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SECOND EDITION

ENTERPRISE SYSTEMS FOR MANAGEMENT

CHAPTER 3

ENTERPRISE SYSTEMS ARCHITECTURE

Learning Objectives

- Examine in detail the enterprise systems modules and architecture.
- Understand the effects of a well-designed architecture on ERP implementation.
- Know the various types of ERP architectures and the related benefits and drawbacks of each architecture.
- Learn about the Service Oriented Architecture and its impact on ERP systems.
- Learn about cloud architecture and its impact on ERP systems.

Preview

- Once ERP systems are integrated and implemented successfully in a company, they become the cornerstone of the organization because every single transaction will be processed through this system.
- In addition to the Systems Integration, it is also necessary to focus on:
 - Business process architecture.
 - Business requirements.
 - Budget.
 - Project management.
 - Commitments from top management.
 - Continuous communication with employees informing them about future changes.

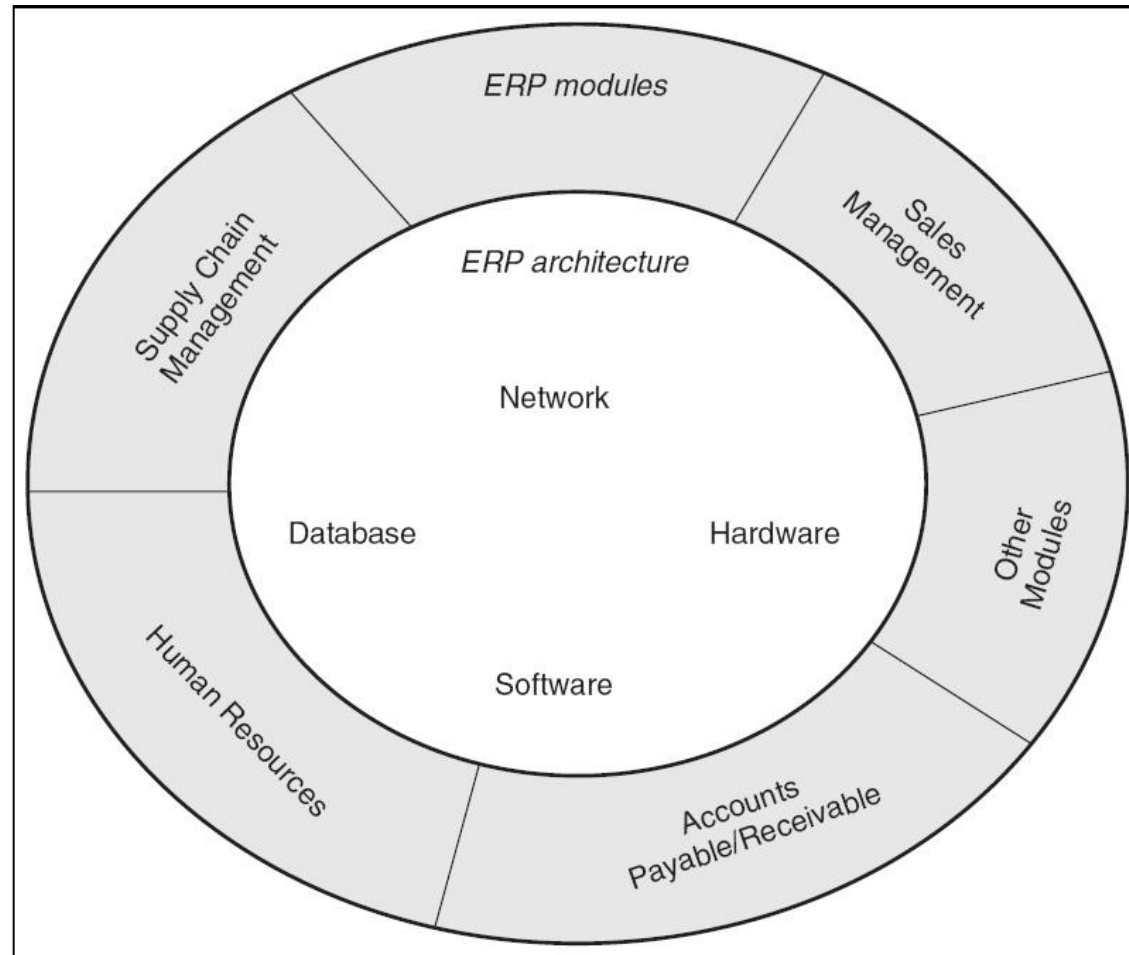
Why Study Enterprise Systems Architecture?

