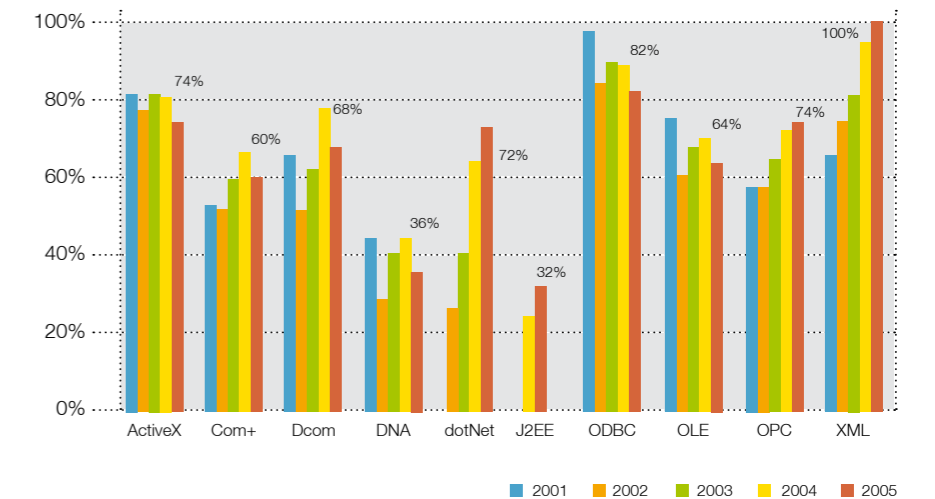
⁴ ANSI/ISA-95: 'Enterprise-Control System Integration - Part 3'

3.3 Integration technology

The report MES Product Survey 2005⁵ shows that in many of the available solutions, modern techniques for integration are available. It also shows that the use of XML has reached 100 per cent. This enables the exchange of data and interaction of functionality between different MES applications and front-office packages.

Microsoft® .NET technology was added to the survey of applied technologies in 2002 and is now supported by 72 per cent of MES applications. J2EE was added in the 2004 questionnaire and in the 2005 survey is supported by 32 per cent of applications.

Applied Technologies from the MES Product Survey 2005 (%)



3.4 Emerging IT requirements

To enable plant floor visibility and effective use of MES functionalities, the following IT requirements are expected to emerge:

- Support for cross functional workflow, where the business process in an organisation determines the workflow (i.e. the necessary actions) and where the IT systems support the workflow, where the actual applications in the systems landscape co-operate instead of each system delivering its own function.
- Central control of user rights and permissions instead of each application having its own structure for rights and permissions.

⁵ Jan Snoeij - Logica: 'MES Product Survey 2005 - 2nd edition'

- Cross-application event management, where events in execution trigger various systems dependent on the actual business process and workflow.
- Application-independent reporting of information.

Typically, technology developments in the following areas will impact on MES and plant floor visibility:

- Web services
- Service-oriented architecture (SOA)
- Portal technologies

4. Technological Developments Enabling Plant Floor Visibility

As plant floor visibility has become more relevant to the business, in the IT world integration of systems and real-time visibility have become possible. The following evolutions in the industrial IT landscape have led to these integration possibilities:

Increased application of the Microsoft Windows Server operating system platform in the industrial environment.

Companies and software vendors increasingly choose to work with Microsoft Windows server and client operating systems. Although Unix has traditionally dominated the server-side in industrial manufacturing scenarios, Microsoft Windows has proven itself in this environment with high performance and minimal unplanned system downtime. In this way, the IT systems for the whole enterprise - both servers and desktops - come under the same operating system, enabling sharing of information and application services. Benefits include:

- Stability and scalability by clustering technology and server-based terminal services.
- Integrated security facilities (one database for user login, access, and user rights).
- Integrated reporting facilities, such as Microsoft SQL Server™ 2005 Reporting Services, offering Web-based reporting services on database information, independent of the application running or using the database

Integration of ERP software with portal- and Web services technology

There is increased focus on connecting ERP systems to other applications. Typically in the industrial environment ERP vendors have had a monolithic strategy to offer all functionality in one software application, from production planning, manufacturing execution and even process control.

The monolithic approach is not always the best choice. Instead, practice shows that almost every IT system fits in an IT landscape and should have the tools to connect to other systems.

Portal technologies, the adoption of web services technology, and message exchange based on XML have made it possible to place the user and their business process in the centre, and to design supporting IT systems around them. For an example on this integration see section 3.2 on B2MML, an XML implementation of the S95 standard.

Availability of mature message exchange solutions

Traditionally, many large industrial companies identified the need to develop a kind of 'message broker software, typically to exchange messages from their planning and specification systems to their SCADA and control systems. Traditionally, these message broker solutions crossed the borders of different applications and even crossed the borders of different operating systems.

