Lecture 25
Web Engineering Basics

SE-805 Web 2.0 Programming (supported by Google)

http://my.ss.sysu.edu.cn/courses/web2.0/

School of Software, Sun Yat-sen University

Outline

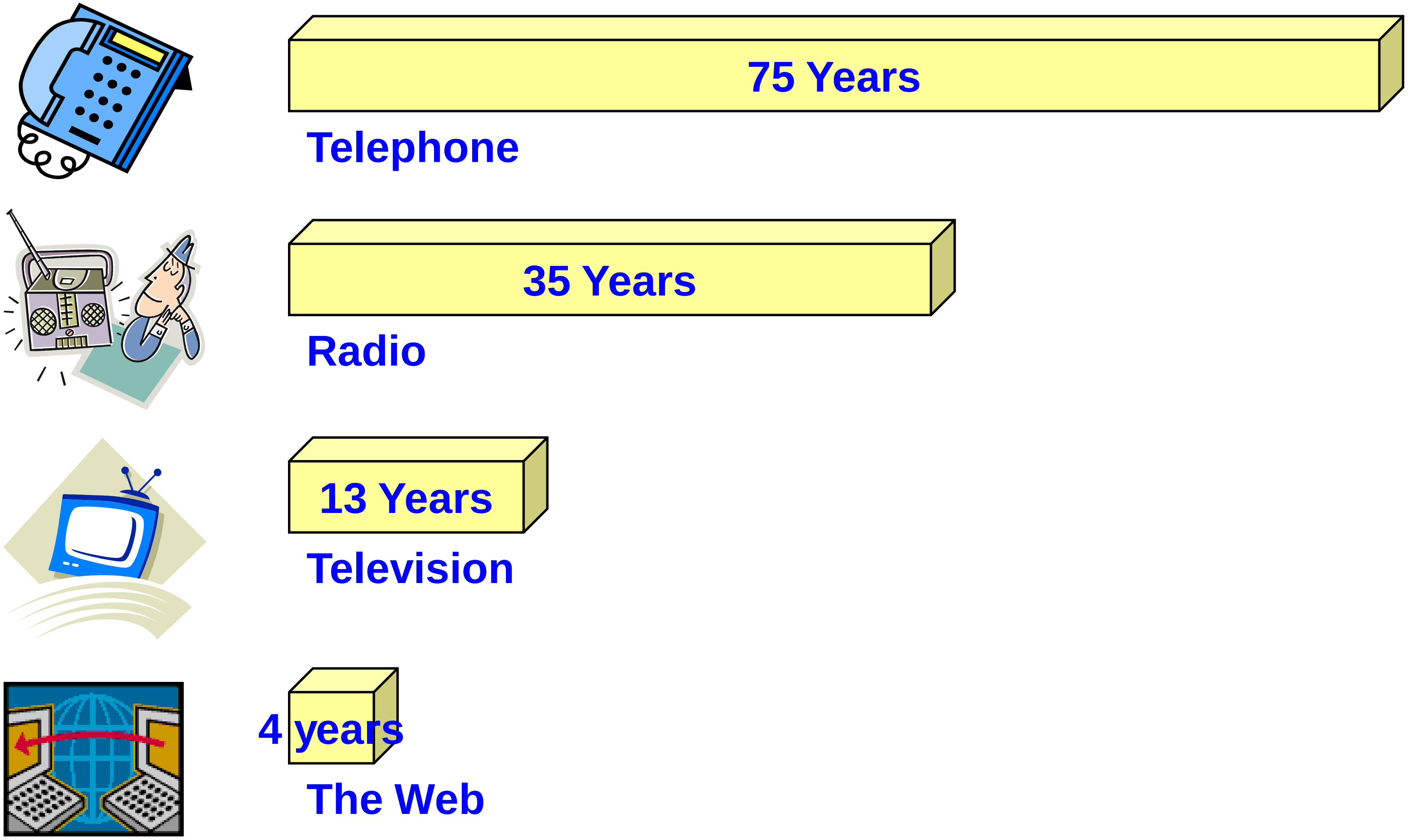
- **Web Engineering & Web Applications**
- Web Engineering Process & Management
- Requirements for Web Application Analysis
- Design Modeling for Web Applications
- Reading Materials

Web Engineering is Important

- The World Wide Web and the Internet that empowers it are arguably the most important development in the history of computing.
  - Billions of people collaborate, create, and share information together
- Web Engineering (WebE) is the process used to create high-quality, *ubiquitously available* Web App.
  - Process
  - Methods
  - Tools
- Web Engineering vs. Software Engineering?
  - Technique, method, tool, process
  - Requirement, design, implementation, testing,……

Fact 1: Rate of Growth

- Time to reach 50 million people



75 Years

Telephone

35 Years

Radio

13 Years

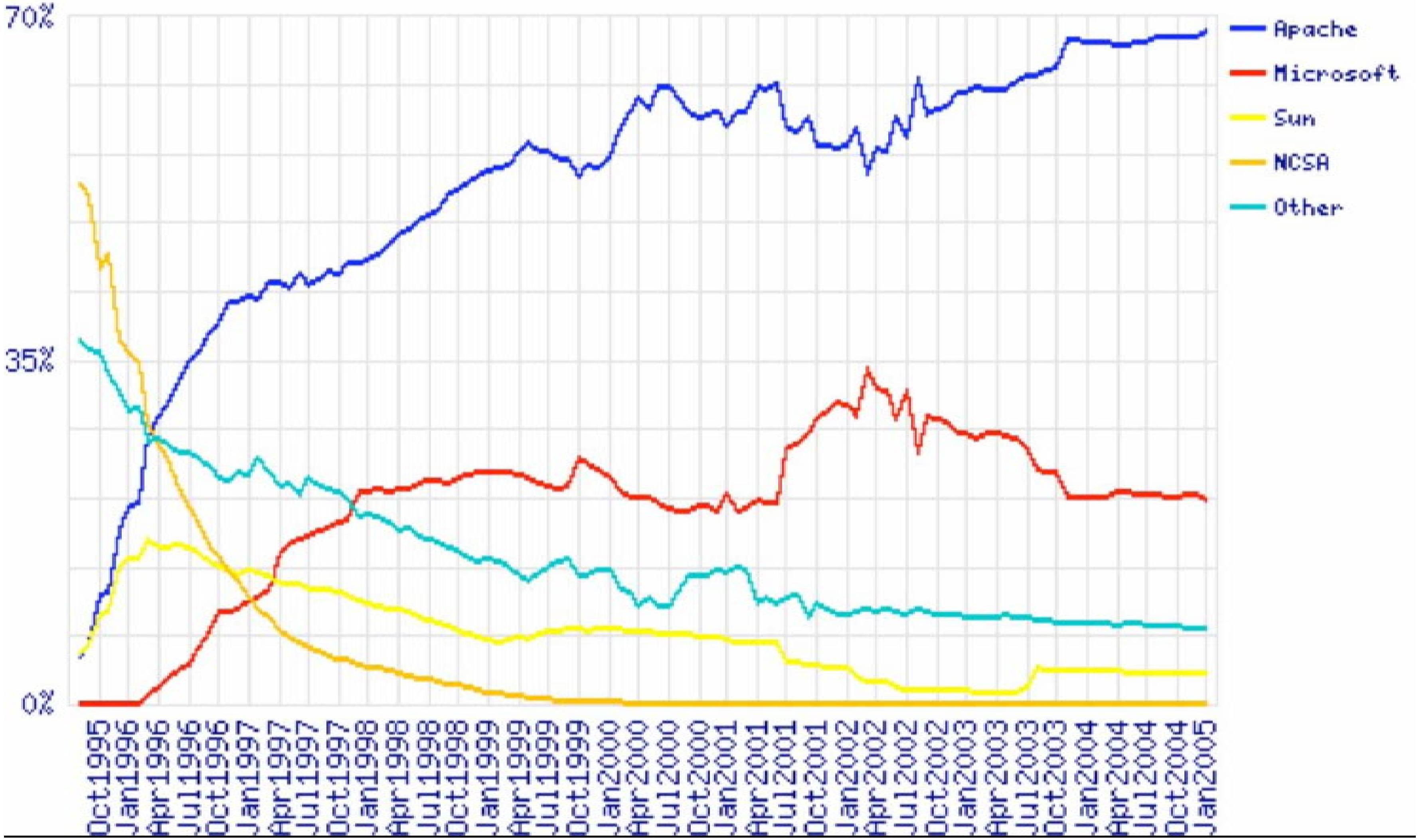
Television

4 years

The Web

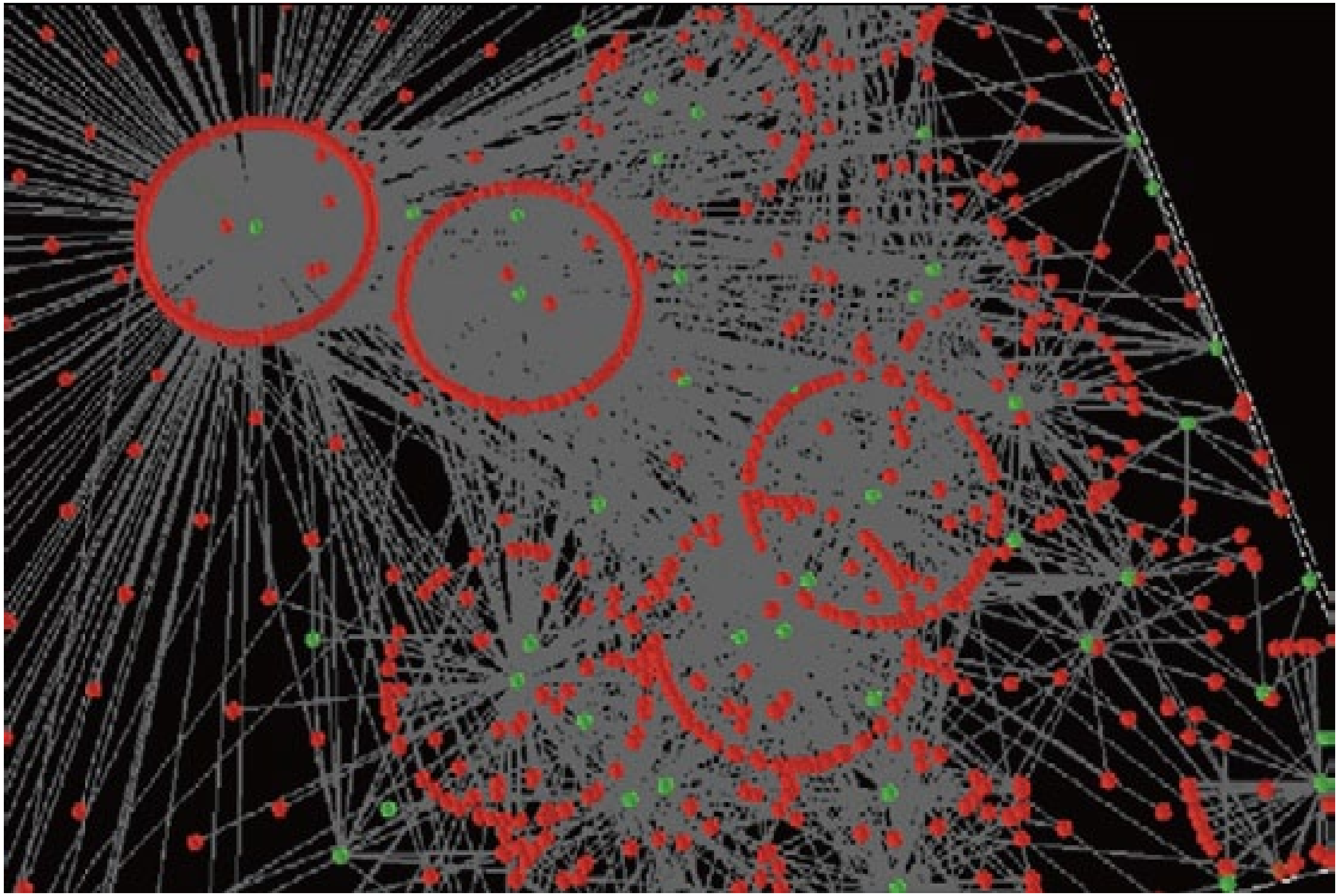
Fact 2: Growth of Web Servers

Market share for top servers across all domains (Aug 1995 - Jan 2005)



Posted by wss at 11:24 PM UTC on Jan 1, 2005 in Web Server Survey

Fact 3: Complexity of the Web



Mash-up Web Service in two-dimension diagram

(Green nodes are Web Services, Red nodes are mash-up applications)

True or False?

