

- ◆ Offers Web site designers and evaluators guidelines that cover the most important and broadly relevant navigation issues
- ◆ Provides an example and a synthesis of research, theory, and expert opinion for each guideline

Guidelines for Designing Web Navigation

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INTRODUCTION

Web users display a succession of Web pages as they try to meet their information needs. We usually refer to this activity as navigation. Supporting navigation must be an important priority for designers, for few Web sites will succeed unless users can efficiently find the content they are interested in. This article provides guidelines for designing the navigation within a Web site.

The Web has precursors in earlier hypertext systems dating back to the 1960s and, in speculative writing, back to the 1940s with Vannevar Bush's article "As we may think." Bush anticipated what we today call "information overload" and proposed sophisticated technologies to help knowledge workers store and, more importantly, link text and graphics for later retrieval (Bush 1945). Hypertext has figured in many experimental publication systems and became widely available with the introduction of HyperCard for the Macintosh in 1987. The Web, however, has brought hypertext to many millions of new users.

All of the hypertext systems developed over the last several decades—and not least among them the many online help systems created by technical communicators—have prompted and have benefited from theory, research, and practical insights about navigation in digital space. The understanding and skills of the design community have grown considerably—though probably just enough to keep up with the extra difficulties posed by ever larger and more complex Web sites.

Background: The navigation metaphor, nodes and links, and information structures

We start with the idea that navigation is only a metaphor for Web use. No one ever goes anywhere. The navigation metaphor, however, pervades the experience of both users and designers—so much so that we often speak of the "navigation paradigm." No one can doubt the influence of the navigation paradigm. The language of Web use and

Web design (visiting Web sites, getting lost, backtracking, and so forth) is the language of navigation and travel.

There are various reasons why human beings perceive Web use as navigation. One is the natural correspondence between successively displaying new screens of content and moving to a new physical location. In both cases we change our field of view. Another is that we instinctively apply our wayfaring experience and skills from the physical world to the world of digital information.

The experience of Web navigation (as well as navigation in pre-Web hypertext systems) has been formalized into the idea that chunks of Web content (roughly corresponding to individual Web pages) can be understood as nodes and that we navigate from node to node via electronic pathways we call links. Each Web site, then, is a network of nodes and links within the vast network that makes up the entire World Wide Web. The idea of nodes and links is the foundation of hypertext theory. This idea does not properly account for everything that happens when we use the Web—far from it—but it does account for enough to be valuable, especially to designers.

Networks of nodes and links are arranged in particular configurations that in hypertext theory are very often referred to as information structures. These information structures, which derive from the branch of mathematics known as graph theory, include the hierarchy, the linear structure with its multipath variant, the web (a disordered structure), and the matrix (Parunak 1991; Horton 1994). These structures are depicted in Figure 1.

The hierarchy is by far the most prevalent structure. This is true because human beings naturally order their world by establishing categories and subcategories. Also, from the perspective of Web navigation, we can say that

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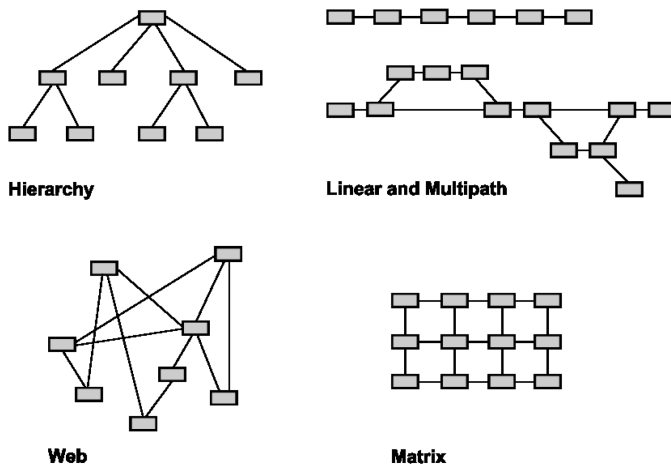


Figure 1. The major information structures.

the hierarchy (especially when secondary links supplement the basic “tree” structure) is a highly usable combination of order and navigational freedom. As the information retrieval specialists Rosenfeld and Morville (1998) observe:

The foundation of almost all good information architectures is a well-designed hierarchy. In this hypertext world of nets and webs such a statement may seem blasphemous, but it's true. . . . Hierarchy is ubiquitous in our lives and informs our understanding of the world in a profound and meaningful way. (p. 37)

This set of guidelines is articulated entirely within the navigation paradigm, and assumes hierarchical information structures (though these may take various forms). A lengthier treatment of Web use and Web design would encompass other Web metaphors and information structures.