While this need was identified many years ago, recently more and more professional software has become available to fulfil this function. This middleware software connects to each application through an adapter, which enables the application to send and receive messages and make remote calls or transaction requests. The messaging software transports the message from one application to another, typically offering:

- Delivery services such as holding messages in queue when needed, or delivery acknowledgement.
- Support for high performance and message throughput.

Development of industry standards in manufacturing

Traditionally, suppliers of manufacturing equipment and control systems have had their own solutions and standards for the exchange of real-time information. To enable integration and to connect administrative systems, a separate driver was needed to connect each type of equipment.

Object linking and embedding (OLE) for open process control (OPC) was introduced in the second half of the 1990s. It made it a lot easier to connect to real-time information, as equipment suppliers provided control systems with an OPC interface. This makes it possible to get information from and to equipment directly as things happen on the shop floor. Real-time events and alarms are presented to operators or trigger application functions in the IT landscape. Today, more than 400 plant floor solution providers with more than 7,500 products have adopted the OPC standard for integration.

The following developments will offer more in the field of integration:

- Microsoft Office SharePoint® Server 2007 for document management, which provides not only a network directory where users can place their documents, but integrated (Web-based) functionality on permissions, versions, functionality around and in documents (team work).
- Microsoft/SAP connection (i.e. Duet), which connects SAP functions to Microsoft Office applications.
- The evolution of OPC to become native on XML and Web services based architectures, which will help organisations implement a full plant floor unified architecture.

4.1 Microsoft Architecture to Support Plant Floor Visibility

Effective plant floor visibility solutions focus on three key components: collaboration, analytics, and integration.

Collaboration

It is essential that people who need real-time manufacturing data can communicate with others throughout the supply chain in a secure environment, which protects intellectual property. This includes partners, suppliers, and customers that need timely information about inventory and product availability, as well as decision makers within the manufacturing company. People can collaborate using solutions as simple as e-mail or, for real-time communication, instant messaging. Providing workers with real-time intelligence and alerts improves quality, enables proactive responses, supports good decisions, and improves productivity and return on assets.

With Microsoft Windows SharePoint Services, cross-functional teams can share information and collaborate on documents. Using SharePoint Server 2007, people can create website portals where they can locate information easily and connect to others quickly. With the portal, people can track document versions, create approval workflows, and enforce document check-in and check-out processes. Using Web Parts, people can access data from a variety of disparate plant and business systems.

With Microsoft Exchange Server communication and collaboration server and Microsoft Office Outlook® messaging and collaboration client, workers can distribute information via e-mail messages. And because their calendars are shared, users can easily coordinate schedules and plan meetings. Microsoft Office Communications Server 2007 takes collaboration one step further. Through a feature called presence awareness, users can instantly find and collaborate with local and remote users to share time-sensitive information. And because presence awareness is available from within Microsoft Office system and other line-of-business applications, critical issues can be addressed far more quickly, making people more productive.

Analytics

MES systems generate a great deal of production data. In the past, people collected that data manually, but it had limited value because it was not in a usable form. Effective plant floor visibility solutions include analytics that model plant performance—past, present, and future. Analytics tools transform data into key performance indicators (KPIs), identify historical trends, and perform detailed cross-data analysis. Even more valuable are analytics that deliver data about plant performance in real time. With current data, managers can predict and avoid future problems and plan for maintenance. Using digital simulations, managers can optimise the process and flow of materials, thereby increasing speed, flexibility, and throughput across multiple facilities. With good analytics, managers can establish industry-specific KPIs and benchmarks.

The Microsoft .NET Framework is a foundational technology for enabling analytics. Developers can create .NET-enabled solutions for individual or multiple plants for real-time supervisory control and for creating projections to help plan production.

Microsoft SQL Server 2005 and its supporting tools also play a key role in analytics. SQL servers provides a stable, scalable base for storing warehouse, plant production, and plant application data. SQL Server Analysis Services allow the data to be analysed and manipulated while SQL Server Reporting Services help people create paper-based or interactive Web-based reports.



Using SQL Analysis Services, developers can create multidimensional data cubes and make them available to applications. SQL Server Analysis Services also supports industry-standard data mining algorithms as well as the latest innovations in data mining to help decision makers identify trends and predict future results. Supporting the need for collaboration, Microsoft Office Information Bridge Framework lets developers export plant data and events to Microsoft Office Excel® spreadsheets, where users can further manipulate the data using preconfigured formulas.

Integration

Plant managers can make sound business decisions only when they have access to data that is integrated from many systems, both within the plant and across multiple plants. To do this, systems at all levels must be able to share data so that it can be fed into ERP systems or directly to suppliers and customers. Integration of systems also facilitates traceability—the ability to identify every action taken for a specific component of a particular order—and ensures that appropriate data is aggregated in context.

Microsoft BizTalk® Server and Microsoft Host Integration Server are essential products for helping manufacturers achieve integration across multiple plants. BizTalk Server brings disparate applications together, both vertically and horizontally in a plant environment. Vertically, BizTalk Server sends data back and forth between plant applications and business systems such as ERP. Horizontally, BizTalk Server is used as a message service to transfer data between applications and orchestrate the execution of plant applications in a logical sequence.

