ARC WHITE PAPER

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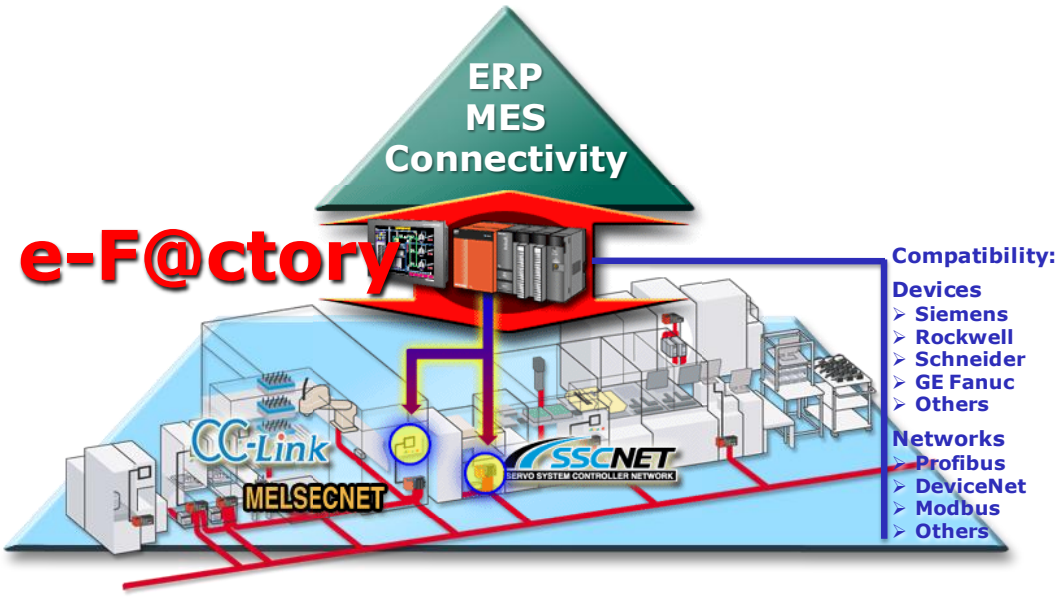
Unlocking Automation Systems for Higher Business Responsiveness

ARC Advisory Group

Modern Infrastructure, Connectivity and Processes



e-F@ctory Concept for Manufacturing
Connects Control Systems with Business Systems

Executive Overview

Every manufacturing industry is experiencing an increasing speed of business in several areas including changing schedules, customer needs, costs of materials, business models, and technologies. At the same time, many manufacturing sites - particularly in the discrete industries - have growing complexity in their operations which makes it more difficult to adapt. There are more SKUs and data to keep track of due to product proliferation, smaller lot sizes, and compliance to government regulations.

The demands for improved speed and agility conflict with the plants' ability to respond. Visibility into current operations, including the control system, is the primary reason manufacturers buy Manufacturing Execution Systems (MES). This visibility provides the information necessary for informed decision making in real-time by all levels of personnel – plant floor to the executives.

Increasing speed of business is driving integration of control systems with other business systems. Mitsubishi Electric's e-F@ctory concept for manufacturing systems provides a flexible "future proof" platform for integration and business process automation.

MES applications contain the critical business processes for executing a production schedule. These systems perform the production-centric functions of planning, controlling, operating, and informing. Control systems execute these functions to produce the goods needed to fulfill customer orders. By integrating MES with control systems, manufacturing becomes more agile for responding to change in this increasingly dynamic business environment. Integrating the control system with the MES allows for more effective and broader set of production management functions to improve operational performance.

To improve their response to operational issues, managers look to technology for connecting plant floor and business systems for automated business processes. Some manufacturers have implemented point solutions on a case-by-case basis. Because of the higher development costs and support issues, this approach is not acceptable. An integration platform is needed.

Mitsubishi Electric's e-F@ctory concept for manufacturing systems provides data integrity while supporting network security and lower project risk. e-F@ctory provides a far superior platform than one based on a point integration solution with a Windows PC. By partnering with others, Mitsubishi Electric can provide a complete solution including hardware, software, integrations services and support.

Drivers for Business Integration

Accelerating Speed of Business

Business pressures continue to increase as the competitive landscape expands from a local geography to worldwide. The "Flattening of the World" allows manufacturers to have a presence in places that are more distant. At the same time, it allows additional distant competitors to enter. This competitive pressure increases the demand for higher business performance. Every manufacturing industry is experiencing an increasing speed of business in several areas including changing schedules, customer needs, costs of materials, business models, and technologies. At the same time, many manufacturing sites - particularly in the discrete industries - have growing complexity in their operations which makes it more difficult to change. The demands for improved speed and agility are in direct conflict with the manufacturing plants' ability to respond.

