IBM e-business infrastructure
September 2001

Managing e-business integration challenges

e business infrastructure

Key Topics

Understanding the need for e-business integration

Identifying key integration components

Assessing integration requirements at the states of e-business adoption

Readying the infrastructure

Introduction

Some of the most dreaded words in the English language are "assembly required"; gone are the days of being able to simply plug in a mainframe and be up and running. Now, the words "assembly required" often mean integrating countless multivendor systems, networks, applications, middleware, databases and Web technologies into current environments and business units – as well as with customers, suppliers and partners. Ever-changing business processes require changes in internal operations and, ultimately, the corporate culture.

How do companies tackle the challenge of continually integrating to remain competitive as e-business technologies evolve? One approach is to look at integration requirements within the "states of e-business." Focusing on these requirements can help companies continue to use their legacy systems (today's current system can be tomorrow's legacy system) while building an integrated IT infrastructure that can support tomorrow's business goals.

Key integration components

As shown in Figure 1 on page 5, IBM has identified multiple states of e-business based on research conducted with 33,000 customers. Although many companies naturally evolve from one state to the next, this does not have to be the case; different divisions of a company may be implementing IT projects in different states; some may omit certain states, depending on their business process model and the need for customer, partner and supplier integration. As companies implement IT projects using Web technologies within these states, however, there is a common need to continually define certain fundamentals. These are:

- *What is the meaning of the data being shared?*
- *What functions will applications need to transact?*
- *What data is required to make those transactions?*
- *What are the processes required for mutual business activities to occur?*

The role of standards

Adoption of industry standards to help achieve integration is vital when developing or purchasing IT hardware, software and applications. Standards provide a set of services, application program interfaces (routines, protocols and tools for building software applications), and data transmission formats (protocols) that provide the functionality for developing multitiered, Web-based applications. Because standards are platform independent, they are essential if multivendor systems are to communicate within and across enterprises.

Selecting standards can be very challenging. Because it is often not clear which standard may prevail, companies need to consider whether or not a standard is "open." Open standards provide the flexibility to integrate with numerous vendor platforms. The general rule is to select an open standard with critical mass, and if that doesn't work, choose the most open, popular standard available. It is understandable for a company to want to build around a platform because that company has made a substantial investment in it. The trap here is that if the platform is not built using completely open standards, then the company subsequently may have to make substantial investments in order to integrate with other platforms.

As we examine each state, we will look at applicable standards as well as what data, application and process changes are needed to meet integration requirements. As we proceed, companies may wish to consider some of their own IT projects and how they map to integration requirements in each state.

*Please request a copy of our white paper, "Linking security needs to e-business evolution" for a detailed discussion of the security requirements in each state of e-business.**

* This can be obtained by contacting your sales representative.

States of e-business

Figure 1 - States of e-business

State	Description	Integration requirements
Publish	Use the Web for e-mail. Site provides multiple Web pages or non-interactive access to business information.	Web front end to data source • Data integration – limited access • Application integration – none • Standards – simple (HTML)
Transact	Use the Web to execute one-way or two-way transactions against core business systems.	Web front end to core business applications within business units • Data integration – two-way access • Application integration – one-to-one • Standards – optional
Internal integration	Use the Web to improve and/or integrate core business processes.	Cross functional within firm • Data integration – full integration • Application integration – many-to-many • Standards – important
External integration	Use the Web as a means of integrating business processes across enterprise boundaries.	Multifirm within value net • Data integration – multifirm • Application integration – multifirm • Standards – necessary
Digital economy	Use the Web as the foundation for existing in a digital community.	Cross-industry • Data integration – industry-defined • Application integration – industry-defined • Standards – imposed

Publish

Most traditional companies begin their transition toward e-business by providing a Web site, using the Internet for e-mail, or providing non-interactive access to business information. Companies are loosely coupled with their customers and suppliers. A typical Web site has multiple pages with limited use of dynamic content. Common uses include internal and external e-mail, publishing company information, online marketing and read-only catalogs to drive Web-generated sales.

Data integration – Data is moving in one direction, from the company to its Web site pages. Companies need to clearly define data definitions so their messages are clearly understood. For example, if a company ships bulk products by the truckload, it's critical to define the size of those trucks, otherwise miscommunication can occur.