- Web application is always β-version online.
- Web application can satisfy all customers.
- Web application as service
- Web Engineering is now the era of Software Engineering.
- Ad-hoc is the keyword in Web Application
- Software can not be built by users
- Service on demand is promoted by IBM
- Cloud Computing is now the technique in Web Engineering

Web Engineering vs. Software Engineering

	Software Engineering	*Web Engineering*
User range	Small	Large
Number of simultaneous users	Small	Very large
User requirements	Specific	Changes fast
Growth and change	Slow	Fast
Design and development expertise	Few	Wide range
Budgets	Varies in a wide range according to the size of the company	Comparatively small and varies in a wide range
Timing constrains	Longer time (3 months-2 years)	Comparatively less time (1 week – 4 months)
Hardware and software environments constrains	Specific	Unknown
Adherence to standards and protocals	Not very important	Very important
Security and legal issues	Not very important	Very important
Look and feel of the final product	Not very important	Varies by culture, terminal etc.

We Have Done this Before...

Evolution of Engineering Disciplines

- Civil Engineering(back to 3000 BC)
- Mechanical Engineering (back to 100 BC)
- Electrical Engineering (back to 1900)
- Telecommunication Engineering (back to 1840)

- Software Engineering
  - Early stages in1955; treated as an engineering practice in 1970's
- Web Engineering
  - In the process of **making the history**

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- **Web Engineering Process & Management**
- Requirements for Web Application Analysis
- Design Modeling for Web Application

The Web Engineering Scenario

Stakeholders

Facebook helps you connect and share with the people in your life.

Sign Up

It's free and anyone can join

The Web Engineering Scenario

Resource & technique pool

ColdFusion

Struts

PHP

Firefox

Applets

Perl

XFORMS

Java

HTML

?

ASP

Internet Explorer

DHTML

XML

HTTP

CGI

Dreamweaver

Flash

CSS

UTF-8

XHTML

GB2312

JavaScript

Ajax

SOAP

SOA

RESTful

JBDC

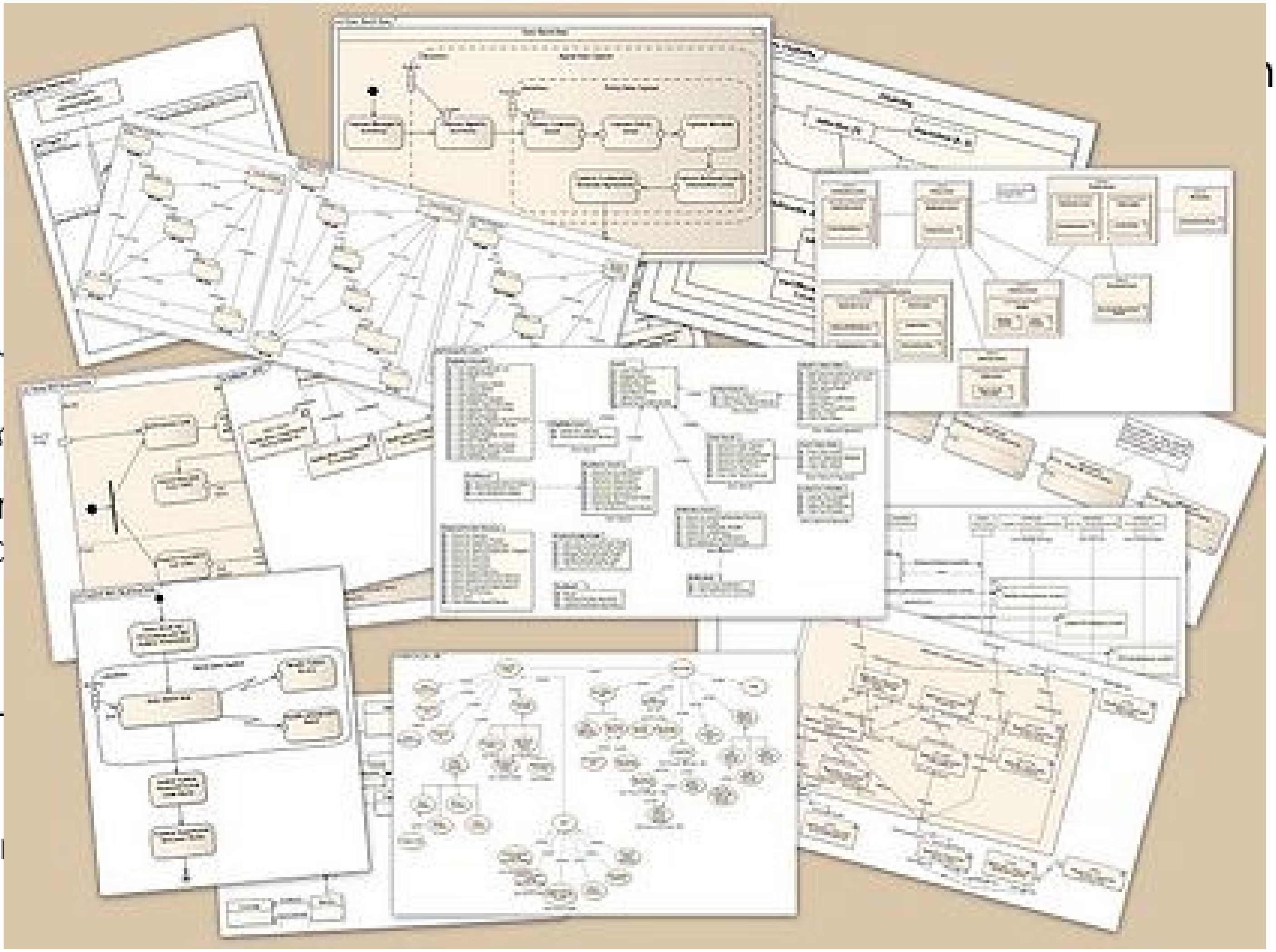
Servlets

MySQL

Embedded Multimedia Objects

The Web Engineering Scenario

System analysis, design & modeling



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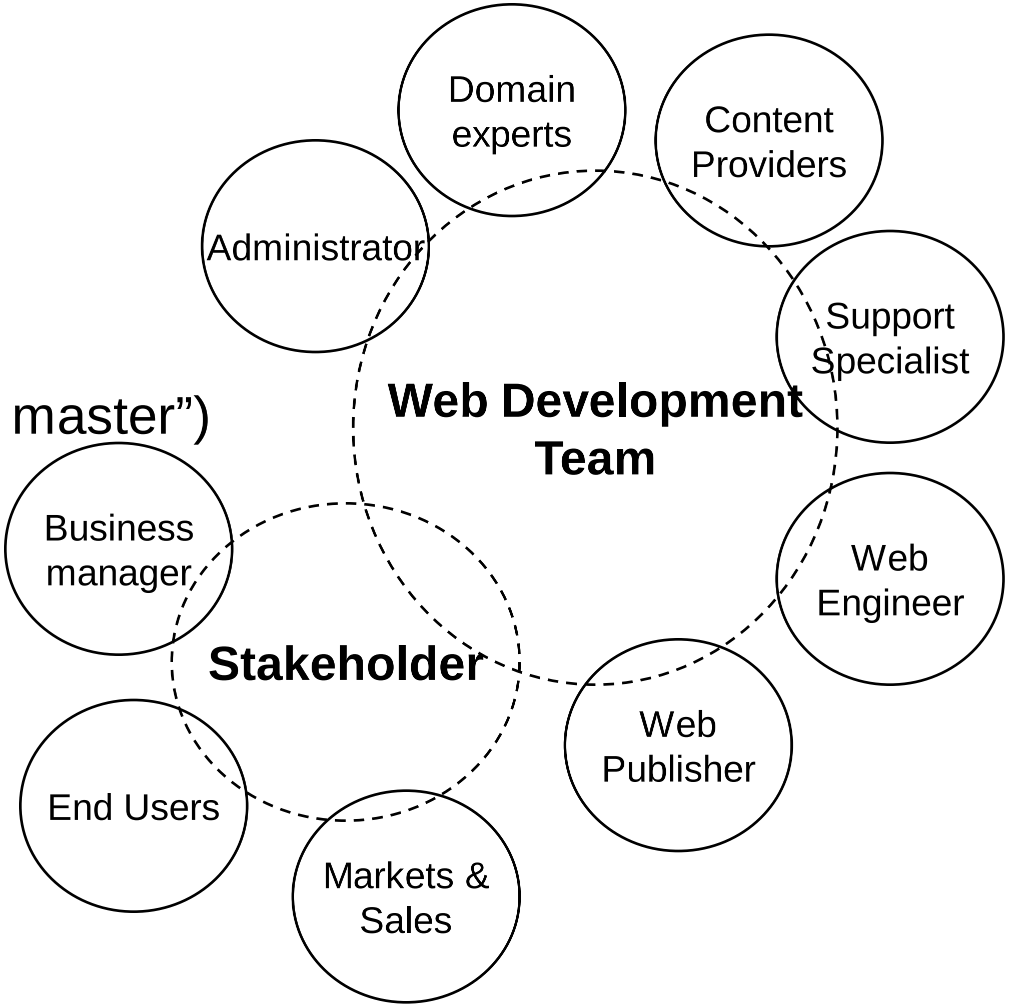
The Web Engineering Scenario