Dynamic	Trend
Product proliferation and options	Increasing
Production lot or order size	Smaller
Quantity of lots and orders	Higher
Frequency of schedule changes	Increasing
Speed of New Product Development and Introduction	Faster
Product Lifecycle	Shorter
Agility to meet the needs of a dynamic global market	Increasing
Government Regulations	Expanding
Cost control pressures as markets mature	Accelerating with globalization

Accelerating Speed of Business

Manufacturers are attempting to both lower inventory and improve customer on-time delivery. Unfortunately, changes in the business environment conflict with these goals. For example, due to product proliferation, smaller lot sizes, and compliance to government regulations, there are more SKUs to make and data to track. This converts to an exponential increase in the volume of data transactions.

At the same time, complexity is increasing with multiple product lines, varied production routings, dynamic customer demand, and competition among products for the same production resources. Routings vary by product and component, and do not have a consistent, "connect the dots" straight path - sometimes they are even dynamic and recursive. These multiple product lines with independent value streams and routings have overlapping requirements for the same resources creating spurious, moving and often hidden constraints.

As manufacturing becomes increasingly dynamic and complex, a point is reached where it is beyond the capability of humans to manage manually. This becomes an impediment to operational performance. Some plant managers bully their people in an attempt to get the information they need. More enlightened managers realize their business has changed and it cannot be managed with manual business processes.

To improve their response to operational issues, managers look to technology using automated business processes with connectivity between plant floor and business systems. Typically, manufacturers have implemented point solutions on a case-by-case basis. In today's environment, this approach is no longer acceptable. An integration platform is needed.

Operational Connectivity

This changing nature of business operations is driving manufacturers to improve real-time performance across the enterprise. A real-time enterprise is characterized by high levels of synchronization and collaboration, extensive visibility, and excellent agility. Connectivity to the Plant floor and related operations represents a critical element in achieving success. Technology is available to help them overcome the barriers imposed by legacy plant IT infrastructure. Manufacturers should consider more than a narrow view towards specific functionality. In order to become a real-time enterprise, manufacturers need to consider a holistic, operations-wide approach. This does not mean a massive rip-and-replace solution. New technology enables legacy systems for effective applications integration.

Modern Infrastructure and Connectivity

A plant-wide approach to IT in Operations has these components:

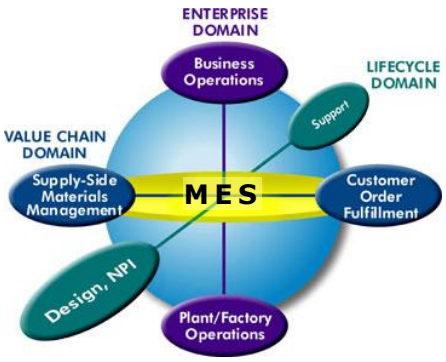
- An infrastructure with a modern platform and architecture to handle the real-time availability and performance needs of the plant floor, business process management, and security.

- Connectivity to embrace and support bi-directional communications to a broad range of external systems and people. It should provide the tools for easy integration and synchronization of business processes that extend beyond the plant floor into a variety of business systems.

- Support for processes that provide for the local functionality needed across all of operations, and for rolling-up performance results to central business systems.

- Flexibility to adapt as the integration expands. Initial project success leads to additions and extensions. Anticipation for connectivity bandwidth avoids success becoming a "dog." The initial project provides proof of concept and incremental increases in capacity will be required as applications are added.

No matter what specific pain points lead manufacturers to seek new plant solutions, it is important to think about the infrastructure and architecture early in the process. A strategy and architecture that considers infrastructure, connectivity and processes will help manufacturers minimize risks and ensure project success.



Three Dimensional Collaborative Manufacturing Management (CMM) Model

"Production Operations" is central to every dimension of manufacturing. It is in the middle of the design chain, the middle of the supply chain, and between business systems and automation and control systems. MES integrates with all of these systems. It is critical that MES has superb connectivity to the control systems so that the other systems they feed have current and accurate information.

