Ch3 – Enterprise Systems Architecture
& The Future of ERP

What is "architecture", anyway?

Architecture (Latin architectura, from the Greek ἀρχιτέκτων – arkhitekton, from ἀρχις "chief" and τέκτων "builder, carpenter, mason") is both the process and product of planning, designing and construction. (Wikipedia)

Commodity

Firmness

Delight

What is Enterprise Architecture?

The defining characteristic that differentiates Enterprise Architecture from other architectures is:

**enterprise scope**
- it crosses (internal) organizational boundaries
- covers multiple business units
- crosses functional boundaries

Why would we do anything across the scope of the enterprise?
- it creates opportunities and allows problems to be tackled that cannot be effectively dealt with at a “lower level”, i.e., a more narrow scope
- e.g., increase collaboration decreasing duplication across business units resulting in savings on development costs

Enterprise Systems Modules and Architecture

What’s architecture? Logical vs. Physical

**Logical Architecture – A Closer Look**

- Logical architecture addresses the information system seen macroscopically, by focusing on its main components, their interconnections and the flows exchanged, and by structuring them by groups into larger-scale modules.
- There are two reasons why the logical modules are so important to the Enterprise.
  - First, you can’t design something (Enterprise included) using the actual material components of the product (Enterprise).
  - Second, you need Logical Modules because when the business grows so big that management is no longer able to physically maintain contact with the modules of the business, they will have to create data "surrogates" of those modules in order to manage the business.
Why Study Enterprise Systems Architecture?

- Help management and the implementation teams understand in detail the features and components of the enterprise system.
- Provide a visual representation of the complex system interfaces among the ERP application and databases, operating systems, legacy applications, and networking.
- Management can develop a better IT plan if the requirements for system infrastructure, training, change management, and business process reengineering are clarified.

Enterprise Systems Modules and Architecture

Each ERP software module corresponds to a major functional area of an organization. Organizations implement these modules in ERP that are both economically and technically feasible. Each module is committed with the best business practices to allow organizations to easily implement their policies and procedures.

Overview of Modules
- Production: Helps in the planning and optimization of the manufacturing capacity, parts, components, and material resources using historical production data and sales forecasting.
- Purchasing: Streamlines the procurement process of required raw materials and other supplies.
- Sales and Marketing: Implements functions of order placement, order scheduling, shipping, and invoicing.
- Finance: Can gather financial data from various functional departments and generate valuable financial reports.
- Human Resource: Streamlines the management of human resources and human capitals.

Effects of well-designed architecture (Logical) on implementation

Self Services
- Flexible support for employees’ business functions
- Simplified access to relevant information

Product Development and Production
- Shorten time to market
- Deliver higher quality products and ensure timely delivery
- Improve visibility in real time

Financials
- Ensure predictability of business performance
- Automate accounting and financial SCM

Sales and Service
- Higher number of sales orders processed and reduced administrative costs
- Easy access to accurate, timely customer information
- Reduce travel costs by using online functions

HR Management
- Attract the right people, develop and leverage talents, align efforts with corporate objectives, and retain top performers
- Enable creation of project teams based on skills and availability, monitor progress on projects, track time, and analyze results

Physical Architecture – A Closer Look

Database Layer
- Typically a relational database distributed across multiple servers.

Application Layer
- Application components supporting user interactive access bind to dialog work processes.
- Application components that generate background work bind to batch processes.
- Additional work processes coordinate activities between servers.

Presentation layer
- Provides the menu-driven GUI interface between users and applications.
- May reside locally on a user’s desktop computer or be a completely separate presentation server on the LAN.
- May keep in temporary, local storage a list of recently invoked transactions and data specific to the process being supported to alleviate the need to access the server.
- May be customized for a specific user

Tiered Configurations

Most of the current ERP implementations follow a Three-tiered architecture

Three-tiers architecture

Benefits
- End-users have access to ERP applications over the Web.
- Easily integrate ERP applications with existing systems.
- Client-centric—Architecture has better response time because user requests are mostly processed on the client’s computer.
- Web-based architectures also allow better system-to-system integration.

Drawbacks
- Client-centric architectures lack security
Web services and SOA

Web services

• Ongoing in last decade (2002?)
• “Fourth tier”: web split into services & browser
• Powerful new ability for access and integration
• Simple, ubiquitous access to ERP modules and enables open flow of information between systems

Parts involved…

• Web server
• ERP portal (ie. SAP Front End)
• Back-end server integration
• Browser plug-ins or applets

Architecture can be server-centric or client-centric

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Service-Oriented Architecture

• AKA Object-oriented architecture for web platforms
• SOA decomposes business tier into smaller, distinct units of services…collectively support ERP functional module

• Exist autonomously
• Evolve independently
• Can share biz logic across corporate firewall

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SERVER-CENTRIC

Need: Access to Internet

Standard browser: IE, Firefox, with a few plug-ins

Client can be any Internet device using standard Internet technologies

- HTML (user access)
- XML (back-end)

CLIENT-CENTRIC

Need: Installation of SDKs

Configuration and integration with client devices -- practically disappearing

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Example of SOA exchange

Hi, send me the data for Device at Location, and wants to see its properties

Display screen

Device Name 123ABC...