- 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.

Components of the Enterprise Systems Architecture

- Functional
 - Defines the *ERP modules that support the various business functions* of the organization. Examples include:
 - Accounting
 - Human Resources
 - Procurement
 - Fulfillment
 - Etc.
- System
 - Defines the *ERP architecture through the physical components* of hardware, software, and networking angle.

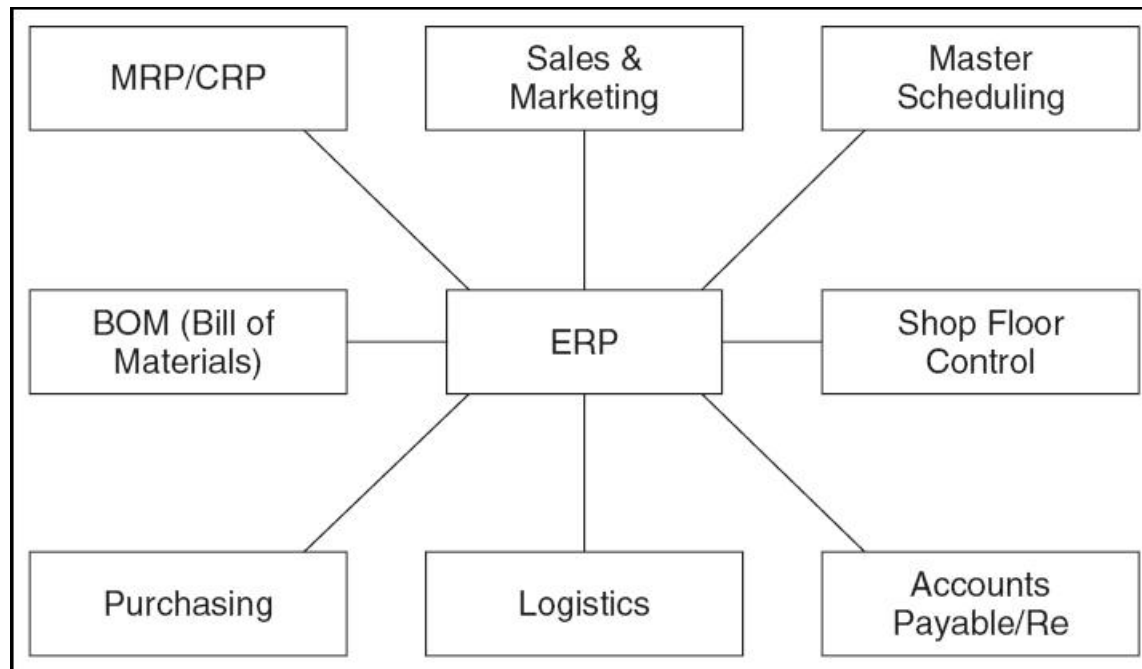
Figure 3-1 Enterprise Systems Architecture (ESA) Model



ERP Modules

- The key role of an ERP system is to provide support for such business functions as accounting, sales, inventory control, and production.
- ERP vendors, including SAP, Oracle, and Microsoft, etc. provide modules that support the major functional areas of a business.
- The ERP software embeds best business practices that implement the organization's policy and procedure via business rules.