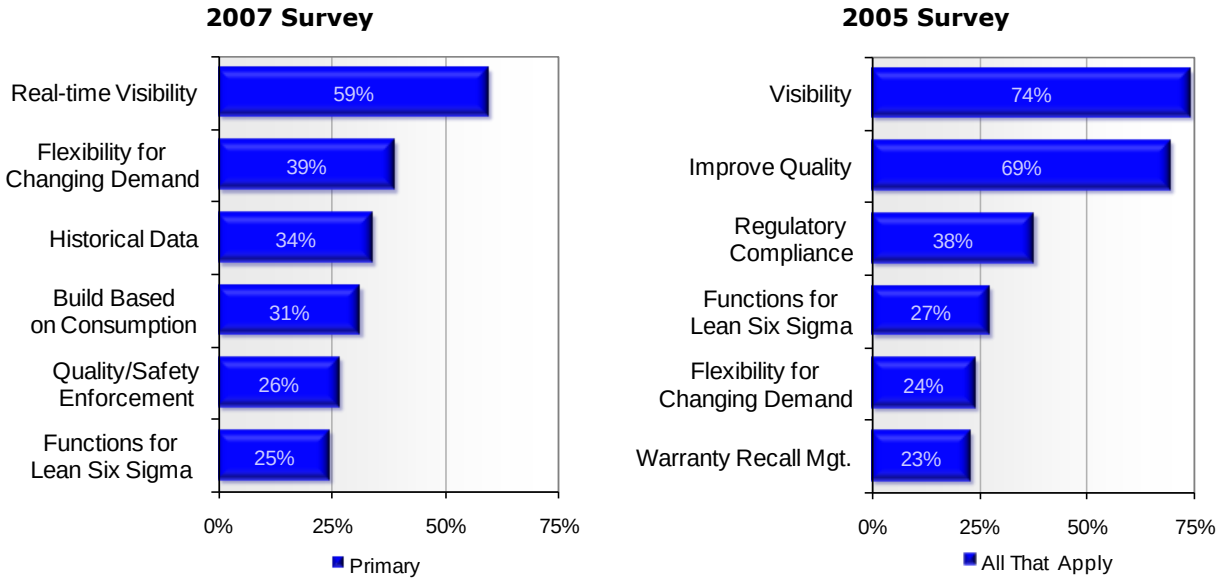
Why Manufacturers Buy MES

Surveys among manufacturers performed by ARC Advisory Group in 2005 and 2007 have a consistent point. They identify the same primary reason that manufacturers buy MES systems. It is a difficult admission for the average plant manager, and a difficult justification for the average CFO. Yet, the market grew 27% in 2007. Here we explain why.

"Visibility" is the primary reason for acquiring production management applications. With the increased volume of change, Plant Managers cannot manage their plants anymore - a tough admission. Does the CFO have a clear financial justification? No. But, they are buying at a record pace.

During a recent MESA International conference,

the presentations and conversations with users of MES had a significant common thread for the justification. To manage their increasingly dynamic production environment, improved visibility is needed. None of the presenters justified their MES system based on a financial ROI. During an interview, a manufacturer said he tried an ROI justification, but reverted to "we just need it to manage our business." Despite the weak financial justification, management understood and approved the investment. This need for visibility is the prime driver of MES adoption. Exposing information available in the control systems is particularly important.



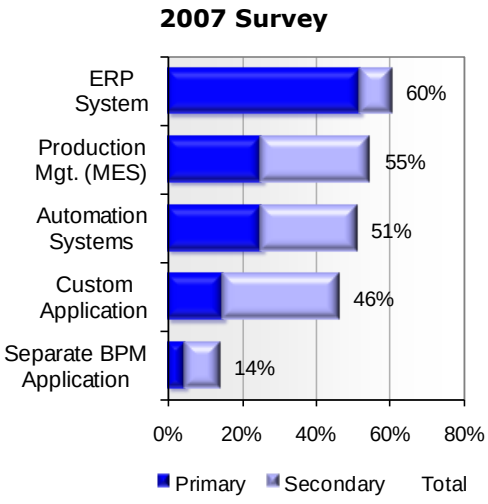
Visibility is the Primary Reason for MES Acquisition

These observations are consistent with the results of surveys performed by ARC. In Q4 2005 and Q3 2007, ARC surveyed manufacturers. The Q4 2005 survey had 88 responses from manufacturers. The Q3 2007 survey was conducted with MESA International and had 106 responses. Both surveys asked a question about why their production management application was acquired. The 2005 survey asked for all reasons while the 2007 survey asked for the prime reasons (thus the slightly lower percentages). These charts list the top six choices. In both cases, visibility has the highest percentage. The surveys are consistent and confirm the key driver for acquisition of production management systems is improved visibility. **This visibility includes access to data in the control system.**

Business Process Management

Business Process Management (BPM) includes managing the transactions that transfer information as processes progress. The well accepted business improvement programs - Lean Manufacturing and Six Sigma - include a focus on reducing variation. By reducing variation and increasing consistency, the processes become easier to manage with processes consistently producing good results.

