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# The current state of Web Engineering and its future

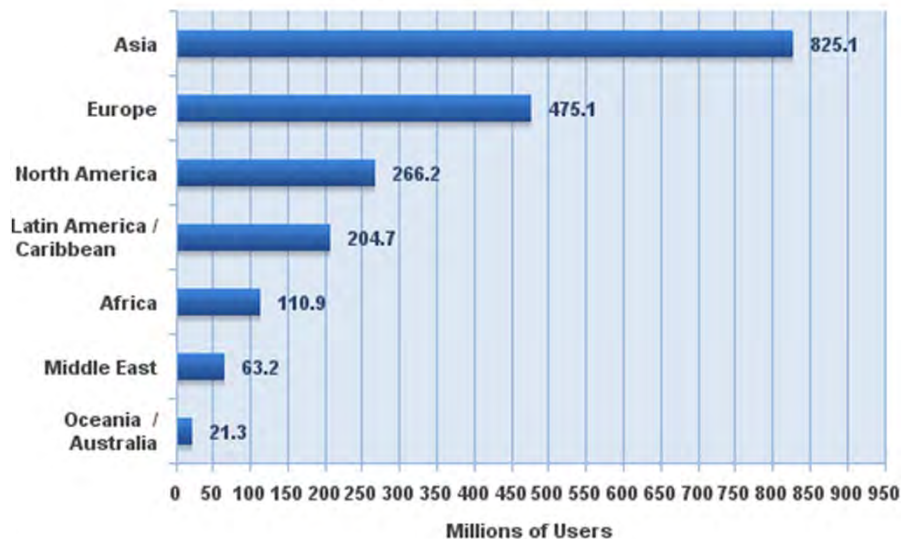
# How connected are we to WWW?

WORLD INTERNET USAGE AND POPULATION STATISTICS						
World Regions	Population (2010 Est.)	Internet Users Dec. 31, 2000	Internet Users Latest Data	Penetration (% Population)	Growth 2000-2010	Users % of Table
<a href="#">Africa</a>	1,013,779,050	4,514,400	<b>110,931,700</b>	10.9 %	2,357.3 %	5.6 %
<a href="#">Asia</a>	3,834,792,852	114,304,000	<b>825,094,396</b>	21.5 %	621.8 %	42.0 %
<a href="#">Europe</a>	813,319,511	105,096,093	<b>475,069,448</b>	58.4 %	352.0 %	24.2 %
<a href="#">Middle East</a>	212,336,924	3,284,800	<b>63,240,946</b>	29.8 %	1,825.3 %	3.2 %
<a href="#">North America</a>	344,124,450	108,096,800	<b>266,224,500</b>	77.4 %	146.3 %	13.5 %
<a href="#">Latin America/Caribbean</a>	592,556,972	18,068,919	<b>204,689,836</b>	34.5 %	1,032.8 %	10.4 %
<a href="#">Oceania / Australia</a>	34,700,201	7,620,480	<b>21,263,990</b>	61.3 %	179.0 %	1.1 %
<b>WORLD TOTAL</b>	<b>6,845,609,960</b>	<b>360,985,492</b>	<b>1,966,514,816</b>	<b>28.7 %</b>	<b>444.8 %</b>	<b>100.0 %</b>

Source: [www.internetworldstats.com](http://www.internetworldstats.com)

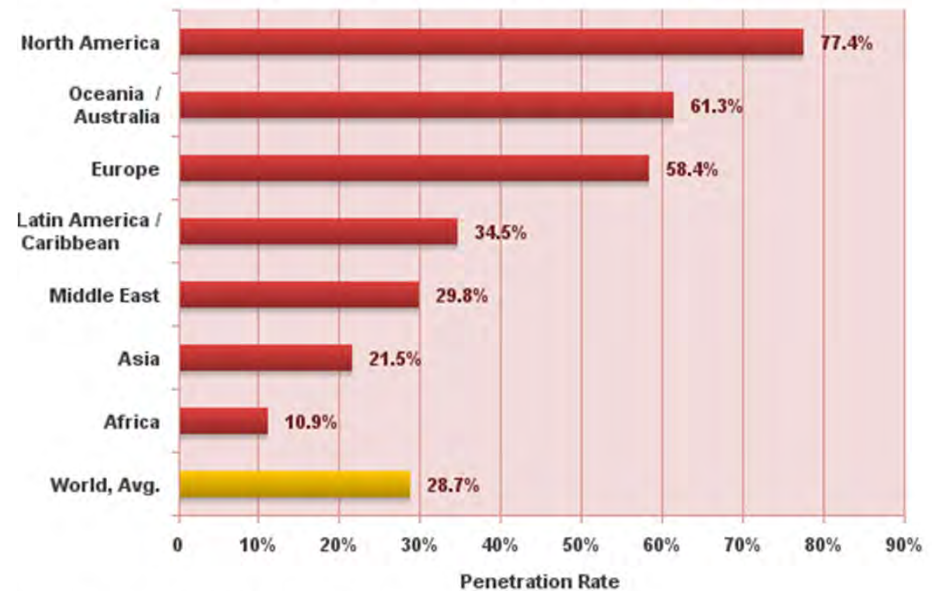
# How connected are we to WWW?