In contrast, Host Integration Server unites dissimilar systems, such as host applications, data sources, messaging, and security systems built on an IBM operating system, with solutions developed using Microsoft Windows Server operating systems. Host Integration Server makes it possible to bring together networks and applications, and publish business processes in IBM mainframes and AS/400 applications as XML Web services.

Microsoft and its partners deliver real-time plant floor visibility solutions that bridge the levels of a manufacturing enterprise. Plant floor visibility solutions summarise data, put it in context, and analyse it. By gathering and aggregating data from many sources, plant floor visibility solutions deliver information to people who need to make fast and accurate decisions about operations planning, and current production output. Information is presented in user-friendly formats such as dashboards.



4.2 Logica: System Integrator for Manufacturing Solutions

Logica:

- Is a major international force in business and ICT services.
- Enables its customers to build and maintain leadership positions.
- Has deep industry knowledge and a track record of successful delivery.
- Provides business consulting, systems integration, and IT and business process outsourcing across diverse markets including telecoms, financial services, energy and utilities, industry, distribution, transport, and the public sector.
- Headquartered in Europe, Logica is listed on both the London Stock Exchange and Euronext (Amsterdam) (LSE:LOG; Euronext:LOG).
- Is a Microsoft Gold-Certified Partner.
- Has around 3,000 SAP experts worldwide and is one of a small number of SAP Global Services Partners.
- Is a leading MES system integrator in Europe focussing on the industrial and utilities sectors
- Is founding member of MESA Europe.
- Co-operates with World Batch Forum and the Instrumentation, Systems, and Automation Society.
- Produces the annual survey of leading MES in the marketplace. Readers state that it helps them to meet their strategic goals.
- Has more than 30 years' experience in MES and production control.
- Supports plant-to-enterprise integration (ERP-MES-Control) creating transparency and visibility for its customers.
- Provides business consultancy, system integration, and maintenance and support 24/7.
- Has dedicated industry knowledge and experience of:
 - Pharmaceuticals, fine chemicals
 - Food and beverage /CPG
 - Automotive and metals
 - Utilities
- Implements best practices based on 6 improvement methodologies and ICT solutions.

More information is available at www.logica.com.

4.3 Microsoft: Providing Technology and Innovation in Plant Information Systems

Microsoft provides a state of the art technology foundation to build collaborative manufacturing solutions. These support innovative scenarios in plant information systems such as plant floor visibility and plant analytics. This foundation is based in a Web-based architecture that includes Microsoft .NET technologies and XML-based data management, key foundations for implementing SOA. The architecture is implemented through a set of products, designed to work together and able to interact in a heterogeneous environment via web services or specific components. This product set as outlined in the diagram on page 14 includes:

The Microsoft Office system

The Microsoft Office system provides new ways to connect individuals, teams, and organisations, helping workers to collaborate effectively from any Office application. It also provides a consistent interface to line-of-business applications via common tools such as Office Outlook 2007, Office Excel 2007, Microsoft Office Word 2007 and Microsoft Office InfoPath® 2007. See: www.microsoft.com/uk/office/prodinfo/default.aspx

Microsoft Office SharePoint Server 2007

Microsoft Office SharePoint Server 2007 enables distributed teams and individuals in the plant or across the manufacturing organisation to work together sharing, consistent information. www.microsoft.com/sharepoint

Microsoft Office Communication Server

Microsoft Office Communications Server provides the basis for staff to work with co-workers, partners, suppliers, and customers in a real-time and secure environment, sharing critical and time-sensitive information. www.microsoft.com/livecomm

Microsoft Office Live Meeting

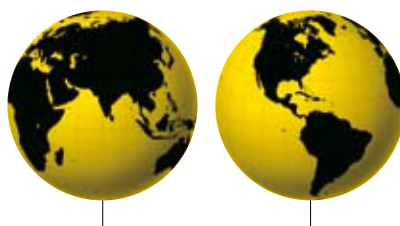
Microsoft Office Live Meeting can help organisation participate in meetings around the world, at a moment's notice, and at a fraction of the cost. www.microsoft.com/livemeeting

Microsoft SQL Server 2005

The Microsoft SQL Server™ 2005 business intelligence (BI) platform enables rich integration, analysis and reporting mechanisms. It delivers a complete, integrated, and extensible platform that drives consolidation and standardisation, leveraging the strengths of the Microsoft Office system. www.microsoft.com/sql

Microsoft BizTalk Server

BizTalk Server integrates inter-process XML message routing and transforming capability, with an ability to initiate and track ad-hoc workflows. The wide use of XML by applications means that BizTalk Server is increasingly positioned as a communications hub—by creation of one interface to BizTalk Server each application can be connected to every other application with a BizTalk Server interface. Manufacturers use BizTalk Server to simplify application integration and support data communication between departments and across companies. www.microsoft.com/biztalk



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