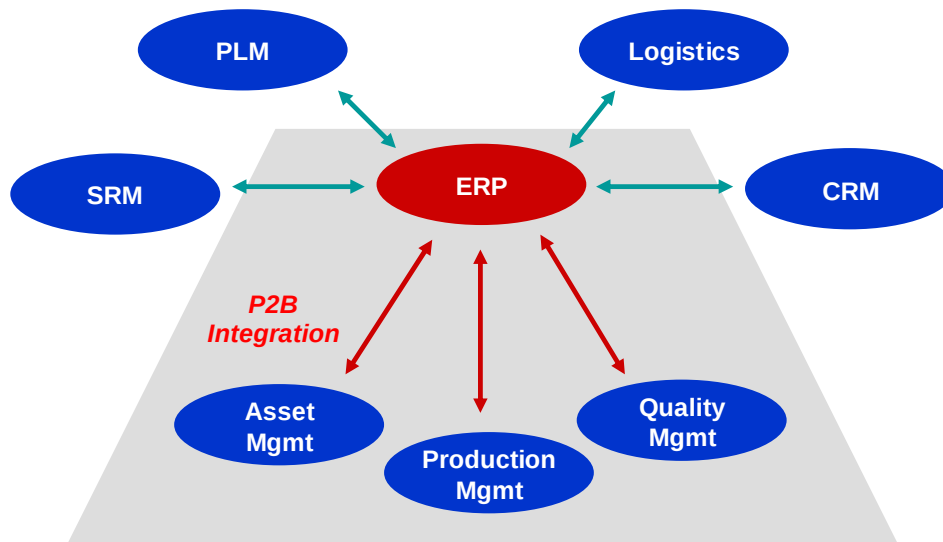


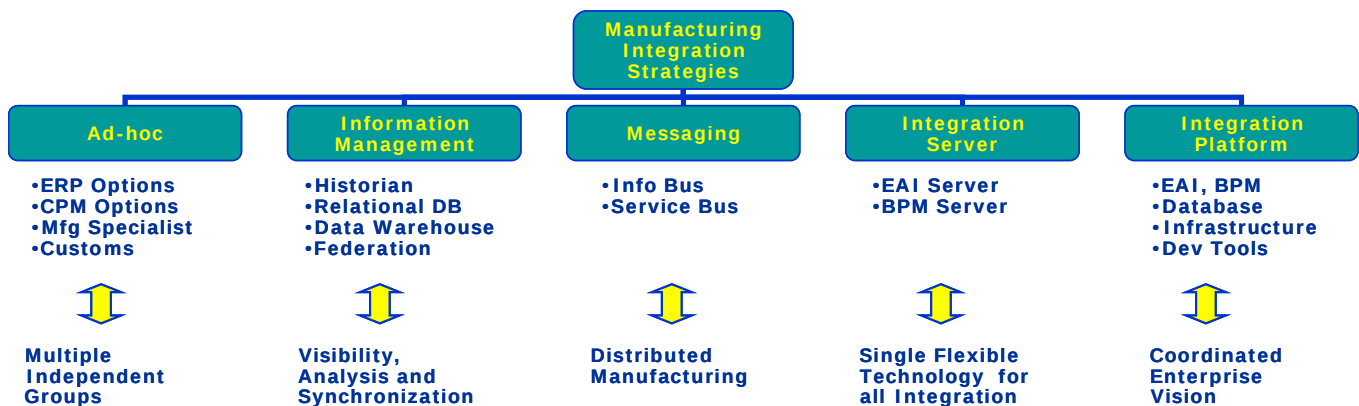
Process Industry P2B Integration Strategies

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A Real-time Business Needs Production to Business (P2B) Integration



Match Integration Strategy to Organization and Business Needs

Executive Overview

Integration seems to show up in almost all business initiatives, new product architectures, platforms, and standards activities, even though it is seldom considered a strategic activity. Just when many integration technologies are maturing and perhaps even reaching commodity status, new technologies such as Web services are challenging existing wisdom, throwing existing integration strategies and architectures into question. Throw in a healthy mix of standards activities at all levels of the standards stack, and we have a very complex situation.

The evolution of new technologies has challenged mature integration technologies. This is making the development of an integration strategy difficult at a time when business needs are forcing manufacturers to integrate at a higher scale in every direction.

This is really business as usual for the enterprise integration markets, which have always been on the leading edge of technology, but the difference is that application integration is becoming an up-front requirement instead of its traditional place at the end of the applications implementation process. The cost of delaying the integration question can be high and a proactive strategy is advisable.

Both software suppliers and end users are in the throes of creating or re-examining their integration strategies. This report examines strategies and trends relative to integrating production systems with enterprise business systems (P2B integration). Discussion of suppliers and practices is limited to the process industries. Discrete industry priorities, standards, and systems are different and related integration strategies will be discussed in a subsequent report.

There is no single best integration strategy for the process industries. Each company's strategy must be driven by the information and business process priorities of that organization. Accordingly, several integration strategies are identified from an end user perspective, and each is related to company organization and general integration technologies: Ad-hoc, manufacturing information management, messaging, integration server, and platform strategies are profiled. Examples of solutions which align with their strategies are presented from among the Collaborative Production Management (CPM) suppliers. It is clear that things are changing and that Web services will play a role in future strategies. The long term vision is interoperability with integration blending into all development activity.

