E-commerce
business. technology. society.

Fifth Edition

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Chapter 4

Building an E-commerce Web Site

Right-Sizing a Web Site
Class Discussion

- What are the factors you should take into account when sizing a Web site's infrastructure?

- Why is peak usage an important factor to consider?

- What did eBay discover from its use of OPERA?

- How can operators of smaller sites deal with the right-sizing issue?

Building an E-commerce Site: A Systematic Approach

- Most important management challenges in building a successful e-commerce site are:

  - Developing a clear understanding of business objectives

  - Knowing how to choose the right technology to achieve those objectives

Pieces of the Site-Building Puzzle

■ Main areas where you will need to make decisions in building a site include:

  ■ Human resources and organizational capabilities—creating a team that has the skill set to build and manage a successful site

  ■ Hardware
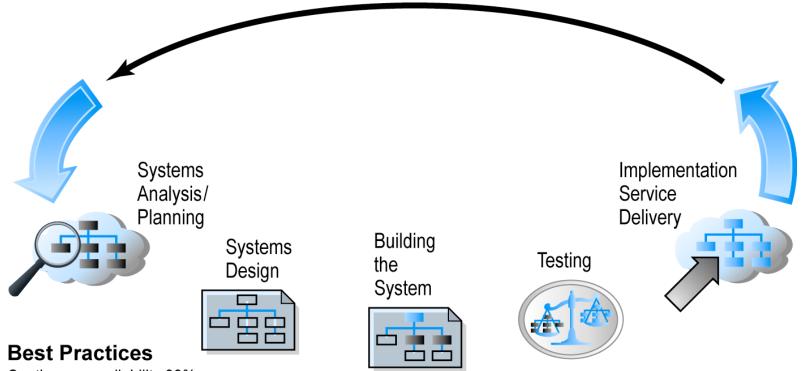
  ■ Software

  ■ Telecommunications

  ■ Site design

The Systems Development Life Cycle

■ Methodology for understanding business objectives of a system and designing an appropriate solution

■ Five major steps in SDLC

    1. Systems analysis/planning

    2. Systems design

    3. Building the system

    4. Testing

    5. Implementation

Web Site Systems Development Life Cycle

Figure 4.2, Page 203

Systems Analysis/ Planning

Systems Design

Building the System

Testing

Implementation Service Delivery

Best Practices
Continuous availability 99%+
Design for scalability
Build in management for end-to-end delivery
Plan for growth
Design pages for high-speed performance
Understand and optimize workload on system

System Analysis/Planning: Identifying Business Objectives, System Functionality, and Information Requirements

- Business objectives:
  - List of capabilities you want your site to have

- System functionalities:
  - List of information system capabilities needed to achieve business objectives

- Information requirements:
  - Information elements that system must produce in order to achieve business objectives

Business Objectives, System Functionality, and Information Requirements for a Typical E-commerce Site

Table 4.1, Page 204

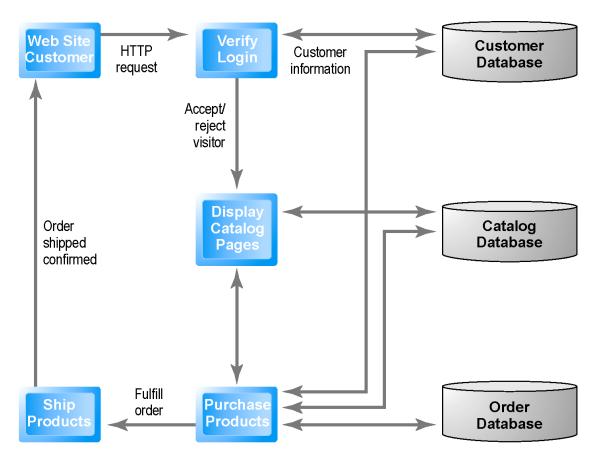| TABLE 4.1	SYSTEM ANALYSIS: BUSINESS OBJECTIVES, SYSTEM FUNCTIONALITY, AND INFORMATION REQUIREMENTS FOR A TYPICAL E-COMMERCE SITE	
BUSINESS OBJECTIVE	**SYSTEM FUNCTIONALITY**	**INFORMATION REQUIREMENTS**
Display goods	Digital catalog	Dynamic text and graphics catalog
Provide product information (content)	Product database	Product description, stocking numbers, inventory levels
Personalize/customize product	Customer on-site tracking	Site log for every customer visit; data mining capability to identify common customer paths and appropriate responses
Execute a transaction payment	Shopping cart/payment system	Secure credit card clearing; multiple options
Accumulate customer information	Customer database	Name, address, phone, and e-mail for all customers; online customer registration
Provide after-sale customer support	Sales database	Customer ID, product, date, payment, shipment date
Coordinate marketing/advertising	Ad server, e-mail server, e-mail, campaign manager, ad banner manager	Site behavior log of prospects and customers linked to e-mail and banner ad campaigns
Understand marketing effectiveness	Site tracking and reporting system	Number of unique visitors, pages visited, products purchased, identified by marketing campaign
Provide production and supplier links	Inventory management system	Product and inventory levels, supplier ID and contact, order quantity data by product

