Enterprise Integration System Models

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Introduction

• Corporations grow, and as they grow the need for integration across the enterprise increases.
• Integration can be accomplished through various means. Both organizational and technological integration is necessary.
• Business processes are the vital link between the technical and organizational infrastructures of the organization. So that processes are the mechanism through which most inter-organizational interaction takes place and are the foundation for increasingly electronic forms of commerce.
• Enterprise integration doesn’t happen naturally, it needs to be planned. Yet the planning cannot be precise, as business processes and facilitating technologies will change, creating different needs and different potential solutions.
• New mechanisms for integration can be utilized. Such as to create a flexible, loosely coupled framework, within which special integration needs can be quickly fulfilled.
• These new technical mechanisms depend on standards that work both inside and outside the enterprise.
# Common Departmental Applications

<table>
<thead>
<tr>
<th>Department</th>
<th>Applications</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales &amp; Marketing</td>
<td>• Lead generation • Lead tracking • Customer management</td>
<td>• Sales forecasting • Product and brand management</td>
</tr>
<tr>
<td>Operations</td>
<td>• Order entry • Order management</td>
<td>• Finished-goods inventory mgmt.</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>• Inventory (raw materials, goods-in-process) • Planning</td>
<td>• Scheduling • Operations</td>
</tr>
<tr>
<td>Customer Service</td>
<td>• Order tracking • Account tracking</td>
<td>• Customer support and training</td>
</tr>
<tr>
<td>Human Resources</td>
<td>• Recruiting • Compensation</td>
<td>• Assessment • HR Planning</td>
</tr>
<tr>
<td>Accounting</td>
<td>• General ledger • Financial reporting • Cost accounting • Accounts receivable</td>
<td>• Accounts payable • Cash management • Budgeting • Treasure management</td>
</tr>
</tbody>
</table>
Inter-organization Data Processing

Finance:
- Modules for bookkeeping and making sure the bills are paid on time.
- General Ledger
- Accounts Receivable
- Fixed Assets
- Treasury Management
- Cost Control

Human Resources
- Software for handling personnel-related tasks for corporate managers and individual employees.
- HR Administration
- Payroll
- Self-Service HR

Manufacturing & Logistics
- A group of applications for planning production, taking orders and delivering products to the customer.
- Production Planning
- Materials Management
- Order Entry & Processing
- Warehouse Management
- Transportation Management
- Project Management
- Plant Maintenance
- Customer Service

Transaction Engine:
- Core software that manages the flow of transactions among applications and handles tasks such as security and data integrity.

Data Analysis:
- Decision-support software that lets senior executives and other users analyze transaction data to track business performance.

Supply Chain Management:
- Advanced planning applications that take into account production constraints, demand forecasting and order delivery promises.

Front-Office Applications:
- Sales force automation, telemarketing and call center support software for use in dealing directly with customers.
What are Enterprise Systems?

• An integrated suite of information systems that form the backbone of the enterprise for running and managing its operations

• Four Major Components of Enterprise Systems
  • ERP (Enterprise Resource Planning systems)
  • CRM (Customer Relationship Management systems)
  • SCM (Supply Chain Management systems)
  • BI (Business Intelligence systems)
Major Category Applications of Enterprise Systems

- **ERP**
  - Enterprise Resource Planning systems evolved from Manufacturing Resource Planning (MRP) systems
  - Integrate all the internal processes and data flowing through the organization: the “back-end” systems

- **CRM**
  - Customer Relationship Management systems evolved from Sales Force Automation (SFA) for contact and lead management
  - A full suite of applications for telemarketing, call center (today, contact center), for supporting marketing, sales and services: the “front-end” systems dealing with the customer
Major Category Applications of Enterprise Systems

- **SCM**
  - Supply Chain Management systems address the problem of fulfilling, and responding to changes in, demand at a minimum cost.
  - Advanced planning applications that take into account demand forecasts, production constraints, front-end systems connecting to suppliers, logistics providers, to get the right product to the right place at the right time at the right cost.

- **BI**
  - Business Intelligence systems, the new label for Decision Support Systems (DSS) and Executive Information Systems (EIS), including Data Warehousing and Data Mining
  - Systems for analyzing the vast amount of internal transaction data and external data about customers and competitors to track performance and manage the business more effectively

L. Mohan
What is ERP?

• Enterprise Resource Planning (ERP) is a set of integrated business applications, or modules which carry out common business functions such as general ledger, accounting, or order management

• Support business through optimizing, maintaining, and tracking business functions

• Broken down into business processes
  • HRM
  • Distribution
  • Financials
  • Manufacturing
What Makes ERP Different?