The Integration Landscape

The Business Drivers

Almost everyone today will agree that application integration is necessary for today's business environment. The business case is seldom hard to find, even though each industry has a different set of drivers. To name a few:

- Regulatory compliance requires documented, reliable processes — the TREAD Act, Sarbane-Oxley, and FDA regulations are just a few.
- Collaboration across organizational and business boundaries is seen as a way to reduce redundancy and costs.
- Labor dependent, manual processes (paper, faxes, emails, etc.) limit business speed and quality of results.
- Business expectations are higher — businesses must understand and often automate processes. Interest in cross functional processes is high.
- Information is spread throughout organizations making it difficult to leverage.
- Visibility is required to monitor performance in real-time.
- Even for those already integrated, more flexibility is required to react to changes in business conditions.

The Integration Challenge

Many companies are creating or re-visiting their integration strategies both in the enterprise and production organizations. This can be a formidable task for large organizations because integration, as currently defined, can touch almost all aspects of the business.

Integration Touches All Domains

- Product Lifecycle Management
- Enterprise Planning (ERP)
- Supply Chain (SCM)
- Customer Facing (CRM)
- Logistics
- Production Management (CPM)
- Automation

Addressing integration in such a broad context is difficult or impossible in some organizations and industries. There are often multiple "IT" organizations — business, production, and R&D for example — at multiple sites around the globe. Furthermore, varying technologies and domain requirements may render a single integration strategy not feasible.

Domain	Domain Characteristics
"ERP"	Planning and scheduling, records, orders, suppliers, etc. Typically everything integrates with ERP, including legacy. Strong support from all EAI suppliers. All ERP suppliers offer some integration capability.
Supply Side (B2B)	Often a large number of suppliers of different capabilities. Involves sourcing, requisitions, payment, shipping notices, changes orders, cancellations, event management, etc. Technologies must include standard business documents, EDI, AS2, reliable delivery, high security, and collaboration.
Customer Side	Widely varying with industry. Involves PO's, credit, invoicing, shipping notices, status, managing changes. Includes EDI, AS2, VMI, CPFR, and accommodating customer e-business requirements.
Product Lifecycle	Mostly internal but also includes collaborating with suppliers in some industries. Involves widely varying and complex data formats, critical change management, and formal review processes. Coordinates different information for design, planning, production, service, and support functions. Involves complex transformations and industry specific product models.
Logistics	Large number and variations of participants. Complex scheduling and real-time tracking for customer support. Integration is not new and IT is very advanced in some cases.
Production (P2B)	Almost always internal, typically integrates with ERP only, and involves two or more IT organizations. Involves exchanging production schedules, manufacturing information, plant asset and maintenance information, product quality data, and inventory information. (HR typically addressed separately.) Minimal solutions from ERP and EAI suppliers — often leaves it up to CPM suppliers. Lines between ERP and CPM are blurring somewhat.
Automation	Typically integrated with business systems through production management applications or databases. Some direct support from ERP suppliers through OPC.
"Legacy"	All areas have some requirements to include legacy systems, which are specific to each domain.

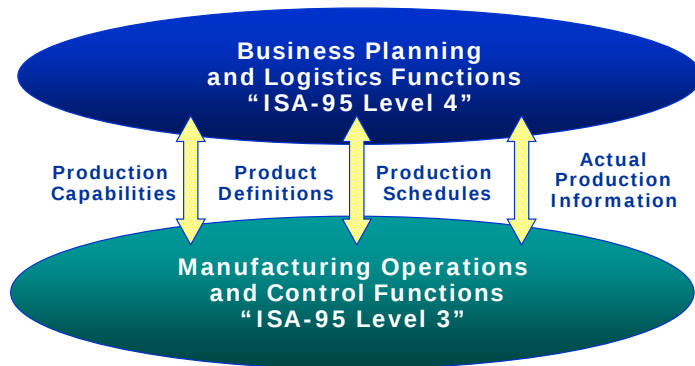
Each Domain Has Unique Priorities

P2B Integration Strategies Involve Unique Challenges

This report addresses Production to Business (P2B) integration. In simple terms, this primarily involves "ERP" and "CPM" applications integration, but many plant floor application types are involved to a lesser extent.

Organizations typically work independently, using different technologies, giving the development of an integration strategy unique challenge.

Process Industries P2B Functions



ANSI / ISA-95 (ISO IEC 62246) Defines the P2B Integration Context, Models, and Terms

P2B integration in the process industries is certainly not new, and the general context has been well defined and updated by the ISA-95 efforts. The

ISA-95 specifications, in three parts, also define concepts, models, and terminology — independent of technology. The result is that most of the process industry, end users and suppliers, are considering how ISA-95 should fit into their integration strategies. ISA-95 serves well as a functional reference model, which is its highest value. It currently does not address interoperability.

P2B integration in the process industry primarily involves the integration of a variety of CPM applications with ERP, with SAP R/2 and R/3 being the most common target. Integration with the SAP Production Planning module for the Process Industries (PP-PI), the maintenance module (PM), and the Quality Management module (QM), are well supported, and no end

user should have to develop SAP specific code. Other ERP supplier's offerings in these areas are supported less frequently.

Function	Characteristics
Planning and Scheduling	- Most complex, but best supported - ERP does general scheduling - CPM does detailed scheduling - CPM reports progress, events, actuals, status, and completion
Maintenance	- Not a clear division between ERP, maintenance, and asset management software - Synchronization is often the issue - May take the form of data collection
Quality	- ERP competes with LIMS and other quality management - Integration not as widely supported
Inventory and Logistics	- Increasing important - Involves CPM, ERP, and others

Integration Support Varies with CPM Function

Programs such as real-time performance management (RPM), operational excellence, and outsourcing of a variety of functions, have created a need for non-traditional integration of production systems with enterprise applications. These are often the result of "visibility" programs, which are primarily focused on information management — aggregation and federation, but also include computation of performance metrics and alerting.

