
ENTERPRISE APPLICATION INTEGRATION - AN OVERVIEW

Prepared By



TABLE OF CONTENTS

1.	ABOUT EAI	3
2.	REASONS FOR EMERGENCE OF EAI	3
3.	ADVANTAGES OF IMPLEMENTING EAI	4
4.	EAI FUNCTIONING	4
5.	EAI TECHNOLOGY	4
5.1.	TRENDS	4
5.1.1.	POINT-TO-POINT INTERFACES	4
5.1.2.	INTEGRATION WITH PACKAGED INTEGRATION BROKERS	5
5.2.	EAI TOOLS/ PRODUCTS	5
5.2.1.	DATA LEVEL PRODUCTS	5
5.2.1.1.	CODE GENERATORS	5
5.2.1.2.	TRANSFORMATION ENGINES/ HUBS	6
5.2.1.3.	DATA WAREHOUSE AND DATA MART LOADERS	6
5.2.2.	BUSINESS MODEL LEVEL PRODUCTS	6
5.3.	EAI SOLUTION TYPES	6
5.4.	OSI MODEL FOR EAI	7
6.	EAI ARCHITECTURE	7
6.1.	LAYERS OF EAI	8
6.1.1.	COMMUNICATIONS	8
6.1.2.	ROUTING AND BROKERING	8
6.1.3.	BUSINESS INTELLIGENCE	8
6.2.	EAI SOFTWARE TOPOLOGY	8
6.2.1.	TYPES OF SOFTWARE TOPOLOGY	8
6.2.1.1.	HUB/ STAR TOPOLOGY	8
6.2.1.2.	BUS TOPOLOGY	9
6.2.1.3.	POINT-TO-POINT TOPOLOGY	9
6.2.1.4.	PIPELINE TOPOLOGY	9
6.2.1.5.	NETWORK TOPOLOGY	9
7.	EAI SOLUTION	9
7.1.	REQUIREMENTS FOR EFFECTIVE EAI SOLUTION	9
7.2.	EAI SOFTWARE FLEXIBILITY	9
7.2.1.	BUSINESS PROCESS SUPPORT	10
7.2.2.	TRANSPORTATION	10
7.2.3.	SERVICES	10
7.2.4.	INTERFACES	10
7.2.5.	TRANSFORMATION	10
8.	EAI SOLUTION EVALUTION	10
8.1.	CRITERIA FOR SELECTION	10
8.2.	EAI SOLUTION EVALUTION METHODOLOGY	10
8.2.1.	ADAPTER/ CONNECTOR FIT	11
8.2.2.	TOOLS PRODUCTIVITY/ QUALITY	11
8.2.3.	RUNTIME QUALITY/ SCALABILITY	11
8.2.4.	RUNTIME FIT TO PURPOSE	11
8.2.5.	BUSINESS PROCESS SUPPORT	11
8.2.6.	INTEGRATOR RESOURCES	11
8.2.7.	PURCHASE AND OWNERSHIP COST	11
9.	EAI SOFTWARE CHECKLIST	11
9.1.	TOPOLOGY INDEPENDENCE	12
9.2.	SUPPORT FOR MULTIPLE OPERATING SYSTEMS	12
9.3.	SUPPORT FOR MULTIPLE MIDDLEWARE SYSTEMS	12
9.4.	CONNECTIVITY TO DATABASES AND FILES	12
9.5.	CONTENT- BASED APPLICATION ADAPTERS	12
9.6.	PROCESS FLOW CONTROL	12
9.7.	EVENT COORDINATION AND MANAGEMENT	12
9.8.	INTEGRATION WITHOUT PROGRAMMING	12
9.9.	HIGH PERFORMANCE	12
9.10.	PROVEN IMPLEMENTATION	12
10.	EAI MARKET SEGMENTATION	12
10.1.	PLATFORM INTEGRATION	12
10.2.	DATA INTEGRATION	13
10.3.	COMPONENT INTEGRATION	13
10.4.	APPLICATION INTEGRATION	13
10.5.	PROCESS INTEGRATION	13
11.	EAI IMPLEMENTATION:	13
11.1.	DATABASE LINKING	13
11.2.	APPLICATION LINKING	14
11.3.	DATA WAREHOUSING	14
11.4.	COMMON VIRTUAL SYSTSEM	14
12.	TYPES OF EAI	14
12.1.	DATA LEVEL	14
12.2.	BUSINESS MODEL LEVEL	14
12.2.1.	APPLICATION PROGRAM INTERFACE LEVEL	14
12.2.2.	METHOD LEVEL	14
12.2.3.	USER INTERFACE LEVEL	14
13.	EAI IMPLENTATION COSTS AND ROI:	14

1. ABOUT EAI

EAI solutions provide an integrated approach to connecting the different components of IT infrastructure- people, applications, platforms and databases to enable secure, intra and inter enterprise collaboration. EAI solutions enable an organization to integrate business processes internally and externally with business partners to create dynamic environments that support current and evolving business requirements, thereby creating a global organization.