In ARC's recent survey of manufacturers, manual processes for business management are commonly used, i.e. written documents, institutional knowledge, verbal instruction and ad hoc decisions. With these manual processes, there is variation among individuals; especially those with different training, locations, time schedules, business units, or length of service. The variation leads to errors and exceptions which then cause rework to fix the issue - if identified at all. As the volume and speed of transactions increases, this variation with the corresponding errors and recovery overwhelms the capacity of management to manage. The manual approach to business process management is unacceptable.



When BPM is automated, these IT Systems are employed

When business processes are embedded into the IT systems, standardized practices become automated, so exceptions decrease. Operational consistency and compliance are achieved more easily and the need for enforcement decreases. The IT systems can also manage the business processes and report exceptions, so management can focus on issues of more strategic importance.

The survey of manufacturers asked those who use IT systems for their BPM to identify the IT systems employed. The chart includes both primary (in dark blue) and secondary (light blue). Each system is used to automate and manage the business processes in their domain area including ERP, MES and Control Systems.

As an organization matures into a real-time enterprise, business processes become more automated and closed loop scenarios between business systems and plant systems are deployed. Workflow and BPM tools are used to synchronize business processes across departments and operations, and

between business and control systems. With automated BPM, conformance with business rules rises

Integration Architecture

The control system and MES must support the delivery of execution activity to users throughout the enterprise. Users need appropriate information to match their various roles such as Operator, Supervisor, Plant Manager, and Executive. When the control system is connected to MES, the visibility of data from the control system includes operating data, compliance information, production capacity, and cost data. At the plant level, information from business systems supports work planning and deployment as well as plant floor visibility of selected financial information for plant floor metrics.

The control system operates in real-time at the local plant level, and connects to other systems such as MES and other business systems. It can be asked to support multiple instances at multiple sites with centralized administration, support, and validation.

Connecting Factory Operations to the Enterprise

MES applications contain the critical business processes for executing a production schedule. These systems perform the production-centric functions of planning, controlling, operating, and informing. They integrate with control systems, business systems, and maintenance systems both within and across multiple plants and enterprises. MES systems control the value stream and enforce many of the business processes that are integral to production operations.

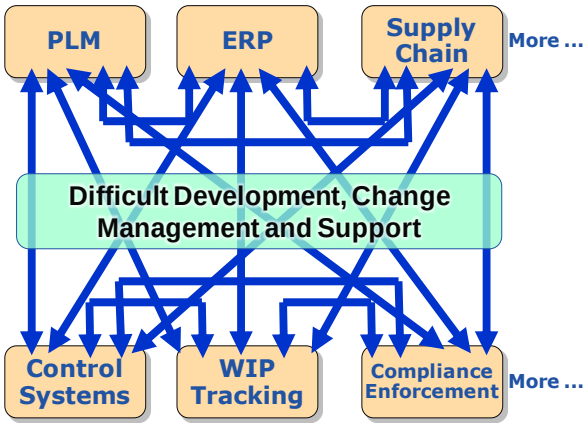
Information used to manage and improve the process must be real-time; not what happened yesterday.

To achieve optimal results, information used to manage and improve processes must be real-time, not what happened yesterday or last week. This level of responsiveness demands application integration and interoperability.

Integration Nightmare

For the typical manufacturer, a pair of applications is integrated in response to a particular business need or issue. Each integration effort is a separate

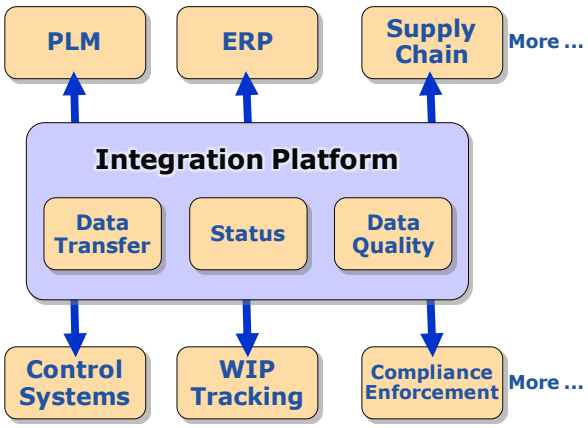
project with a team that chooses technologies that are appropriate at that particular time. The software suppliers have used proprietary application programming interfaces (APIs) to enable other applications to access their data. When a link is completed, the project team disbands. The next project usually has a different team that often chooses its own approach and technologies. This series of integration projects leads to a proliferation of point-to-point integration links with each having a unique set of technologies and APIs.