## Internet Users in the World by Geographic Regions - 2010



Source: Internet World Stats - [www.internetworldstats.com/stats.htm](http://www.internetworldstats.com/stats.htm)  
Estimated Internet users are 1,966,514,816 on June 31, 2010  
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## World Internet Penetration Rates by Geographic Regions - 2010



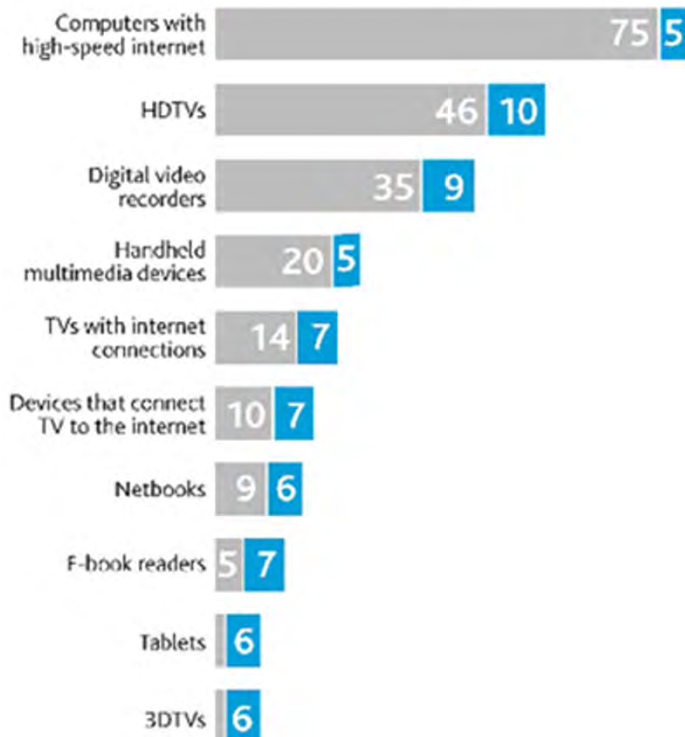
Source: Internet World Stats - [www.internetworldststs.com/stats.htm](http://www.internetworldststs.com/stats.htm)  
Penetration Rates are based on a world population of 6,845,609,960 and 1,966,514,816 estimated Internet users on June 30, 2010.  
Copyright © 2010, Miniwatts Marketing Group

# Growth of Mobile Web

## Emerging media devices<sup>8</sup>

Adoption amongst "connected consumers" in the U.S.

● Already own ● Definitely/probably will buy



- In U.S. there are 228M mobile phone users, 13+
  - 83.2M of them have Web access

## U.S. mobile internet time by category<sup>9</sup>

Share of mobile internet time based on total time at an individual site-level\*

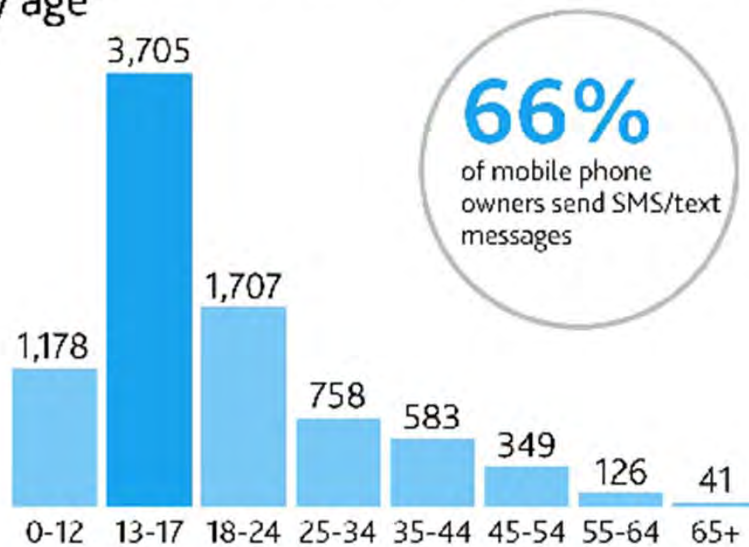
May 2010



Source: The Nielsen Company

# New generation on WWW

Number of SMS sent/received per month by age<sup>6</sup>



- More than 500 million active users
- 50% of active users log on to Facebook in any given day
- People spend over 700 billion minutes per month on Facebook
- Twitter have 175 million registered users.
- 95M tweets are written per day.