EAI assists in unrestricted sharing of data and business processes among any connected applications or data sources in the enterprise without making major changes to the applications or data structures. EAI integrates multiple, independently developed applications using incompatible technologies into a single enterprise wide system with information flowing seamlessly.

2. REASONS FOR EMERGENCE OF EAI

The reasons for emergence of EAI need are varied. Efforts by the leading Enterprise Business Application Suppliers seeking to establish themselves as the primary provider of the business and the IT backbone that supports the enterprise's operations. But the core driving forces behind EAI is of following categories, which are within themselves inter-related.

- **Mergers & Acquisitions**

Mergers &/ or Acquisitions to be successful require overnight integration of dissimilar business processes of two or more companies, so that they can work as a single corporation. EAI is the only solution, which will enable such a rapid integration

- **E- Business**

E-business requires connecting of customers, suppliers and partners across the world, so as to form an integrated value and supply chain over the Internet

- **Industry regulation & de-regulation**

Opening up of business processes to share information and allow market access requires information to flow transparently and seamlessly both externally and internally.

- **Business Process Automation**

Business Process Automation requires new products and services to be integrated with already existent applications so as to improve efficiency, operating costs and customer services across an organization.

- **Growth in implementation of ERP packages**

ERP vendors are coming up with a product line complete with interfaces/ adapters to assist the ERP solution to be integrated with other applications as they have realized that ERP solutions to be effective should be integrated with the back end legacy applications.

- **Supply Chain Management & Customer Relationship Management**

There is a movement towards virtual enterprise linking application systems from various companies in the supply chain. Significant developments in peer to peer networking and distributed processing have made it possible for businesses to integrate better their own functional departments as well as integrate with their partners and suppliers for better SCM & CRM. Re-engineering of business processes by organizations for greater customer focus requires close cooperation between standalone applications.

- **Zero Latency Enterprise**

Zero latency enterprise refers to an organization that can change its business rules in real time to act on new market opportunities and customer demands. An enterprise application integration solution accelerates responses and facilitates business changes in the zero latency enterprise.

- **Reduction of business process life cycle**

In the today's competitive business environment the need to align business systems with business goals is all the more a reality. Business processes evolve continuously requiring new methods and data, which in turn require integration with the existing ones. These new applications should start operations quickly moving IT management to shorter application lifecycles. This is made possible because of EAI solutions which help in integrating different applications and also assist in changing the business rules as required in minimum amount of time.

- **Intranet/ internet explosion**

The Intranet/ Internet explosion is leading to surge in the demand for a new class of human active applications that require integration with back end legacy applications. This feature again is enabled by EAI solution which can integrated the front end and back end applications.

3. ADVANTAGES OF IMPLEMENTING EAI

- Assists in Supply Chain Management and has the ability to adapt to business changes like Mergers and Acquisitions as it unifies/ integrates applications in no time
- Presents user applications with an unified view of information for better decision making thereby achieving cross system consistency.
- Assists in formation of Zero Latency Enterprise - when all functions within the organization work with the same up-to-data information, latency between applications is eliminated/ reduced.
- Updating and integrating of applications is possible whenever required. New applications can be created by integrating real time data from different parts of the enterprise
- Assists in rapid business process change
- Enables creation of virtual corporations with virtual supply chains and operations through sharing of data beyond the organization
- Makes possible for legacy or proprietary systems to function on web
- Enhancements to standard applications can be made rapidly

4. EAI FUNCTIONING

The EAI solution works at both data level and business process level and assists in sharing data of different applications. This sharing of data involves different types business process depending on the type of data sharing involved.

The various logical steps for data sharing are as given below:

- i. Unload raw data from source database
- ii. Validate raw data against source business model
- iii. Transform source business model data into target business data
- iv. Validate business data against target business model
- v. Load data into Target database

The various integration processes are as follows:

- i. Data to data
- ii. Business model to business model
- iii. Business Model to data model
- iv. Data model to business model

5. EAI TECHNOLOGY

5.1. TRENDS

The initial focus of EAI was at the data-level i.e., moving or replicating data among databases, but it is evolving into business process automation. The present EAI technology is different to the earlier EAI solutions as its focus is on integrating enterprise applications and not data or assortment of different application types. Also the EAI solution can be reused for many other needs, not just on the same platform but also across heterogeneous platforms and networks and between multiple suppliers' packaged applications. The other differences in the past and present EAI solutions are that the integration is now at business process and practices level, not at application level or database level and the middleware is transparent to the user, so specific expertise in particular application-infrastructure technologies not required.