Figure 3-2 Typical ERP Modules



ERP Modules From Three Vendors

| Function | SAP | Oracle/ PeopleSoft | Microsoft Dynamics |
|-------------|--|---|--|
| Sales | Sales and Distribution, Sales Opportunity | Marketing and Sales, Supply Chain Management | Retail POS, Field Service Management |
| Procurement | Purchasing, Supplier Relationship Management | Procurement and Supplier Relationship Management | Supply Chain Management |
| Production | MRP, Product Life Cycle Management | Manufacturing | Manufacturing |
| Accounting | Financial Accounting | Financial Management | Financial Management |

ERP Modules From Three Vendors (Cont' d)

| Function | SAP | Oracle/ PeopleSoft | Microsoft Dynamics |
|--|---|--|----------------------------|
| Distribution | Warehouse Management | Supply Chain Management | Distribution Management |
| Customer Service | CRM | CRM | CRM |
| Corporate Performance & Governance | Governance, Risk, and Compliance Management | Corporate Performance Management | Analytics |
| Human Resources | Human Capital Management | Human Capital Management | HR Management |
| Miscellaneous | Banking | Campus Solutions | E-commerce, Portals |

Overview of Modules

- **Production**
 - Helps in the planning and optimizing 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.
- **Inventory Management**
 - Facilitates the processes of maintaining the appropriate level of stock in a warehouse.

Overview of Modules (Cont' d)

- **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.
- **Miscellaneous Modules**
 - Nontraditional modules such as business intelligence, self-service, project management, and e-commerce.

Benefits of Key ERP Modules

- **Self Services**

- Flexible support for employees' business functions.
- Simplified access to relevant information.

- **Performance Management**

- Delivery of real-time, personalized measurements and metrics.
- Provides executives with access to such information as business statistics and key performance measurements.

- **Financials**

- Ensure compliance and predictability of business performance.
- Gain deeper financial insight and control across the enterprise.
- Automate accounting and financial SCM.
- Rigorous support for financial reporting—SOX Act.

Benefits of Key ERP Modules (Cont' d)

- **HR Management**

- Attract the right people, develop and leverage talents, align efforts with corporate objectives, and retain top performers.
- Increase efficiency and help ensure compliance with changing global and local regulations by using standardized and automated workforce processes.
- Enable creation of project teams based on skills and availability, monitor progress on projects, track time, and analyze results.
- Manage human capital investments by analyzing business outcomes, workforce trends and demographics, and workforce planning.

Benefits of Key ERP Modules (Cont' d)

- **Procurement and Logistics Execution**
 - Sustain cost savings for all spending categories by automating such routine tasks as converting requisitions into purchase orders and by allowing employees to use electronic catalogs to order products and services.
 - Reduce costs through process automation, integration of suppliers, and better collaboration.
 - Improve resource utilization with support for cross-docking processes and data collection technologies. (RFID and bar codes).
 - Enhance productivity of incoming and outgoing physical goods movements.
 - Reduce transportation costs through better consolidation and collaboration.

Benefits of Key ERP Modules (Cont' d)

- **Product Development and Production**
 - Shorten time to market.
 - Deliver higher quality products and ensure timely delivery.
 - Real time visibility and transparency (availability check).
- **Sales and Service**
 - Higher number of sales orders processed and reduction in administrative costs.
 - Easy access to accurate, timely customer information.
 - Cost-effective mobile access for field employees.
 - Reduce travel costs by using online functions.
 - Adhere to environmental, health, and safety reporting requirements.
 - Improve the management of incentives and commissions.
 - Realize more effective real estate management.

