Enterprise Application Integration

Motivation
Middleware, EAI, B2Bi
Point-to-point vs. EAI integration
Dimensions of EAI/B2Bi
Integration approaches
Summary and outlook to future on EAI
B2B Integration basics
After this: Case METSO 14:45
Islands of automation: result of the development

- Separate systems which cannot exchange information
- Large amount of manual work is required to prepare input for the various systems and to process the outputs, leading to errors
- Average organisation has 68 application systems

Point-to-point integration

With 68 systems there are 2278 possible (n*(n-1)/2) interconnections!
EAI – “Hub and Spoke” architecture

With 68 systems there are 68 possible interconnections!

IT Priorities — Change in % of Respondents & Change in Rank

In your organization, which areas are your top priorities in 2002?
(Multiple responses permitted)

<table>
<thead>
<tr>
<th></th>
<th>July 2002</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>% of Rank</td>
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<tr>
<td>Application integration</td>
<td>55</td>
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<tr>
<td>Security software</td>
<td>35</td>
</tr>
<tr>
<td>ERP software/ERP upgrade</td>
<td>32</td>
</tr>
<tr>
<td>Windows 2000/XP upgrade – desktop</td>
<td>77</td>
</tr>
<tr>
<td>E-commerce initiatives</td>
<td>73</td>
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<tr>
<td>Microsoft Office upgrade</td>
<td>64</td>
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<tr>
<td>Data mining/OLAP tools</td>
<td>61</td>
</tr>
<tr>
<td>Web site enhancements</td>
<td>56</td>
</tr>
<tr>
<td>Windows 2000 upgrade – server</td>
<td>56</td>
</tr>
<tr>
<td>Storage hardware</td>
<td>53</td>
</tr>
<tr>
<td>Network security</td>
<td>51</td>
</tr>
<tr>
<td>Content Management software for Web sites</td>
<td>49</td>
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<tr>
<td>Business Intelligence tools</td>
<td>49</td>
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<tr>
<td>CRM software</td>
<td>46</td>
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<tr>
<td>Document management software</td>
<td>46</td>
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<tr>
<td>Employee/Enterprise data portal projects</td>
<td>46</td>
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Source: Morgan Stanley CIO Survey, July 2002
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Middleware definition

- "glue together" or mediate between two separate and usually already existing programs. Common application of middleware is to allow programs written to a particular database to access other databases (whatis.com)
- Messaging between applications is a common service provided by middleware programs so that different applications can communicate

- "Non-application-specific software that performs infrastructure tasks" (McComb, semantics in business systems)
Layered architecture

- Middleware hides the heterogeneity and distribution of operating systems and network from the application.
- Middleware hides the heterogeneity and distribution of databases from applications.

Categories of middleware

- Remote Procedure Calls
- Distributed objects
- Database access middleware
- Message oriented middleware
- Transaction Processing monitors
- Brokers
**EAI definition (whatis.com)**

- EAI (enterprise application integration) is aimed at modernizing, consolidating, and coordinating the computer applications in an enterprise.
- Typically, an enterprise has existing legacy applications and databases and wants to continue to use them while adding or migrating to a new set of applications.
- ERP vs. EAI encompassing all?

**EAI to B2B application integration**

- Basically EAI extended to trading partners
- Integrating applications across partners
- Integration defines a common way for both business process and data to communicate between linked organizations securely
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Pitfalls in point-to-point integration

- Complexity
- Custom Interfaces
- Manual re-keying
- Stovepiped processes
- Data migration & consistency
Integrated enterprise

Enterprise Resource Planning system

EAI services

- Platform, protocol management..
- Asynchronous, Synchronous messaging support..
- Security services, encryption, non-repudiation.. etc
- Routing services, publish/subscribe..
- Directory services..
- Metadata management & repository services..
- Event management, topology & synchronization..
- Data mapping & transformation services.. (not always unified data model behind)
EAI selling arguments

- Adding new interfaces or new application cheaper
- Utilizing legacy systems (information availability)
- Fewer interfaces
- Data transformations in one place with ready-made tools
- Reusability
- Flexibility
- Better control and visibility with transactions

EAI limitations

- EAI doesn’t solve semantic problems – you still need to define intermediate data formats etc.
- EAI products are fairly young (except Message Oriented Middleware)
- Standardization, information ownership, semantics etc big problems also within companies
  - Customer data...
  - Product data...
- Technology is not enough, sometimes need to adjust processes
Considerations in deciding whether to implement EAI solution

- Integration creates opportunities to outsourcing, buying and selling as well as making current operations more effective.
- Can company afford not to engage in more real-time transactions?
- From ERP dependency to own architecture dependency?
EAI costs consists of...