The Enterprise Application Integration trends are as follows:

- i. Point-to-point Interfaces
- ii. Integration with Packaged integration brokers

5.1.1. POINT-TO-POINT INTERFACES

The traditional approach to integration is creation of point-to-point interfaces. The integration is handled through tools like extract programs, file transfers and update programs with screen-scraping tools/ messaging system/ TCP/ IP socket connections. But good documentation is required for further integration or for incorporating changes. Disadvantages/ constraints:

- i. If the number applications connected are many this leads to inter application spaghetti.
- ii. The approach is labor intensive and involves high cost and risk. It also does not assist if applications need to be changed or added.
- iii. The maintenance costs are also huge.

5.1.2. INTEGRATION WITH PACKAGED INTEGRATION BROKERS

Integration brokers/ message brokers are a type of high-level middleware. They work as follows:

- i. Data level integration assists in accessing and updating of data in different applications by directly accessing the source and target applications' data either in files or database management systems.
- ii. Program level integration invokes existing application code to implicitly access the target application's data.

Tasks performed by Integration brokers:

- i. **Interfacing**-to move data to and fro applications
- ii. **Transforming**-to convert the semantic content of the data
- iii. **Distributing**-to move data between applications
- iv. **Routing**-to determine the destination of the data
- v. **Managing**-to instrument the process and provide a toolset to support operator control of the process.

Characteristics of Message broker/ Integration Broker:

- i. Scalability-
 - a. For content based and subject based routing
 - b. For incrementing applications
- ii. Advanced team development and management development capability-version control, source code management etc
- iii. Handle batch as well as near real time integrations
- iv. Handle integration of mainframe as well as client/ server capability
- v. Low to moderate learning curve
- vi. Strong service and support capabilities to assist with project management
- vii. Vendor reputation

5.2. EAI TOOLS/ PRODUCTS

There are many types of products that have one or more functionalities of EAI. These are MOM systems, publish/subscribe systems, Transaction Processing monitors, application servers, data warehouse and data mart systems and logical integration systems. On the basis of the level of integration the tools perform the EAI solutions can be broadly categorized into Data level products and Business Model level products.

5.2.1. DATA LEVEL PRODUCTS

The various products, which support the movement of data between applications, are:

- i. File transfer tools
- ii. Copy management
- iii. Data propagation
- iv. Schema-specific data synchronization
- v. Database replication
- vi. Extraction/ Transformation

Only extraction/ transformation products are capable of getting data directly into and/or out of an application's data store and can also change the format of the source data so as to fit the target product group of EAI solutions.

Extraction/ transformation products are of three types:

- i. Code Generators
- ii. Transformation Engines
- iii. Data Warehouse and Data mart Loaders

5.2.1.1. CODE GENERATORS

The code generator assists in the manual coding of programs by extracting data from an application and transforming it for loading into another application. This is useful for simple application network.

Disadvantages:

- i. The resulting program is not independent of the source or target system, so for integrating with more than one system extra programming / processing is required.
- ii. The desired level of data movement cannot be achieved, so modifications have to be done to the generated code
- iii. Language used for the generated program may differ from system to system
- iv. Scalability is a major concern as the integration is point-to-point
- v. Modifying an application can require major regenerations and modifications to existing interfaces.

5.2.1.2. TRANSFORMATION ENGINES/ HUBS

They use application metadata to create export-transform-load programs like code generators. But the difference is that all code is executed at a central location independent of the source and target. This works by getting the source data and moving it to a separate location where transformation takes place.

Advantages

- i. Centralized approach assists in scalability
- ii. Rapid interface development
- iii. Data staging
- iv. For large volumes of data some tools have transient data store, where excess data is processed.
- v. The same development environment and tools can be used for all application interfaces, so there is minimal impact on the source and target systems.
- vi. It is very useful for large data volumes

Disadvantage

- i. As transformation is done in a centralized location the tools are not scalable.

5.2.1.3. DATA WAREHOUSE AND DATA MART LOADERS

The Data warehouse and Data mart loaders can be found in either code generator or engine/ hub forms. The focus is in transforming operational data into a form that can be loaded into a very specific type of data store. Data aggregation is required so as to transform data in an application network.