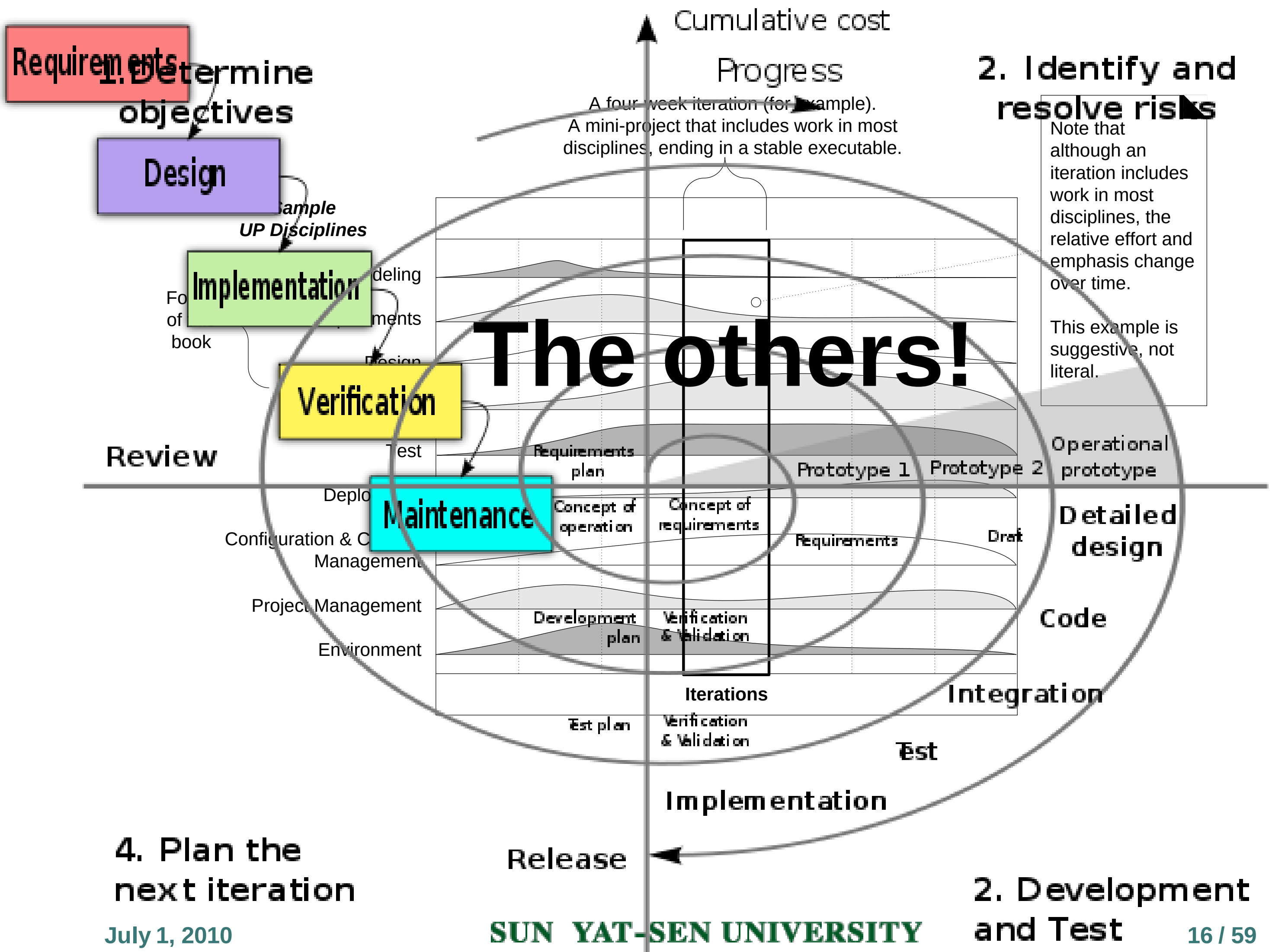
Team building

- Web engineering team roles
  - Content providers
  - Web publisher
  - Web engineer
  - Business domain experts
  - Support specialist
  - Administrator (a.k.a. “Web master”)



Web Engineering Process

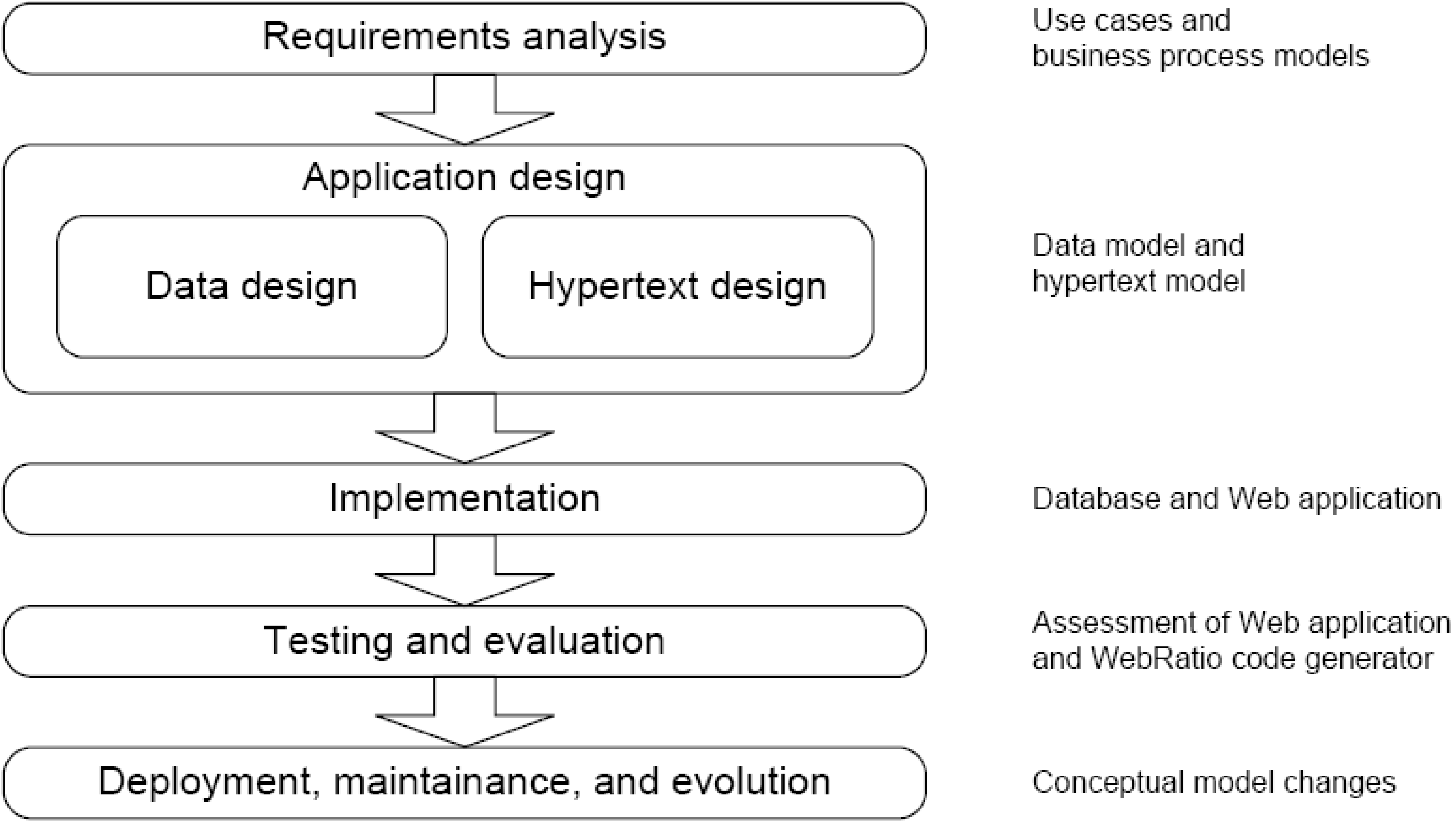
Software life cycle: waterfall model, spiral model, unified model, which one?



The others!

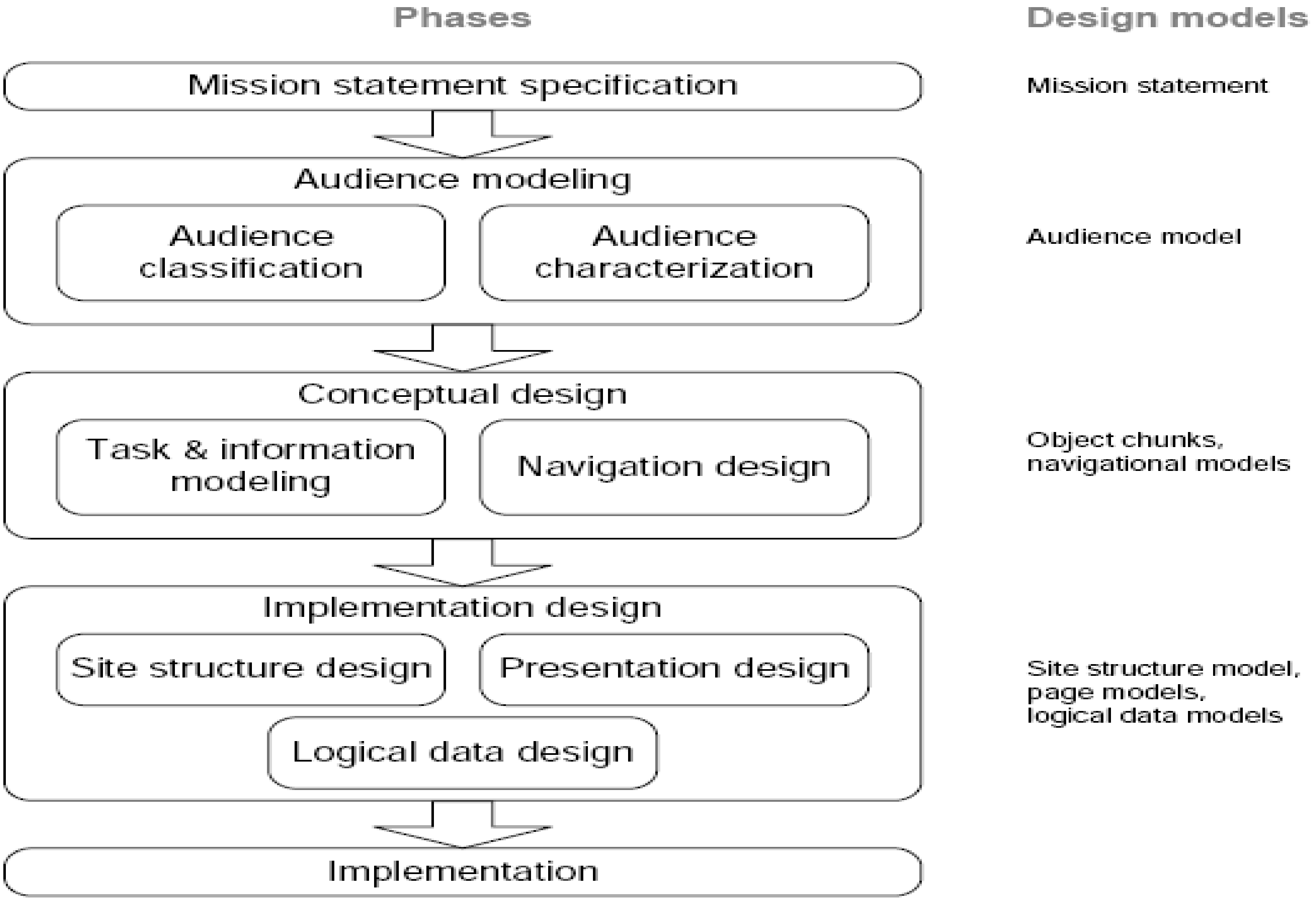
The WebML Model

Web Modeling Language (WebML) proposed in 2000: a visual language and development method for specifying the content structure of a Web application


Requirements analysis
Use cases and business process models
Application design
Data design
Hypertext design
Data model and hypertext model
Implementation
Database and Web application
Testing and evaluation
Assessment of Web application and WebRatio code generator
Deployment, maintainance, and evolution
Conceptual model changes