End User Integration Strategies

There is no single best integration strategy, except to start with written requirements. This may be the most difficult part depending on organization structure and practices. Many organizations have multiple IT organizations

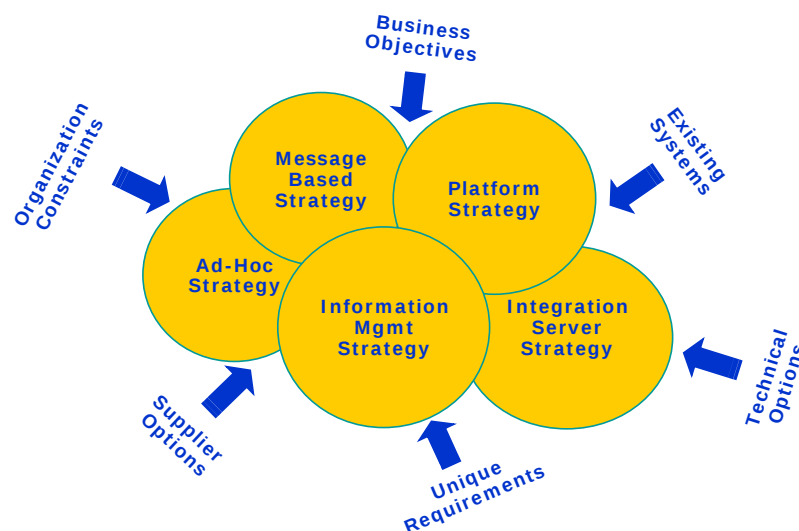
Consider	Examples
Business objectives which create the need for integration	Automate critical processes, visibility for decision support
Catalog existing integrations — the current state	Function, products, technologies, standards, results, lessons learned, practices
Applications to be integrated	SAP, Oracle, ABB, Aspen-Tech, Invensys, L.I.M.S.
Organizational requirements	Budget source, stakeholders, existing teams, governance, staffing objectives
Constraints	Budget, timing, technology decisions, product decisions, architecture, justification model

and collaborative structures may need to be created. This is critical for P2B integration because each organization has different priorities, requirements, and practices. Organizational complexity and distribution may be a dominant factor in forming an integration strategy.

It is critical to consider existing integrations in analysis and planning. For example: leave them alone, migrate toward consistency, or bring things into alignment as fast as possible. Changes in integration strategy must also consider the impact on application and infrastructure upgrade replacement programs.

The Development of an Integration Strategy Always Starts with Requirements

From a cost standpoint, one of the more difficult decisions is placing a value on future-proofing investments. Clearly open systems using layered standards establish a framework for insulating investments from the rapid technology evolution that is underway.



Requirements Drive the Integration Strategy Which May Be a Blend of the Simpler Strategies

Shaping a Strategy

The following sections outline five basic integration strategies. None are inherently bad unless misapplied — that is poorly matched to organizational and business requirements. These are good starting points for shaping a local or corporate strategy.

Ad-Hoc Integration Strategy

Consideration	Ad-hoc P2B Strategy
Strategy	Each organization defines integration needs independently as needed, minimizing short term costs
Organization	Suitable for organizations with minimal integration needs or strong technical staff in each domain
Solutions	Typically CPM suppliers and manufacturing integration specialists are the best source of packaged integrations. However, even these range from simple integrations to entire platforms.
Success Factors	- Always involve integration specialist - Define requirements well - Do only what is necessary and use simple solutions
Pro's	- Short term cost can be minimized - Decision process and implementation may be faster
Con's	- High risk of maintenance and update problems - Poor at developing integration best practices and competency - Can bring a broad range of technology to the infrastructure
Sources	ABB, AspenTech, Honeywell, Invensys, OSIsoft, Siemens, Rockwell Automation, Verano, IndX, etc.
Notes	1. The term "Ad-Hoc" is relative to a corporate view, and may consist of solid localized strategies 2. Collaboration between groups will have strong rewards

Multiple Independent Organizations Result in Ad-hoc Strategies

Ad-hoc integration means that each integration need is handled as an almost isolated situation, and often by a local organization or within a very limited scope. In a sense it is the default when no other strategy has been defined, and consequently is what many organizations have been doing.

One of the most serious consequences is that integration competency never advances from a corporate viewpoint. Consequently continuous improvement is not possible, and lessons learned are seldom shared beyond a site.

Ad-hoc strategies are not necessarily doomed for failure. Cost and fast pay-back should be the priority, and customs should be avoided. Manufacturers have the opportunity to select the best fit for each integration need, but some mechanism should be developed to limit diversity.

Organizations should prefer simpler solutions that can be easily managed by manufacturing IT organizations. Good sources of solutions are the CPM and manufacturing specialists listed in the table.

Manufacturing Information Management Strategy

Consideration	Manufacturing Information Management and P2B
Strategy	Integration efforts focus on data management facilities, synchronization, visibility, and optimized delivery to ERP.
Organization	Some industries have invested heavily in collecting information for reporting and analysis and activities. Others know that tremendous gains are to be had by making real-time performance information visible for optimization and response to events.
Solutions	Information management in the process industries is very mature. More recent activities aim to provide real-time performance tools, and in general better visibility to plant floor information. Approaches typically share information by: - <i>Plant-wide Database</i> - open access using standards - <i>Relational DB</i> – company standard (one supplier) - <i>Federation</i> – providing standard access methods to disparate data without aggregating it.
Success Factors	- Consideration for legacy information is critical - Define information needs well — vs. store everything - Use standards wherever possible and identify “the master”
Pro's	- Information visibility often has the biggest short term ROI - Mature and reliable, can extend to P2B data movement - Technology have developed specifically for plant floor use - Can be low cost and fast start
Con's	- Data synchronization is only part of the problem - Solutions may be weak in support of business processes - Offers no general purpose integration technology
Sources	CPM suppliers and Mfg. Specialists: IndX, Lighthammer, EMT, some EAI data synchronization specialists, and RDB suppliers
Notes	1. Some offer options that go beyond data management 2. Can be complemented with Integrations Servers or manufacturing specific integration solutions: Verano EL, Junot

Manufacturing Data Is Critical for Process Industries

Manufacturing Information Management in the process industries center around plant-wide historians, which are highly evolved to handle the needs of the industry — some have even delved into discrete industries.