Systems Design: Hardware and Software Platforms

- ## System design specification:
  - Description of main components of a system and their relationship to one another
- ## Two components of system design:
  - Logical design
    - Data flow diagrams, processing functions, databases
  - Physical design
    - Specifies actual physical, software components, models, etc.

Logical Design for a Simple Web Site
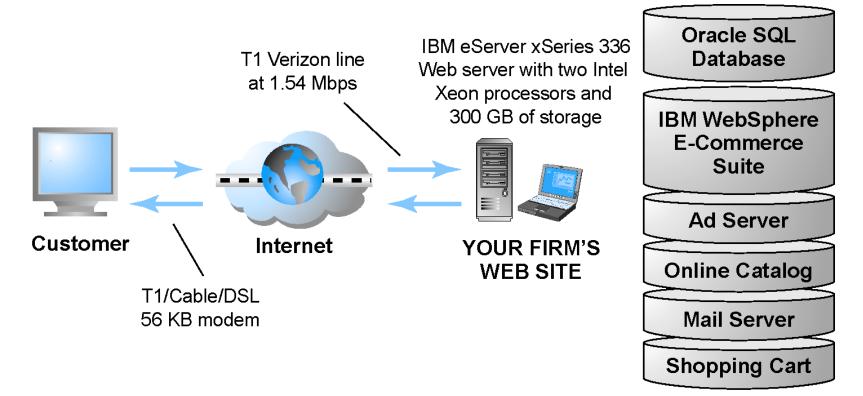## Figure 4.3 (a), Page 206

(a) Simple Data Flow Diagram

This data flow diagram describes the flow of information requests and responses for a sample Web site

Physical Design for a Simple Web Site

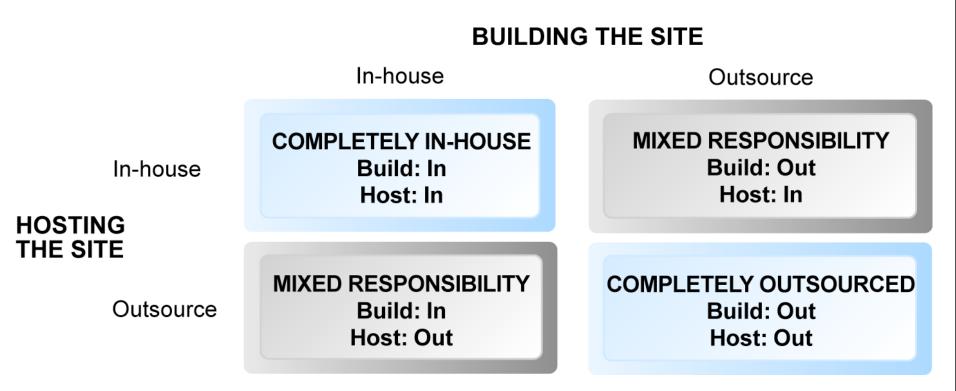**Figure 4.3 (b), Page 206**

(b) Simple Physical Design

A physical design describes the hardware and software needed to realize the logical design

Building the System: In-House versus Outsourcing

- Outsourcing: Hiring vendors to provide services involved in building site
- Build own vs. outsourcing:
  - Build your own requires team with diverse skill set; choice of software tools; both risks and possible benefits
- Host own vs. outsourcing
  - Hosting: Hosting company responsible for ensuring site is accessible 24/7, for monthly fee
  - Co-location: Firm purchases or leases Web server (with control over its operation), but server is located at vendor's facility

Choices in Building and Hosting

Figure 4.4, Page 207

BUILDING THE SITE

In-house   Outsource

HOSTING THE SITE

In-house

COMPLETELY IN-HOUSE
Build: In
Host: In

MIXED RESPONSIBILITY
Build: Out
Host: In

Outsource

MIXED RESPONSIBILITY
Build: In
Host: Out

COMPLETELY OUTSOURCED
Build: Out
Host: Out

Curly Hair and Tattoos: Getting Started on the Cheap
Class Discussion

- How does a small, niche Web site become profitable?