Source: The Nielsen Company

# WWW's influence

- WWW is transforming our lives.
  - Economy, industry, education, healthcare, entertainment
- WWW is globally and permanently available.
- WWW itself is transforming too.
  - From purely informational to application-oriented.
  - From published content to user generated content.

# Development practices

- Web applications are developed ad hoc.
  - Similar to software development practices of 60s.
  - Quality issues in production leading to operation and maintenance problems.
  - As applications are strongly interlinked, problems spread from one application to another.
- What caused these issues and how can we improve the current situation?

# Some of the reasons for the current situation in Web Engineering

- Document-centric approach
  - An authoring viewpoint is not adequate for the development of software intensive Web applications.
- Assumed simplicity of Web applications development
  - The tools allow the simple generation of Web environments with emphasis on visual design rather than internal structuring and programming.
- Know-how from relevant disciplines cannot be applied or is not used
  - Software Engineering sometimes is not adequate due to special characteristics of Web. Concepts and techniques from other disciplines from other disciplines, such as HCI, are ignored.

# What are the top problems in large-scale Web application projects?

Problems	Percentage
Failure to meet business needs	84%
Project schedule delays	79%
Budget overrun	63%
Lack of functionality	53%
Poor quality and deliverables	52%

# What is Web Engineering?

- Application of systematic and quantifiable approaches to cost-effective development of high-quality Web systems.
- The approaches can be
  - Concepts
  - Methods
  - Techniques
  - Tools
- Web Engineering is also the scientific discipline concerned with the study of these approaches.

# Comparison of Web Engineering to Software Engineering

- Web Engineering is not a one-time event; rather it is a process related to the whole lifecycle of a web system, similar to Software Engineering.
- Both disciplines are still not mature compared to established engineering disciplines. (Web Engineering is much less mature!)
- Despite some similarities, the special characteristics of Web systems require the development of new approaches.

# Differences to Software Engineering

- Variety of people involved in development
  - programmers, database experts, designers, content providers, system administrators, project managers, ...
- Typically developed for unknown set of users with no training
- Intrinsic characteristics of web applications
  - reliance on communication technologies
  - multi-platform accessibility
  - hypertext-based interaction
  - range of technologies
- Speed of development and evolution