WSDM

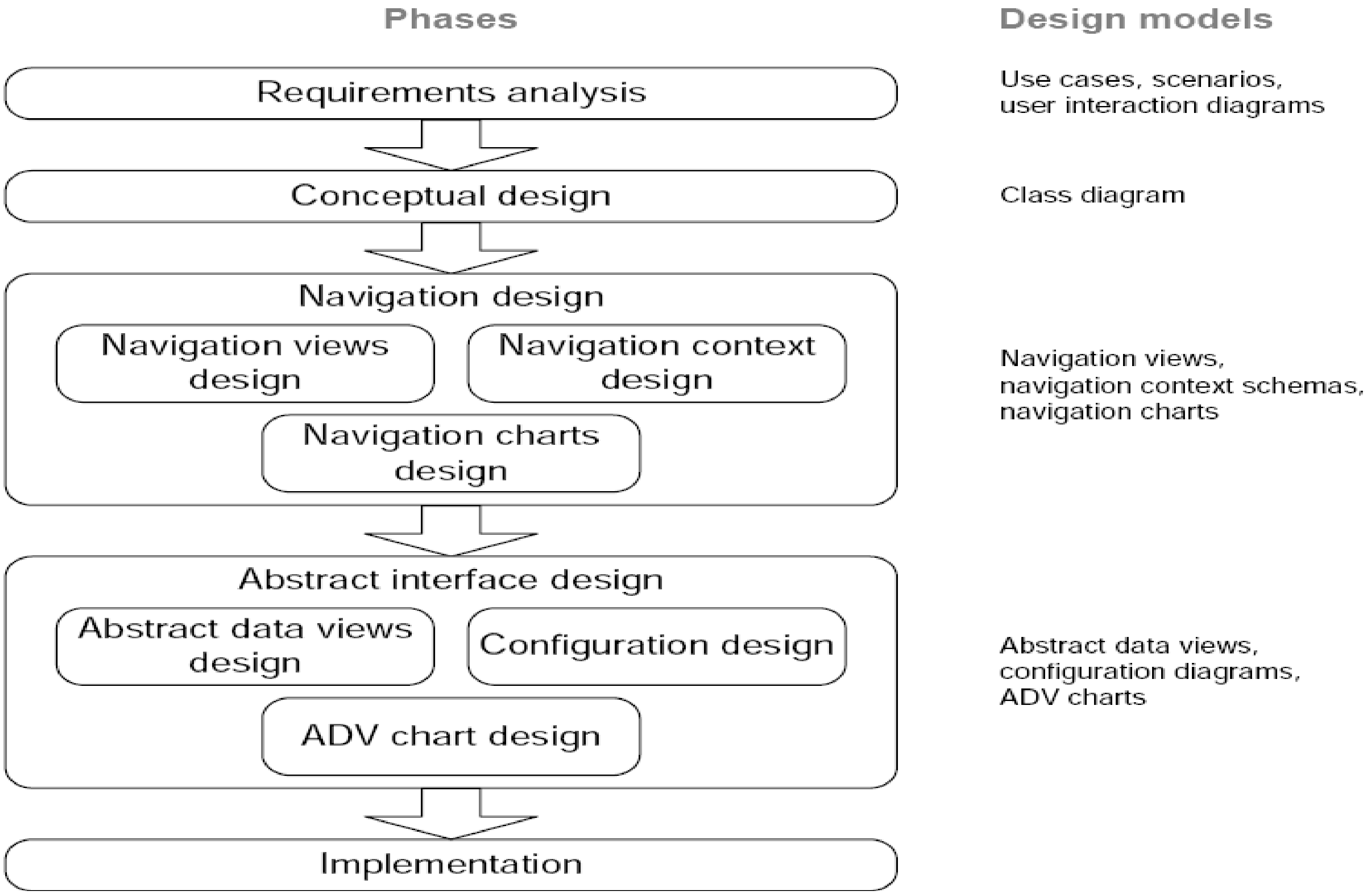
Web Site Design Method (WSDM) proposed in 1998: the first Web design method



* Later re-baptized as Web Semantics Design Method.

The OOHDM Model

Object-Oriented Hypermedia Design Method (OOHDM), proposed in 2000: one of the first methods adopted for Web application development projects


Phases
Design models
Requirements analysis
Use cases, scenarios, user interaction diagrams
Conceptual design
Class diagram
Navigation design
Navigation views design
Navigation context design
Navigation charts design
Navigation views, navigation context schemas, navigation charts
Abstract interface design
Abstract data views design
Configuration design
ADV chart design
Abstract data views, configuration diagrams, ADV charts
Implementation

Metrics for Web Engineering

- Function point ?
- Use case point ?

- For static website
  - Pages
  - Links
  - Medias

- For dynamic web site
  - Client functions
  - Mash-up services
  - Server actions
  - External services
  - External data

Web Engineering Process Summary

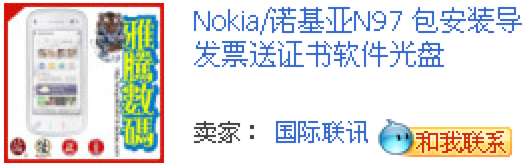
- The general characteristics
  - ***Continuous*** and ***fast*** development and release times are paramount.
  - Web development processes are less documentation-based and, rather, put high emphasis on ***prototypes*** (prototypes are much more expressive than technical documents, especially to unskilled customers).
  - High ***user involvement*** and early feedback is desirable.
  - A new actor enters the development process: the ***graphic designer***.
- Review "The Agile Manifesto"

Outline

- Web Engineering & Web Applications
- Web Engineering Process & Management
- **Case Study**
- Requirements for Web Application Analysis
- Design Modeling for Web Application

Case study

- mini-project “context driven On-line Call Center System” (OCCS)
- The application scenarios
  - When visiting taobao.com, a customer might click the link “contact with sale”
  - The content provider wants to embed it easy.
  - The store manager wants the team to give the customer instant services by text or voice on-line. And common Q & A will be listed before service.



Nokia/诺基亚N97 包安装导航 另有正港行带发票送证书软件光盘

卖家： 国际联讯 和我联系

- As the service provider, you must develop your OCCS just like Taobao
  - Steps and activities
  - Analysis and design method & documentation
  - Code will not be needed

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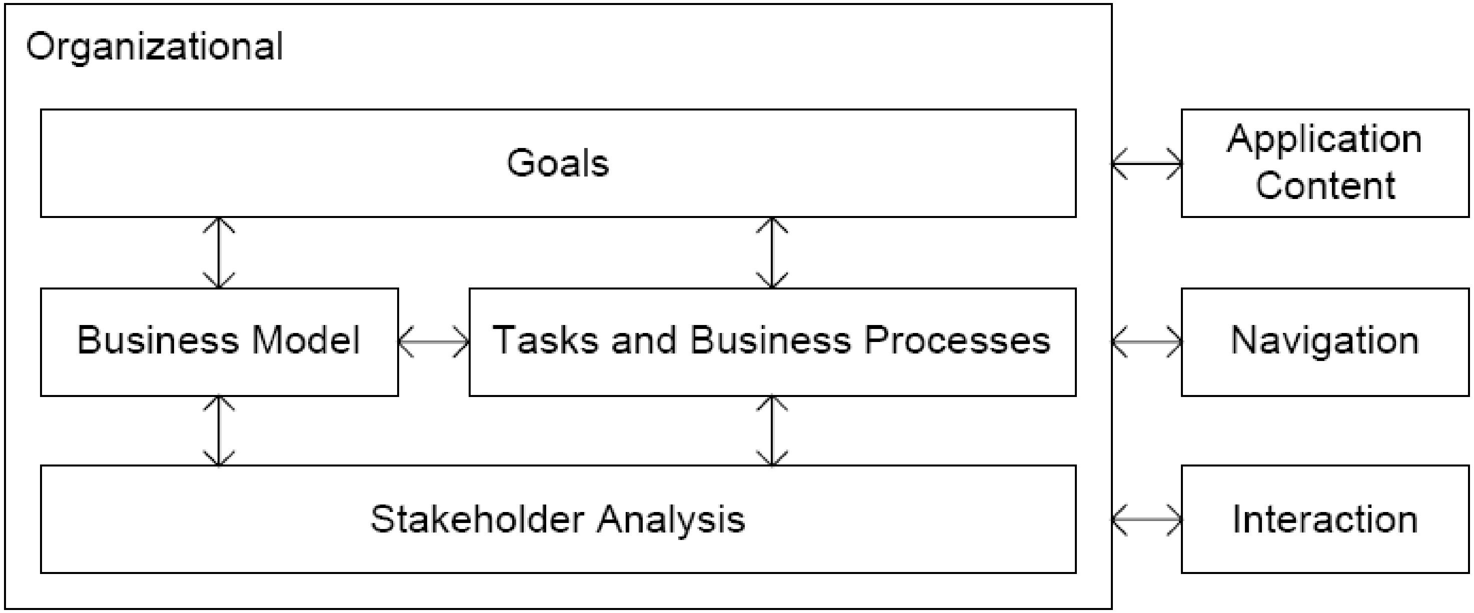
- Web Engineering & Web Applications
- Web Engineering Process & Management
- Case Study
- **Requirements for Web Application Analysis**
- Design Modeling for Web Application

Requirements Relevant to the Web

- Functional requirements
  - Organization requirements
  - Application domain requirements
    - Information content, information flow, information structure
  - Navigation requirements
  - Interaction requirements



Requirements Relevant to the Web

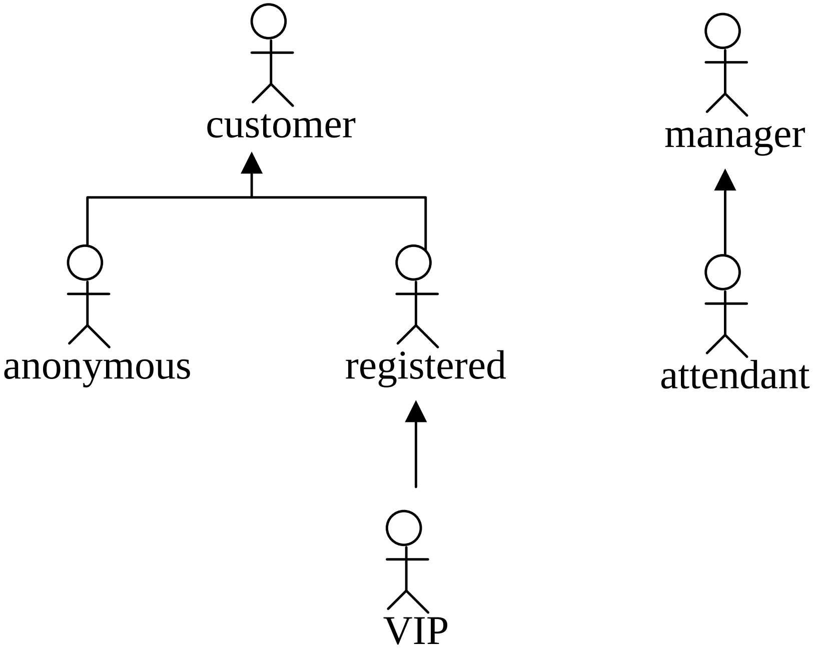
- Nonfunctional requirements
  - Product requirements: FURPS+ except function
  - Project organizational requirements: posed by customers' and developers' organizations, process standards, programming languages, and so on
  - External requirements: the environment and infrastructure in which the Web application resides, such as interoperability requirements with external systems

Requirements Elaboration and Specification

- Organization requirements analysis
  - Business value model : values will be exchanged between actors that will use the Web application
  - Business information flow model: information in business
  - Goals model : goals of stakeholders in project
  - Business process model : processes of business activities.
  - Task model : the tasks a user need to perform.
  - Audience model : trace matrix of functional requirements
- Application domain analysis
- Navigation and interaction analysis
  - Navigation relationships
  - High-Level interaction and navigation units