Project by Project "Integration Nightmare"

General purpose Windows PCs are often used because they are cheap and available. Unfortunately, they constrain performance and open security, reliability and maintenance issues.

This project-by-project integration sets-up a nightmare of support issues for IT with a very complex and fragile infrastructure that hinders improvement. When an application is upgraded, all of the point-to-point links for it need to be tested. When something breaks, support is problematic with each link being unique, poorly documented (if at all), and the needed skills are no longer present. The costs are excessive for development, implementation, and maintenance. Also, expansion is often not designed-in as a native element and integrating new applications becomes logarithmically difficult.



Manufacturing Integration Architecture

Integration Platform

An integration platform provides an improved path to integration. Instead of multiple point-to-point links, each application has one connection to the platform. The API and technologies are consistent for easier support and maintenance. This approach avoids the "integration nightmare." In addition, tools are present for managing data transfer, status, data quality and security consistent with the needs of an enterprise level solution.

With this integration, these benefits are achieved:

- Improved visibility so that performance or production problems are more quickly indentified and resolved
- Disparate systems can be integrated more effectively at lower cost
- Organizations can better leverage the plant information to determine improved business processes

Truly practical integration between the plant floor, where execution occurs, and the business systems, where standardization and optimization derive, can become reality.

e-F@ctory Approach

Mitsubishi Electric's e-F@ctory concept for manufacturing systems provides the necessary focused link between control systems and other applications – most commonly MES. The benefits of this approach cover a range of IT and manufacturing performance issues. Some of the benefits are a result of using a well chosen integration platform for sharing data and enabling interoperability among applications. Other benefits are specific to the functions and features of e-F@ctory that facilitate this integration. Integration of Control Systems with Business Systems has several aspects and we review a few here.

Mitsubishi Electric's e-F@ctory concept for manufacturing systems pro-vides the necessary focused link between control systems and other applications – most commonly MES.

Edge Processing - eMES

With e-F@ctory, pre-processing or distributed computing occurs at the "edges" of the MES application; i.e. next to the factory equipment layer. The MX MES Interface IT appliance (abbreviated as eMES) provides the necessary communication interfaces for the variety of suppliers and associated systems found in a typical plant. Integration of legacy systems and equipment changes (upgrades, replacement and additions) are accommodated in e-F@ctory with little or no change to the core MES application. Thus, change becomes far easier and less costly to implement.

eMES provides a wide array of computing system connectivity features for the equipment layer and for higher level business systems. These range from OPC protocols, to direct database transports, and even enterprise transport protocols such as IBM® WebSphere® MQ (Message Queue) and Enterprise Service Bus (ESB). These increase in importance as Service Oriented Architecture (SOA) becomes more widely adopted.

Users can start with a very basic eMES configuration for specific project goals and then expand the functionality as additional applications requiring direct equipment connectivity are implemented. The breadth of available technologies greatly simplifies the integration process and reduces cost, because the eMES handles the interface variability. Existing computing systems need less modification to accommodate ongoing evolution.

The local database, macro logic and other processing capabilities embedded inside eMES provide opportunities for optimizing overall system performance with data buffering and by off-loading data manipulation functions from the MES computing application. Access to these functions, increase the capabilities of the control system to previously unattainable levels. Stored procedures, SQL commands, listeners and other capabilities provide new opportunities for handling the unique requirements of a particular workcell with its equipment or business processes.

Combined, the various pre-processing functions act at the edges of the MES to expand and enhance its capabilities.

Data Conversion

The mapping of control system data into a transaction that is understood by a business application is non-trivial. Control systems usually store data in registers. Most of this data is the current value of I/O points which is of little interest to a business application like MES. Business applications often contain data that is cumulative in nature (i.e. total produced in a time span). This type of data is rarely of value to a control operation, but is often calculated and maintained in the control system.