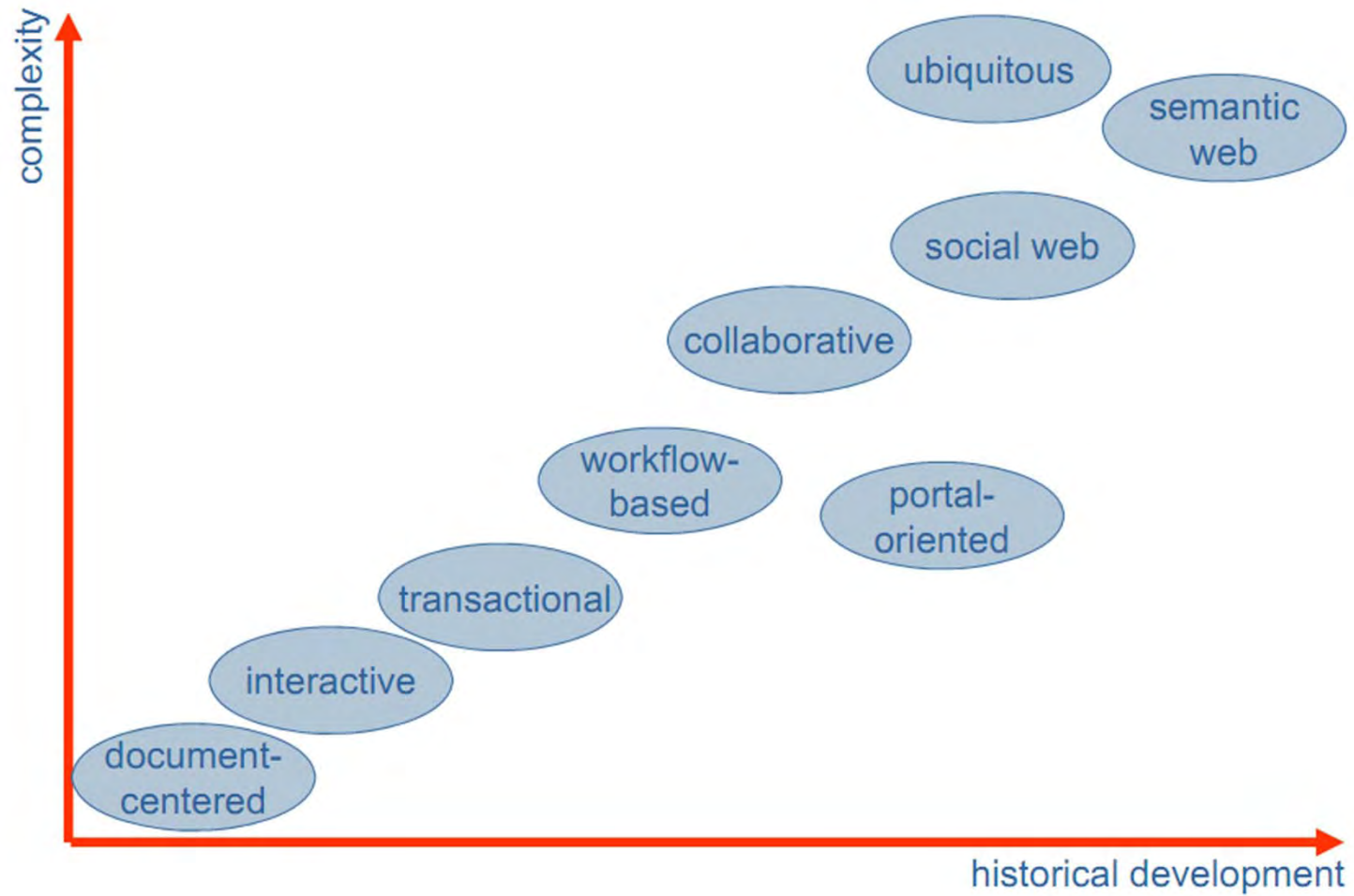
# Multi-Disciplinary Nature of Web Engineering

- Software Engineering
- Hypermedia Engineering
- Information Engineering
- Graphical Design
- Usability Engineering
- Network Management
- Project Management