Application integration – In this state, Web applications are not integrated into a company's core business processes, although they may access basic company data.

Process integration – Training of internal company representatives is required so they can respond appropriately to Web inquiries.

Standards – In this state, basic standards for static Web pages are important. These include Hypertext Transfer Protocol (HTTP), Hypertext Markup Language (HTML), Common Gateway Interface (CGI), Java™ servlets, and active server pages. If dynamic content is needed at this state, then a selection may be made between JavaServer Pages™ (JSP), Microsoft® Active Server Pages (ASP), or Hypertext Preprocessor Pages (PHP). (Definitions for standards are given at the end of this paper.)

These Web standards, which are in general use, facilitate communication between disparate systems and applications by providing specifications for data and application interfaces. They facilitate the "plug and play" of disparate systems and applications. Ultimately, using standards can reduce a company's Web development time and support costs, and expedite time-to-market of Web products and services.

Transact

In an effort to use the Web to more directly increase revenue or reduce costs, companies provide the ability to transact business over the Web. In this state, companies begin to provide online sales, online enrollments and other e-commerce activities. Customers can access a company's core IT systems to request information about their relationship to the company. For example, they can inquire about the status of a bank account or actually perform transactions online, such as making payments or buying merchandise through an e-commerce application.

For real efficiency and cost savings to occur, a company's business processes need to be linked. For example, an online sales transaction affects a company's order entry, shipping, billing, collections and manufacturing systems. This drives the need to begin to integrate IT applications and data.

Data integration – Integration at this state means two-way sharing of data. It is important to clearly define and format data so that it can flow seamlessly between sales, financial and manufacturing systems. For example, if a company is communicating with its dealers relative to product sales, all companies involved must have a common definition for "date sold." Currently, that may be the date the order was placed for one subsidiary and the date shipped for another.

Additional requirements at this state center on capturing data about who is using the Web site and what transactions are occurring. This information can then aid companies in personalizing the user experience, creating future market plans, and improving Web site information and logistics. Ultimately, the knowledge gained from data gathered in this state can help companies as they move to be even more customer oriented in later states.

Application integration – Departments or divisions of companies in this state integrate their Web applications with existing applications on a one-to-one basis (e.g., a department's/division's Web order-entry system communicates directly with its internal order-entry system). If the Web and internal order-entry applications have not been integrated, then e-mail can be used to

communicate Web-form information to back-end transaction systems. Web applications need to be modular to separate the front-end Web presentation from the back-end business systems. The requirement for providing transactional integrity begins to introduce component-based development to manage the complete processing of transactions by back-end systems.

One-to-one applications (often referred to as "point solutions") can be a trap. Ultimately, if a company is to improve its customers' experience, it needs to provide one interface for all products and services. If, for example, customers wish to buy cameras, film and processing at one time, they may not remain customers if three separate transactions must be done. The challenge is to begin to think about the next state, which is looking beyond the departmental or divisional viewpoint to integrate data, applications and processes across company organizations.

Process integration – Companies need to implement processes that help make sure that the relevant data in back-end systems is moved to Web applications, including all updates to that data.

Standards – Building on the standards used in previous states, companies begin to use Enterprise JavaBeans™ or similar transaction-control standards. Standards such as Secure Sockets Layer (SSL) facilitate adding security features to Web communications; eXtensible Markup Language (XML) provides flexibility to define formatting commands. For those companies that

use wireless devices to expedite company operations – e.g., delivery services or remote repair operations – then the Wireless Application Protocol (WAP) standard incorporated into applications allows communication between disparate wireless devices. Companies may also want to select a standard application server, such as IBM WebSphere,® that contains features for safeguarding the enterprise and maintaining the state of transactions until they are completed.

Internal integration

In this state, companies are driving changes in business processes and underlying IT technologies. Customers can order products or services online and follow orders through the entire production process. The Web is now being used to improve and integrate core business processes within the enterprise, not just within a single division or department.

Data integration – Companies can take data stored in various organizational databases and integrate that data to create a holistic view of their customers. That integrated data then serves as a powerful differentiator, as companies can tailor products and services to their customers. Data integration expands beyond just data access to include full manipulation, integration and integrity.