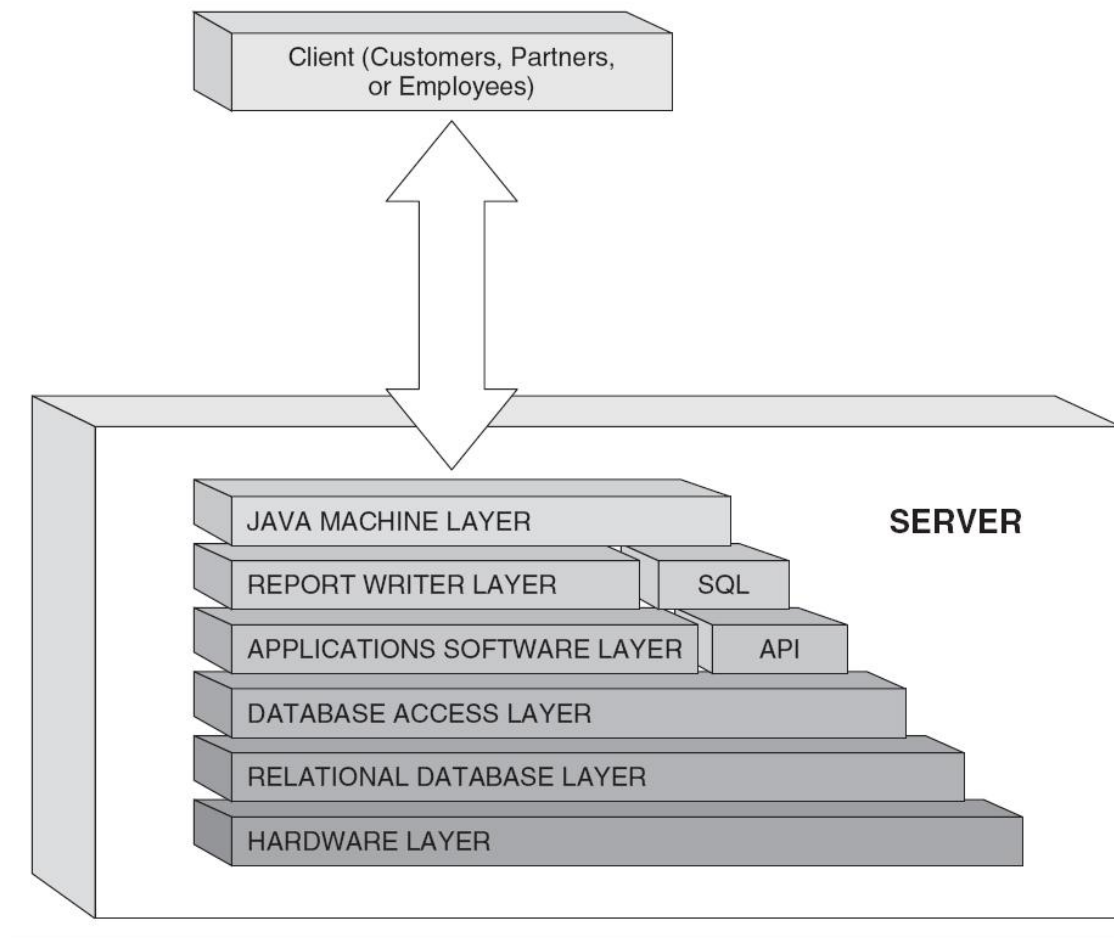
ERP Architecture

- ERP system architecture is organized in layers or tiers to manage system complexity in order to provide scalability and flexibility.
- Three-layer architecture (*the most reliable, flexible, and scalable architecture*) is the most prevalent today and includes:
 - Web Servers.
 - Application Servers.
 - Database Servers.

Layered Architecture Example (Info.Net)

- The Layered ERP architecture generalizes the functional layers to allow it to change with newer technologies.
- A Web-based user interface is provided.
 - Users can access the application via the Internet.
 - The PC needs to be capable of running a Java-enabled Web browser.
 - The PC is connected to both Intranet and Internet to be able to use one of Info.Net's servers.
 - The user interacts with the Java Virtual Machine™ Interface layer to establish a secure connection via a secure socket layer (SSL) connection.
 - The user is then communicating with the server through the applications software layer (ASL).

Figure 3-3 Example of Info.Net Architecture



Infrastructure Requirements

- Traditional networks require upgrading prior to the deployment of ERP systems and must be a component of the overall budget.
- A high-availability network is a requirement for a fully functioning ERP system, one that grows with the user population and supports continued expansion and integration of a supply chain.
- Integration with partner and customer systems allows “a company to manage important parts of the business such as order tracking, inventory management etc.”
- Online analytical processing (OLAP) provides the ability to access, present, and analyze data across dimensions.