- What is the primary source of income for these kinds of sites?

- What are Internet incubators and what is their relationship to the ventures they support?

Testing, Implementation, and Maintenance

- Testing
  - Unit testing
  - System testing
  - Acceptance testing

- Implementation and maintenance:
  - Maintenance is ongoing
  - Costs of maintenance parallel to development costs
  - Benchmarking: Comparing site to competitors in terms of response speed, quality of layout, and design
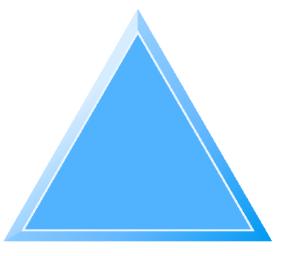
Factors in Web Site Optimization

Figure 4.7, Page 213

Page Delivery

Content delivery networks
Edge caching
Bandwidth

Page Generation

Server response time
Device-based accelerators
Efficient resource allocation
Resource utilization thresholds
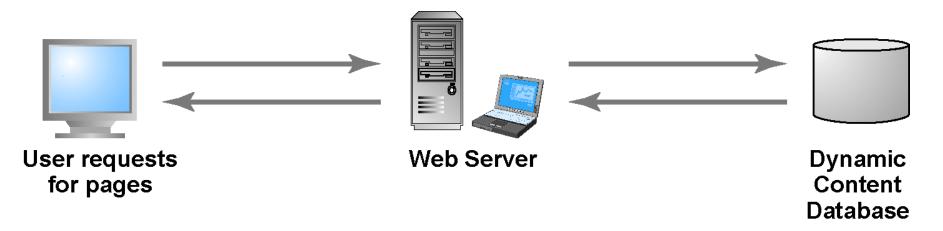Monitoring site performance

Page Content

Optimize HTML
Optimize images
Site architecture
Efficient page style

Simple versus Multi-tiered Web Site Architecture

- **System architecture:**
  - Arrangement of software, machinery, and tasks in an information system needed to achieve a specific functionality

- **Two-tier architecture**
  - Web server and database server

- **Multi-tier architecture**
  - Web application servers
  - Backend, legacy databases

Two-Tier E-commerce Architecture

Figure 4.9(a), Page 216

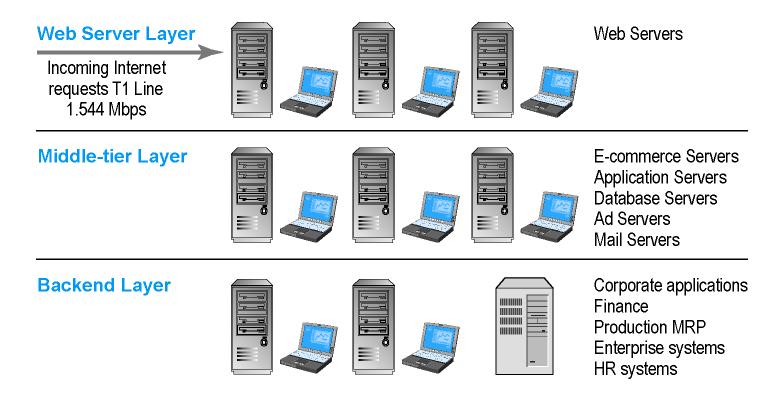**User requests for pages**   **Web Server**   **Dynamic Content Database**

(a) Two-tier Architecture

In a two-tier architecture, a Web server responds to requests for Web pages and a database server provides backend data storage.

Multi-tier E-commerce Architecture
Figure 4.9(b), Page 216

Web Server Layer   Web Servers

Incoming Internet
requests T1 Line
1.544 Mbps

Middle-tier Layer   E-commerce Servers
Application Servers
Database Servers
Ad Servers
Mail Servers

Backend Layer   Corporate applications
Finance
Production MRP
Enterprise systems
HR systems

(b) Multi-tier Architecture

In a multi-tier architecture, a Web server is linked to a middle-tier layer that typically includes a series of application servers that perform specific tasks, as well as to a backend layer of existing corporate systems.