Application integration – Applications require integration, but now it is not on a one-to-one basis, but many-to-many. Collaborative applications that incorporate workflow and push technologies are required to support the matrix organization, crossing division and department lines. Workflow and push technology systems allow individuals across an organization to implement successive stages of a process, such as order entry. This may include receiving e-mail to alert them to actions they need to take – e.g., approve a customer's credit.

Process integration – Business processes are supported by application logic on different in-house systems, transparently working together. A change in the corporate culture is occurring, causing a change in business process and employee behavior. Employees are now adapting processes to support application logic that, in turn, supports collaborative applications.

Standards–Standards relevant to this stage include lightweight directory access protocol (LDAP) and X.500 directory services, which provide a common way to define user lists. Message brokering, such as Java messaging services, is important to facilitate reliable communication through asynchronous transmission.

External integration

As companies integrate externally, they begin to look to selected suppliers, partners and customers (value networks) as extensions of their businesses. Collaborative activities, such as product development, are possible as suppliers, engineers, designers and others are able to execute across enterprise boundaries. Functions such as product manufacturing can be coupled with supplier component manufacturing, fulfillment, transportation and logistics.

Application and data integration – Applications may run in a company's customer, partner or supplier enterprise; therefore, applications and data require integrity across company boundaries. Integration is key so that applications and data may be shared across the multiple companies participating in the chain from order entry through manufacturing to shipping (or service delivery), billing and collections. Since it is likely that the companies involved in a supply chain, for example, may have different Enterprise Resource Planning (ERP) systems, then integration is required to control communication, data translation and process interactions between linked supply chain applications.

Process integration – Companies' core business processes are very tightly coupled with their customers, suppliers and partners. These processes are now adapted to communicate across enterprise boundaries to facilitate the business-process chain of activities.

Standards – Standards have expanded to include Simple Object Access Protocol (SOAP), Universal Description, Discovery and Integration (UDDI), and Trading Partner Agreement Markup Language (tpaML). The purpose of these standards is to allow enterprises to obtain information from any Web application. In the internal integration state companies may elect to build their own one-off connectors between internal and Web applications. In this state, because of the broad range of applications and systems that can exist among enterprises, standards are essential.

Digital economy

Very few companies fully participate in the digital economy. In this state, business processes are supported by applications that are created dynamically from components developed either in-house or sourced externally in realtime. A company's core competencies are coupled dynamically with the core competencies of other companies, resulting in a superior end product. Through external collaboration and knowledge management, intelligent choices are made to acquire IT services and to link to providers of IT function.

One way to think about the digital economy is to start with the common, essential processes that companies perform – order processing, invoicing, collections, payroll, benefits, etc. Standard components for the universal functions of these processes may be created and made a part of the business infrastructure. The advantage is that companies will not only be able to effectively collaborate dynamically, but more of a company's limited resources can go into accomplishing business goals, e.g., expanding into new markets or introducing new business models that provide a competitive edge.

Evolution to this state is unlikely if open standards have not been deployed. The expectation is much the same as our thinking about electricity – we flip a switch and we have light. The underlying infrastructure is invisible to us. In the case of IT technology, applications will execute because the digital infrastructure is in place to allow the application and system components to come together and conduct the business process.

Data integration – If a company does not keep its internal data in standard external form, it won't be able to collaborate effectively. If it does collaborate, it will need to invest in massive programming efforts.

Application integration –Applications should have standardized interfaces. Wherever possible, these interfaces should be extensible so required changes can be implemented transparently.

Process integration – Processes and people interaction will become more standardized. Companies' cultures will develop to incorporate the actions of many, extending from collaborations that are already occurring today at the industry level – e.g., electronic business-to-business exchanges.

Standards – Standards are likely to be required by law. Standards adhered to, in addition to those identified in the previous states, include Web Services Description Language (WSDL), Electronic Business eXtensible Markup Language (ebXML), Transaction Authority Markup Language (XAML), and Trading Partner Agreement Markup Language (tpaML). All of these standards serve to extend the ability of companies to develop applications that can communicate universally.

Readying the infrastructure

What are some of the principles to apply as you assess your current infrastructure and look to expand/incorporate Web technologies in the five states? Below are some general suggestions. Please see the bibliography at the end of this paper for additional, in-depth materials.