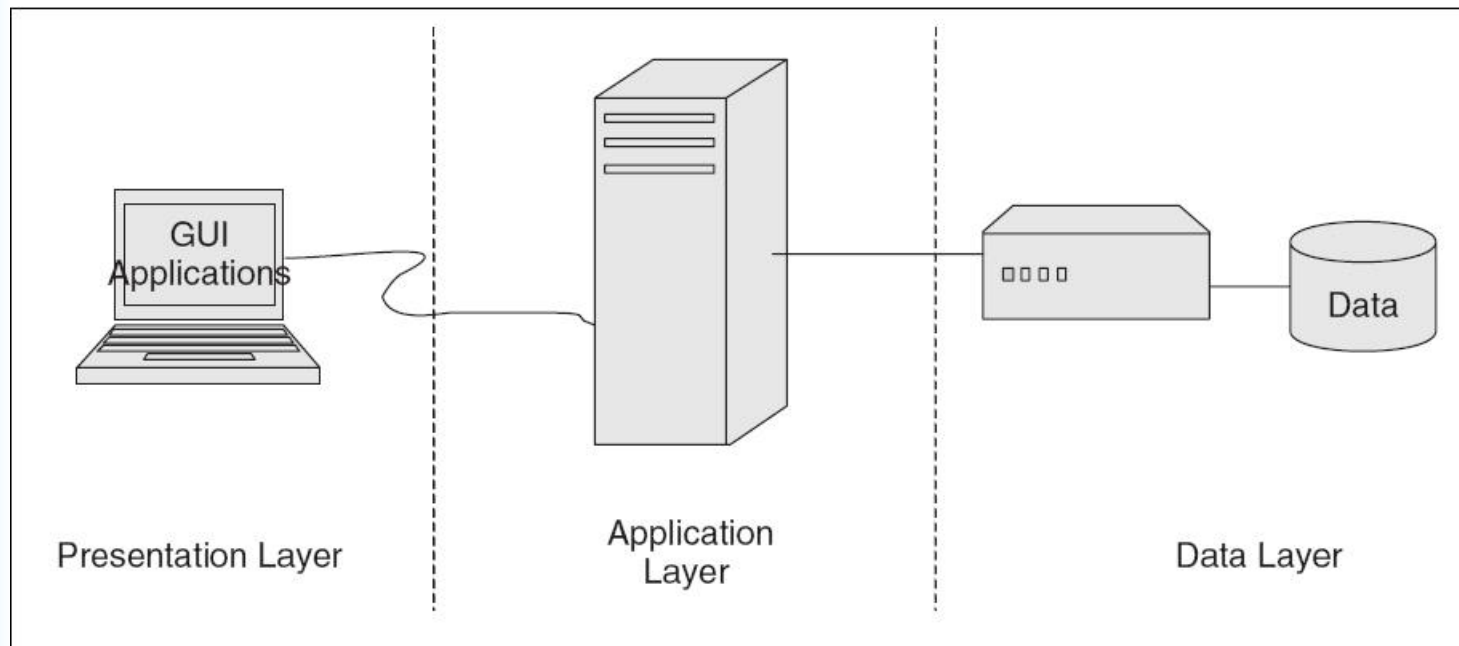
Three-Tier Architecture

- Most of the current ERP implementations follow a *three-tiered architecture, which consists of a Web tier, an application tier, and a data tier.*
- Benefits
 - Scalability - Easier to add, change, and remove applications.
 - Reliability - Implementing multiple levels of redundancy.
 - Flexibility - Flexibility in partitioning is very simple.
 - Maintainability - Support and maintenance costs are less on one server.
 - Reusability - Easier to implement reusable components.
 - Security - IT staff has more control system to provide higher security.
- Limitations
 - Can be very expensive and complex.

Tiers

- The Web Tier
 - Web-based portal allows users the ability to access and analyze information through their Web browser.
- The Application Tier
 - Consists of a Web browser and reporting tool where business processes and end-users interact with the system.
 - It shields the business users from the inner workings of an ERP system, but still provides the information relevant to their job and business process.
- The Data Tier
 - Focus is on structure of all organizational data and its relationships with both internal and external systems.