Business systems like ERP and MES need a complete data transaction for an input. A transaction contains a group of related data values that have a common context. For example, when a production lot is completed the higher level systems need to be notified. The associated transaction would include data values like part number, lot number, quantity completed,

quantity good, operator ID, start time, stop time, and more. Independently, each data value is not useful. Together, they provide context and value. The mapping of the correct controller register data to a business database is often difficult and error prone.

e-F@ctory minimizes these difficulties. The specific controller register values that contain data of interest to the MES are mapped into transactions that transparently move the data. In a similar manner, a set of data values (i.e. a recipe or work instruction) automatically moves from the MES database into a specific controller. e-MES is designed to be easily configured with workbench software in a menu driven format. Underlying technologies, such as Java, SQL, XML, and others that are commonly required to interface computing systems are transparent to the user, so the configuration function is accessible to both engineering and IT personnel. This solution provides ease-of-use, reduced errors, faster commissioning, and greatly reduced cost.

Data Quality

Software needs data to function and, without automated collection, data acquisition must occur manually, if at all. One issue is the labor cost of data entry; though often buried in overhead, it is real. Another is improved accuracy of the data collected. A third is support for zero defect production, where quality analysis and decision making occur during manufacturing processes instead of after.

Track More:
Product proliferation, more options, smaller lot size with more lots, costs to control

Faster:
Frequent order changes, faster new product intro, global market dynamics

Visibility and Agility

Manual data entry is prone to error. A complete transaction can easily contain 80 characters. When written on a form and sent to a data entry function, typically 10% of the transactions have an error. With that error rate, exceptions that should be reported for attention are overwhelmed by the incorrect records. Management decision making is incorrectly skewed. In this environment, "Visibility" becomes more of a nuisance than an aid, and it is very difficult to detect or improve.

Avoiding entry delays, duplicate and erroneous items, and manual processes provide hard benefits. e-F@ctory automates data transfer with the related transactions while avoiding the issues with manual entry.

Data Consistency

Separate systems with independent data collection leads to inconsistency, arguments and deadlock. If each application independently gathers its own data, inconsistencies between the applications and their reports occur. These differences lead to different conclusions regarding the appropriate action to take. Different data sources will drive arguments among departments like production, QC and engineering.

However, when everyone is using the same data, and the data is accurate and timely, decision making becomes easier and the business is more manageable. e-F@ctory's automated data collection can simultaneously feed multiple applications using their different connections, and each receives the appropriate set of data.

Data Reliability

When connecting separate domains, one must consider the ramifications when one of the systems goes off-line (either intentionally for an update or unplanned as would occur with a failure). For example, if IT needs to install a patch in the MES system and temporarily shuts down the database, the control system must continue to operate for the plant to make product. It is unacceptable for IT system outage to require an outage in production.

To recover when an outage occurs, the integration platform must store the transactions and forward them when the system restarts. Similarly, data outbound to the control level must not be constrained, so "store and drip-feed" is needed to allow continued operation during the shutdown. This "store and forward" and "store and drip-feed" are capabilities of e-MES. These functions provide a buffer for data transmission to ensure data is not lost and production can continue during computing outage.

Interoperability

Interoperability

Today's "speed of business" demands current information and fast response times. Rather than stored for off-line analysis, the data, events and alerts must be real-time, i.e. available when it occurs.

The integration platform should include functions that facilitate the transfer of data

so that it is synchronized with the associated business processes. For example, e-F@ctory can perform a calculation using PAC/PLC data values and apply the result as a trigger for a transaction. It can calculate when a batch is nearly complete, ask the MES for the next scheduled batch, and request its recipe when ready for it.

Security

A company's IT systems contain proprietary information including financial, intellectual property, and much more. A company could not function effectively without its IT systems. There are misguided people who attempt to hack into these systems through the internet. IT is responsible for protecting those assets. This protection includes both intentional from hackers and unintentional from those who do not fully understand the ramifications of their actions.

IT needs to ensure that an action by a control engineer does not compromise the security of the business systems. Similarly, the control engineer does not want a change by IT to compromise the control system and its ability to make high quality products. Both IT and Control need an integration platform that allows them to cooperate for data transfer and, at the same time, insolate for security. e-F@ctory provides this separation and security.

Viruses are an intentional attack and nearly all viruses are for Microsoft Windows operating systems (OS). e-F@ctory provides protection in two ways. First, e-F@ctory uses a real-time OS that is not vulnerable to viruses written for Windows or Macintosh. Second, e-F@ctory provides the option for encrypted XML to protect data integrity, manage visibility, and prevent the promulgation of viruses. Essentially, e-F@ctory provides a barrier for viruses between the Control and IT systems.

Lower Project Risk

Integration projects often involve multiple layers of software and systems that are between the control system and MES application. These layers provide the functions discussed above and more. Unfortunately, these layers also add complexity, sources of failure, and cost. Projects often go beyond budget and schedule when the "99% done" wall is hit. The project always looks like it is almost done except for "a few issues." When those issues are solved, a few more crop-up. Thus, the project always appears to

be 99% done. This occurs during commissioning of the project causing cost overruns and missed schedules.