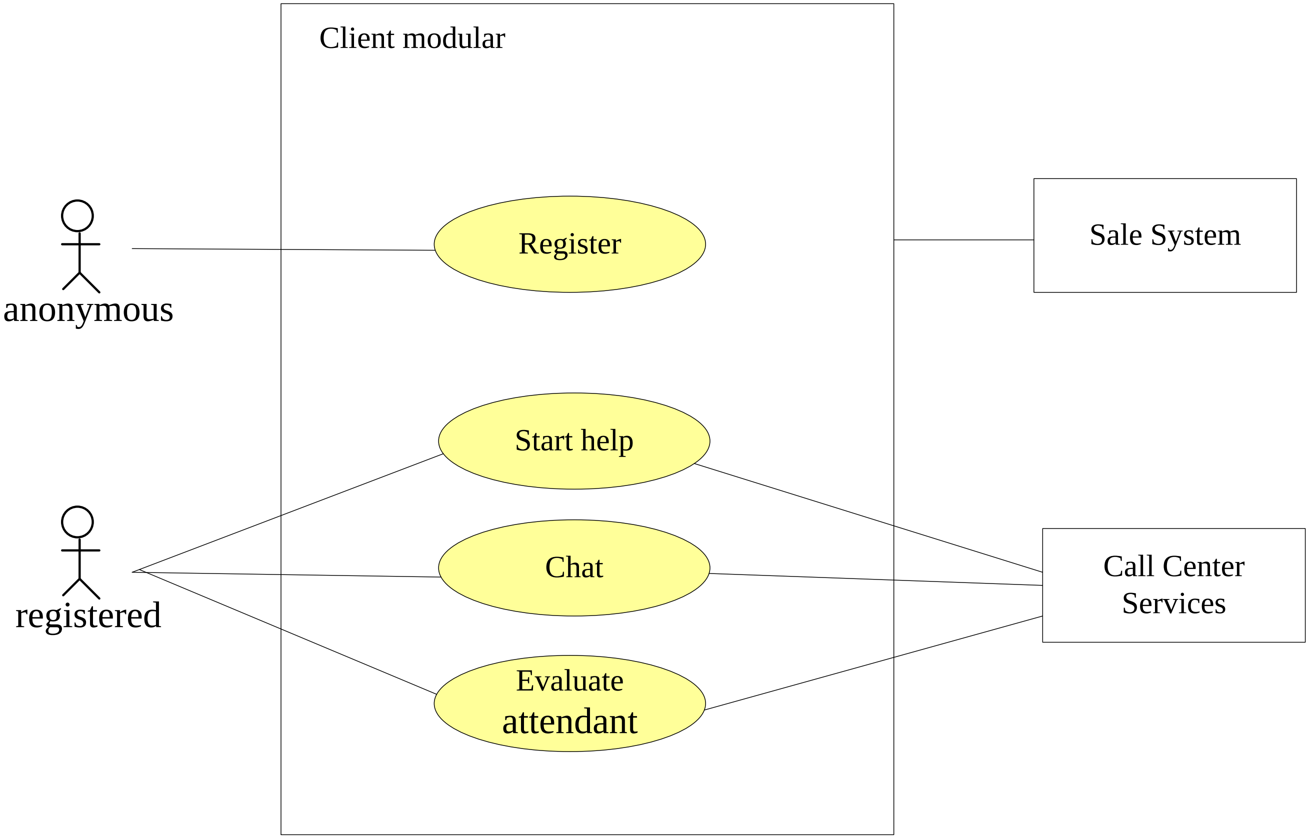
Step1:Finding Actor in Organization

- Goals model
  - List more business scenarios
  - Find users and modeling with UML class diagram
  - List goals and responsibility briefly for each stakeholder



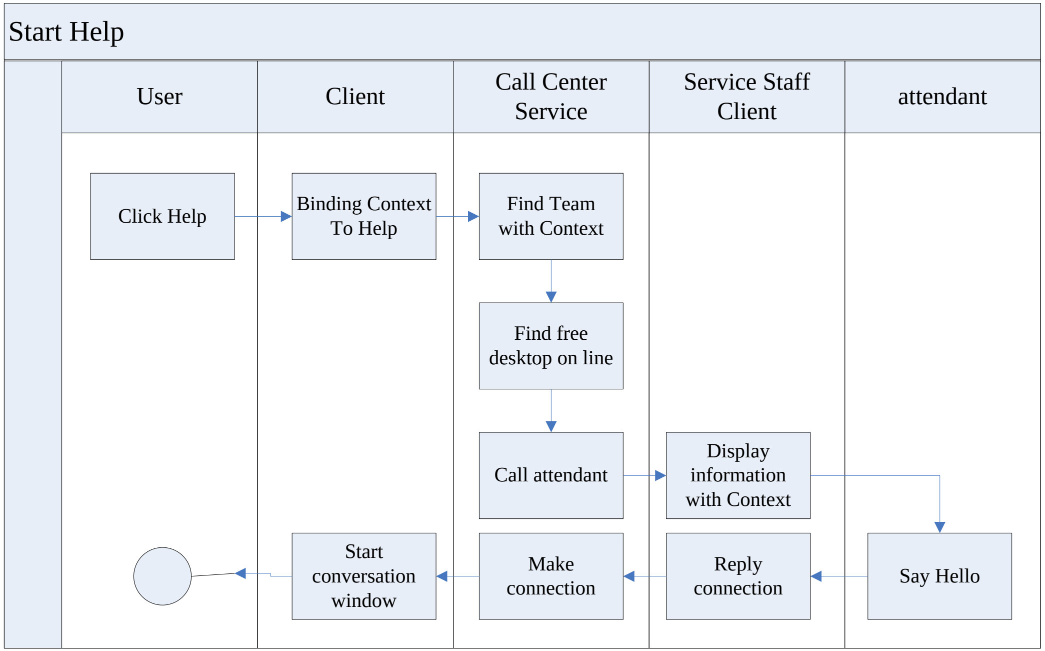
Step2:Developing Use-Case

- Task Model
  - Identify use cases and draw UML use-case diagram
  - Describe each use case in text
-



Step3:Modeling Business Process

- Business process model
  - Divide a system into subsystems
  - Describe business collaboration among the subsystems with UML activity diagram or sequence diagram
- Business information flow model
  - Identify data in business
  - Study data in/out process with UML data flow diagram



Step4:The Content Model

- Content objects are extracted from use-cases
- The relationship of content objects and/or the hierarchy of content objects maintained by a Web application
  - Relationships—entity-relationship diagram or UML
  - Hierarchy—data tree or UML

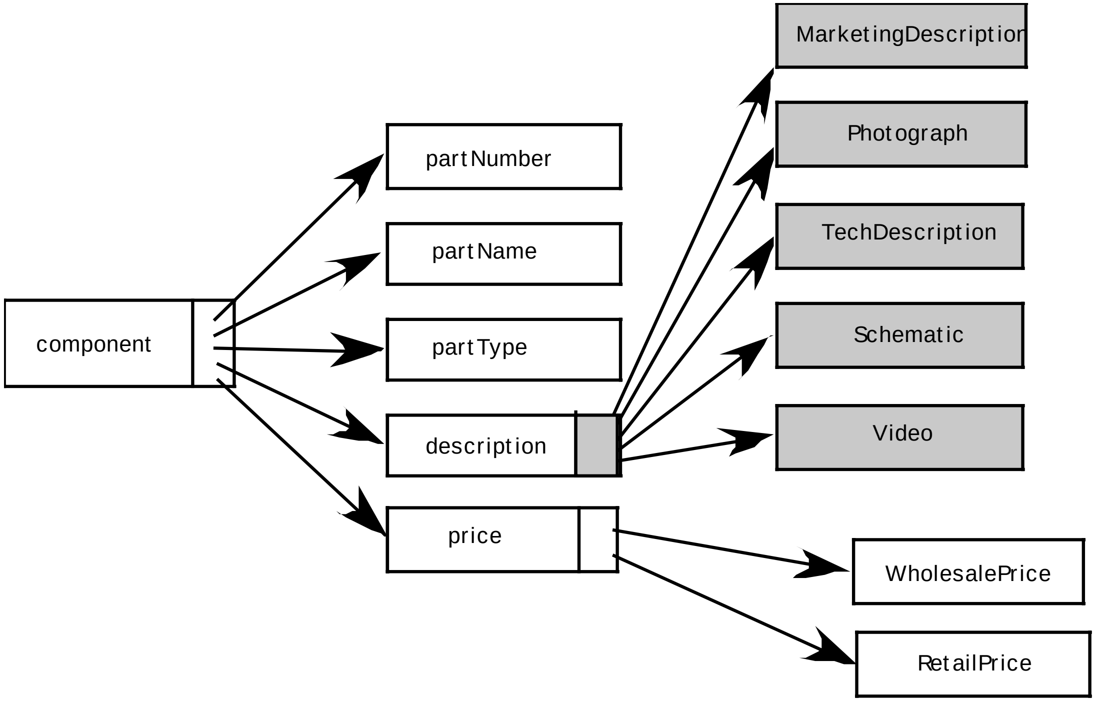
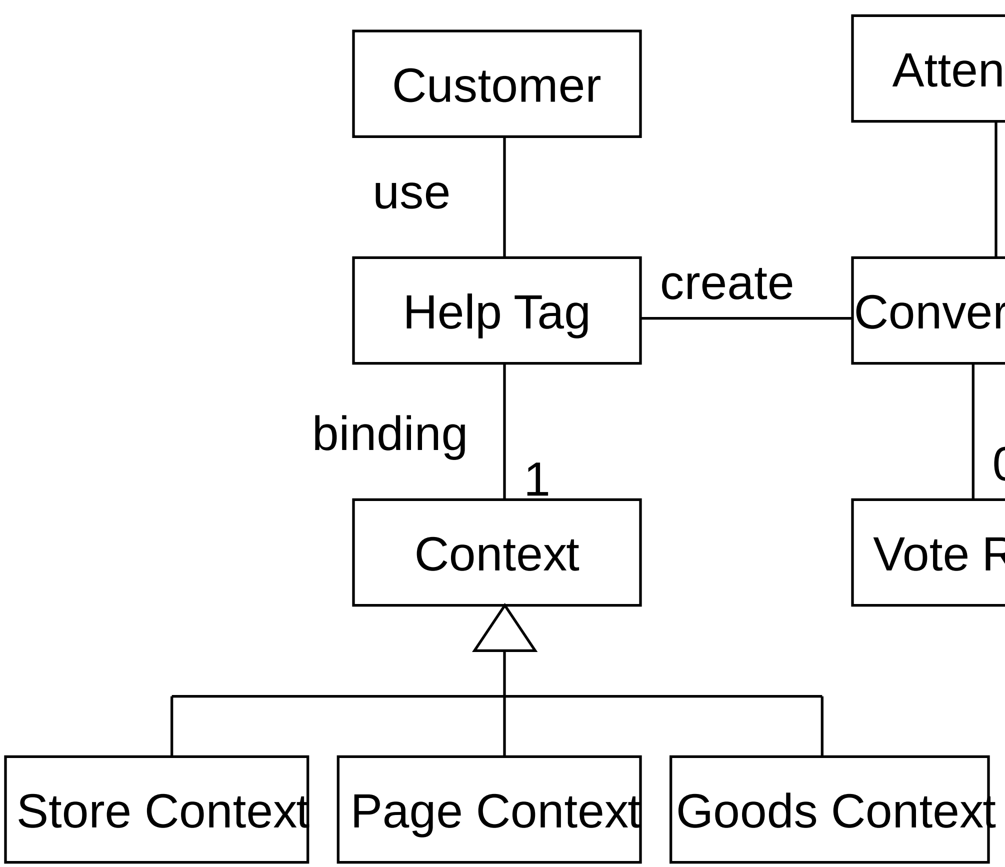


Figure 18.3 Data tree for a *SafeHome* component

Step5:The Domain Model

- Grammatical parse is used to identify candidate classes
- Class diagram



Partial core conceptions in OCCS System

Step6: Relationship-Navigation Analysis

- Relationship-navigation analysis (RNA) identifies relationships among the elements uncovered as part of the creation of the analysis model
- Steps:
  - ***Stakeholder analysis***—identifies the various user categories and establishes an appropriate stakeholder hierarchy
  - ***Element analysis***—identifies the content objects and functional elements that are of interest to end users
  - ***Relationship analysis***—describes the relationships that exist among the WebApp elements
  - ***Navigation analysis***—examines how users might access individual elements or groups of elements
  - ***Evaluation analysis***—considers pragmatic issues (e.g., cost/benefit) associated with implementing the relationships defined earlier

Step7:The Configuration Model

Server-side

- Server hardware and operating system environment must be specified
- Interoperability considerations on the server-side must be considered
- Appropriate interfaces, communication protocols and related collaborative information must be specified

- Client-side
  - Browser configuration issues must be identified
  - Testing requirements should be defined

- Deployment Diagram

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When should Web Application Design Should be Emphasized?