Create an overall IT infrastructure blueprint by identifying functional component requirements. This blueprint will serve as a living document that will change as the technology and business environment changes. Select your Web technologies within the context of this overall infrastructure blueprint. As part of that blueprint, plan for scalability so that your infrastructure can effectively manage the many interactions that will occur between internal and external systems.

Deploy and reuse modular components
The use of objects in code and other modular components can assist in lowering costs (through reuse), speeding development, and creating standards for integration (commonality). Whether building or buying IT components, companies should investigate tools that allow these components to be created from smaller building blocks. This applies to everything from developing applications to multiapplication systems.

Integrate security into architectural elements
Ideally, security features are built in from the start. Security as an add-on component can lead to a never-ending struggle to fix and repair. The goal is to balance accessibility and ease-of-use with protection of assets.

Strive for universal access to information
Security and modular components come together to enable the dream of universal access. Layering of security mechanisms, rather than putting trust in firewalls or other single elements of security, makes it easier to provide different levels of participation. Thus, the appropriate amount of access (not too much, not too little) is granted. The use of modular components makes it possible to reach cell phones, PDAs, pagers and other devices; and to personalize access for people who speak different languages, have different style preferences or prioritize information in a variety of ways.

Use off-the-shelf solutions where feasible
Off-the-shelf solutions can be viewed as a form of de facto standardization. If a large community uses the same solutions, then that facilitates interoperability. It reduces the need for company programming staffs to code software solutions to obtain application and systems integration.

Focus on return on investment (ROI) in planning and assessing integration solutions
To help ensure adequate funding, IT management needs to effectively communicate to executive management the tangible and intangible benefits of integration projects. This is especially true in the later states. In these states, executive management sets the business strategies that will ultimately be translated into IT infrastructure initiatives and resulting integration projects. For more information, please refer to our white paper, "Optimizing IT Infrastructure Return on Investment," a case study describing the use of our ROI methodology.*

* This can be obtained by contacting your sales representative

Summary

As companies expand their business universe to become part of the digital economy, they need to share information and work collaboratively with an increasingly larger community of companies – including customers, suppliers, partners, exchanges and currently undefined "others." By focusing on the integration aspects discussed in this paper, organizations can continue to use their legacy systems while moving toward facilitating data sharing and collaborative business processes. Ultimately, a far-reaching view of integration is key to creating an IT environment that can support companies in achieving their business goals, enabling them to operate in new ways to exploit business offerings.

Bibliography

The following online resources represent a large knowledge base of IBM technical research and practical experience relative to overcoming the challenges discussed in this white paper. Although the online "Patterns of e-business" materials approach the problem initially from a different viewpoint, they quickly delve into the "how to's" of integration from a deliberate platform-independent viewpoint.

These patterns can be used and reused by IT staff to guide them through their available choices. They are intended to cover:

- *The business process the system must deliver*
- *The business and IT drivers that affect the choice of both process and solution*
- *The application patterns and their logical components that are best suited to delivering the process*
- *The runtime patterns and actual technology required to make the application pattern work*

Patterns for e-business – homepage: A portal for information on reusable assets that can help speed the process of developing applications:

ibm.com/developerworks/patterns/

Patterns for e-business – library index: A listing of available resources – redbooks, analyst reports, white papers, Webcasts, etc., – for understanding "Patterns for e-business":

ibm.com/developerworks/patterns/library/index.html

Included in "Patterns" are the following relevant materials:

• *Patterns for e-business; Lessons learned from building successful e-business applications*
ibm.com/developerworks/library/lessons/

• *Patterns for e-business: A Strategy for reuse*
http://www.iirpubs.com/ibmpress/5206.cfm

• *e-business Architecture – Build your scalable e-business solutions quickly*
http://webevents.broadcast.com/ibm/developer/051601/home.asp

Definitions of standards

ASP (Active Server Pages) – a Microsoft-developed specification for a dynamically created Web page that utilizes ActiveX scripting. When a browser requests an ASP page, a Web server generates a page with HTML code and sends it back to the browser. ASP pages let Visual Basic programmers work with familiar tools.