Web Server Software

- All e-commerce sites require basic Web server software to answer HTTP requests from customers

- Apache
  - Leading Web server software (50% of market)
  - Works only with UNIX, Linux OSs

- Microsoft's Internet Information Server (IIS)
  - Second major Web server software (35% of market)
  - Windows-based

Basic Functionality Provided by Web Servers

Table 4.3, Page 218

TABLE 4.3	BASIC FUNCTIONALITY PROVIDED BY WEB SERVERS
FUNCTIONALITY	**DESCRIPTION**
Processing of HTTP requests	Receive and respond to client requests for HTML pages
Security services (Secure Sockets Layer)	Verify username and password; process certificates and private/public key information required for credit card processing and other secure information
File Transfer Protocol	Permits transfer of very large files from server to server
Search engine	Indexing of site content; keyword search capability
Data capture	Log file of all visits, time, duration, and referral source
E-mail	Ability to send, receive, and store e-mail messages
Site management tools	Calculate and display key site statistics, such as unique visitors, page requests, and origin of requests; check links on pages

Site Management Tools

- **Basic site management tools**
  - Included in all Web servers
  - Verify that links on pages are still valid
  - Identify orphan files

- **Third-party software and services for advanced site management**
  - Monitor customer purchases, marketing campaign effectiveness, etc.
  - e.g. WebTrends

Dynamic Page Generation Tools

- Dynamic page generation:
  - Contents of Web page stored as objects in database and fetched when needed
- Common tools:
  - CGI (Common Gateway Interface)
  - ASP (Active Server Pages)
  - JSP (Java Server Pages)
- Advantages
  - Lowers menu costs
  - Permits easy online market segmentation
  - Enables cost-free price discrimination
  - Enables Web content management system (WCMS)

Application Servers

- Web application servers:

  - Provide specific business functionality required for a Web site

  - Middleware

  - Isolate business applications from Web servers and databases

  - Single-function applications increasingly being replaced by integrated software tools that combine all functionality needed for e-commerce site

Application Servers and Their Functions

Table 4.4, Page 222

TABLE 4.4	APPLICATION SERVERS AND THEIR FUNCTION
APPLICATION SERVER	**FUNCTIONALITY**
Catalog display	Provides a database for product descriptions and prices
Transaction processing (shopping cart)	Accepts orders and clears payments
List server	Creates and serves mailing lists and manages e-mail marketing campaigns
Proxy server	Monitors and controls access to main Web server; implements firewall protection
Mail server	Manages Internet e-mail
Audio/video server	Stores and delivers streaming media content
Chat server	Creates an environment for online real-time text and audio interactions with customers
News server	Provides connectivity and displays Internet news feeds
Fax server	Provides fax reception and sending using a Web server
Groupware server	Creates workgroup environments for online collaboration
Database server	Stores customer, product, and price information
Ad server	Maintains Web-enabled database of advertising banners that permits customized and personalized display of advertisements based on consumer behavior and characteristics
Auction server	Provides a transaction environment for conducting online auctions
B2B server	Implements buy, sell, and link marketplaces for commercial transactions

E-commerce Merchant Server Software

- Provides the basic functionality for online sales
    - Online catalog
    - Shopping cart
    - Credit card processing

- Merchant server software packages:
    - Offer integrated environment

- E-commerce merchant services
    - e.g. Yahoo's Small Business Merchant Solutions

- Open source Web building tools:
    - e.g. Apache Web server, MySQL, PHP, PERL

Choosing the Hardware for an E-commerce Site

- Hardware platform:

  - Underlying computing equipment that system uses to achieve e-commerce functionality

- Objective:

  - Have enough platform capacity to meet peak demand but not so much that you waste money

- Important to understand the different factors that affect speed, capacity, and scalability of a site

Right-Sizing Your Hardware Platform: The Demand Side

- Demand that customers put on site the most important factor affecting the speed of site