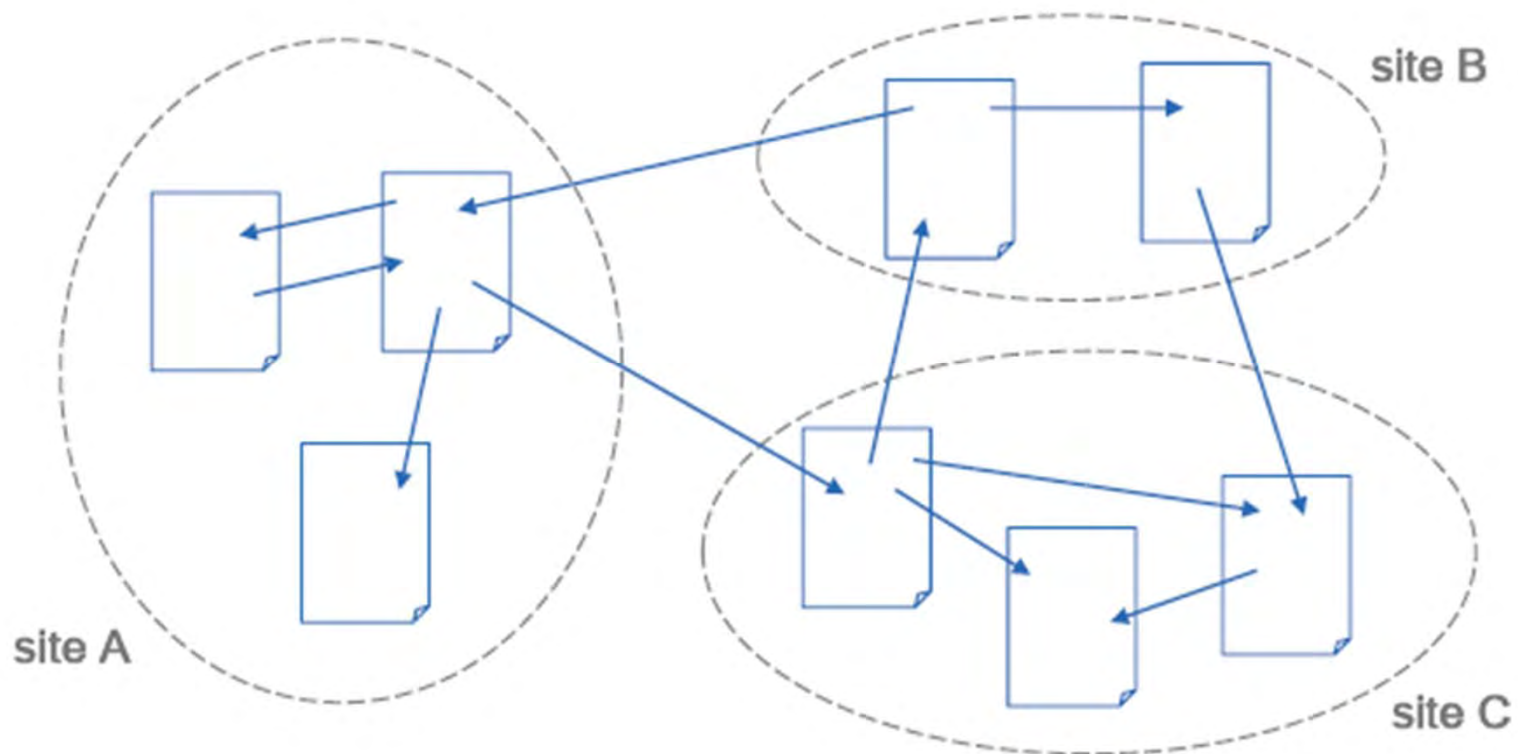
# History of Web

- <http://www.w3.org/History.html>
- 1945 – first hypertext system described
- 1965 – “hypertext” coined by Ted Nelson
- 1987 – HyperCard on Mac
- 1991 – WWW published by Tim Berners-Lee
- 1994 – World Wide Web Consortium
- 1998 – Google
- 2000 – Dot-com burst
- 2004 – Web 2.0
- Future – Semantic Web, Web 3.0