- Integrated modules
- Common definitions
- Common database
- Update one module, automatically updates others
- ERP systems reflect a specific way of doing business
- Must look at your value chains, rather than functions
Benefits of ERP

• Common set of data
• Help in integrating applications for decision making and planning
• Allow departments to talk to each other
• Easy to integrate by using processed built into ERP software
• A way to force BPR (reengineering)
• Easy way to solve Y2K problem
An Example of Enterprise Business Processing

![Diagram showing the process of patient discharge with steps such as issue discharge order, prepare discharge, deliver meds, prepare room, and stop food, followed by discharge patient, arrive hospital, schedule pickup, and prepare home meds. The diagram also includes a note saying "OK, you're ready to go home!" and arrows indicating the flow of the process.]
Multi-application platform system
Need Model to Integration

IT Architecture should Integrate Information, Processes and Functions

Traditional View

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

Example of a banking environment
A Supply Chain Data Transaction

Coordinates:
✓ Procuring materials
✓ Transforming materials into intermediate and finished products or services
✓ Distributing finished products or services to customers

In manufacturing firm, information in an SCM system flows between the following areas:
✓ Product flow
✓ Information flow
✓ Finances flow

Four key decisions in supply chain management:
✓ Location
✓ Inventory
✓ Production
✓ Transportation
ERP Information System

All activity processed by ERP application programs and consolidated data stored in centralized ERP database.
Sales Dashboard

Current Forecast (in 1000s): Total = $62,196

Won Deals (in 1000s); YTD Total = $163,599

Top 10 Key Deals

<table>
<thead>
<tr>
<th>Account</th>
<th>Est. Close Date</th>
<th>Est. Revenue (in 1000s)</th>
<th>Recent Activity</th>
<th>Win Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consolidated</td>
<td>6/25/2008</td>
<td>$999</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vice World Imports</td>
<td>5/29/2007</td>
<td>$999</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Litane Inc.</td>
<td>5/22/2007</td>
<td>$885</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marge's Travel</td>
<td>6/2/2008</td>
<td>$987</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consolidated</td>
<td>6/25/2007</td>
<td>$857</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fabricum Inc.</td>
<td>6/25/2007</td>
<td>$856</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School of Fine Art</td>
<td>5/18/2008</td>
<td>$852</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Litane Inc.</td>
<td>5/16/2008</td>
<td>$852</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alpine Ski House</td>
<td>6/27/2006</td>
<td>$851</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Phone Company</td>
<td>6/27/2006</td>
<td>$850</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Top 10 Sales Leaders in Current Year

<table>
<thead>
<tr>
<th>Sales Representative</th>
<th>Actual Revenue (in 1000s)</th>
<th>Win Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilma Johnson</td>
<td>$2,153</td>
<td>41 %</td>
</tr>
<tr>
<td>Fred Birds</td>
<td>$1,092</td>
<td>44 %</td>
</tr>
<tr>
<td>Steve Masters</td>
<td>$1,023</td>
<td>62 %</td>
</tr>
<tr>
<td>John Emery</td>
<td>$1,013</td>
<td>58 %</td>
</tr>
<tr>
<td>Paul West</td>
<td>$895</td>
<td>41 %</td>
</tr>
<tr>
<td>Lost Raven</td>
<td>$785</td>
<td>48 %</td>
</tr>
<tr>
<td>Barbara Decker</td>
<td>$695</td>
<td>45 %</td>
</tr>
<tr>
<td>William Ngoh</td>
<td>$685</td>
<td>44 %</td>
</tr>
<tr>
<td>Anton Kinfo</td>
<td>$554</td>
<td>38 %</td>
</tr>
<tr>
<td>Brian Cox</td>
<td>$480</td>
<td>38 %</td>
</tr>
</tbody>
</table>

Estimated Revenue (in 1000s) by Stage:

- Stage 1: 45 Deals, $11,314
- Stage 2: 100 Deals, $27,809
- Stage 3:
- Stage 4: 45 Deals, $10,270

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Enterprise Application Integration (EAI)

- Enterprise application integration (EAI) is a business need to make diverse applications in an enterprise including partner systems to communicate to each other to achieve a business objective in a seamless reliable fashion irrespective of platform and geographical location of these applications.
- EAI comprises of message acceptance, transformation, translation, routing, message delivery and business process management.
- Usually messages transportation is asynchronous but for a business need it can be synchronous as well.
- There are two basic architectures to achieve this, bus and hub/spoke architecture. Both of these can be used to develop services and then it also becomes service orientated architecture.
Enterprise architectures consist of many systems and applications that provide various services a company relies upon to conduct its day-to-day business.