An information management strategy is important for planning and scheduling, asset capability, trends, batch records, analysis, optimization, reporting, traceability, and increasingly regulatory compliance. Information is typically multi-purposed, requiring considerable attention to information collection and management throughout its lifecycle. Information management suppliers are a good source of specific integration solutions but they are unlikely to evolve into general purpose integration platforms.

Message Based Strategies

Consideration	Messaging-Based P2B Strategies
Strategy	Reliable and distributed messaging is selected for integrating global manufacturing businesses
Organization	Typically requires some central manufacturing organization or team to define requirements, coordinate design, select suppliers and oversee implementations.
Solutions	Messaging is a mature EAI technology that handles communications, reliable delivery, queuing, caching, security, and may provide an adapter framework and transformation capability. - <i>Information bus</i> approaches focus on documents and processes - <i>Service bus</i> approaches focus on exposing services on the bus
Success Factors	- Define requirements across manufacturing organizations - Develop internal integration specialists - Protect investments using standard messaging interfaces and adapter frameworks
Pro's	- Broad applicability — can use same technology as enterprise IT - Mature, reliable, and secure base technology - Enables re-use and long term savings - Application upgrades (ERP, CPM) are more manageable
Con's	- There are few adapters to production software (CPM, QM, etc.) - Requires broad up-front analysis, design, and buy-in - May be more than manufacturing IT wants to manage
Sources	Most EAI Suppliers: Ascential (Mercator), BEA, IBM, Microsoft, TIBCO, SeeBeyond, Sonic, Sterling Commerce, etc.
Notes	1. Some CPM suppliers offer messaging based solutions for their products: AspenTech and Honeywell are examples 2. ERP adapters are readily available 3. Tools and technologies vary widely for EAI products

Messaging Strategies Suit Distributed Manufacturing Organizations

Message-based integration strategies fall into at least two general categories. One publishes documents on the bus, requiring considerable up front design of a document set. The other publishes services on the bus to expose capabilities using existing and new applications. Either may be implemented using mature EAI messaging technology, or using messaging developed by an application supplier. EAI based solutions will be more open, more likely to support a variety of adapters (sometimes called “wrappers”) and standards, and better suited for integrating competitive products. Application supplier messaging will tend to be less expensive and simpler to install and maintain.

Messaging strategies should be developed in collaboration with Enterprise IT to leverage their experience and avoid redundant efforts.

Integration Server Strategy

Consideration	Integration Server-Based P2B Strategies
Strategy	Select an Integration Server with tools that suit organizational capabilities as the corporate standard.
Organization	As with messaging, requires corporate team to define requirements, evaluate, and select a supplier. Very well suited for the corporate SWAT team, taking on one business problem at a time.
Solutions	Integration Servers typically have process visual modeling and document transformation tools, view integrations as applications, and leverage other EAI technologies such as messaging. Most have a broad range of adapters to applications and support for relational databases and Web services.
Success Factors	- Define requirements across manufacturing organizations - Develop internal integration specialists - Protect investment with language standards (e.g., BPEL4WS)
Pro's	- Broad applicability — across all IT organizations - Mature, reliable, and secure technology - High-end tools for capturing integration processes - Can integrate different messaging implementations
Con's	- There are few adapters to production software (CPM, QM, etc.) - Some products require coding to supplement tools - Cost can be high — but not necessarily - May be more than manufacturing IT wants to manage
Sources	Most EAI Suppliers: BEA, IBM, Microsoft, TIBCO, SeeBeyond, Seeburger, Sterling Commerce, Vitria, webMethods, etc. (some BPM solutions may also suffice: Intalio, Fuego, Q-link, etc.)
Notes	1. Most large companies already have integration servers 2. AspenTech AEP is built on TIBCO Integration server

Integration Server Strategies Offer Flexibility with High-end Tools

Integration servers are available from a large number of sources, and they are used by application suppliers to develop integrations. This is a good practice for application suppliers, but end users must be aware of the long term implications. Many of the integration servers do not store processes in a form that can be exchanged with competitive products. Standards, such as BPEL4WS, are evolving to alleviate this problem.

Integration servers typically support a very broad range of adapters, including popular enterprise applications (SAP, Oracle, etc.), and can be supplemented by companies like iWay and Attunity, who specializes in adapter development. Web services are already supported by most.

Integration server approaches tend toward hub and spoke architectures but can be used in a variety of designs.

