Expansion of EAI Technology

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These days, companies need information systems that can quickly adapt to the constantly changing business environment. One of the technologies for meeting this need is Enterprise Application Integration (EAI). EAI can provide an infrastructure for promptly establishing a link between business applications according to a business process. However, to quickly respond to changes, it is first necessary to detect those changes by analyzing and evaluating business activities. Therefore, to realize an information system that can respond to changes more quickly, a new technology called Business Process Management (BPM) has been added to EAI so it can also be used to analyze and evaluate business activities. BPM is now the principal technology of EAI, and it is already being used in enterprise front-ends, which are heavily dependent on human workflows.

1. Introduction

The advent of open systems such as UNIX and the PC facilitated the use of IT and contributed enormously to the advancement of informatization in the business world. As a result, many companies have installed information systems in each of their divisions. Because these are standalone information systems that were introduced to achieve local solutions, it is important to integrate them organically and use them to optimize the activities of an entire company. Packaged business software such as Enterprise Resource Planning (ERP) is an effective option for system integration. In some companies, however, there are a lot of systems that cannot be integrated using such packaged business software.

Enterprise Application Integration (EAI) technology is a system integration solution that quickly and seamlessly integrates the business applications in a system. However, companies are experiencing amazing changes in the business environment. For example, the lifecycle of products is getting shorter day by day. To keep up with this change, it is not enough to just link business applications together. Instead, it is also necessary to reform the workflow (business processes) by using a set of business applications that, for example, eliminate bottlenecks and simplify business by sharing processes between divisions.

The technology targeted for this business process reform is Business Process Management (BPM). BPM is an approach to using IT united with the concept of the PDCA (Plan, Do, Check, Action) cycle, which consists of planning, implementation, quantitative evaluation, and feedback of results for optimizing company activities. We have realized EAI/BPM using Fujitsu's Interstage integration middleware.

This paper outlines EAI and BPM and describes the relation between EAI and BPM from the functional point of view. Next, it describes the EAI/BPM solution offered by Interstage and the Interstage CollaborationRing, which is the core product of Interstage. Finally, it shows how BPM technology is being used in an actual application.

2. Advent of EAI and its main technologies

EAI is a technology for realizing data sharing without restriction between business applications and databases in a network. The word "Integration" in "Enterprise Application Integration" means seamless interlinkage between applications using data.

EAI can be regarded as a response to the progress in distributed computing and open information systems. In the era of mainframe central computing, services were carried out by many business applications mutually cooperating in a single general-purpose computer called a mainframe. Then, the client-server type system appeared and various server systems were constructed around a mainframe so they could use its data. This brought the need for stronger linkages between servers and between servers and mainframes (e.g., improvement in data freshness). There are three main considerations when strengthening these linkages:

1) Generally, there is more than one target system.
2) Because the target systems are already in use, they should be connected with as few reconfigurations as possible.
3) The linkage should be performed in real time to speed up business activities.

To meet these requirements, a new integration system called the hub-and-spoke was introduced. In this system, data flow is controlled in a unified way by part of the hub and differences in the data formats of information systems are absorbed by conversion. This allows quick linkage between different information systems with minimum reconfiguration and is the system used to achieve EAI.

EAI provides three key features (**Figure 1**): hubs (also called brokers), adapters, and process automation. The hubs form the infrastructure for highly adaptable information systems. The adapters enable speedy data sharing by using the existing system as is. Lastly, EAI's process automation links business applications according to a business process and automate execution of a series of business applications. The following is a more detailed description of EAI's effects.

1) Realization of a highly adaptable infrastructure

In a conventional integration system, which directly links information systems, each system must be changed simultaneously, because a change in one system inevitably influences the others.