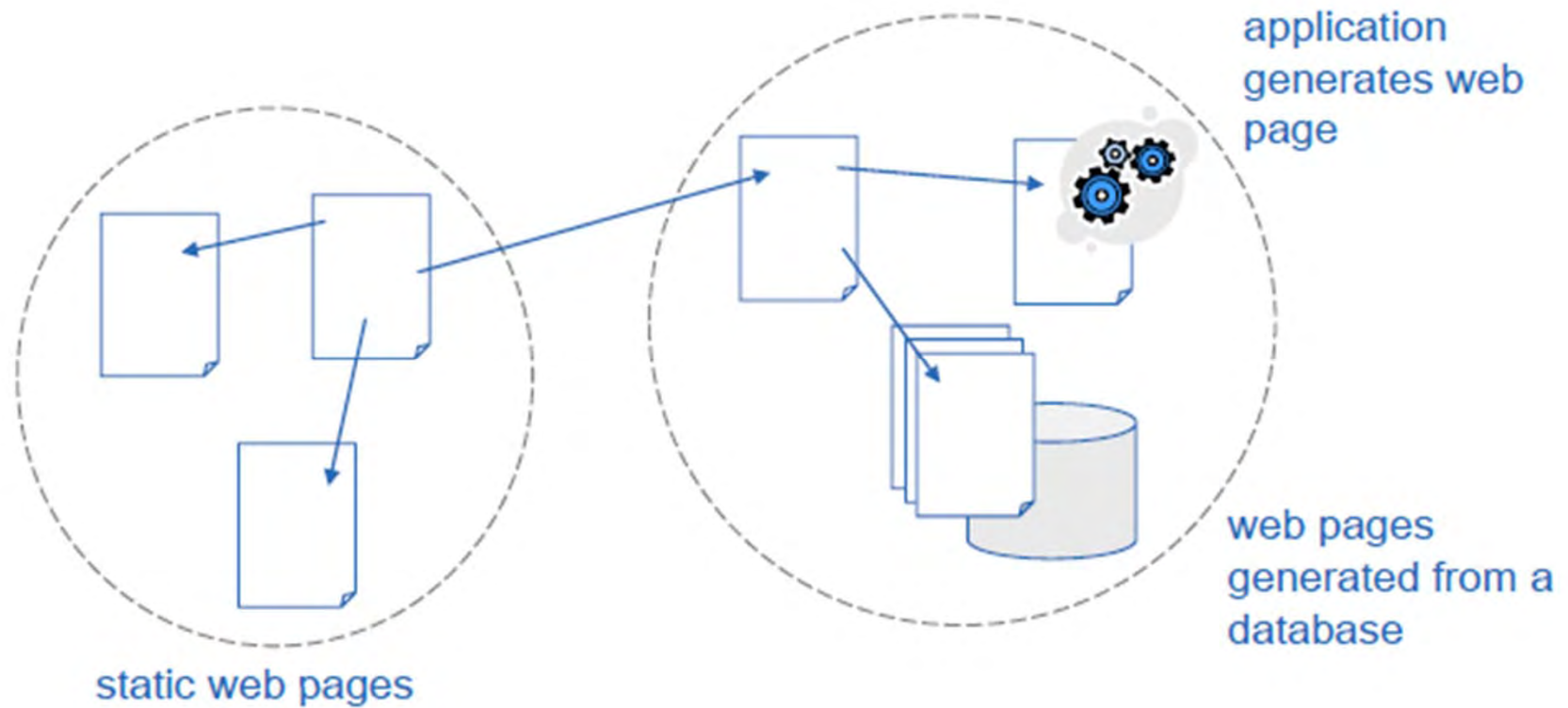
# Transformation of Web



# Web-Based Hypertext Model



# Web Nowadays



# The Web Today

- Environment to deliver all kinds of information and services
  - multimedia of different types and formats (images, video, animations, audio)
  - software distribution
  - applications (search engines, currency converters, kitchen design, ... )
  - complex systems (e-Commerce, enterprise planning, ....)
- Platform for collaboration
  - discussion forums
  - social networking sites (Facebook,...)
  - collaborative authoring (Wikipedia, .... )
  - web conferencing and meeting systems (Sharepoint,..)

# Challenges of Web Engineering

- Users and usability
- Information sources
- Technologies
- Maintenance
- Legal, Social and Ethical Issues

# Users

- Generally unknown
  - expectations, behavior patterns not known at development time
  - more difficult to design interface
  - no training
  - dealing with globalization - different cultures, languages, etc.

# Information Sources

- Dealing with a range of information sources and systems
  - database systems
  - file systems
  - multimedia storage devices
- Variety of types and formats of multimedia content
  - images, sound, animation, video, ..... in different formats
  - documents of different forms
  - text in different languages (alphabets)
  - clients may only be able to handle certain formats
  - certain formats may be specific to certain clients

# Technologies

- Web developers must work with a range of technologies and languages
  - document formats (HTML, XML, VoiceXML ...)
  - presentation (CSS, XSLT, ...)
  - programming (CGI, PHP, JavaScript, JSP, Java, ....)
  - databases
  - content management systems
  - web servers
  - application server
- Made even more difficult because of the rapid development of new technologies and standards

# Maintenance

- Web sites evolve continuously without specific releases
- Maintenance cycles may be days or even hours
- Content, functionality, structure and presentation may change significantly from one moment to the next
- Necessary to provide some sort of controls over changes
  - accuracy and quality of content
  - translation of content into different languages
  - conforms to corporate presentation guidelines
  - modifications to structure and navigation
  - modifications to services

# Legal, Social and Ethical Issues

- Copyright
  - content
  - links
- Privacy
- Criminal Activities
- Libel versus Freedom of Speech
- Internationalization of Laws
- Access for the disabled and minorities

# Web 2.0

- Web 2.0 websites allow users to do more than just retrieve information.
- Provides the user with more user-interface, software and storage facilities, all through their browser. (Network as platform computing)
- Users can provide the data that is on a Web 2.0 site and exercise some control over that data.
- Wikipedia, blogger, twitter, youtube, facebook

# Characteristics of Web 2.0

- Rich user experience
- User participation
- Dynamic content
- Metadata
- Web standards

# Future of Web

- More technologies
- Better usability
- Semantic Web
  - Knowledge management on the Web
  - Linking and integrating existing knowledge
  - Locating new knowledge
  
- “The **Semantic Web** is an extension of the current web in which **information** is given **well-defined meaning**, better enabling **computers and people to work in cooperation.**”

Tim Berners-Lee, James Hendler, Ora Lassila,  
[The Semantic Web](#), Scientific American, May 2001

# Technology demo

- <http://www.w3.org/2009/03/web-demo.xhtml>
- [http://mrdoob.com/projects/chromeexperiments/ball\\_pool/](http://mrdoob.com/projects/chromeexperiments/ball_pool/)
- W3C recommendations
  - [http://en.wikipedia.org/wiki/World\\_Wide\\_Web\\_Consortium](http://en.wikipedia.org/wiki/World_Wide_Web_Consortium)

# User Interfaces and Usability

What are the factors that influence User Interfaces?