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Benefits and drawbacks to Internet platform

1. End-user access
2. Easier integration of ERP apps
   - existing internal systems
   - external trading partner systems
3. Cheaper, since no complex client software reqd.
4. SLOWER.

SOA Standard

- Description language provides medium for business process messages
- Interactions independent of each other and protocols
- Any operating system, any language
- Web services an application of SOA (SOAP, XML)
### SOA software development model

- Contract between client and server...
- Functional description of the service
- Input requirements and output specifications
- Precondition environment state
- Post condition environment state
- Error handling

Provides flexibility and agility!

### SOA benefits/drawbacks

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<th>Benefits</th>
<th>Drawbacks</th>
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<td>Benefits</td>
<td><strong>Short term benefits:</strong>&lt;br&gt;- Enhances reliability&lt;br&gt;- Reduces hardware acquisition costs&lt;br&gt;- Leverages existing dev skills&lt;br&gt;- Accelerates move to standards-based server &amp; app consolidation&lt;br&gt;- Provides a data bridge</td>
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Benefits of Cloud Computing

- Pay for subscription, not for licenses and upgrades.
- Reduced capital and operating expenditures for IT equipment and support personnel.
- Accessed from everywhere, as long as you have an Internet connection.
- No need to install anything on the user’s computer.
- Dynamic scalability available on demand.
- No maintenance fees for software or hardware.
- Promotes green computing environment as servers in cloud run on clean energy.
- Guaranteed reliability.

Drawbacks of Cloud Computing

- Data security.
- Vulnerability.
- Possible conflict of interest, if the company who stores your applications decides to create a similar application to what you created on their servers.
- Not suited for all highly competitive industries like biotech where intellectual property cannot be protected easily.

Implications for Management

- Enterprise architecture is an important technology for the long-term functioning of the organization.
- ERP architecture decisions are complex because their impact goes beyond systems and technology to people, organizational policy, and business processes.
- ERP architecture must be flexible to support a diverse set of hardware and software platforms.
- Management must learn how to filter out the hyped technologies that do not provide value to their organization.
How to choose?

- Cloud brokers (like Infosys) want to enable customers to pick and choose different levels of public cloud, private cloud, and enterprise assets.

  Faster provisioning (6 weeks down to 6 minutes)

  ‘Cloud burst’ in times of extraordinary demand

  Accelerate IT project delivery (15-20% reduction)

  Customized self-service catalog (shows Salesforce.com)

  Efficient set up (save up to 30%), improve productivity by 20%.

  Smart Brokerage: select and compare best-in-class brokerages to choose best provider.

  Business Collaboration Wall – discussion board.

  Time to Market improved (by 40%).

  Dashboard shows enterprise-wide business intelligence graphics.

  Build, manage, and govern cloud ecosystem.

Future trends - RFID

Radio frequency identification (RFID)

RFID is a generic term that is used to describe a system that transmits the identity (using a unique serial number) of an object or person wirelessly, using radio waves.

- A basic RFID system consists of three components:
  - An antenna (transmitting)
  - A transceiver (with decoder)
  - A transponder (RF tag) electronically programmed with unique information

Critical Factors for RFID Success

- Deploy Proven Use Cases that Solve Real Problems
- Adopt a Flexible Deployment Architecture
- Take Advantage of Real-Time Data
- Integrate RFID Data and Events with Production Systems
- Use a Standards-Based Approach
- Require Broad Device Support from the Beginning
- Plan for Continuous Improvement

Thin clients (aka ERP on iPads)

Need an app version of SAP GUI!

- [http://softwaretopic.informer.com/sap-front-end-for-ipad](http://softwaretopic.informer.com/sap-front-end-for-ipad)

Future trends - BI

Business Intelligence (BI)

In the context of bringing transparency to the business and order to the potential chaos, perhaps the most significant of the extensions to ERP is Business Intelligence (BI). Think of it as a layer on top of or embedded within ERP and other applications which would wind up being giant repositories of data. While ERP and BI may indeed be implemented together, just as often they are viewed as separate initiatives.

BI products have had a reputation of working only with historical data gathered from data warehouses. However, in today’s highly competitive climate, executives demand visibility into the status of their business process networks as they relate to the business key performance indicators (KPIs) in real time, therefore the focus of BI is shifting:

BAM is a real-time, event-driven extension of BI. The extension is subtle but powerful.
Summary

• System architecture provides answers to questions like:
  – What will the system look like?
  – How will the system work?
  – How will it be developed?
  – Do we have the required infrastructure to support the system?
  – Can the system be used for any business function or just for a specific business function like human resources?
• System architecture includes ERP modules and ERP architecture.

Summary (Cont’d)

• Service-oriented architecture separates the service provider from the service consumer similar to object-oriented system architecture which has a higher degree of separation.
• Management must be involved in the design of the architecture from the very beginning of the ERP implementation project because the system has a wide and long-lasting implication on the organization.

Summary (Cont’d)

• Major vendors provide modules to support basic business functions as accounting, finance, marketing, and HR to such advanced business functions as self-service, compliance management, business intelligence.
• ERP systems have traditionally been organized in three-tiers or layers providing flexibility and scalability: data, application, and presentation.
• There are various types of layered architecture.
  • Two-tier architecture is the simplest form.
  • Three-tier architectures separate application from the presentation layer.
  • Web-based architectures facilitate better integration with Internet technologies.