An organization may choose to implement separate systems, either a third-party licensed version or an in-house version to effectively manage its customer relationships, supply chain, business logic and employee information.

Problems presented by Enterprise Architecture Integration

**Interoperability:** Various components of the infrastructure may use different operating systems, data formats, and languages, preventing connection via a standard interface.

**Data integration:** For a modular, distributed system to be functional, a standard method of handling the flow of data between applications and systems to enforce consistency across the database is crucial.

**Robustness, Stability and Scalability:** These are the functions that hold together a modular infrastructure, and hence, integration solutions must be highly robust, stable, and scalable.
Impact to Software Development Method

Enterprise Architecture Integration Views

- Business architecture. Shows how business is done -- models the enterprise using business processes and the events that trigger them.

- Information (data) architecture. Enables the enterprise to develop a shared, distributed, consistent data resource -- consists of data models and databases that serve all participants in the enterprise business environment and the strategies, standards, policies required to develop and implement them.

- Application architecture. Supports business processes, provides automated solutions, manages information storage and retrieval, links the Data and Business architecture.

- Technology (infrastructure) architecture. Meets the infrastructure needs of business clients -- interoperates with and supports the Application, Business, and Data Architectures to provide interoperable technology platforms.

EA View Components

**Business Architecture**
- Business Arch Diagram
- L1 – 3 process
- Process Maps
- SIPOC
- RACI
- Required Capabilities
- Process Metrics
- Process Specific Policies

**Application Architecture**
- Conceptual Application Model
- Logical Application Model
- Physical Application Model
- Implementation View
- List of Applications

**Data Architecture**
- Conceptual Data Model (ER-Diagram)
- Logical Data Model (ER-Diagram attributed)
- Physical Data Model
- Entity-Business Process CRUD Matrix
- Data Flow Diagram
- Common Information eXchange Specification (CIXS)
- Data Trustees and Stewards

**Infrastructure Architecture**
- Conceptual Infrastructure Model
- Logical Infrastructure Model
- Physical Infrastructure Model
- Implementation view
- List of services and foundation enablers
EAI Approaches and Techniques

The Advantages of ESB
1. Lightweight
2. Easy to expand.
3. Scalable and Distributable
4. SOA-Friendly
5. Incremental Adoption

Hub/Spoke architecture uses a centralized broker (Hub) and adapters (Spoke) which connect applications to Hub.

Spoke connect to application and convert application data format to a format which Hub understands and vice versa.

Hub on the other hand brokers all messages and takes care of content transformation/translation of the incoming message into a format the destination system understands and routing the message.

Adapters take data from source application and publish messages to the message broker, which, in turn, does transformation/translation/routing and passes messages to subscribing adapter which sends it to destination application(s).
Bus architecture uses a central messaging backbone (bus) for message propagation. Applications would publish messages to bus using adapters.

These messages would flow to subscribing applications using message bus. Subscribing applications will have adapters which would take message from bus and transform the message into a format required for the application.

Key difference between hub/spoke and bus topology is that for the bus architecture, the integration engine that performs message transformation and routing is distributed in the application adapters and bus architecture requires an application adapter to run on the same platform as the original applications.
Enterprise Service Bus

- **Enterprise Service Bus** is a software architecture that provides integration of enterprise applications and services for complex architectures, such as middleware infrastructure platforms.

- An ESB’s primary function is to provide the connections between communicating applications - acting much like a router to control the data. It is commonly used in enterprise application integration (EAI) or service-oriented architecture (SOA) principles.

- The interaction and communication between components are across the bus, which has a similar function to the physical computer bus to handle data transfer or message exchange between services, without writing any actual code.

- ESB as an infrastructure software service-oriented model works as a managed message system that provides routing, data transformation, translation upon a client’s request and event-interpretation. It is often needed to transform messages into a format that the application can interpret. ESB is also used to change data content or execute services via a rule engine.
Enterprise Service Bus
ESB with Service Oriented Architecture

- ESB “is a software architecture model used for designing and implementing the interaction and communication between mutually interacting software applications in Service Oriented Architecture
- Promotes asynchronous message mediation
- Message identification and routing between applications and services.
- Allows messages to flow across different transport protocols
- Transforming of messages
- Allows secure, reliable communications
- Extensible architecture (based on pluggable components)
Trends of Enterprise Application Integration

- **Traditional Integration**: Point-to-Point connection between applications, Simple basic connectivity, Used messaging
- **Enterprise Application Integration**: Connects Application using Centralized hub, Easier to manage larger number of connections
- **Service Oriented Integration**: Integration and choreography of services through service bus, Flexible connections with well-defined standard-based Interfaces