Platform Strategy

Consideration	Platform P2B Strategies
Strategy	Develop set of products, tools, and standards for broad integration and some application requirements, specifically cross functional applications. Involves standard approaches toward exposing application capability.
Organization	Requires a strong corporate team to define requirements, evaluate and select a supplier, and provide on-going governance.
Solutions	Enterprise platforms consist of coordinated set of tools and infrastructure, including visual and coding development (IDE) environments, EAI technologies, relational DB, etc. Increasingly, component-based production platforms will be used. Platform approaches are tending toward service based architectures.
Success Factors	- Enterprise-wide requirements definition and governance - Defining and maintaining enterprise architecture - Substantial standards selection and development program - Integration competency center
Pro's	- Broad applicability and management - Facilitates long term vision and enterprise architecture - Productivity — the most appropriate tools for the internal users - Long term cost control through re-use - Development of strong skills
Con's	- Requires executive level support and broad coordination - Can be highly complex - Cost can be high - May be too much for some organizations and needs
Sources	Major EAI, Infrastructure, and Application suppliers
Notes	1. Some application suppliers offer a platform in their domain 2. Typically involves a technology strategy 3. Integration servers strategies can evolve into a platform strategy

Platform Strategies Facilitate Long Term Vision

A platform strategy is far reaching, requiring a broad look at diverse requirements, with an organized approach to architecture, standards, technology, re-use, legacy utilization, and supplier selection. Today this would include consideration for cross functional applications and infrastructure. It is especially difficult for large manufacturing companies that have multiple organizations in different domains (enterprise and production, for example). The payback is also potentially large for these organizations.

Platform strategies typically involve the definition of a strategic platform, the management of migration toward it, and management of exceptions. A strong argument can be made for multiple platforms.

Software Suppliers Strategies

To illustrate the strategies discussed in previous sections, these sections summarize integration options and strategies for a few manufacturing software categories and suppliers. It is important to note that this is not comprehensive, and suppliers with broad product lines often have multiple integration strategies, suitable for specific customer needs.

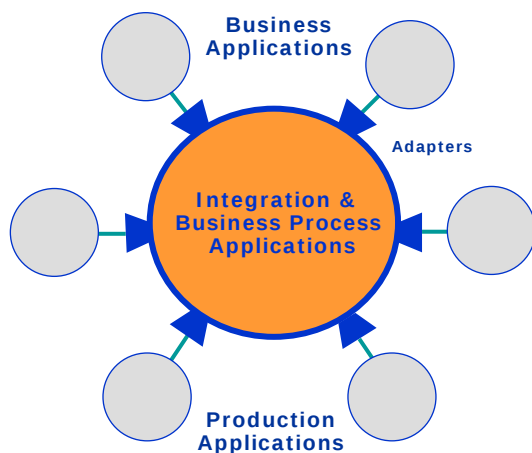
Custom Integration Development

Today, almost no manufacturer will have custom integration as a strategy, but coding will be necessary when the applications to be integrated are custom or legacy. Coding is also necessary to develop adapters (wrappers) to production applications.

In these cases, manufacturers should use a consistent approach to facilitate re-use, reduce maintenance costs, and facilitate application updates. Custom integration solutions should always be developed by an organization that will appreciate the issues and use appropriate — but not excessive — technology. This usually requires an integration specialist.

Production Management Software Supplier Approaches

For P2B integration, CPM suppliers are often at the center of the activity. Consequently, they are often the richest source of ready-to-go integration solutions. Solutions range from simple point-to-point options to domain specific platforms with several adapters. Ad-hoc integration strategies will typically opt for the simpler solutions. The following illustrate various approaches.



Integrations Server Strategies Tend toward Hub and Spoke Architecture

ABB

ABB has a very broad product line, and in early 2003 aligned with Accenture, Microsoft, and Intel to develop integrations. The general approach is close to the “Integration Server Strategy” described previously. The architecture is a hub and spoke architecture with Microsoft BizTalk (the integration server) at the center. BizTalk connectors (adapters) are used to access SAP (for example), ABB’s Aspect Integration Platform (AIP) for automation, and any

other application supported by BizTalk. Companies such as iWay and At-tunity, which specialize in adapter development, offer a comprehensive list of adapters for enterprise applications and standards.

AspenTech

AspenTech products span plant floor and enterprise (SCM), leading them to develop AEP (AspenTech Enterprise Platform), arguably the most advanced integration platform from a CPM-Process supplier deployed today. AEP is a “Messaging Bus Strategy”, founded on TIBCO Portal and BusinessWorks integration products, including Rendezvous messaging, the integration engine, adapters, and Hawk monitoring and managing tools.

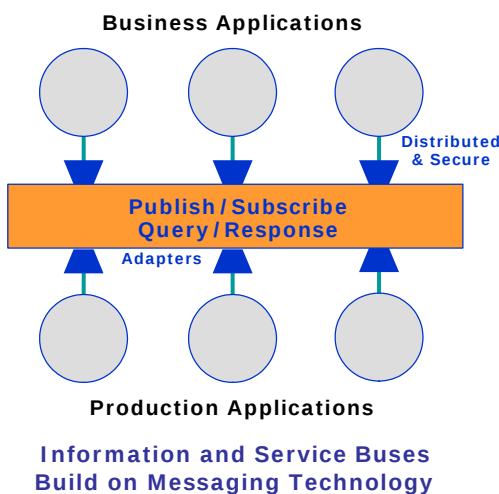
AspenTech uses TIBCO messaging to construct “InfoBus” which exposes services from AspenTech products. The TIBCO integration engine and adapters are used to develop services and place them on the bus. The services can be as elaborate as needed, and use of the TIBCO visual tools to implement them gives AEP many of the advantages of a “Platform Strategy”.

Honeywell

Honeywell serves many industries, with some industry specific product lines (Pulp & Paper, for example, which was obtained through acquisitions.) Consequently, Honeywell has multiple integration strategies: Business Hiway, POMS, and OptiVision. Business Hiway is a “Messaging Bus Strategy” and POMS is an “Integration Server Strategy”.

Business Hiway is Honeywell technology consisting of a messaging passing infrastructure surrounded by “objects” that implement the interface to each

integrated application (Uniformance, SAP, etc). The POMS solution includes a Honeywell Server to connect their CPM modules with control systems as well as ERP software. Honeywell plans to consolidate ERP integration solutions across markets, making extensive use of .NET technologies to deliver Web service-based solutions that support multiple middleware software.