Disadvantages:

- i. Warehouse loaders do not have the fault tolerance or performance requirements that make them viable for linking together a host of operational systems

5.2.2. BUSINESS MODEL LEVEL PRODUCTS

The various products are:

- i. Remote Procedure Calls
- ii. Stored Procedure Calls
- iii. Object Request Brokers
- iv. Transaction Processing Monitors
- v. Database Triggers
- vi. Message Queuing
- vii. Message Broker
- viii. Asynchronous RPCs
- ix. Publish and Subscribe

At business model level two applications can be integrated through the use of function calls i.e., one application sends data to the other by calling a function over a network. In the PRC mechanism the source application calls the function of another by specifically naming the target application and its function.

In the Message Broker the application calls a logical function that it wishes to be executed. The broker then maps this to a specific function in another application. Neither the source nor the target applications know in advance which application is involved. This makes the message broker the most scalable and best EAI option as the source and/ or the target applications and/ or the business process logic can be changed without interrupting the whole system. The Message broker is a set of software components that allow applications to communicate with each other through non-invasive bi-directional exchange of messages

5.3. EAI SOLUTION TYPES

There are primarily two types of EAI solution at high level- data level integration and message-based integration. Data level integration basically assists applications in the exchange and sharing of data across a common data store. For inter-enterprise application integration at data level Extensible Markup Language (XML) is very useful. Message based application integration is based on messaging software that is network aware. This is nearer to the complete EAI solution. Message oriented middleware products are thus becoming increasingly popular. Most EAI software offer tools to model business processes and link the applications with middleware that can make each application communicate via data message

5.4. OSI MODEL FOR EAI

The Open System Interconnection Model for EAI contains 12 layers as against the seven-layered structure for network applications. The various layers are as follows:

Layer	Name	Description	Best source of Knowledge
Layer 12	Business Process	Defines company specific business processes	Operational users
Layer 11	Business Semantics	Holds company specific data definitions and structures	Operational users and IS staff
Layer 10	Application Semantics	Contains in-depth knowledge of application structure and meaning	Application vendor's staff and vendors staff
Layer 9	Interface Syntax	Defines methods for sending/ receiving information to and fro applications	Application vendor's staff
Layer 8	Integration Middleware multiple applications	Architecture for integrating	Middleware Vendor's staff
Layer 7	Application	Provides standardized services	
Layer 6	Presentation	Encodes, encrypts and specifies data transfer formats	
Layer 5	Session	Manages session protocols	
Layer 4	Transport	Manages network layer connections and delivers packets	
Layer 3	Network	Addresses and routes packets	
Layer 2	Data link	Frames packets and controls physical layer data flow	
Layer 1	Physical	Electrical and mechanical specifications	

6. EAI ARCHITECTURE

EAI architecture reduces the number of interfaces and provides a standard methodology for application integration. Layering the different transport technologies does this. The black box EAI solution employs an array of middleware comprising message broker, transaction processing integration, Database Remote Procedure Calls, Screen scrapers, Java applets, Active X Controls, etc.

The EAI architecture also provides services such as application development tools, repository management, routing, publish/ subscribe services, data flow, data transformation, security services, recoverability and workload balancing.

Hub and spoke architecture is the most common. All applications connect to a central hub, which connects to many application spokes. The hub provides centralized services while connectors or adapters provide the services for each spoke or integration point. Adapters provide integration with the centralized hub for a specific resource like relational database or a java application, enabling information or invocation of a process against a specific resource.

EAI assists by causing existing and new applications to exchange data via messages governed by the rules of the business process. The business process is to be modeled and rules defined for the applications to follow. A message Broker routes the messages according to these rules. The data in the messages is transformed into the format required by the target application along the way. As the EAI software is independent of the individual applications it connects, the business processes can change and grow without requiring changes to the application.

6.1. LAYERS OF EAI

The EAI solutions can be categorized as a three-layer solution on the basis of the level of integration and functionality.

The three specific layers to EAI solution are:

- Communications
- Routing and brokering
- Business Intelligence

6.1.1. COMMUNICATIONS

The communications layer comprises of tools that assist in accessing data sources, inter-process communications, network transports and representations of messages that pass between applications. It includes the facilities for distributing processing over a network and includes the following technologies: TCP/IP, publish and subscribe, database server protocols and middleware, multicast IP, asynchronous messaging, remote procedure calls, etc. The communications layer essentially views the world as a set of data sources.