- When the content and function are complex
- When the size of the Web application encompasses hundreds of content objects, functions, and analysis classes
- When the success of the Web application will have a direct impact on the success of the business

Design & Web Application Quality

- Security
  - Rebuff external attacks
  - Exclude unauthorized access
  - Ensure the privacy of users/customers
- Availability
  - The measure of the percentage of time that a Web application is available for access
- Scalability
  - Can the Web application handle the significant variation in user or transaction volume
- Time to Market

Quality Dimensions for End-Users

- *Time*
  - How much has a Web site changed since the last upgrade?
  - How do you highlight the parts that have changed?
- *Structural*
  - How well do all of the parts of the Web site hold together?
  - Are all links inside and outside the Web site working?
  - Are all of the images displayed appropriately?
  - Are there parts of the Web site not connected?
- *Content*
  - Does the content of critical pages match what is supposed to be there?
  - Do key phrases exist continually in highly-changeable pages?
  - Do critical pages maintain quality content from version to version?
  - What about dynamically generated HTML pages?

Quality Dimensions for End-Users

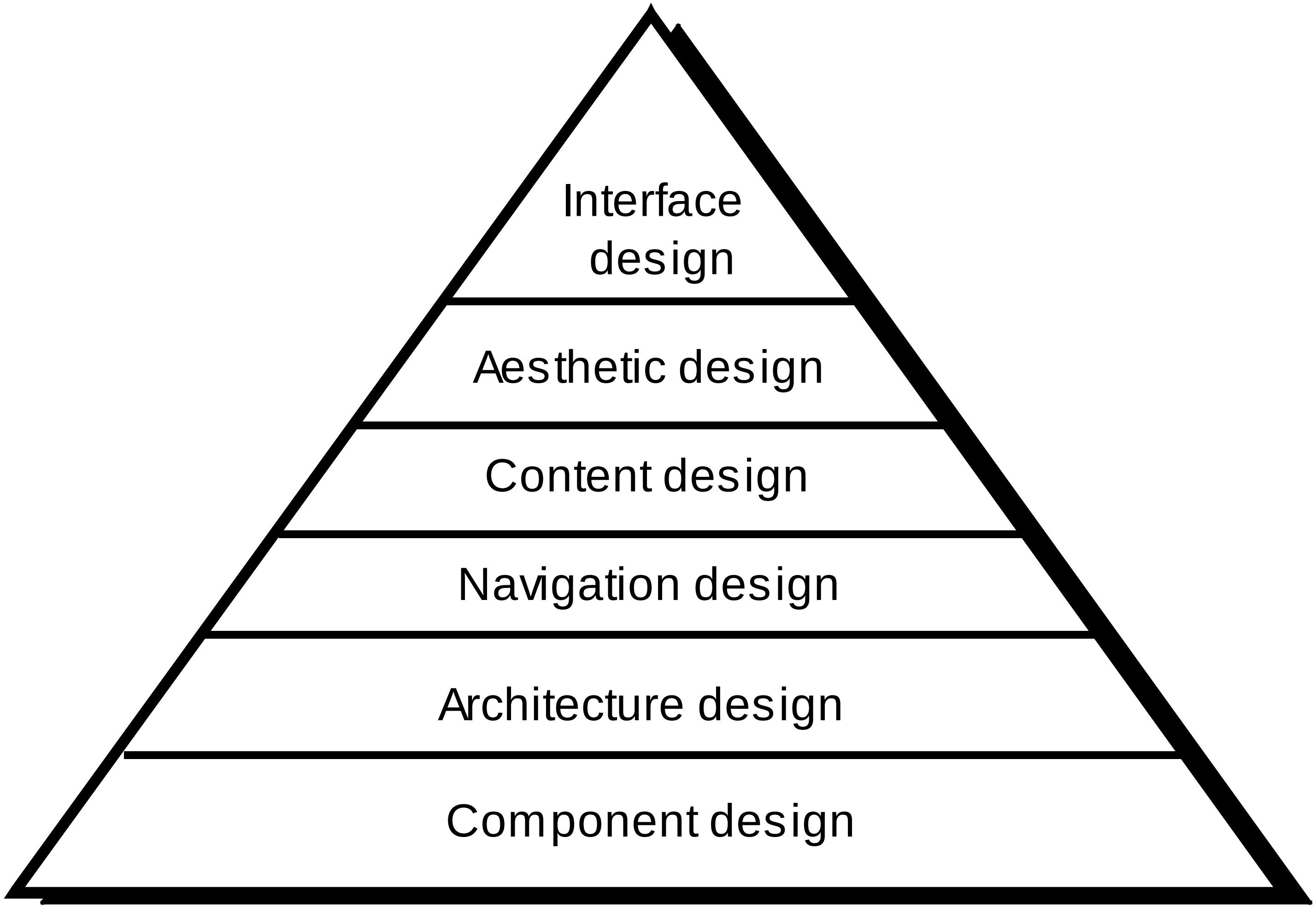
- *Accuracy and Consistency*
  - Are today's copies of the pages downloaded the same as yesterday's? Close enough?
  - Is the data presented accurate enough? How do you know?
- *Response Time and Latency*
  - Does the Web site server respond to a browser request within certain time?
  - In an E-commerce context, how is the end to end response time after a SUBMIT?
  - Are there parts of a site that are so slow that the user declines to continue working on it?
- *Performance*
  - Is the Web request responded quick enough?
  - How does the performance vary by the time of day, by load and usage?
  - Is performance adequate for E-commerce applications?

Web Application Design Goals

- Consistency
  - ***Content*** should be constructed consistently
  - ***Graphic design (aesthetics)*** should present a consistent look across all parts of the Web application
  - ***Architectural design*** should establish templates that lead to a consistent hypermedia structure
  - ***Interface design*** should define consistent modes of interaction, navigation and content display
  - ***Navigation mechanisms*** should be used consistently across all Web application elements
- Robustness
- Navigability
  - designed in an intuitive and predictable manner
- Visual appeal
- Compatibility

Web Engineering Design Pyramid

user



technology

Web Application Interface Design

- Where am I? The interface should
  - provide an indication of the Web application that has been accessed
  - inform the user of her location in the content hierarchy.
- What can I do now? The interface should always help the user understand his current options
  - what functions are available?
  - What are the links?
  - what content is relevant?
- Where have I been, where am I going? The interface must facilitate navigation.
  - Provide a "map" (implemented in a way that is easy to understand) of where the user has been and what paths may be taken to move elsewhere within the Web application.

Effective Web Application Interfaces

- Bruce Tognozzi [TOG01] suggests…
  - Effective interfaces are visually apparent and forgiving, instilling in their users a sense of control. Users quickly see the breadth of their options, grasp how to achieve their goals, and do their work.
  - Effective interfaces do not concern the user with the inner workings of the system. Work is carefully and continuously saved, with full option for the user to undo any activity at any time.
  - Effective applications and services perform a maximum of work, while requiring a minimum of information from users.

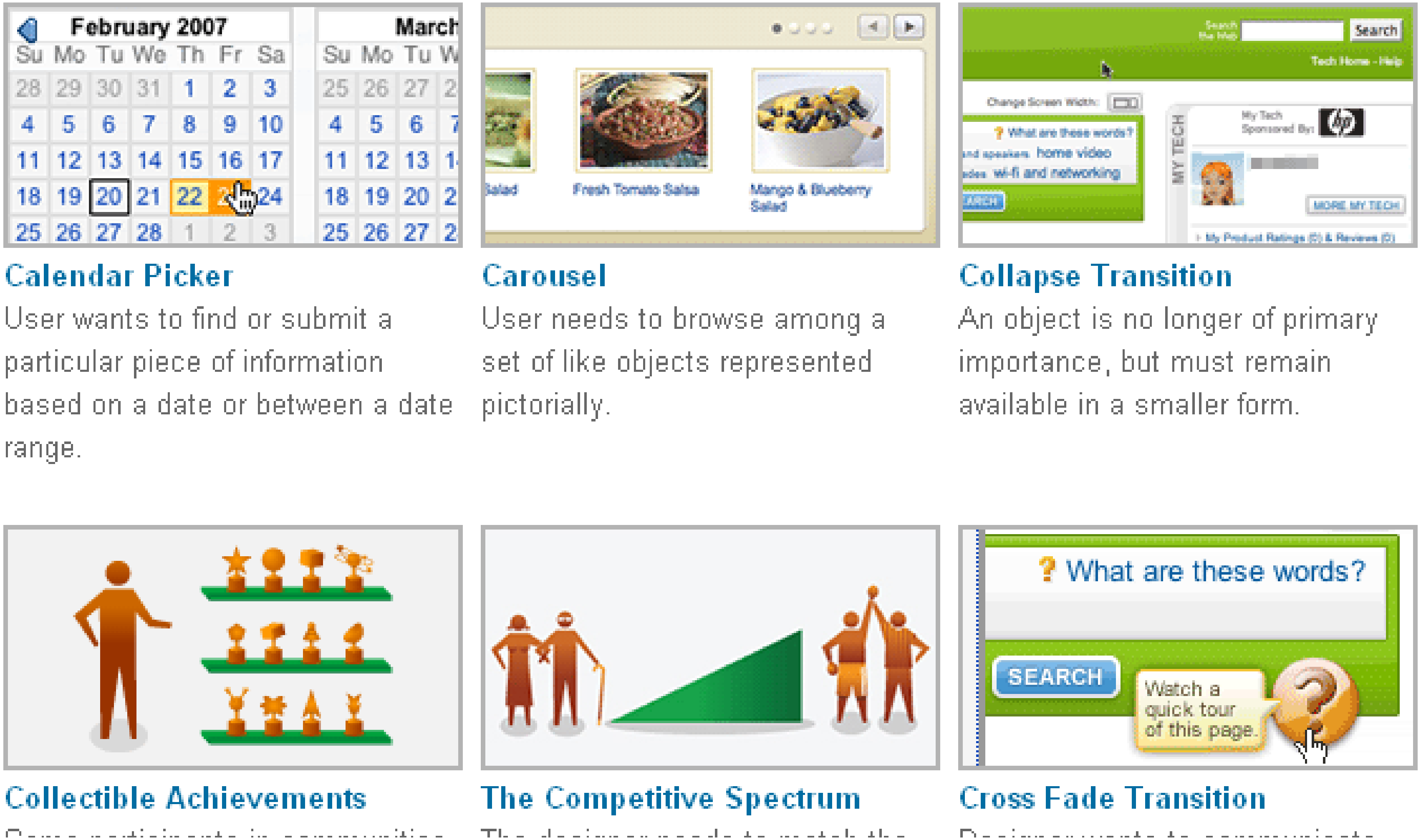
Interface Design Workflow

- Review information contained in the analysis model and refine as required.
- Develop a rough sketch of the Web application interface layout.
- Map user objectives into specific interface actions.
- Define a set of user tasks that are associated with each action.
- Storyboard screen images for each interface action.
- Refine interface layout and storyboards using input from aesthetic design.
- Develop a procedural representation of the user's interaction with the interface.
- Develop a behavioral representation of the interface.
- Describe the interface layout for each state.
- Refine and review the interface design model.