- Factors involved in overall demand:
  - Number of simultaneous users in peak periods
  - Nature of customer requests (user profile)
  - Type of content (dynamic versus static Web pages)
  - Required security
  - Number of items in inventory
  - Number of page requests
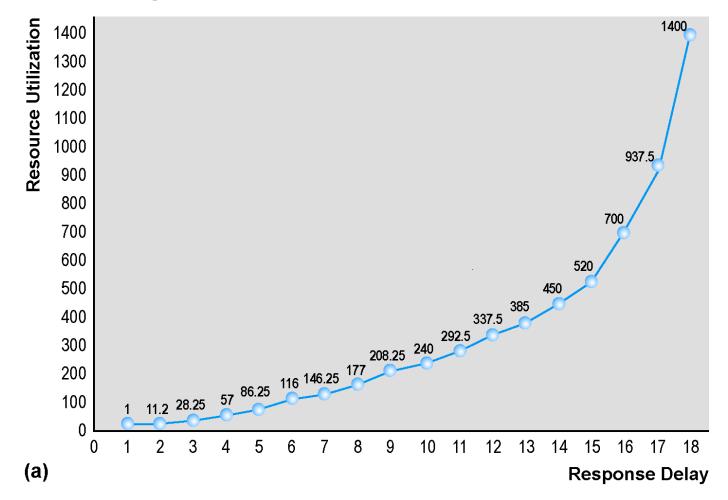 - Speed of legacy applications

Factors in Right-sizing an E-commerce Platform

Table 4.7, Page 227

TABLE 4.7	FACTORS IN RIGHT-SIZING AN E-COMMERCE PLATFORM				
SITE TYPE	**PUBLISH/ SUBSCRIBE**	**SHOPPING**	**CUSTOMER SELF-SERVICE**	**TRADING**	**WEB SERVICES/B2B**
Examples	WSJ.com	Amazon	Travelocity	E*Trade	Ariba e-procurement exchanges
Content	Dynamic Multiple authors High volume Not user specific	Catalog Dynamic items User profiles with data mining	Data in legacy applications Multiple data sources	Time sensitive High volatility Multiple suppliers and consumers Complex transactions	Data in legacy applications Multiple data sources Complex transactions
Security	Low	Privacy Non-repudiation Integrity Authentication Regulations	Privacy Non-repudiation Integrity Authentication Regulations	Privacy Non-repudiation Integrity Authentication Regulations	Privacy Non-repudiation Integrity Authentication Regulations
Percent secure pages	Low	Medium	Medium	High	Medium
Cross session information	No	High	High	High	High
Searches	Dynamic Low volume	Dynamic High volume	Non dynamic Low volume	Non dynamic Low volume	Non dynamic Moderate volume
Unique items (SKUs)	High	Medium to high	Medium	High	Medium to high
Transaction volume	Moderate	Moderate to high	Moderate	High to extremely high	Moderate
Legacy integration complexity	Low	Medium	High	High	High
Page views (hits)	High to very high	Moderate to high	Moderate to low	Moderate to high	Moderate

Degradation in Performance as Number of Users Increases

Figure 4.12 (a), Page 229

(a)

Degradation in Performance as Number of Users Increases

Figure 4.12 (b), Page 229

(b)

The Relationship of Bandwidth to Hits

Figure 4.14, Page 231

Right-Sizing Your Hardware Platform: The Supply Side
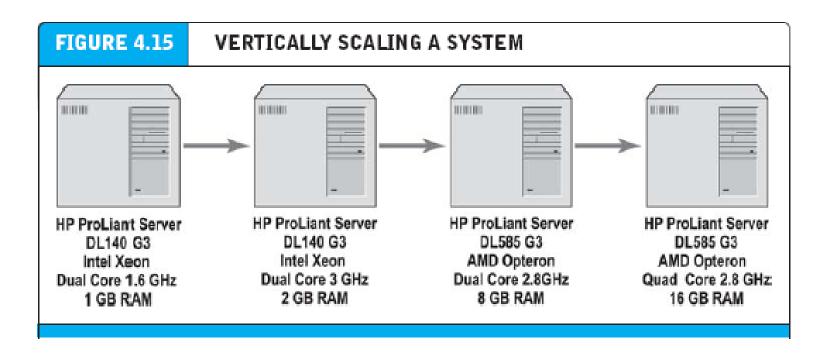
- Scalability:
  - Ability of site to increase in size as demand warrants

- Ways to scale hardware:
  - Vertically
    - Increase processing power of individual components
  - Horizontally
    - Employ multiple computers to share workload
  - Improve processing architecture