6.1.2. ROUTING AND BROKERING

In this layer some amount of decision-making and processing capabilities can be found. The primary job of this layer is to aggregate, broker, transform, filter, and format data so it can be understood by the other systems that are connected by the EAI solution.

6.1.3. BUSINESS INTELLIGENCE

The Business Intelligence layer plays a critical role in achieving the virtual application. This layer provides an environment that responds to messages from the routing and brokering layer. It then uses a set of declarative rules to make intelligent business decisions based on company goals. This layer connects to rules analyzers and on-line analytical processing (OLAP) services to assist in the decision making process. It is essential for companies to build this layer for a more proactive and competitive approach to conducting business

6.2. EAI SOFTWARE TOPOLOGY

The integration topology is a major consideration when building an EAI architecture to meet the diverse set of integration requirements in an organization. Selecting the right topology will assist in integration performance, event management and maintenance costs

6.2.1. TYPES OF SOFTWARE TOPOLOGY

- Hub/ star topology
- Bus topology
- Point-to-point topology
- Pipeline topology
- Network topology

6.2.1.1. HUB/ STAR TOPOLOGY

Hub topology is useful for creating a central point of control. Messages are sent from source to central hub, which is often in the machine itself. Hub topology works well if business events are independent and if the Message Oriented Middleware (MOM) on which the topology is based is from a single vendor. Here the source application sends a single message in one format and the hub reformats the message as necessary and relays it to the various spokes connected to the hub.

Advantages:

- Reduces re-entry of the data as it is centralized
- Promotes re-use of the data
- As all data must pass through the hub it is easy to monitor and audit data flows across the network from the hub
- Scalability is more

Disadvantages:

- Mostly the hubs available cannot handle incoming transaction from any other source than the middleware on which they operate.
- They cannot manage integration events involving multiple sources and destinations
- If database is required, it would become a source of processing or routing bottlenecks as volumes grow and integration rules become complex.

6.2.1.2. BUS TOPOLOGY

Bus topology is useful for distributing information to many destinations. Source applications put messages onto a system-wide logical software bus that is accessible to other applications. One or more applications can then selectively subscribe to the messages broadcast on the bus. Traffic does not need to flow through the central switching point. This is possible in publish and subscribe middleware only. Bus topology circumvents the problem of bottlenecks.

6.2.1.3. POINT-TO-POINT TOPOLOGY

Point-to-point topology enables applications to communicate directly with one another. This is useful when synchronous communication and persistence are required. Applications with pre-built integration for ERP applications use this topology. Too much of the point-to-point integration in an organizations IT structure leads to inter application spaghetti. Benefit of this topology is its ability to take full advantage of the context and semantics of the original data as it is transformed into one or more target structures. The major constraint for this topology is if there is any change in either of the applications like up gradation, etc then the whole integration has to be changed.

6.2.1.4. PIPELINE TOPOLOGY

Pipeline topology is useful if dynamic configuration is not required and multiple pipelines are independent of each other. The information flows will be based on the First In First Out approach. This is a very simple level of integration.

6.2.1.5. NETWORK TOPOLOGY

Network topology is the best option available if there is a lot of asynchronous activity and independent transactions must coexist with one another. For this topology to work well, the interfaces must be well defined and robust. If there is a snag at the interface level then the entire network communication can fail.

7. EAI SOLUTION

The solution for EAI consists of technology for supporting both data level and business model level interfacing. Design patterns are used to identify, categorize and reuse interfaces so as to ensure that the selected method of application-to-application communications is the best. Effective EAI solutions reduce the up front costs of implementation and provide open, seamless integration of business processes with any type of technical infrastructure. This also results in a Zero Latency Enterprise

7.1. REQUIREMENTS FOR EFFECTIVE EAI SOLUTION

- IT strategy needs to be mapped out according to the business strategy and the objectives
- Complete understanding of the business processes data models and the supporting systems and applications currently in place
- Planning for the whole process – right from need identification, vendor selection to implementation and future requirements
- The EAI architecture, viz., process models and integration requirements, has to be formulated from the IT strategy and architecture
- Evaluate the EAI tools and the vendors
- Accountability and ownership has to be established
- Evaluate the solutions and the scope of integration covered by the technology
- Invest in systems management and administration
- Right implementers with right skill set are required.

EAI implementation requires careful planning. This is because EAI is more than moving data from source to a target; it is a function of application semantics. EAI involves transformation of application content as data moves among the various systems. This requires a top-down approach – focusing on integrating application at a business context level and not just at technical level. Business level integration is concerned with business processes and the associated business rules.