OSIsoft

OSIsoft is well known for its data historian presence in the process industries, with challenges from all the major CPM suppliers. Accordingly, OSIsoft’s RLINK

can be an important element of a “Manufacturing Information Strategy”, and illustrates functionality beyond an historian.

RLINK interfaces with SAP’s PP-PI, PM, and QM modules, serving as the data source for SAP modules, including information manually entered

The Next Challenge?

Very few integration solutions today leverage EAI technologies. This is about to change, and the challenge for manufacturers will be to manage the diversity of infrastructure that may result.

through the PI-ProcessBook. RLINK also exchanges process orders and recipes, including transforming generic recipes to site specific recipes and sending them to CPM batch applications for execution. By managing process orders, RLINK can filter, package, and deliver required reconciled data to SAP. OSIsoft is embracing Service Based Architectures for customers' future integration needs.

ERP Supplier Strategies

SAP is the dominant ERP supplier to process industries and offers several methods for others to integrate with their software, such as Remote Function Calls (RFC), Business API’s (BAPI), and XML-based Business Connector. SAP has expanded its integration capability through the Netweaver platform. Netweaver includes stronger integration technology support and involvement with EAI suppliers such as webMethods and SEEBURGER AG. Netweaver itself offers no out-of-the-box integrations with production applications, leaving the development to partners, integrators, ISVs, and end users. (A more thorough discussion of Netweaver is available in a previous ARC Strategy Report.)

Other ERP suppliers also have integration platforms but seldom offer links to production applications except through specific partnerships

Manufacturing Visibility and Integration Specialist

Several manufacturing business initiatives led to a need to pull together selected production information from a broad range of disparate production systems. At the same time, EAI technologies were viewed as too expensive or too complex for production needs, and application suppliers were not addressing the integration issues. In response, independent software suppliers (ISVs) leveraged emerging technologies to develop products specifically to meet manufacturing needs — cost, ease-of-use, rapid deployment, and good access to production data. These fall into two categories.

A few, such as Verano and Junot, addressed the integration problem directly, integrating CPM and enterprise applications without the use of EAI software and without custom coding.

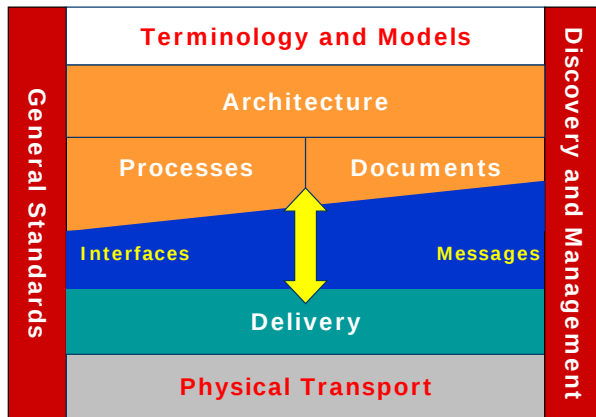
Others, such as IndX, Lighthammer, and EMT (some are discrete industry focused) addressed the visibility aspect of the integration problem. These are not marketed as integration products, but production data aggregation or federation is core to their existence and a strong part of their value.

Integration Standards and Interoperability

Standard Body	Summary and Highlights
ISA	ISA-95 defines the concepts and terminology associated with P2B integration. At this time it does not define documents, interfaces, or communications.
OPC	OPC defines interfaces for Microsoft platforms using COM. The OPC Foundation is adding XML based interfaces.
OAG	OAG support from the discrete industry (automotive) is strong, and has a mature set of integration documents for business.
OASIS	Broad range of activities. ebXML is building a following for communications with partners. Strong support from technology companies.
OMG	The owner of CORBA, UML, and Model Driver Architecture standards. CORBA is no longer stylish but its concepts are a foundation for other standards efforts. UML has momentum for platform independent modeling and software design.
CIDX	CIDX is a chemical industry e-business effort. P2B does not appear to be within scope of CIDX activities.
W3C	Defining many general purpose standards (XML, for example).
ISO/IEC	Very broad range of manufacturing standards, including international version of ISA-95

Noteworthy Standards for Process Industries

Standards are necessary to achieving new business models and controlling cost and complexity. However the standards landscape is very complex with efforts supported by industry groups and supplier groups, as well as official standards bodies. When possible, specifications from formal standards bodies are, of course, preferred. However even de-facto standards are better than closed approaches.



**Integration Strategies Involve
Selection of Complementary Standards**

No single standard or standards body offers a complete solution. Consequently, the development of an integration strategy involves the selection of complementary standards. For example, ISA-95 does not provide interoperability because it does not define the lower levels in the standards stack. Suppliers and end users can look to other bodies to provide these.

While the lower levels of the standards stack can be very generic, the upper levels are very industry specific. Process and discrete industries are quite different in many respects. However, there is ample opportunity for diverse industry groups to leverage each others standardization efforts. This is especially attractive where there are only subtle differences between requirements.

Interoperability Is the Goal

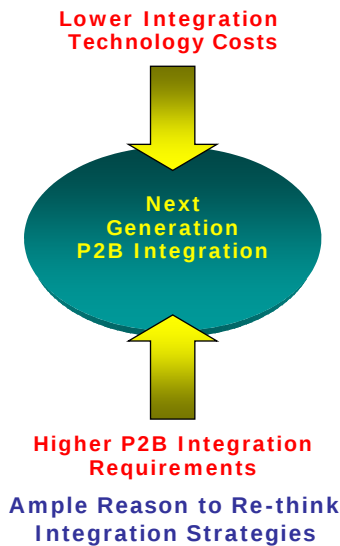
In general, integration refers to pulling together applications so that they work together. Interoperability means that applications from multiple suppliers will communicate out of the box. This requires comprehensive standardization, and certainly will include variations, as for physical layers and delivery methods. From an application viewpoint, the focus must be on technology independent, standardized interfaces and content (documents).