Vertical and Horizontal Scaling Techniques

Table 4.8, Page 231

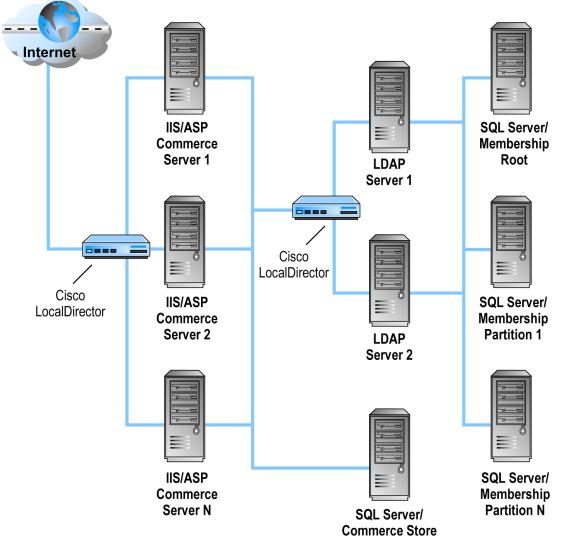| TABLE 4.8	VERTICAL AND HORIZONTAL SCALING TECHNIQUES
TECHNIQUE	**APPLICATION**
Use a faster computer	Applies to edge servers, presentation servers, data servers, etc.
Create a cluster of computers	Use computers in parallel to balance loads
Use appliance servers	Special-purpose computers optimized for their task
Segment workload	Segment incoming work to specialized computers
Batch requests	Combine related requests for data into groups, process as a group
Manage connections	Reduce connections between processes and computers to a minimum
Aggregate user data	Aggregate user data from legacy applications in single data pools
Cache	Store frequently used data in cache rather than on the disk

Vertically Scaling a System

Figure 4.15, Page 232

FIGURE 4.15 | VERTICALLY SCALING A SYSTEM

HP ProLiant Server
DL140 G3
Intel Xeon
Dual Core 1.6 GHz
1 GB RAM

HP ProLiant Server
DL140 G3
Intel Xeon
Dual Core 3 GHz
2 GB RAM

HP ProLiant Server
DL585 G3
AMD Opteron
Dual Core 2.8GHz
8 GB RAM

HP ProLiant Server
DL585 G3
AMD Opteron
Quad Core 2.8 GHz
16 GB RAM

Horizontally Scaling a System

Figure 4.16, Page 233

Improving the Processing Architecture of Your Site

Table 4.9, Page 234

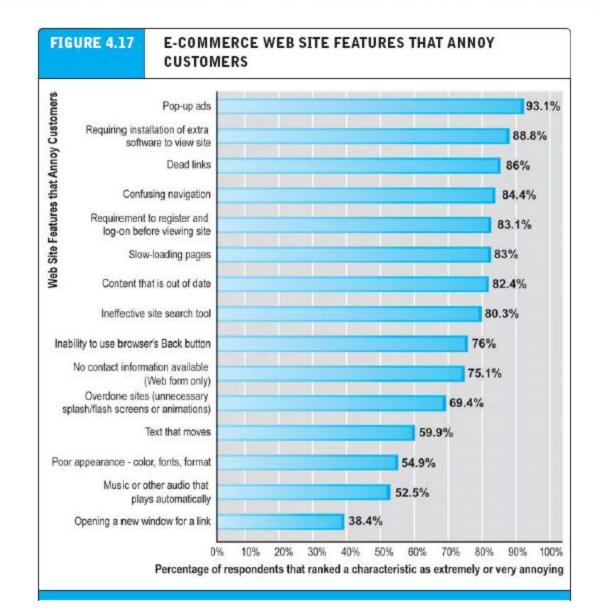| TABLE 4.9	IMPROVING THE PROCESSING ARCHITECTURE OF YOUR SITE
ARCHITECTURE IMPROVEMENT	**DESCRIPTION**
Separate static content from dynamic content	Use specialized servers for each type of workload.
Cache static content	Increase RAM to the gigabyte range and store static content in RAM.
Cache database lookup tables	Cache tables used to look up database records.
Consolidate business logic on dedicated servers	Put shopping cart, credit card processing, and other CPU-intensive activity on dedicated servers.
Optimize ASP code	Examine your code to ensure it is operating efficiently.
Optimize the database schema	Examine your database search times and take steps to reduce access times.