7.2. EAI SOFTWARE FLEXIBILITY

EAI software must be implemented with five layers of technology for flexibility. The different layers are as follows:

- Business Process Support
- Transportation
- Services
- Interfaces
- Transformation

7.2.1. BUSINESS PROCESS SUPPORT

EAI solution set has tools, which let the users visually diagram the business processes so as to let the users declare rules for each message. This is useful to visualize the business processes and thereby control different activities and ease the flow of information. Intelligent routing capability that can look at a message and figure out the next course of action is required in a EAI solution.

7.2.2. TRANSPORTATION

Data can be routed point-to-point or with an architecture called publish/ subscribe, in which applications send messages to other applications that have registered interest with the message broker. The application sending information is the publisher and that receiving information is the subscriber. Depending on the network and platforms the application resides on this can be done with middleware such as database drivers, component object models or messaging middleware

7.2.3. SERVICES

This characteristic is required by messages to carry out missions successfully. The different services that are to be present are:

- Queuing to store messages if receiving application is slower than the sending one
- Transactional Integrity- to confirm that the transaction has completed before a message is sent or acknowledged as received.
- Message priority, error handling and hooks to let the network management tools control the network traffic

7.2.4. INTERFACES

Access to application is through the interfaces. Interfaces interact with the application either via descriptions they provide to their platforms component model or by taking advantage of the program Application Programming Interface. Thus the interfaces play an important role in selecting an EAI tool as they should be such that no/ minimum coding will be required while integrating.

7.2.5. TRANSFORMATION

As data format is not same for all applications, tools are required that let users visually map, coordinate one application data format with the another application data format and transform the information as required.

8. EAI SOLUTION EVALUATION

8.1. CRITERIA FOR SELECTION

The EAI solution should have the following functionalities:

- Workflow Management- facility for designing transaction work flows across applications
- Seamless Data Transformation- full and simultaneous transformation of application content among multiple sources and destinations, regardless of application complexity.
- Intelligent Content Based Routing- powerful, rules based routing of messages, files and other data objects based on content from any part of the transaction and centralized management of the routing rules
- Business Rule Management- graphical environment for definition and management of business rules to support business process that cross application boundaries
- Resource Adapters- for seamless technology integration with wide array of data sources and destinations
- Functional capabilities and characteristics
- Flexibility, ease of response to change in integrated applications over time
- Support for components, including standard component architectures like COM and CORBA
- Simplicity or complexity of tools for configuring integration behavior
- The extensibility provided via traditional programming
- Development tools provided
- The other integrators and partners supported
- The legacy application integration capability and access to mainframe transactions
- Support provided for heterogeneous messaging infrastructure

8.2. EAI SOLUTION EVALUATION METHODOLOGY

GIGA Information Group has come out with an evaluation methodology for EAI solution on the basis of seven criteria, which can be used to compare different solutions. The point to note here is that these criteria are customer specific i.e., dependent on the customer requirements the importance of each criterion varies.

The criteria to be checked are:

- Adapter/ Connector Fit
- Tools Productivity/ Quality

- Runtime Quality/ Scalability
- Runtime Fit to Purpose
- Business Process Support
- Integrator Resources
- Purchase and Ownership Cost

8.2.1. ADAPTER/ CONNECTOR FIT

The extent of provision of pre built or pre configured adapters or connectors in the solution. The rating is dependent on what packaged applications and legacy environments are required to be integrated and the quantitative and qualitative assessment of the adapters/ connectors. The important point to consider in assessment is the impact of the adapter/ connectors available on the time to market, where a high rating means the amount of pre built connectivity will accelerate the integration project.

8.2.2. TOOLS PRODUCTIVITY/ QUALITY

The productivity of the integration development work is dependent on the quality of tools provided and thus this criterion's impact is more in the case where the adapter/ connectors are not available. If the amount of custom integration work to do is more then this criterion increases in vitality. This also determines the flexibility and the maintenance cost of the system.

8.2.3. RUNTIME QUALITY/ SCALABILITY

Scalability is important as it determines the speed of the system. Quality of service includes the level of reliability or guarantee of delivery and the level of transaction integrity. Throughput, latency and efficiency may also be considered for assessment of quality of service.

8.2.4. RUNTIME FIT TO PURPOSE

There are four main points, which are required in different combinations:

- Transactional real-time component integration
- Queued messaging model
- Publish and subscribe messaging
- Bulk data movement

8.2.5. BUSINESS PROCESS SUPPORT

All integration scenarios require business process support. There are two ways by which this can be taken care of are:

- Facilities to model business processes and generate or execute an automated version of the process are include in the integration solution
- Specific business processes are already pre configured as part of the solution

8.2.6. INTEGRATOR RESOURCES

They can be provided by the vendor/ partners/ the Organization itself.