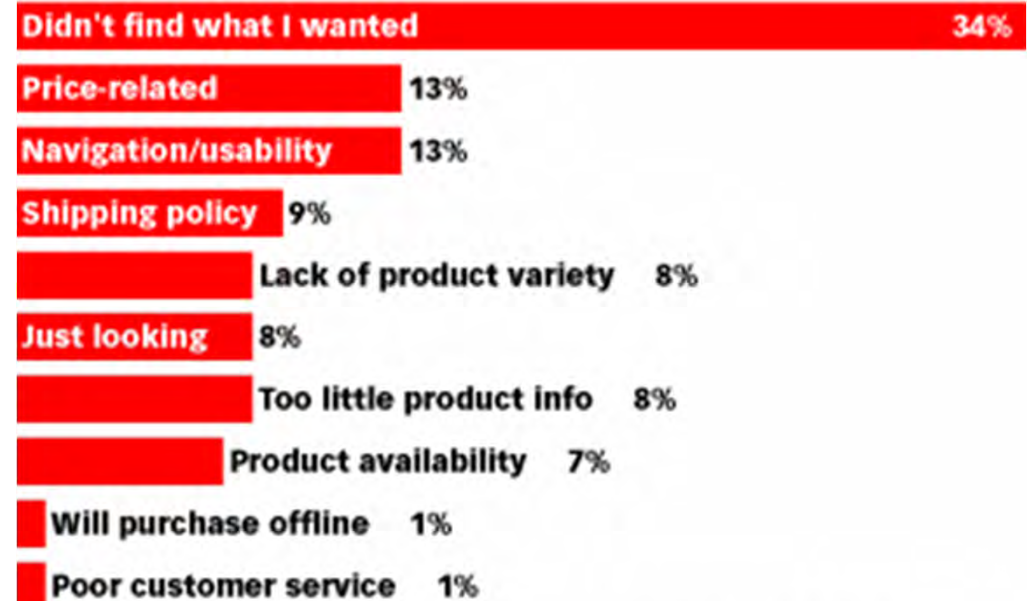
# What is “Usability” ?

- = Quality
- Learnability
- Efficiency
  - Productivity
- Memorability
  - Little “re-learning” required
- Error handling and tolerance
- Satisfaction
  - #1 principle of Agile Manifesto:
  - “Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.”

# Navigation and Usability issues lead to lost customers

- Studies find 58% to 74% failure at achieving a task at a site!
  - Lower rate when need a *sequence* of steps
  - eMarketer study: 61.5% success rate
    - Source:  
*Keys to E-Commerce Success*, Nov. 2, 2009  
<http://www.emarketer.com/Article.aspx?R=1007358>

## Barriers to Buying on a Retail E-Commerce Site\* According to Internet Users Worldwide, April-June 2009 (% of respondents)



Note: \*refers to retail e-commerce site visit that prompted the survey  
Source: iPerceptions, "Retail/E-Commerce Industry Report Q2 2009,"  
October 2009

# Web is an Attention Economy

- Ultimate currency is the user's time
- There is *too much content* on the WWW
- In traditional media, inertia helps keep people reading
- On the web, it is almost as easy to go to the competitor as to go to your next page
- Web **content** must give immediate benefits to the users or they will allocate their time to other sites

# Why are Interfaces Important?

- Sit-down-and-use software and web systems.
  - Users do not read manuals.
- Usability is critical to software sales
  - Make them “User friendly” for all, not only for smart people.
- Human-computer-interaction (HCI) trained people build better interfaces
  - Programmers don't think like end-users
  - Exposure to different kinds of interfaces, problems
  - User model, not system model
  - Guidelines