Web Site Design: Basic Business Considerations

- Need design guidelines and software tools that can cost-effectively achieve required business functionality

  - e.g. enabling customers to find what they need, make purchase, leave

- 75% users say they would not revisit a Web site that they found annoying to use

E-commerce Web Site Features that Annoy Customers

Figure 4.17, Page 235

SOURCE: Based on data from Hostway Corporation's survey, Consumers' Pet Peeves about Commercial Web Sites, Hostway Corporation, 2007.

FIGURE 4.17   E-COMMERCE WEB SITE FEATURES THAT ANNOY CUSTOMERS

Web Site Features that Annoy Customers	Percentage
Pop-up ads	93.1%
Requiring installation of extra software to view site	88.8%
Dead links	86%
Confusing navigation	84.4%
Requirement to register and log-on before viewing site	83.1%
Slow-loading pages	83%
Content that is out of date	82.4%
Ineffective site search tool	80.3%
Inability to use browser's Back button	76%
No contact information available (Web form only)	75.1%
Overdone sites (unnecessary splash/flash screens or animations)	69.4%
Text that moves	59.9%
Poor appearance - color, fonts, format	54.9%
Music or other audio that plays automatically	52.5%
Opening a new window for a link	38.4%

Percentage of respondents that ranked a characteristic as extremely or very annoying

The Eight Most Important Factors in Successful E-commerce Site Design

Table 4.10, Page 236

TABLE 4.10	THE EIGHT MOST IMPORTANT FACTORS IN SUCCESSFUL E-COMMERCE SITE DESIGN
FACTOR	**DESCRIPTION**
Functionality	Pages that work, load quickly, and point the customer toward your product offerings
Informational	Links that customers can easily find to discover more about you and your products
Ease of use	Simple fool-proof navigation
Redundant navigation	Alternative navigation to the same content
Ease of purchase	One or two clicks to purchase
Multi-browser functionality	Site works with the most popular browsers
Simple graphics	Avoids distracting, obnoxious graphics and sounds that the user cannot control
Legible text	Avoids backgrounds that distort text or make it illegible

Tools for Web Site Optimization

- Optimization:
  - How to attract a large audience to Web site
- Search engine rankings
  - Keywords and page titles
  - Identify market niches
  - Offer expertise
  - Link to and from other sites
  - Buy ads
  - Local e-commerce

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Tools for Interactivity and Active Content

- ■ Widgets:
  - ■ Small pre-built chunk of code that executes automatically in an HTML Web page
- ■ Mashups:
  - ■ Pull functionality/data from one program and include it in another
- ■ CGI (Common Gateway Interface):
  - ■ Standards for communication between browser and program running on a server that allows for interaction between the user and the server

Tools for Interactivity and Active Content (cont'd)

- ## ASP (Active Server Pages):
  - Used to build dynamic pages with Microsoft's IIS
- ## Java:
  - Used to create interactivity and active content on client computer
- ## JSP (Java Server Pages):
  - Similar to CGI and ASP; allows developers to use HTML, JSP scripts, and Java to dynamically generate Web pages

Tools for Interactivity and Active Content (cont'd)

- JavaScript:
  - Used to control objects on a Web page and handle interactions with browser
- ActiveX:
  - Invented by Microsoft to compete with Java
- VBScript:
  - Invented by Microsoft to compete with JavaScript
- ColdFusion:
  - Integrated server-side environment for developing interactive Web applications

Pumping Up the Customer Experience Using AJAX and Flash
Class Discussion

- What is AJAX? How does it work?

- Compare AJAX to the traditional client/server Web model.

- How does Google Maps use AJAX?

- What are some alternative ways to achieve the same results as AJAX?

Personalization Tools

- ## Personalization:

  - Ability to treat people based on their personal qualities and prior history with your site

- ## Customization:

  - Ability to change the product to better fit the needs of the customer

- ## Cookies:

  - Primary method for achieving personalization and customization

The Information Policy Set

- ## Privacy policy

  - Set of public statements declaring how site will treat customers' personal information that is gathered by site

- ## Accessibility rules

  - Set of design objectives that ensure disabled users can affectively access site

Insight on Society
Designing for Accessibility with Web 2.0
Class Discussion

- ■ What is Section 508 of the Rehabilitation Act?

- ■ Why are merchants reluctant to make their Web sites accessible to disabled Americans?

- ■ How can Web sites be made more accessible?

- ■ Should all Web sites be required by law to provide "equivalent alternatives" for visual and sound content?