On the other hand, in EAI, which remotely links information systems via a hub, only the links with the hub need to be considered, because all the interface operations with the other systems

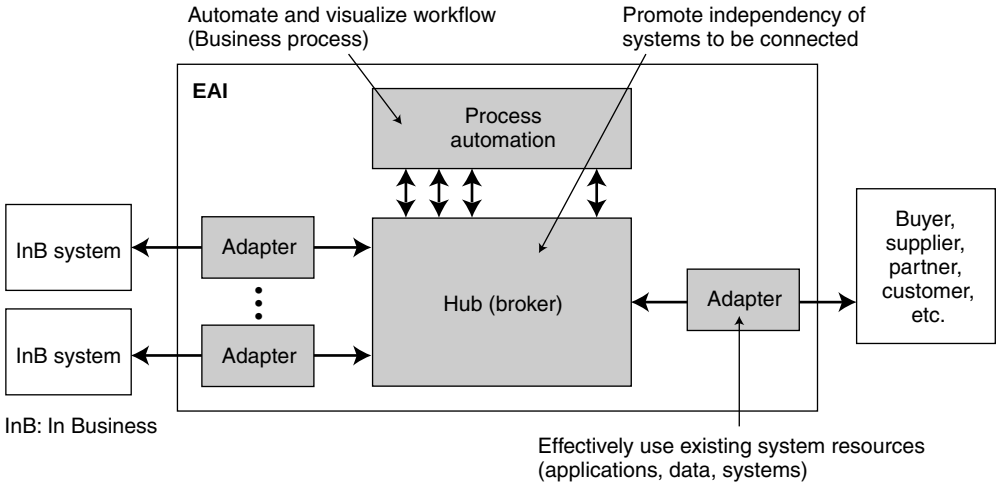

Figure 1
Key features of EAI.

are performed by the hub. For example, when updating an entire information system, related systems can be changed step-by-step instead of simultaneously and the work needed to make the changes can be reduced (the hub can absorb the temporary interface differences caused by the changes). Thus, the system can respond flexibly to various changes in company activity, for example, additions and changes to business applications and the acquisition of new customers.

2) Speedy data sharing using existing systems

Adapters connect an existing information system with a hub using a linkage method that the system already uses, for example, file transfer or message transmission. It also provides a service for communication processing with a partner information system and a data conversion service for passing communication through an adapter. Furthermore, it provides an administrative service that, for example, resends data when communication with a partner information system fails.

The data conversion service changes the data format so a partner information system can read the data to be transmitted. The functions provided by the data conversion service include the following:

- Conversion between standard formats such as CII,[1] EDIFACT,[2] and RosettaNet and also between Extensible Markup Language (XML), Comma Separated Value (CSV), and company-original formats
- Sorting, partitioning, and combining of data items; changing of data item lengths; and other data item manipulations
- Conversion between data item values of different data item types (e.g., conversion from product codes to product names)

These adapter functions make it easy to link between information systems and integrate a new information system with an existing one. They therefore make it easy to start business with a new customer and can add value to information systems.

3) Work automation according to a business process

The process automation function provided by EAI connects business applications according to a business process in a company and automates their execution. It can also respond to the need to integrate human processes such as reviews and approvals, which up to now have been coordinated by humans. Moreover, it enables a business process to be defined as a workflow, an application flow, or a combination of both, which makes it possible to change a business process by changing its flow definition.

3. From EAI to BPM

As mentioned above, EAI offers a new infrastructure that simplifies and promotes the integration of all the activities and information of a company. By concentrating all the integration tasks in a single hub, the so-called "spaghetti state" can be eliminated. Also, by minimizing the development work required for this integration, it can be achieved earlier and the associated cost can be reduced. Furthermore, because all the data flows into a hub, it can easily be collected and used for company activities. The integration infrastructure provided by EAI, therefore, can be used as an infrastructure for management.

Based on this idea, BPM can be used to raise the analysis and evaluation capabilities of businesses. For example, BPM provides an index for business process reforms and facilitates evaluation of their results. BPM's main functions are to 1) gather and monitor information and 2) analyze and evaluate the information required to speed up the PDCA cycle for process innovation. By using EAI, independent information systems and business applications can be interconnected and then the data required for analysis can be collected and analyzed (**Figure 2**).

We now give a more detailed consideration of the influence of BPM on company activities.