CGI(Common Gateway Interface) – a specification for transferring information between a Web server and a CGI program. A CGI program is any program designed to accept and return data that conforms to the CGI specification. CGI programs are the most common way for Web servers to interact dynamically with users. Many HTML pages that contain forms use a CGI program to process the form's data once it's submitted.

EbXML (Electronic business eXtensible Markup Language) – a modular suite of specifications for standardizing XML in order to facilitate trade between organizations regardless of size. The specification gives businesses a standard method to exchange XML-based business messages, conduct trading relationships, communicate data in common terms, and define and register business processes.

EJB (Enterprise JavaBeans) – is an application program interface developed by Sun™ Microsystems that defines a component architecture for multitier client server systems. EJB systems allow developers to focus on business architecture, rather than worry about endless amounts of programming and coding needed to connect all the working parts. This task is left to EJB server vendors. Developers just design (or purchase) the needed EJB components and arrange them on the server with little or no recompiling and configuring.

HTML (HyperText Markup Language) – the authoring language used to create Web documents. HTML defines the structure and layout of a Web document.

HTTP (HyperText Transfer Protocol) – a Web protocol that defines how messages are formatted and transmitted, and what actions Web servers and browsers take in response to various commands. For example, upon entering a URL in a browser, an HTTP command is sent to the Web server directing it to fetch and transmit the requested Web page.

Java – a platform-independent, vendor-neutral general purpose programming language developed by Sun Microsystems. Small Java applications are called *Java applets* and can be downloaded from a Web server and run on Java-compatible browsers such as Netscape Navigator or Microsoft Internet Explorer.

Java servlet – a Java applet that runs in a Web server environment. Java servlets are becoming increasingly popular as an alternative to CGI programs. Unlike CGI, once a servlet starts to run it stays in memory and can fulfill multiple requests, allowing it to run faster than a CGI program.

JSP (JavaServer Pages) – JSPs are extensions to the Java servlet technology that have dynamic scripting capabilities such that page logic is separate from the actual design and display of the page. Embedded in the HTML page, the Java source code and its extensions help make HTML more functional, for example when performing dynamic database queries.

LDAP (Lightweight Directory Access Protocol) – a set of open protocols for accessing information directories. Although not yet widely implemented, the intent of LDAP is to allow almost any application running on virtually any computer platform to obtain directory information, such as e-mail addresses and security public keys.

PHP (Hypertext Preprocessor) – a server, HTML-embedded scripting language used to create dynamic Web pages. It is compatible with many databases and is shipped standard with a number of software packages, including RedHat Linux.

SOAP (Simple Object Access Protocol) – provides a way for applications to communicate with each other over the Internet, regardless of platform. SOAP uses XML to define information formats and then adds the necessary HTTP headers to send it.

SSL (Secure Sockets Layer) – a Netscape-developed protocol for sending private documents over the Internet. SSL uses a public key to encrypt data that's transferred over the SSL connection. Many Web sites use the protocol to obtain confidential user information, such as credit card numbers. By convention, Web pages that require an SSL connection start with https instead of http.

TpaML (Trading Partner Markup Language) – a vendor-neutral specification based on XML services that provides a common language for trading partner communication.

UDDI (Universal Description, Discovery and Integration) – a Web-based distributed directory that enables businesses to list themselves on the Internet and discover each other, similar to a traditional phone book's yellow and white pages.

XAML (Transaction Authority Markup Language) – a vendor-neutral standard that allows the coordination and processing of online transactions. It defines a set of message formats and interaction models that Web services can use for business transactions among multiple parties on the Internet.

XML (eXtensible Markup Language) – a specification designed especially for Web documents. It allows designers to create their own customized formatting commands, enabling the definition, transmission, validation and interpretation of data between applications and between organizations.

WAP (Wireless Application Protocol) – a security specification that allows users to access information instantly via handheld wireless devices such as mobile phones, pagers, two-way radios, smartphones and communicators.

WDSL (Web Services Description Language) – an XML-formatted language that describes a Web service's capabilities in terms of communication endpoints capable of exchanging messages. WSDL is an integral part of UDDI; it is the language that UDDI uses.

Find out more

To learn more about IBM e-business infrastructure products and solutions, please visit the following Web sites:

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Printed in the United States of America
09-01

G565-1057-00