SOA

• Service oriented architecture is approach to have software resources in an enterprise available and discoverable on network as well defined services.
• Each service would achieve a predefined business objective and perform discrete units of work.
• The services are independent and do not depend on the context or state of the other services. They work within distributed systems architecture.
Service Oriented Architecture

- Portals
- Desktop Applications
- Web Applications
- Composite Applications

Client Applications

- WSDL
- XML
- JBI
- ESB
- BPEL

Services

- JDBC
- CORBA
- EJB
- Web Services
- Messages

Core Enterprise Applications
Service Oriented Architecture

- **Service oriented architecture** is an integration paradigm that is based on a fundamental design principle and provides architectural interoperable services - hence its name. It encompasses legacy systems, software components and message processing capabilities.

- Its primary function is integration of services and the development of applications. SOA-based systems have become more common (than ESB and EAI) because of development technologies and platforms and the changes in traditional IT roles and responsibilities. SOA has been the solution for business logic and technology.

- SOA represents distinct principles that foster service-orientation in loosely coupled systems (like ESB where it acts as a broker between services), network change management governance and has become an important aspect of Web 2.0 applications and services.

- It is a framework that can automate business processes while specifying service-oriented modeling business systems within an architectural application. It is used as design scheme of application-level and enterprise-level solutions for modeling a computing environment.

- Apparently, SOA is a solution to overcome all sorts of shortages in EAI and ESB technologies and provide a means for reusable services. It supports Distributed Enterprise Application Integration and “enterprise service bus” integration environments. The latter is the new software architecture, called SOA-based enterprise service bus (ESBsoa), which is a Web services-based application supporting platform ideal for transport adaptation, service adaptation and common services.
Sample Business Intelligence Architecture

User interaction

Process integration

Business policies/rules

Transaction processing

Data management
Why Metadata for Governance?

Companies have different ways of reporting data

Data is in different Formats

Multiple codes exist for the same thing

Companies use different IT systems

Organisations change rapidly

IT systems change

"Semantic Disconnect"
Metadata Uses in Data Governance

- Strategic (data stewardship; information reuse; information management; data integration strategy)
- Tactical (project flexibility and adaptability; portfolio management)
Metadata Extraction Tool Example: Saphir

• Saphir (Silwood Technology) is a tool that reads the data structures of Peoplesoft,, SAP (BW & mySAP ), Siebel, and JD Edwards databases and extracts the definitions and relationships of the tables and columns, which can then be exported into tools such as ERwin, PowerDesigner, Popkin System Architect, or Visio.

• “Data warehouse designers, reporting teams and data architects use this powerful application to analyse their data requirements from the key enterprise applications. Saphir helps you take control of your data management projects as you strive to understand exactly where vital business information is stored.”

• [http://www.silwoodtechnology.com/saphir.htm](http://www.silwoodtechnology.com/saphir.htm)
**Enterprise Integration Challenges**

- **Communication**: Services need to communicate reliably with each other over the network. A reliable, scalable, robust, and location-independent communications system dramatically reduces the development time for distributed systems while increasing reliability.

- **Connectivity**: To extract data from a service, one first needs to be able to easily connect to that service. Absent any standards, this has been difficult.

- **Transformation**: Data produced by a given service is typically not easily understood by another service; to make the data digestible by another service, it first needs to be suitably transformed.

- **Service-Oriented Architecture (SOA)**: Distributed enterprise systems span multiple nodes and operating systems, and typically consist of a set of independently running services loosely bound to each other via event-driven messages. This SOA for application composition allows incremental, dynamic extensibility and greatly reduces costs of maintenance and Total Cost of Ownership (TCO).

- **Portability**: Most enterprises have a variety of computer systems, ranging from thin-clients and Windows desktop PCs to higher-end Unix servers and mainframe systems. Portability and ease of communication between different operating environments remain concerns for enterprise solutions.

- **Security**: Finally, all connectivity to and communication between enterprise services need to be secure at levels satisfactory to the enterprise. Since distributed applications span different departments and locations within and outside the firewall, security is highly important.
Standards

- Messaging: JMS
- Web Services: XML, SOAP, WSDL, UDDI
- Transformation: XSLT, Xquery
- Service-Oriented Architecture (SOA): based of the above standards; loosely-coupled
- Portability: Java, HTTP, XML, SOAP on Windows, Unix, mainframes
- Security: SSL, certificates, signatures, SAML plus all of the WS-* security standards
Intelligent Multiagents Approach
Thanks You