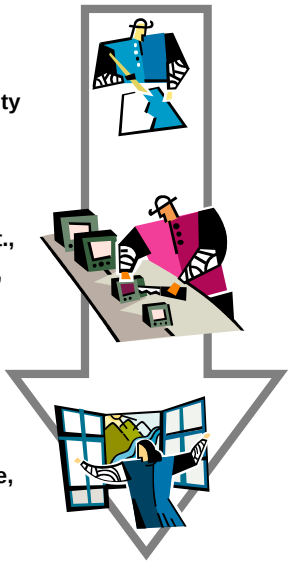
Less complexity with ease-of-use and standard methods lowers risk and provides faster project implementation. e-F@ctory connects the control system directly to the business system. This two layer approach reduces potential points of failure. The faster time to benefit improves the ROI.

e-F@ctory provides a dedicated platform specifically designed for this integration task with a real-time OS and high throughput. It avoids hitting a performance roadblock often found during commissioning with software on a general purpose Windows PC.

Another area of risk is the technology choices. Often the layered approach requires selection of specific technologies that are consistent among the layers. Unfortunately, unanticipated requirements and the dynamic nature of technology often cause the need for additional choices. e-F@ctory is neutral by supporting most operating systems (Windows, UNIX) and SOA infrastructures (.net, NetWeaver, Websphere).

Enabling More Effective Production Management

Integrating the control system with the MES allows for more effective and broader set of production management functions. The data in the control system is used to bring additional capabilities like these examples:



Key Functions for MES & Production Mgt.

- ID an issue that will cause quality problems before bad parts are made
- Automate data collection for WIP tracking and order management
- Improve data collection for genealogy and traceability applications for government regulation compliance
- Accumulate actual equipment run-time for maintenance based on usage rather than calendar time

- Monitor the condition of equipment to predict when maintenance is needed prior to a failure
- Record "as built" for improved customer support and recall management, i.e. limit a recall to the items with bad components rather than everything produced in a broad period of time
- Automate Electronic Kanban loops to avoid lost signals

Introduction for Mitsubishi Electric

Mitsubishi Electric Products

e-F@ctory in Controller Rack

Mitsubishi Electric Corporation is a $40 billion diverse global electronics company which provides a wide range of automation products including PACs (including Q Series released in 1998 and more recently iQ), drives, PLCs, CNCs, motion control, operator interfaces, robotics, and connectivity for MES and ERP applications. It is a major global automation supplier that is strongest in the Japanese market where it has #1 or #2 position in these automation market segments. It has a significant presence throughout Asia and has grown continuously elsewhere.

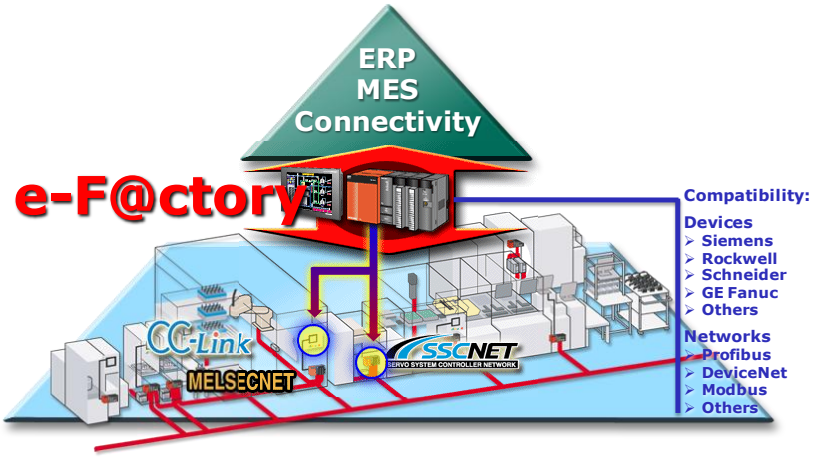
Mitsubishi Electric has been growing its international business with a strategy of hardware leadership and partnering for software solutions. The company is growing sales through close collaboration with OEMs, system integrators, and partners. This strategy allows Mitsubishi Electric to heavily focus on hardware excellence and to avoid competition with its own channel partners who add value with services. The hardware focus also creates clear lines of responsibility when partnering with a software supplier to provide a solution that fits the end-user manufacturer's needs. To date, Mitsubishi Electric has partnered with IBM, Oracle and Wonderware, with whom they actively seek and engage projects. This approach is particularly relevant to e-F@ctory.