Interoperability efforts are aimed at filling out the complete standards stack. XML is being used everywhere without question. Behind that, Web services over SOAP and other protocols are also common to most efforts, including efforts to update standards that predated XML and Web services.

Interoperability also includes the concept of a standard registry for interfaces, services, protocols, and other information necessary for two applications to communicate — the interfaces to the registry have also been standardized. Registries are a relatively new addition to standards-based infrastructure, eliminating the need to exchange volumes of paper specifications and enabling the automation of interface development.

Trends in P2B Integration

The rise of interest in P2B integration, EAI technology, and architecture is being driven from two directions. First, as itemized in an earlier section, the requirements for integration have been constantly increasing in response to business requirements. Second, there has been strong downward pressure on costs. Lower costs have resulted primarily from:



- Less spending, resulting in tougher negotiation, and more competition for integration software sales
- Commoditization of some integration technologies, partially due to standardization
- Entry of application suppliers and Microsoft into the integration infrastructure markets
- An intense interest in the small and medium businesses (SMB), which require lower and different pricing models

Changes which are being made for SMB businesses are also good for P2B integration: For example, SMBs require lower pricing, ease of use, and scalability in smaller increments. Manufacturing IT requires low cost solutions that can be managed by less technical organizations with tighter budgets than other areas of the business. Until recently, cost and ease-of-use have precluded using enterprise integration solutions and technologies for production. This, combined with the growing complexity of the manufacturing enterprise, is justifying the deployment of more integration technology.

CPM Suppliers Are Looking Forward

The CPM suppliers are good indicators that change is underway relative to integration. The table following shows that all the CPM suppliers are investing in or re-shaping their integration strategies. Traditionally they have offered proprietary solutions or helped with custom integrations. Now they must all consider how they will fit within a manufacturer's chosen integration architecture.

CPM-P Supplier	Key Integration Activity
ABB	Partnership with Accenture, Microsoft, Intel. Developing solutions to integrate ABB's "Industrial IT" with enterprise applications.
AspenTech	"AEP" integration platform built on TIBCO EAI Technology. Delivering integrations with TIBCO tools.
Emerson	Leverages OSIsoft PI Historian, enabling OSIsoft integrations.
Honeywell	Product specific integration solutions, including Business Hiway and POMS Integration Server. Moving toward broader application of XML, Web services and Standards. Microsoft .NET
Invensys	Extending Archestra to the enterprise with collaborative integration platform. Microsoft .NET, Web services, and integration templates.
OSIsoft	RLink Integration with SAP, current integration goes beyond data serving. Delivering support for Service Based Architecture.
Rockwell Automation	FactoryTalk and BizWare (Batch, Historian) connection to ERP.
Siemens	Simatic IT "MES" – SIMATIC IT Production Modeler based integration of CPM and ERP applications.
Yokogawa	"LinkForSAP" integration of Yokogawa CPM with most SAP modules.

Process Industry CPM Supplier Integration Activities Are Picking Up

While suppliers are at various stages of delivering integrations and developing next generation solutions, there are a few key observations that will influence integration strategies:

- Most will define a single integration approach and use it throughout their product lines — this is already happening in other enterprise applications, initially through partnerships with technology suppliers.
- Other CPM suppliers are exposing application functionality as Web services, with the intent of fitting into any end user environment.
- Enterprise application suppliers are eyeing CPM markets as growth opportunities. This is blurring the integration line, as in the case of inventory management.
- EAI and B2B suppliers are getting more interested in manufacturing, but primarily in supply and customer domains. To date there has been little activity or investment in defining the P2B interactions.
- Most enterprise suppliers are heavily involved in standards activities leading to interoperability. Without these standards, they will find it difficult to sell products into environments that have selected strategic infrastructure and products.
- Suppliers are concerned over building on one EAI supplier's technology and would like to be middleware independent.

Drivers for the Next Technical Vision

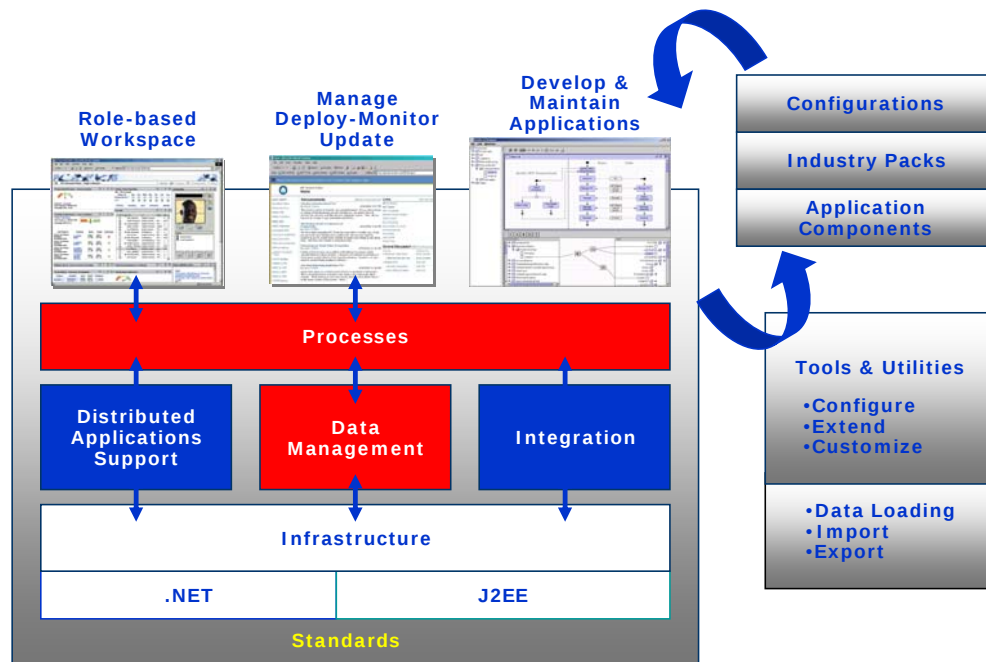
In the midst of rapid change, it is difficult to shape a vision for next generation P2B integration strategies and architectures. However, there are several technical activities that will change the way we do things and shape supplier and manufacturer technology and architecture visions:

Evidence of a Vision

Several technical activities, related to standards and software supplier initiatives, provide fuel for a long term vision. These suggest more flexibility in the way we do things in general, and respond to the needs of the integrated value chain and real-time performance management.

- Modeling at both the functional (business) and design level will offer ways to insulate intellectual property from changes in technology and improve productivity. This is emerging in both business level software development and embedded systems. Model Driven Architecture (MDA) and Model Driver Development (MDD) are the umbrellas commonly used to group this activity.
- Integration is such a common and pressing requirement that it must become part of the normal software development process. Integration concepts such as messaging, Web services, and standard registries are becoming part of the Integrated Development Environments (IDE, such as Microsoft Visual Studio). Furthermore, component-assembly development strategies offer opportunities to make integration easy.
- The industry vision is clearly in the direction of Service Based Architecture (SOA, Service Buses, etc.). These approaches are more flexible and provide faster and cheaper integration through registries and better interoperability. Existing integration tools and technologies and applications are being adapted and will play a role, rather than become obsolete.
- Integration technologies (interfaces, for example) are becoming highly standardized to enable applications to work in a wide variety of environments (infrastructure from different suppliers). Much of the popularity of Java and J2EE comes from its portability and standard interfaces to integration technologies. Microsoft has pulled together all of its technologies in a similar fashion in the .NET Framework.
- Everyone recognizes that the number of legacy systems is constantly building and techniques for including them are key enablers for new approaches and architectures. This is the domain of enterprise integration, adding fuel to the other items in this list.

Long Term Integration Vision



Integration Technologies Must Become Part of the Work Environment

It is tempting to define the future of integration in terms of architecture, buses, messaging, Web services, standards and such. These are certainly the intermediate issues and must be part of corporate strategies. However, the desired end point is that integration does not require special consideration but instead becomes part of an enterprise platform including everything that is needed by various organizations within an enterprise. When multiple platforms are justified — and this is likely — they will be interoperable. A few high priority wishes:

- Application suppliers will deliver functionality as components that can be re-assembled and extended to suit increasingly specialized needs even within vertical industries.
- Manufacturers will use visual tools and modeling to build all applications independent of deployment technology.
- Standards similar to Web services will enable infrastructures (.NET and J2EE) and frameworks to operate together, and provide the levels of security and safety needed by production and business systems.
- Distribution of applications and information will be handled by the environment — of course it must eventually be tied to specific plant hardware.

- A single monitoring and optimization environment will manage the health and security of all applications.

Manufacturers should not wait for this vision to be realized because they can benefit from parts as they are available in commercial products, which are aligned with the long term integration strategy.

Recommendations

Traditionally, it has been acceptable to address integration issues as they come up. As integration activities pick up, this can easily become too ineffective and create long term problems, which consume a business.

- All manufacturers are urged to examine their P2B integration practices, and develop a written strategy to make integration more visible and manageable.
- Many organizations have been following good integration practices, and are in the throes of deciding how to improve them. Moving to the next level of capability typically involves developing an updated standards strategy and deciding how new technology and supplier offerings will impact current practices.
- Integration strategies should be addressed as high as possible in the organization and all stakeholders should be included. This enables an organization to leverage experience across the organization and manage the diversity of tools in the organization as much as possible.
- Most organizations have accumulated custom applications and applications from several suppliers. When adopting a supplier's integration platform, develop plans for integrating those products up front to avoid hidden costs later.
- Participate in standards bodies, especially vertical standards, as much as possible. This will allow you to influence their standardization agendas, as well as collaborate with peers.
- Have a long term vision, but build to interim plans based on available technology and products. Long term vision will keep short term activities aligned in a common direction.

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

ANSI American National Standards Institute	ISA Instrumentation, Systems, and Automation Society
B2B Business-to-Business	ISO Int'l Standards Organization
BPM Business Process Management	IT Information Technology
CPFR Collaborative Planning, Forecasting, and Replenishment	LIMS Laboratory Information Management System
CPM Collaborative Production Management	OLE Object Linking & Embedding
CRM Customer Relationship Management	OMG Object Management Group
EAI Enterprise Application Integration	OPC OLE for Process Control
EAM Enterprise Asset Management	OpX Operational Excellence
EDI Electronic Data Interchange	P2B Production to Business
ERP Enterprise Resource Planning	PLM Product Lifecycle Management
FDA U.S. Food & Drug Administration	QM Quality Management
IDE Integrated Development Environment	RPM Real-time Performance Management
IEC International Electrotechnical Commission	SCM Supply Chain Management
	SMB Small & Medium Businesses
	SOAP Simple Object Access Protocol
	XML eXtensible Markup Language

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