Aesthetic Design

- Don’t be afraid of white space.
- Emphasize content.
- Organize layout elements from top-left to bottom right.
- Group navigation, content, and function geographically within the page.
- Don’t extend your real estate with the scrolling bar.
- Consider resolution and browser window size when designing layout.

Using Design Patterns



Calendar Picker

User wants to find or submit a particular piece of information based on a date or between a date range.

Carousel

User needs to browse among a set of like objects represented pictorially.

Collapse Transition

An object is no longer of primary importance, but must remain available in a smaller form.

Collectible Achievements

Game participants in communities

The Competitive Spectrum

The designer needs to match the

Cross Fade Transition

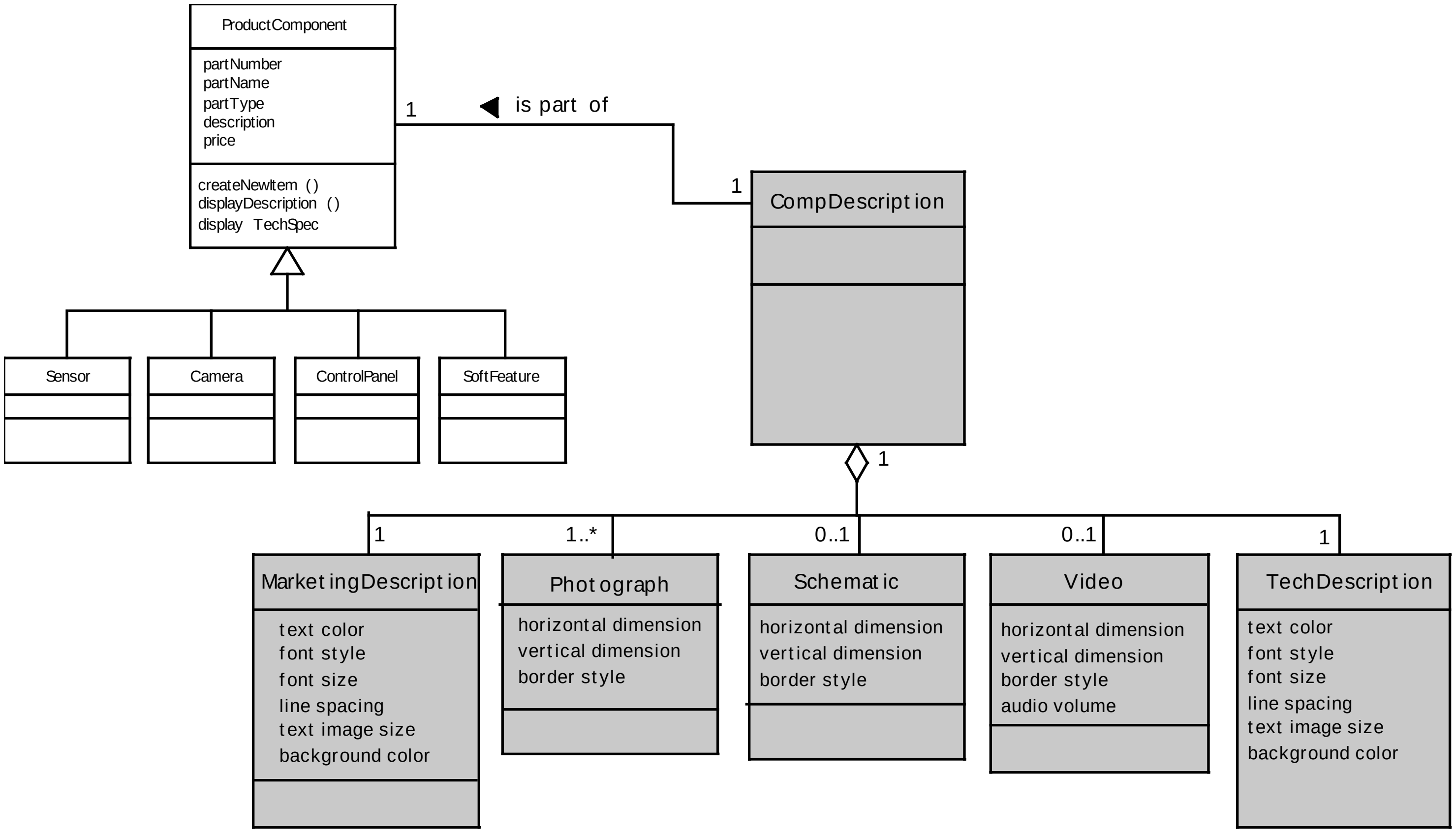
Designer wants to communicate

Yahoo - yPatterns

Content Design

- Develop a design representation for content objects
  - For Web applications, a content object is more closely aligned with a data object for conventional software
- Represent the mechanisms required to instantiate their relationships to one another.
  - analogous to the relationship between analysis classes and design components described in Chapter 11
- A content object has attributes that include content-specific information and implementation-specific attributes that are specified as part of design