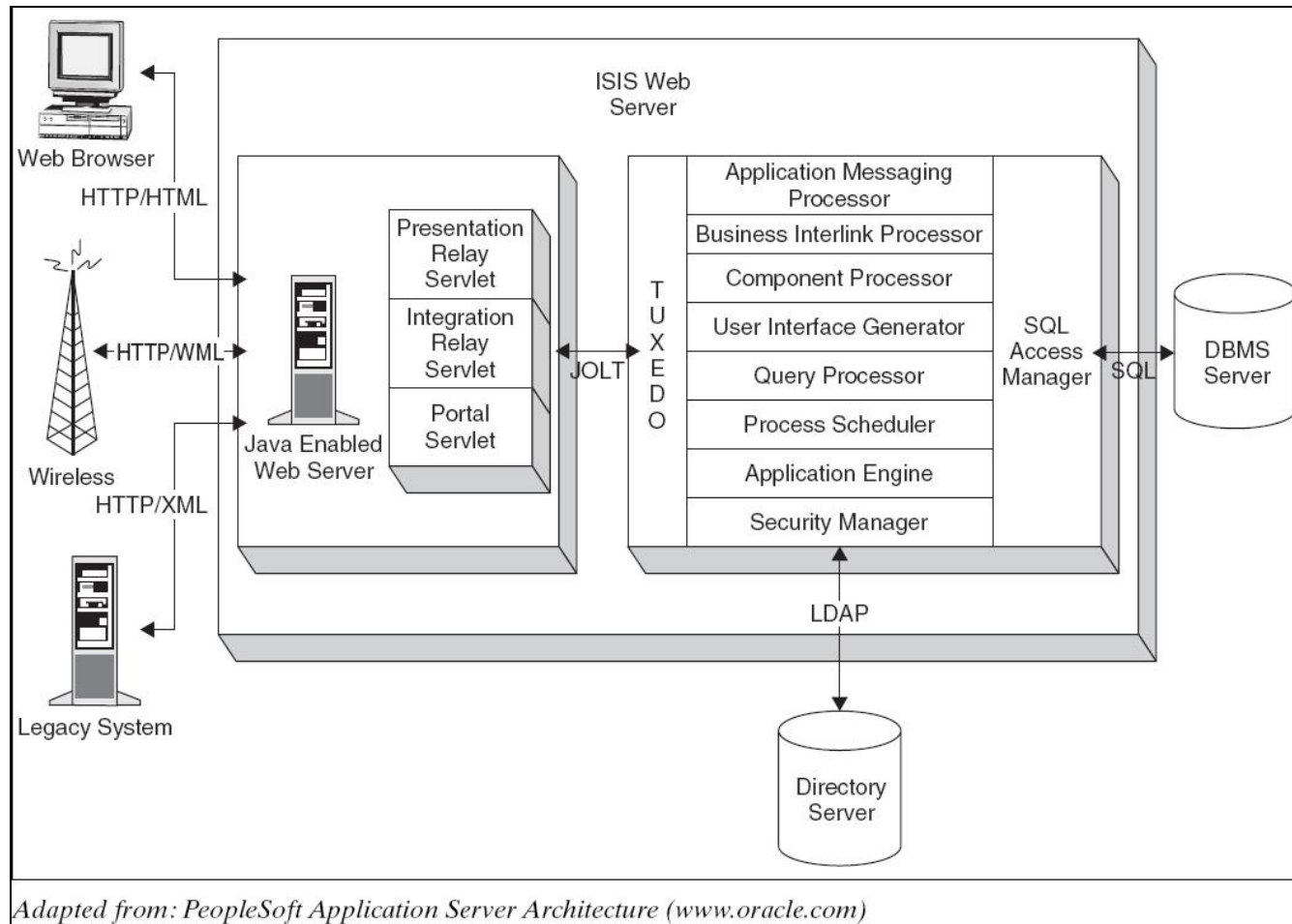
Figure 3-4 A Three-Tier ERP Architecture



Web Services Architectures

- Web-based architecture often described as a fourth tier where the Web tier is split into Web Services tier and Web Browser tier.
- The ERP systems focus on the Internet to provide a powerful new functionality for Internet-based access and integration.
- This functionality is primarily supported through the following Internet access technologies:
 - Web Server.
 - ERP Portal.
 - Back-end Server Integration.
 - Browse Plug-ins or Applets.