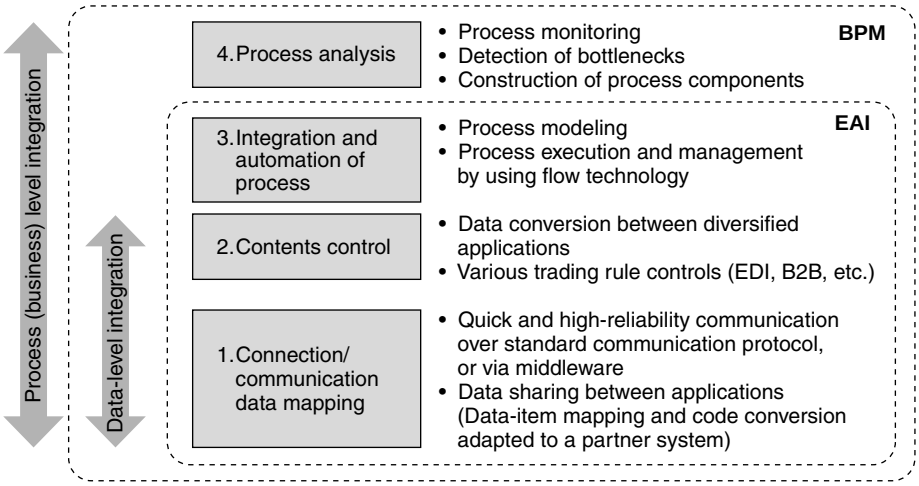

Figure 2
Operation of BPM and EAI from functional viewpoint.

1) Realization of service (process) oriented system configuration

In a conventional application development, the first task is to describe the business process and then determine the execution sequences for the applications. Therefore, when a business process changes, the applications must be changed as well. On the other hand, BPM can provide a single service by means of a business process that combines internal and external business applications.

For future business constructions, much anticipation has arisen for a method that can freely combine and use individual operating processes by wrapping and publishing them using Web services. BPM technology can be used to realize such a method by acting like an adhesive that connects systems to Web services.

2) Improvement in satisfaction level of employees and customers

By monitoring daily company activities, BPM provides decision-makers at the work front (e.g., managers and customer service clerks) with a window on business processes. Therefore, it helps them to distribute work, reply to customer complaints, and take other actions, which improves the satisfaction level of employees and customers.

3) Contribution to optimization of all company activities

Daily accumulation of the business results produced at the work front can speed up the PDCA cycle for optimizing an entire company. More accurate evaluations can be made by analyzing the activity records recorded in real time in combination with the results of conventional quantitative analysis using a data warehouse (DWH).

4. Interstage

Interstage is a Fujitsu software platform that supports company informatization based on the international and industry open standard technologies of the Web, for example, Java, CORBA, and XML. It integrates various information systems and realizes a real-time business environment. Fujitsu built the EAI/BPM solution using Interstage[3] (**Figure 3**).

Interstage is a suite of middleware products. The main products are as follows.

1) Interstage CollaborationRing

This is a core product of the EAI/BPM environment realized by Interstage. It provides the characteristic features of EAI such as an adapter, hub, and process automation as shown in Figure 1. It also monitors and displays the status of business processes.