8.2.7. PURCHASE AND OWNERSHIP COST

The price sensitivity is high in this category as the differentiation is very less.

9. EAI SOFTWARE CHECKLIST

The ability to support evolving integration topologies is important, as there are rapid changes in the business requirements. EAI software if chosen right will play a key role in integrating the business processes. For meeting this requirement of business process integration a typical EAI solution should satisfy the following criteria:

- Topology independence
- Support for multiple operating platforms
- Support for multiple middleware systems
- Connectivity to databases and files
- Content-based application adapters
- Process flow control
- Event coordination and event management
- Integration without programming
- High performance
- Proven implementation

9.1. TOPOLOGY INDEPENDENCE

The architecture to select for connecting an integrated process depends on various factors/ issues like performance, timing requirement, event coordination etc. Therefore an open EAI topology has to be chosen, not restricting only to Hub or Bus or any other approach. Flexibility is the key word.

9.2. SUPPORT FOR MULTIPLE OPERATING SYSTEMS

Business processes often are required to be platform independent. So the EAI software should be flexible enough to execute the process on any platform.

9.3. SUPPORT FOR MULTIPLE MIDDLEWARE SYSTEMS

The EAI software should focus on the business process and not on the underlying technology that is used to transfer the data. Good EAI software provides pre-built adaptability for all middleware categories, like MOM, publish/ subscribe middleware and ORB

9.4. CONNECTIVITY TO DATABASES AND FILES

The EAI software should support not only message routing but also provide direct access to databases, files, e-mail systems etc without separate steps i.e., it should be a part of the integrated process.

9.5. CONTENT- BASED APPLICATION ADAPTERS

The EAI software should not only create and maintain the adapters from applications metadata, but also provide descriptions with semantics and syntax, eliminating the need for coding

9.6. PROCESS FLOW CONTROL

The EAI software should provide a graphical environment to describe the processes and also should have provision for acknowledging events, trigger execution, intelligently route data and ensure transactional integrity across entire integration scenario

9.7. EVENT COORDINATION AND MANAGEMENT

Real time events triggering business processes have to be monitored and managed to ensure that they achieve a coordinated result. The software should also include a run time environment, which supports active listening, event coordination and multi threaded processing.

9.8. INTEGRATION WITHOUT PROGRAMMING

EAI software should handle the complexities of the Business process integration by itself without resorting to hand coding

9.9. HIGH PERFORMANCE

As business process involves high transaction volumes or complex rules, the EAI software should prevent bottleneck and should have features like multi-threading and multi-processing along with performance monitoring tools.

9.10. PROVEN IMPLEMENTATION

The EAI software should be proven and in use by other customers so as to minimize risk, as business process integration is a mission critical task.

10. EAI MARKET SEGMENTATION

EAI Solutions are moving from middleware messaging systems to Business process Integration. The EAI market as of now is concentrated mainly on the layers 8 & 9 of the OSI model for EAI, viz., Integration middleware and Interface Syntax. The main reason for the focus on these two layers is the immaturity of the EAI market and also that profits are easier to achieve in these two layers.

The EAI product market can be differentiated into:

- i. Platform Integration
- ii. Data Integration
- iii. Component Integration
- iv. Application Integration
- v. Process Integration

10.1. PLATFORM INTEGRATION

This provides connectivity among heterogeneous hardware, operating systems and application platforms. The various technologies providing platform integration are:

- i. Messaging – this is for asynchronous connectivity
- ii. Remote Procedure Calls – Synchronous connectivity
- iii. Object Request Brokers – Both types of connectivity

The logic for connecting each application must be defined either through code or pre coded applications adapters. Additional functionality is required to reconcile the differences in data representation in the system. This can be done by hand coding or by the use of data translations and transformation products. Logic is required for message routing and this can be provided either through hand coding or by a Message Broker. Monitoring and management of end-to-end business process has to be done through hand coding or automated process management tools.

10.2. DATA INTEGRATION

This is of two types:

- i. Database gateways like Sybase DirectConnect, Information Builders EDA SQL and Oracle Open Gateway which provide SQL access to heterogeneous data sources. They are synchronous data access products and require application developers with knowledge in the database schemas
- ii. Tools for Extracting, Transforming, Moving and Loading Data- ETML tools:

They are batch or point in time solutions suitable for initial loading of data warehouse or large batch transfers. They extract and load data directly bypassing application logic. ETML vendors are extending functionality through messaging support

The solution set of system-to-system data map. A new system must be mapped to all other systems its integrated with. Changes in application impact mapping to every other systems it's integrating with. Tools that provide impact analysis simplify change management.