- Architecture
  - In the beginning quite big
  - Complexity and number of BU:s.
- Integration costs
  - Depends what is integrated (in EAI cheaper than in point-to-point)
  - Number of interfaces
- Operative costs
  - Maintenance and operative costs. (in EAI cheaper)
  - Number of interfaces

The role of standards in EAI

- Common language
- Vendor lock in / staff
- Semantic difficulties otherwise present
- Vendors can support the standards in many ways
Example of EAI functionality

- For example functionality of EAI & B2Bi platform see e.g. the Microsoft BizTalk 2004 demonstration
  - Similar demonstrations available on IBM, webMethods, SAP Netweaver products)
Common architectural frameworks/dimensions of EAI

- There is not one single view on what should an integration architecture look like
- “The good thing about standards is that there is so many of them” holds true also for integration architectures
- They are good basic mental models to classify different integration issues

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<table>
<thead>
<tr>
<th>Resource/Integration Need</th>
<th>Examples of Integration Mechanisms</th>
<th>Enabling Environment Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Units (Functions/Departments)</td>
<td>E-mail, collaborative software, internal teams</td>
<td>Organization policies/structure</td>
</tr>
<tr>
<td></td>
<td>Top Management Strategy, budgets, performance metrics</td>
<td></td>
</tr>
<tr>
<td>Decision Makers</td>
<td>E-mail, collaborative software, knowledge management systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Face-to-face meetings, job design, performance metrics</td>
<td></td>
</tr>
<tr>
<td>Business Processes (both internal &amp; external to the firm)</td>
<td>Workflow, Collaborative Systems, SCM, CRM, Web Services</td>
<td>Standards</td>
</tr>
<tr>
<td></td>
<td>Process owners, teams, performance metrics, service level agreements</td>
<td></td>
</tr>
<tr>
<td>Applications</td>
<td>Inter-process communication, RPC, Messaging, ERP, Web Services</td>
<td>Networks</td>
</tr>
<tr>
<td>Data</td>
<td>Data Dictionaries, Databases, XML</td>
<td>Systems Architecture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Platforms</td>
</tr>
</tbody>
</table>

Figure 1: Framework for Business Integration

Stohr and Nickersson, 2003
Integration projects

Dimensions EAI/B2Bi

Process integration

Method

Application Interface

Data

Points of integration

Interaction

Linthicum, 2003
**eBusiness integration architecture**

- **Process integration**
  - Process model
  - Process monitoring
  - Process Correlation

- **Interface integration**
  - J2EE
  - CORBA
  - DCOM

- **Data integration**
  - Adapters
  - Rules
  - Translate
  - Transform

- **Transport integration**
  - Message queues
    - FTP
    - HTTP

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**Complete B2B integration architecture**

- **User interface**
  - Modeling
  - Testing
  - Monitoring
  - Analysis
  - Work list
  - Administration
  - Error handling
  - Endpoint management

- **Logic layer**
  - Event management
  - Process management
  - Data type management
  - Transformation
  - Translation

- **Connectivity layer**
  - Application adapters
  - B2B protocol engine
  - Endpoint management
  - Packaging
  - Transport

- **Persistence layer**
  - Database system
  - Persistent queueing system
  - File system

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Yee, Apte

Bussler, 2003
Technology framework for EAI/B2Bi

Business process Integration

Private
- EAI Data Integration
  - Application integration Services
  - Native data
  - Multiple Platforms
  - Diverse Protocols

Public
- B2B Trade
  - Partner management Services
  - Standard data (XML)
  - Platform independence
  - Primarily HTTPS, SOAP

Yee, Apte

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Technology Mechanisms of Enterprise Integration

- Overall frameworks are preferred to point solutions
- Loose Coupling is more popular than tight coupling
- XML is driving out customized file formats
- Industry-wide efforts are driving internal efforts

Approaches by Stohr & Nickerson

- Files, RPC, ERP:s, consolidated databases
- Publish&Subscribe, EAI (not ship with universal data models though – rather tools), Web Services, Workflow, Agents
- Many technical approaches, many of them are over-lapping
Database replication (EAI)

- Very much used for recovery and high availability purposes
- Synchronous Replication ensures consistency between source and target databases
  - Transactions must conform to ACID properties (atomic, consistent, isolated and durable)
- Asynchronous Replication uses queues like MQSeries

B2B Process Integration

Private process (Company-specific)

Public process (Standard)

Private process (Company-specific)