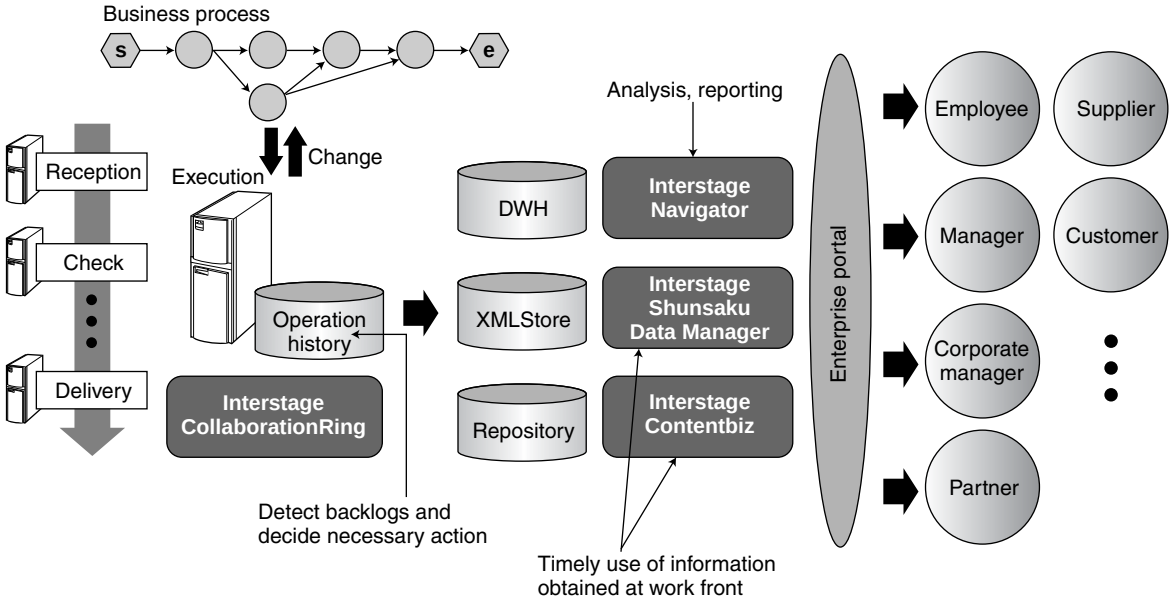

Figure 3
Solution achieved using Interstage.
Realization of flexible information system that can detect changes and quickly respond to them.

2) Interstage Navigator

This product has an OLAP (Online Analytical Processing) function that is used, for example, to analyze and report business activities. Daily results can be managed based on the information collected by Interstage CollaborationRing. It also makes it possible to change a business process based on this information.

3) Interstage Shunsaku Data Manager

This is an XML type database engine that accumulates data in the form of XML documents so it can be easily searched. It features fixed-speed searching, regardless of the number of criteria and users, which means that data at any location in a company can be used at the work front in real time.

4) Interstage Contentbiz

This product provides a repository function by which company information and its relationships with other information can be managed. By using these relationships as knowledge, a wide range of information distributed throughout a network can be used to analyze company activities.

Next, we introduce the features of Interstage CollaborationRing, which is the core of an EAI/BPM solution.

1) Widely applicable integration ability

Companies use various operating applications and packages and also deal with each other in different ways. These diversified integration approaches are indispensable for future business process innovation. Interstage CollaborationRing offers various integration methods, for example:

- A variety of communication protocols such as Web, Simple Mail Transfer Protocol (SMTP), and File Transfer Protocol (FTP)
- Middleware to link between systems, for example, Common Object Request Broker Architecture (CORBA) and Message Oriented Middleware (MOM)
- Business package products such as ERP and Customer Relationship Management (CRM)
- Various trading protocols currently in use, for example, Electronic Data Interchange (EDI) and Business to Business (B2B) protocols such as Rosettanet and Electronic Business XML (ebXML)
- Web services, for example, Simple Object Access Protocol (SOAP), Web Services Description Language (WSDL), and Universal Description, Discovery and Integration

(UDDI)

Interstage CollaborationRing, therefore, can respond to the broad requirements of integration.

2) Response to diversified business processes

Interstage CollaborationRing can integrate various processes, for example, an application flow, a human workflow, or a public process between companies. Especially, regarding human workflows, a sensitive response function is prepared to meet the functional requirements peculiar to human systems, for example, performance by a substitute authority and issue review. Furthermore, EAI makes it easy to realize a seamless interlinkage between a human workflow and external systems. Consequently, even if a company's operations are heavily dependent on processing by humans, it becomes possible to unify them into a single business process and then automate it.

For the definition of business processes, not only a GUI but also XML and Universal Modeling Language (UML) are provided. Therefore, Interstage CollaborationRing can easily cooperate with various business process definition tools that use XML or UML.