Mitsubishi Electric's e-F@ctory provides an information connection between the control systems and IT systems in a manner that is particularly appropriate for MES and enterprise applications. It communicates among these domains using technology that provides high performance and ease-of-implementation while at the same time allowing the domains to retain their solidarity and independence.

The e-F@ctory hardware consists of a module that installs to a Control system rack or Operator Interface Terminal (OIT). It enables two way communications between the control system and major databases, software applications, other Mitsubishi Electric control systems, and 3rd party devices. At the same time, it retains independence with excellent security (satisfying the needs of IT) and ease-of-use (so the control engineers do not need to learn, for example, SQL query syntax). Both benefit with store and forward of transactions so either side can be shut-down without impacting the other.

e-F@ctory in an OIT

Often, integration across domains is a huge risk to a project's success, i.e. completion on-time and in budget. With e-F@ctory's ease-of-use, there is less complexity. This provides faster project completion with lower risk. The direct connection between control systems and business systems eliminates a middle layer of software and systems thus reducing potential points of failure. With faster time-to-benefit, the project's ROI improves.



e-F@ctory Connects ERP, MES and Control Systems

The benefits of e-F@ctory do not stop with the initial project and its commissioning. Designing connectivity solutions to meet the needs of only the immediate project will lead to a solution that is fixed with limited band-

width to handle added applications. E-F@ctory provides flexibility to adapt to change. This can be in the form of changes to the existing project or the addition of other data sources as the business needs expand. Without changing the equipment interface, this connectivity solution has the agility to add additional support for systems including QA, PDM, performance management and others as defined by a manufacturers business needs. Simply add new transactions that point to the additional data sources and destinations. Essentially, e-F@ctory "future proofs" projects for manufacturers.

Mitsubishi Electric uses e-F@ctory in its own manufacturing plants. Their Nagoya Works Servo Motor factory achieved 80% improvement in productivity, 50% reduction in Lead time, and 50% reduction in quality losses.

Summary

The trend of increasing speed of business – quick response for a dynamic market – requires new approaches to the integration of disparate systems. Typically, manufacturers have implemented point solutions on a case-by-case basis. In today's environment, this approach is no longer acceptable. An integration platform is needed. This platform needs to consider:

- Data conversion with easy-to-use dialog boxes
- Data quality with automated data collection
- Data consistency while transferring data to multiple applications
- Data reliability with store and forward to recover from an outage
- Interoperability for BPM with alerts and event notification
- Security for both unintentional errors and viruses
- Lower project risk with reduced complexity and high throughput
- Compliance to a wide range of standards

Integrating the control system with the MES allows for a more effective and broader set of production management functions to improve operational performance.

Mitsubishi Electric's strategy is hardware leadership and partnering for software solutions. The hardware focus also creates clear lines of responsibility when collaborating with a software supplier to provide a solution that fits the end-user manufacturer's needs. For e-F@ctory, Mitsubishi Electric has partnered with IBM, Oracle and Wonderware.

e-F@ctory meets these needs and provides a far superior platform than one based on a point integration solution with a Windows PC. By partnering with others, Mitsubishi Electric can provide a complete solution including hardware, software, integrations services and support.

Analyst: Ralph Rio

Editor: Craig Resnick

Acronym Reference: For a complete list of industry acronyms, refer to our web page at www.arcweb.com/C13/IndustryTerms/

API	Application Program Interface
BPM	Business Process Management
CFO	Chief Financial Officer
CMM	Collaborative Manufacturing Management
CNC	Computer Numerical Control
CPM	Collaborative Production Management
eMES	MX MES Interface IT
ERP	Enterprise Resource Planning
ESB	Enterprise Service Bus
I/O	Inputs and Outputs
ID	Identification
IT	Information Technology
KPI	Key Performance Indicator
MES	Manufacturing Execution System
OEM	Original Equipment Manufacturer
OIT	Operator Interface Terminal
OS	Operating System
PAC	Programmable Automation Controller
PDM	Product Data Management
PLC	Programmable Logic Controller
PLM	Product Lifecycle Management
QC	Quality Control
QA	Quality Assurance
SKU	Stock Keeping Unit
SOA	Service Oriented Architecture
SQL	Structured Query Language
ROI	Return on Investment
RPM	Real-time Performance Management
SCM	Supply Chain Management
WMS	Warehouse Management System
WMQ	WebSphere MQ
XML	Extensible Markup Language

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