PO CRM

SCM

ERP

Figure provided by Vitria Systems
Systematic Approaches

- it is too difficult to anticipate all the potential interconnections between business functions
- process handbook - a bottom-up approach
- top-down efforts (GERAM, TOGAF, CIMOSA,...)
- “To date, neither the academic theory nor the industry architectures has had as much direct impact on enterprises as vendor products and internal IT teams have had”

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Summary on EAI products

- EAI products ease application developers by
  - Reliable message passing
  - Fewer interfaces
  - Transformation capabilities
  - Control and visibility with transactions
  - Business process definitions and executions
- Defining semantics is still a problem and thus the need for universal and internal standards exist

EAI and Web Services offerings

- Web Service technologies help to discover, bind to and transport messages in a loosely coupled way.
- EAI functionality can be offered as a service to other applications
- Business Process Management languages e.g. BPEL are working towards introducing standards for process descriptions and execution making it easier to reuse
- There is still a problem of disparate terminology and vocabularies to which EAI or Web Services don’t give a major help to – need for agreements
Service oriented architecture (SOA)

- New buzzword in Enterprise systems architecture
- SOA expresses a software architectural concept that defines the use of services to support the requirements of software users
- Most definitions of SOA identify the use of Web service technologies (SOAP and WSDL) in implementation. However, SOA can use any service-based technology
- SOAs comprise loosely joined, highly interoperable application services (platform independency)
- E.g. Wikipedia (www.wikipedia.org) good for current information

Enterprise service bus (ESB)

- “ESB refers to a category of Web services standards based middleware infrastructure products or technologies that enable a service-oriented architecture via an event-driven and XML-based messaging engine”
- Key benefits
  - faster and cheaper accommodation of existing systems
  - increased flexibility: easier to change as requirements change
  - standards-based
Semantic Web (Services)

- In Semantic web computers can understand the documents (machine interpretable)
- For heuristic searches to more semantic queries

(c)Fensel & Bussler
Motivation for e-business standards

- Data transfer needs high, volume high, probability of human errors high, frequency of data transfer → Integration is needed between systems.
- XML has been central element in recent B2B standardization but XML alone is not enough.
- Although following are all human readable/interpretable, computers have problems in these things:
  <e-business/> <date>24.11.2004</date>
  <eBusiness/> <date>24th November 2004</date>
  <E-business/> <xs:date>2004-11-24</xs:date>
- XML provides a syntax way to represent information → Need standard to define commonly understood business documents.
- B2B standards often don’t just standardize the business documents, but define also the inter-company business processes and how the business documents can be securely transported over the Internet.
**Automatic process**

Business Document is standardized message encoded using XML or EDI

Reliable messaging = “postal service”

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**EDI background**

- The creators of Electronic Data Interchange (EDI) were mainly concerned about the size of their messages.
- EDI messages are very compressed and use codes to represent complex values.
- The metadata is stripped from an EDI message
  - makes the message difficult to read and debug (but they are meant for computers not human)
- EDI programmers are hard to train and expensive to keep. This complexity drives cost.
- No one global EDI standard (UN/CEFACT, X.12)
EDI (EDIFACT order)

UNH+0002771776+ORDERS:D:99A:UN:FI0084'
BGM+105+40063000277177602748497+9'
DTM+4:20000705:102'
DTM+2:20000706:102'
DTM+9:20000705:102'
NAD+BY+003709895955:100++TRADEKA OY'
NAD+SE+003702134547:100++OY HARTWALL AB'
NAD+CN+40063000::92++VALINTATALO
HERVANTA+LINDFORSINKATU 2+TAMPERE++33720'
LIN+1++6413600001584:EN'
IMD+F+8+:::HTW NOVELLE ORANGE LIME 1,5 L'
QTY+21:144'
LIN+2++6413600000280:EN'
IMD+F+8+:::VICHY 0,33L/HARTWALL'
QTY+21:430'
UNS+S'
CNT+2:2'
UNT+17+0002771776'

Source: TIEKE (EDI standards implementation guidelines document) @ Paavo Kotinurmi 2002-2005 12/10/2005

RosettaNet messaging principle

Company A
Company Specific processing

SAP ERP

Company B
Company Specific processing

I2 APS

RosettaNet defines processes and a framework for how data gets passed over the Web and certain handshake criteria.

source: RosettaNet
Problem that RosettaNet tries to solve

- Standards needed to enable system-to-system B2B collaboration.
- Helps solving some semantical problems in specific industry by providing message guidelines, dictionaries and unique identifiers
- Defines standard business processes
- Reliable messaging over Internet

EAI vs. ESA/ESI. Would Dilbert survive with EAI software ...?