# User Frustration

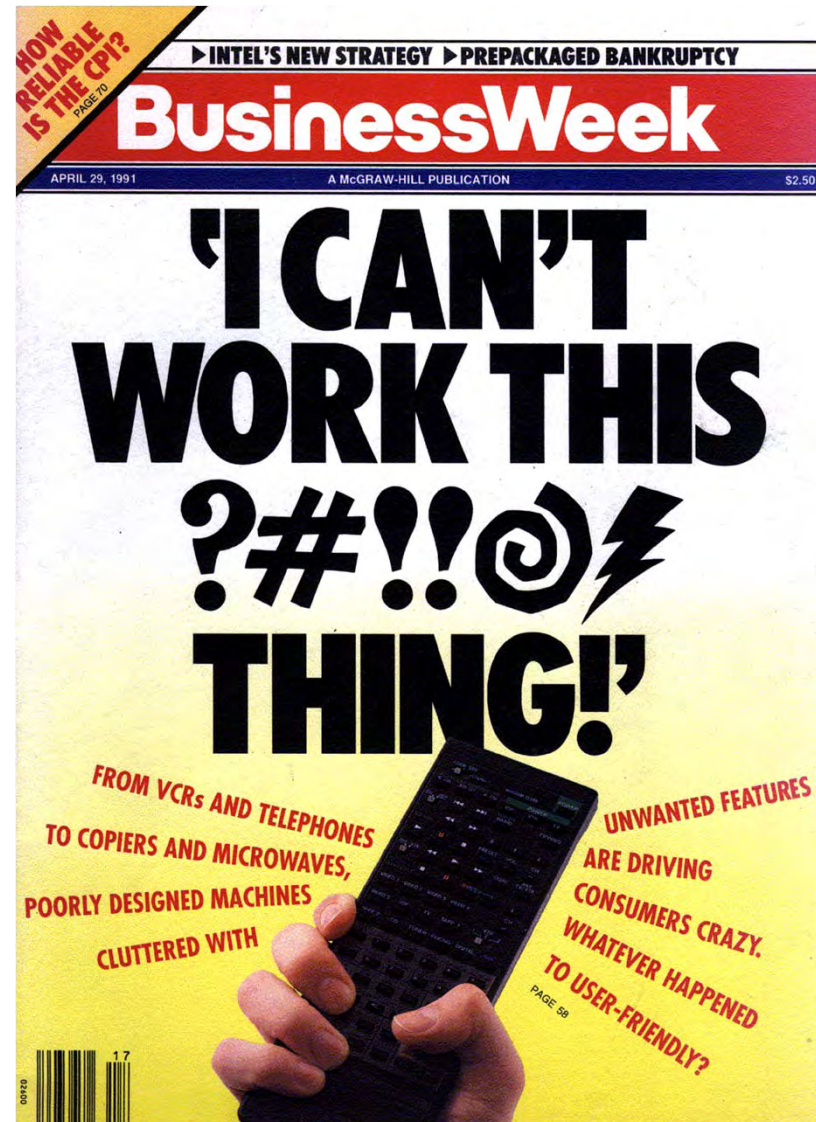
- When I taught a “user interface” class at the University of Virginia, I’d bring in a working VCR on the first day. I would put it on a desk in front of the room. I would pull out a sledgehammer. I would destroy the VCR.
- Then I would say: “When we make something hard to use, people get upset. They become so angry that they want to destroy it. We don’t want to create things that people will want to destroy.”
  - Randy Pausch, The Last Lecture



# User frustration

Problem

April 19, 1991



# Why is usability important?

- There are well-defined usability methods and techniques, especially from industrial engineering.
- Usability is not just opinions, luck, or domain experience.
- It is very expensive to **not** do usability engineering.
  - Interfaces will be re-designed: before or after release.
  - Studies show that usability engineering saves money.

# Usability Benefits

- Based on data from 42 cases where usability metrics were available for website redesigns.

<b>Metric</b>	<b>Average Improvement Across Web Projects</b>
Sales / conversion rate	100%
Traffic / visitor count	150%
User performance / productivity	161%
Use of specific (target) features	202%

- Website usability is dominated by users' ability to avoid errors in navigation and interpret new information.
- “The average business metrics improvement after a usability redesign is now 83%. This is substantially less than 6 years ago, but ROI remains high because usability is still cheap relative to gains.”

# Customer benefits

- Novices will be more effective quicker.
- Make experts more efficient
- Efficiency is important to customers, especially with shrinking workforces and outsourcing.
- Reduce errors.
- Increased pride of ownership.
  - If you like a company's product, you tend to stay with it in the future, e.g. car buying experience.
- Productivity and satisfaction.

# Company Benefits

- Reduce calls to the support center.
- Reduced support costs in general.
- Reduced complaints from customers.
- Can help identify what is really needed.
  - What will be useful and what is not needed.
- Easier to demonstrate and sell.
- Greater usage of features = realized value
- Competitive differentiation - > Revenue and profit

# Good UIs on Successful Products

- Palm succeeded where other handhelds had failed due to a focus on usability:
  - Fit into pocket.
  - Reliable text input.
  - Commands immediately available.
- Apple iPod created a Dial design and a new UI.
- Apple iPhone also has a unique UI.
- Wii vs Xbox or Playstation.





# Usability rules the Web

- If the customer cannot find your product, then it won't be bought.
- Your competitors are only one click away.
- All Web sites are compared to the best. e.g. People expect to have the same features on any bookseller online as Amazon has.