10.3. COMPONENT INTEGRATION

Hub and spoke integration- hub provides some of the integration. Application servers are used to provide data access to variety of relational database sources applications Adapters to packaged applications and middleware services like messaging are also available.

10.4. APPLICATION INTEGRATION

Application integration provides a framework for technology for near real time processing. The framework includes:

- i. Underlying platform integration technology
- ii. Event integration through Message Broker that provide data translation
- iii. Transformation & rules based routing
- iv. Application interface integration provided through application adapters to packages
- v. Custom applications

Integration frameworks assist in reducing the complexity of creating, managing and changing integration solution. The advantage is faster time to market through pre built adapters and reusable integration infrastructure.

10.5. PROCESS INTEGRATION

This provides the highest level of abstraction and adaptability for an EAI solution. This enables managers to define, monitor and change business processes through a graphical modeling interface.

Business Process Modeling helps business users and analysts to define how information flows across systems and organizational boundaries through a graphical model and declarative language instead of programming. The integration solution is generated from the model. When changes are required, they can be made in the model and the same can be regenerated in the solution. Simulation can also be done before the implementation of the solution.

11. EAI IMPLEMENTATION:

Understanding the organizations business processes and data is essential to select which processes and data require integration. There are four different scenarios for EAI viz.,

- Database linking
- Application Linking
- Data warehousing
- Common virtual System

11.1. DATABASE LINKING

This is basically linking two or more databases so that information is shared between the databases at some point. The information can be exchanged and duplicate information maintained or information can be shared. This is the simplest and initial form of EAI

11.2. APPLICATION LINKING

This more complex than database linking. Application linking means both processes and data between two or more applications are integrated. The advantage of this there is redundant business processes are not created as the processes are shared between applications.

11.3. DATA WAREHOUSING

This is similar to database linking. Data Warehousing is the collection of meaningful data from several data sources to support decision-making efforts within an organization. The data from different data stores is extracted, aggregated and migrated into a data mart or data warehouse. EAI assists in real time data warehousing.

11.4. COMMON VIRTUAL SYSTEM

A virtual system means that for any transaction, the information required for it will be available irrespective of where the information exists. EAI helps to integrate diverse systems so that they appear as one monolithic and unified application.

12. TYPES OF EAI

There are two types of EAI on the basis of the level of integration done, type of applications integrated, viz.,

- i. Data level
- ii. Business Model level
 - a. Application program interface level
 - b. Method level
 - c. User interface level

12.1. DATA LEVEL

Data level EAI is the process/ technology to move data between data stores, i.e., extracting information from one database, processing the information if needed and updating the information in another database. Business logic may also be transformed and applied to the data that is extracted and loaded.

12.2. BUSINESS MODEL LEVEL**12.2.1. APPLICATION PROGRAM INTERFACE LEVEL**

Here the custom or packaged applications' interfaces are used for integration. Developers use the interfaces to access the business processes and information so as to integrate various applications to share business logic and information.

12.2.2. METHOD LEVEL

The business logic is shared between different applications within the enterprise. The methods of various applications can be accessed without rewriting each method within the respective applications

12.2.3. USER INTERFACE LEVEL

User Interfaces are used to tie different applications together. This process uses windows and menus to get the relevant data that needs to be extracted and moved to other applications and data stores.

13. EAI IMPLEMENTATION COSTS AND ROI:

The costs of EAI implementation are as follows:

- i. License fee for the integration broker
- ii. Cost of dedicated server
- iii. Cost of installation of integration broker
- iv. Training
- v. Cost of gathering information on various applications, operational activities etc for every process, transaction format, data element definition and API.
- vi. Maintenance of information in the various layers of OSI – layer 9 to layer 12 over time

*The last two costs are hidden costs

Gartner Group has developed a method to calculate the ROI for EAI. For this the following have to be evaluated:

- i. Actual costs associated with building integrations and/ or points of communication using a message broker
- ii. Estimated costs associated with alternate methods of integrating applications

The ROI advantages are to name a few:

- i. More integrations could be done vis-à-vis point-to-point applications, which are costly and labor expensive
- ii. Learning curve decrease as organizations become familiar with the integration engine

Organizations experienced with the integration broker can leverage integrations