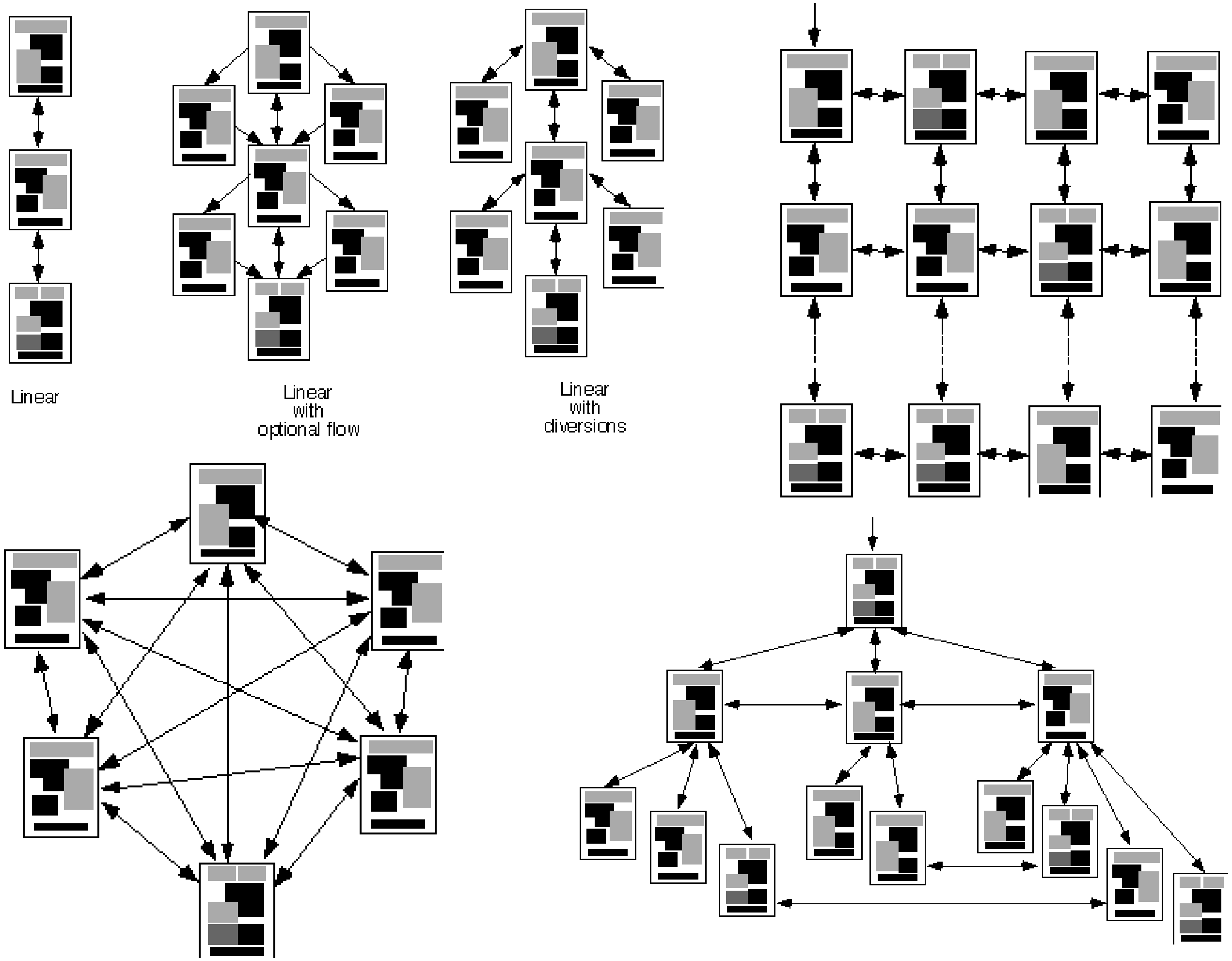
Design of Content Objects



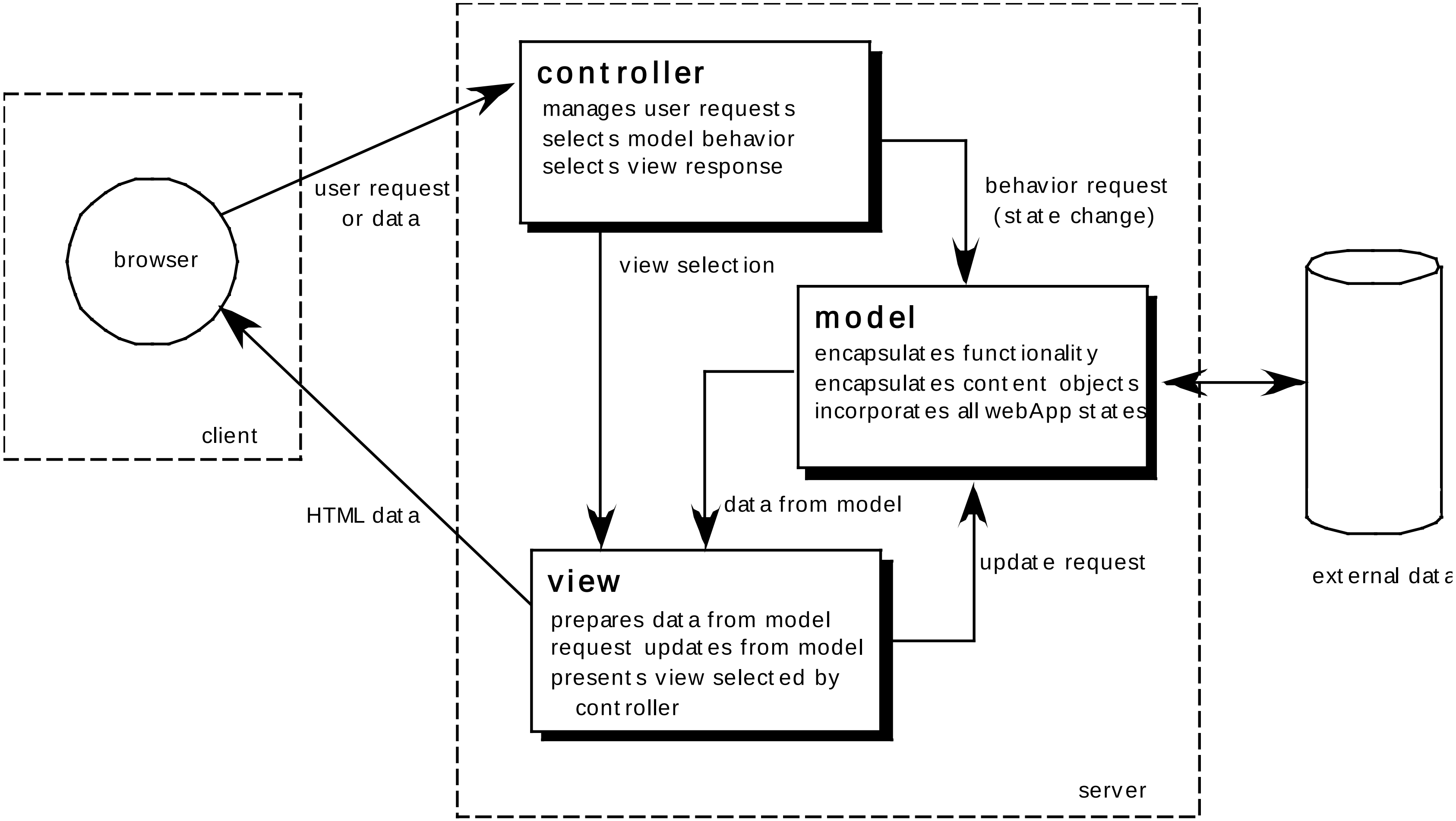
Architecture Design

- *Content architecture* focuses on the manner in which content objects (or composite objects such as Web pages) are structured for presentation and navigation.
  - The term information architecture is also used to connote structures that lead to better organization, labeling, navigation, and searching of content objects.
- *Web application architecture* addresses the manner in which the application is structured to manage user interaction, handle internal processing tasks, effective navigation, and content presentation.
- Architecture design is conducted in parallel with interface design, aesthetic design and content design.

Content Architecture



MVC Architecture

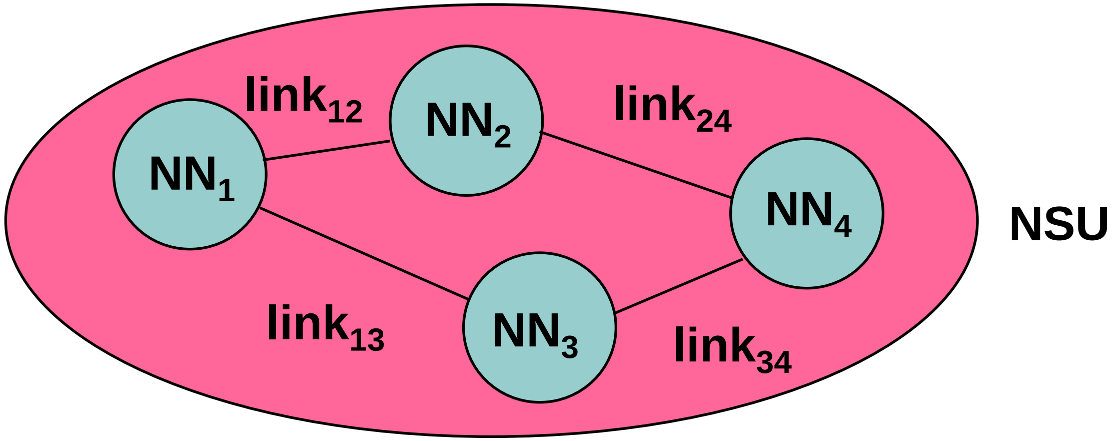


Navigation Design

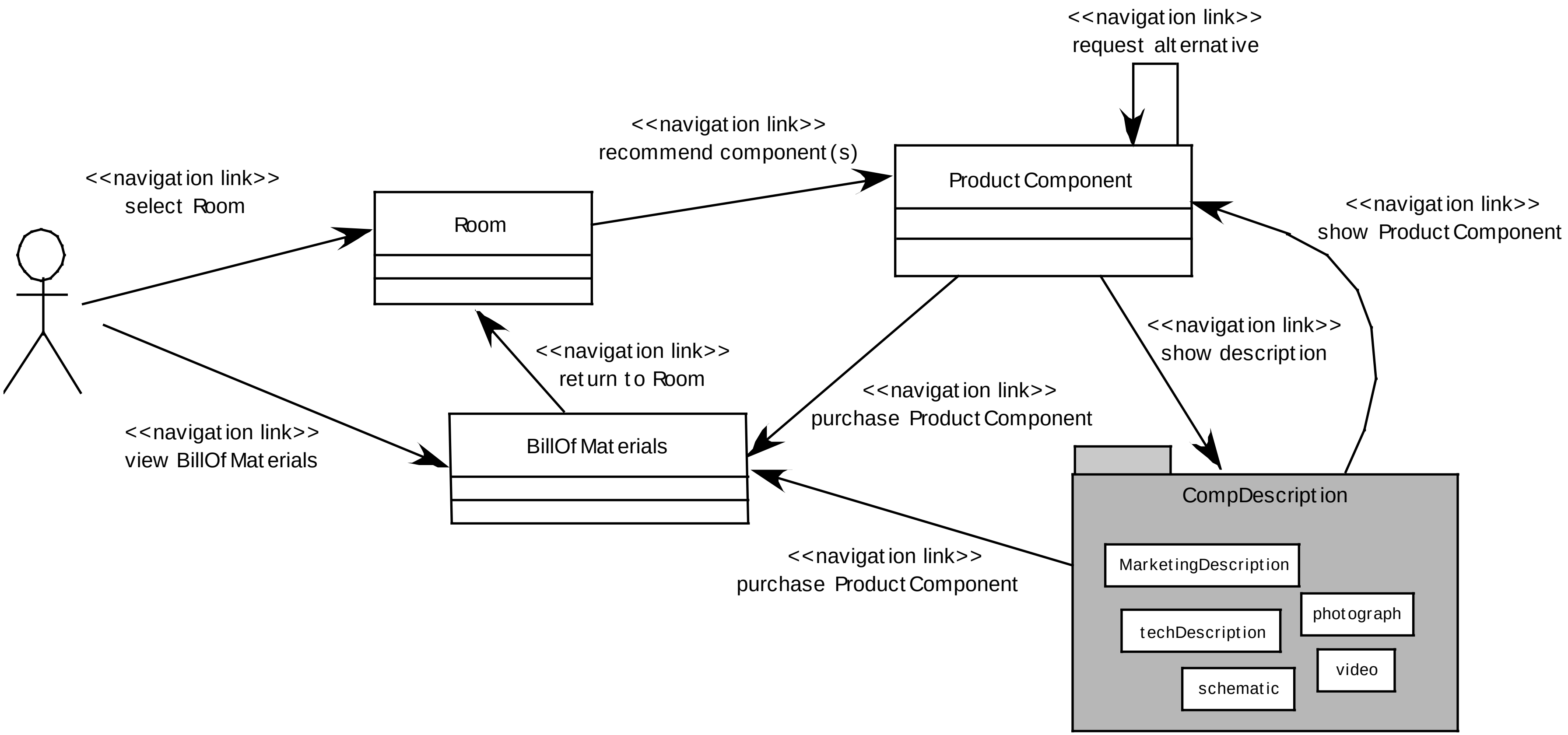
- Begin with a consideration of the user hierarchy and related use-cases
  - Each actor may access a Web application differently and therefore have different navigation requirements
- As a user interacts with the Web application, he may encounter a series of *navigation semantic units* (NSUs)
  - NSU—“a set of information and related navigation structures that collaborate in the fulfillment of a subset of related user requirements”

Navigation Semantic Units

- Navigation semantic unit
  - Ways of navigation (WoN)—represents the best navigation way or path for users with certain profiles to achieve their desired goal or sub-goal. Composed of …
    - Navigation nodes (NN) connected by Navigation links



Creating an NSU



Component-Level Design

- Web application components implement the following functionality
  - perform localized processing to generate content and navigation capability in a dynamic fashion
  - provide computation or data processing capability that are appropriate for a Web application's business domain
  - provide sophisticated database query and access
  - establish data interfaces with external corporate systems

Patterns Repositories for Web Applications

- **Hypermedia Design Patterns Repository**
  - http://www.designpattern.lu.unisi.ch/
- **InteractionPatterns by TomErickson**
  - http://www.pliant.org/personal/Tom_Erickson/InteractionPatterns.html
- **Web Design Patterns by Martijn vanWelie**
  - http://www.welie.com/patterns/
- **Improving Web Information Systems with Navigational Patterns**
  - http://www8.org/w8-papers/5b-hypertext-media/improving/improving.html
- **An HTML 2.0 Pattern Language**
  - http://www.anamorph.com/docs/patterns/default.html
- **Common Ground - A Pattern Language for HCI Design**
  - http://www.mit.edu/~jtidwell/interaction_patterns.html
- **Patterns for Personal Web Sites**
  - http://www.rdrop.com/~half/Creations/Writings/Web.patterns/index.html
- **Indexing Pattern Language**
  - http://www.cs.brown.edu/~rms/InformationStructures/Indexing/Overview.html

Team Discussion: Requirements for OCCS System

- Tasks and questions
  - Find more than three e-Commerce site that has on-line call center system. Collect **functions & user stories**. Which are the most attractive characteristic , and why?
  - Which organizations are involved in OCCS? Find the stakeholders and end-users. Assign **missions and responsibilities** of each role briefly.
  - **Decompose system** into customer subsystem, original business subsystem, call center services subsystem, store attendant subsystem, attendant quality management subsystem. Does business modeling with System Sequence Diagram apply on the most valuable user-stories? List the **Interfaces (services)** of each subsystem.
  - The customer subsystem consists of a help-tag modular, an instant messenger modular, and a vote modular, and it is built on jQuery.
  - Elaborate the **core conceptions** in OCCS, and work out the domain model with UML Class Diagram.
  - Analyze the **content** in quality management subsystem.
  - Identify nonfunctional requirements and environment and infrastructure restrictions. **Deploy** all subsystem with Deployment Diagram.
  - Review the requirements model.

Reading Materials

- http://en.wikipedia.org/wiki/Web_engineering
- Pressman, R.S., 'Applying Web Engineering', Part 3, Chapters 16-20, in Software Engineering: A Practitioner's Perspective, Sixth Edition, McGraw-Hill, New York, 2004. http://www.rspa.com/'
- "Handbook of Research on Web 2.0, 3.0, and X.0: Technologies, Business, and Social Applications", San Murugesan (Editor), Information Science Research, Hershey – New York, October 2009, ISBN 978-1-60566-384-5

Thank you!