Figure 3-5 Example of PeopleSoft's Server-Centric Internet Architecture



Benefits and Drawbacks

- **Benefits**
 - Large numbers of end-users have access to ERP applications over the Web.
 - Easily integrate ERP applications with existing systems.
 - Server-centric—No complex, expensive client software installation.
 - The server-centric architecture enables secure end-user access to ERP application.
 - 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.
 - Server centric is slower.

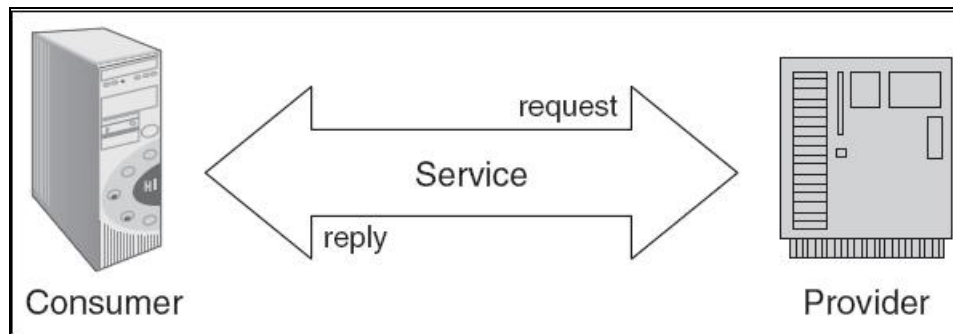
Service-Oriented Architectures

- Also known as object-oriented architectures for Web platforms.
- Breaks the business tier into smaller, distinct units of services, collectively supporting an ERP functional module.
- Allows message interaction between any service consumer and service provider.
- A consumer from a device using any operating system in any language can use this service.

Service-Oriented Architectures

- SOA is a software development model based on a contract between a consumer (client) and a provider (server) that specifies the following:
 - Functional description of the service.
 - Input requirements and output specifications.
 - Precondition environment state before service can be invoked.
 - Post condition environment state after service has been executed.
 - Error handling when there is a breakdown.

Figure 3-6 A SOA Architecture



Benefits of Service-Oriented Architectures

- Business-level software services across heterogeneous platforms.
- Complete location independence of business logic.
- Services can exist anywhere (any system, any network).
- Loose coupling across application services.
- Granular authentication and authorization support.
- Dynamic search and connectivity to other services.
- Enhances reliability of the architecture.
- Reduces hardware acquisition costs.

Benefits of Service-Oriented Architectures (Cont' d)

- Accelerates movement to standards-based server and application consolidation.
- Provides a data bridge between incompatible technologies.
- Provides the ability to build composite applications.
- Creates a self-healing infrastructure that reduces management costs.
- Provides truly real-time decision-making applications.
- Enables the compilation of a unified taxonomy of information across an enterprise.

Business Value Benefits of SOA

- Increases the ability to meet customer demands more quickly.
- Lower costs associated with the acquisition and maintenance of technology.
- Empowers the management of business functionality closer to the business units.
- Leverages existing investments in technology.
- Reduces reliance on expensive custom development.

Drawbacks of Service-Oriented Architectures

- SOA implementations are costly and time-consuming.
- Requires complex security firewalls in place to support communication between services.
- Performance can be inconsistent.
- Requires enterprise-level focus for implementation to be successful.
- Security system needs to be sophisticated.
- Costs can be high because services needs to be junked very often.

SOA and Web Services

- Web services basically are interfaces that allow different software application and components to be operated together.
- According to IT industry standards, different applications can interact with without communication problems.
- The only method of interaction by Web services is by receiving and sending messages.
- Services are developed using open standards such as WSDL (Web Services Description Language), UDDI (Universal Description, Discovery, and Integration), and SOAP (Simple Object Access Protocol).
- The protocols used in Web services are XML-based.

Enterprise Content Management and SOA

- Enterprise content management deals with enterprise software products that usually store, preserve, manage, and deliver content connected to business processes.
- Enterprise content management also about supporting business goals, not just managing content.
- Vendors have come to an understanding that content management takes advantage of technology and information assets across the business and is no longer application specific.