3) Outstanding ability to analyze processes

To dynamically recombine business processes in response to changes in the external environment, a company must be able to rigorously analyze data in real time. Because Interstage CollaborationRing makes the operation status of business processes available by using analysis and reference tools such as Interstage Navigator and Interstage Shunsaku Data Manager, information can be shared and used not only within a specific staff division but also throughout an entire company and centered on the work front.

4) High performance and high reliability

By providing a robust Online Transaction Processing (OLTP) function, Interstage CollaborationRing has realized high performance and high reliability. Stable performance can be guaranteed, even when there is a temporarily heavy load or when a large-scale system is being operated.

5. Example application

At present, the favored approach in BPM is to reform front-end work, which consists mainly of human activities. The reasons for this are that it is comparatively easy to do and sometimes the cost effects are quickly realized. Among others, the main goals of this reform are to reduce the workload of the person in charge by automating operations, detect bottlenecks (caused, e.g., by work backlogs) at an early stage, share information between processes, and optimize personnel assignments. **Figure 4** shows an example in which Interstage CollaborationRing and Interstage Navigator are used to optimize the staff of a company.

Using Interstage CollaborationRing, activities at the work front can be defined as a business process and the relationship between a task and the person in charge can be determined from the process execution status. Then, based on this information, the required action can be taken without placing an excessive workload on specific individuals. Also, Interstage CollaborationRing clearly indicates the process status in other groups, so requests for temporary loans of additional personnel from other groups can be handled smoothly. Furthermore, Interstage Navigator can be used to accumulate the records of an operating process during a specified period and make an overall analysis of them so an effective long-term staff assignment plan can be drawn up.

6. Conclusion

BPM technology improves and enhances a company's ability to analyze and evaluate its company activities. It makes visible many of the invisible areas of company activity and enables quick detection of changes in the business environment. By enabling an operating process to be reorganized at the opportune moment, BPM technology can improve a company's flexibility and

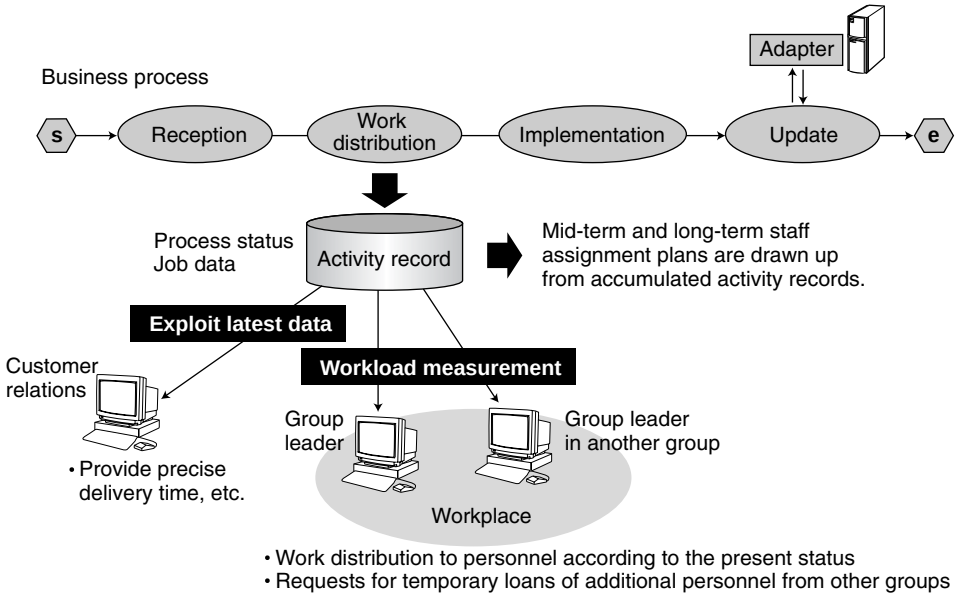

Figure 4
Example application.
Integrate individual operations into a single business process and optimize the work distribution to the personnel based on the process status.

response speed, which will become critical factors in the near future.

BPM is being introduced in the front-ends of companies, where its effects can easily be seen, and it is expected to eventually spread to all business processes, including back-end systems.

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