Cloud Architecture

- Cloud computing is basically a software service provided over the Internet, securely, by a service provider on a monthly or yearly lease.
- Companies leasing CC services save money by replacing their purchased software that requires a license fee per seat.
- Some cloud computing providers also let you build your own applications using their engines and then they would host those applications for you as part of the service.

Cloud Architecture

- The cloud computing platform provides a great alternative for organizations that do not want to:
 - Purchase, install, or maintain software applications.
 - Worry about security, privacy and legal issues associated with data storage.
- The cloud computing platform is risky for organizations as it forces them to rely on external vendors for reliability, security, and continuity of enterprise applications.

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.

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)

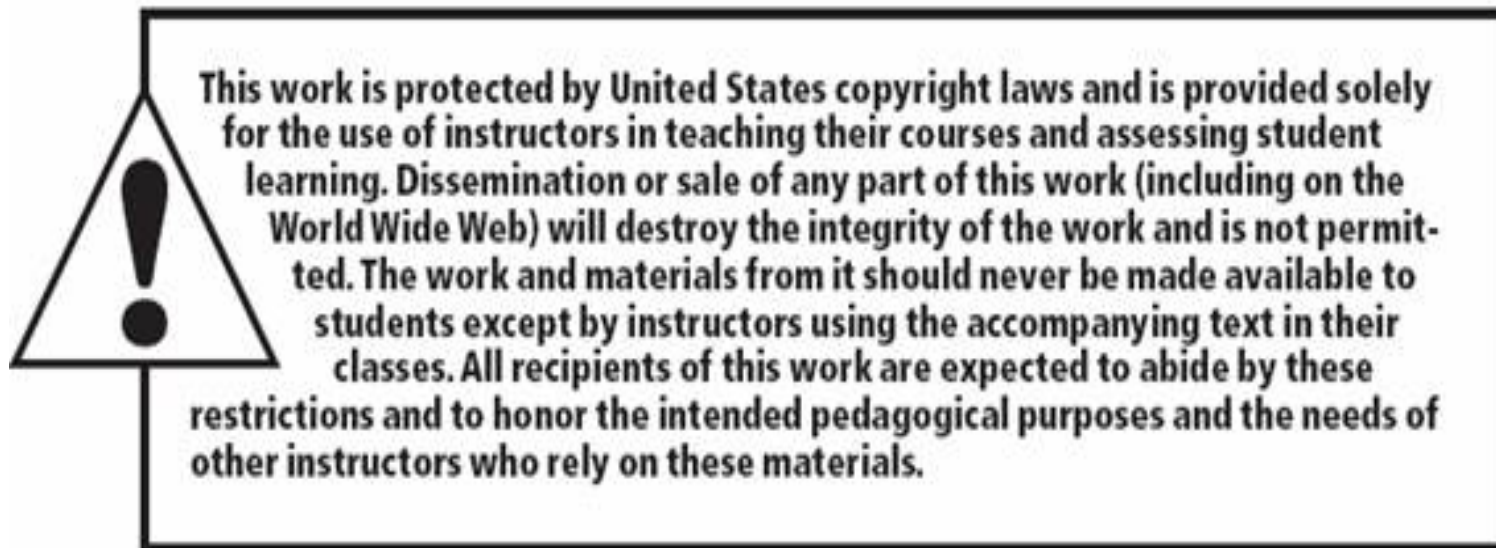
- Major vendors provide modules to support basic business functions as accounting, finance, marketing, and HR to such advanced business functions as self-service, compliance management, business intelligence.
- ERP systems have traditionally been organized in three-tiers or layers providing flexibility 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.

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.

Review Questions

1. What is necessary for the ERP implementation to be successful?
2. What is ERP system architecture?
3. Why is it important to have good enterprise system architecture?
4. What is the role of architecture in ERP implementation?
5. List five of the major functional modules of ERP.
6. Discuss the different types of ERP architectures.
7. List benefits and limitations of one ERP architecture.
8. What is service-oriented architecture and how is it different from Web services architecture?
9. What are the key benefits and limitations of systems integration?
10. What is the role of management in designing enterprise systems integration?



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