Design of the Web navigation guidelines

We have attempted to address the most important and most broadly relevant navigation issues in a manageable number of guidelines: 12, grouped into four broader topics. The guidelines are phrased from the point of view of a designer, but should be equally useful as a means of evaluating existing Web sites.

With each guideline there is an example and our synthesis of the most relevant and compelling research and theory. The empirical research in the area of user navigation is limited, but we can profitably draw from research and theory in the areas of human-computer interaction and interface design, cognitive psychology, information science, hypertext theory, rhetoric, and information design. We also draw on statements from acknowledged Web design experts, our knowledge of contemporary Web de-

sign, and our experience with many pre-Web hypertext systems. The article concludes with a “quicklist” summary of the guidelines.

To keep the guidelines short and useful, we have (as mentioned previously) assumed a hierarchical structure and have not ventured beyond the navigation metaphor. Furthermore, the guidelines assume what can be broadly termed informational Web sites and users with an interest in efficient navigation. These guidelines, therefore, may not apply to sites for game players, art sites, and sites intended for whimsy and fun.

Finally, these guidelines are only a part of a larger whole. We have, therefore, excluded issues that we felt were closer to one of the sets of heuristics provided elsewhere in this issue rather than to Web navigation.

1 DESIGNING AN EFFECTIVE LINK

Users navigate from one node to another, one page to another, via links. The designer is responsible for supporting both the user's departure from the current node and the user's arrival at the destination node. The three items in Topic 1 focus on departure, on helping the user choose his/her next destination.

1.1 Be sure that all links indicate that they are links.

Key points

- ◆ Well-established cues such as underlining and the raised “button” appearance should be used to indicate links. Do not use these cues for other purposes.
- ◆ Links can also be indicated by semantic meaning, layout, and formatting. These cues, however, are less reliable and should be used with care.
- ◆ Graphics, other than icons, are usually not interpreted as links. A special cue, such as a text label, may be necessary to indicate the link.

A basic requirement for easy and effective Web navigation is that users must always know what links are available on the current page. In other words, the user must know “what's hot and what's not.” Users should not be fooled into clicking something that is not a link, and they should not miss out on valuable content because there was nothing to suggest that a particular screen element was in fact a link. As Jakob Nielsen points out, making links noticeable (through underlining or another technique) fits a basic principle of interface design: letting users know “what options are available” (1995, p. 139).

The “classic” cue for indicating a link is underlining, especially when the text and underlining are blue (the browser default color for links). Another strong cue is the raised “button” appearance. To avoid luring users into useless clicks, these cues should be used only for links and not for general formatting.



Figure 2. A Web page with various link cues (<http://www.ibm.com>).

The semantic meaning of many word or phrases—for example, “Products” or “About us”—will be reliably interpreted as a link. Layout and format provide another set of cues. A vertical list of phrases, especially when located in a boxed area at the left of the screen, suggests links, because users so often encounter navigation columns with this appearance. The designer, of course, can strengthen these cues—for example, by underlining these phrases.

On the Web, icons are usually interpreted as links. That is, whether or not the icon is successful at indicating its destination, the user at least guesses that the icon is hot. Non-iconic graphics are problematical. So, for example, if a photograph is hot, the designer may need to provide some kind of cue, even an explicit statement such as “Click the photograph for information about the photographer.”

Both users and designers are benefiting from the evolution of more-or-less standard cues for links. Even so, only usability testing reveals for certain what a particular group of users will recognize as hot.

Many of the cues discussed above are used on the well-designed home page shown in Figure 2. Users get no special cue, however, that the paragraphs in the News section (in the middle of the page) are hot unless they move the cursor over the text and see that the arrow changes to a hand.

1.2 Work to ensure that users will view and notice links.

Key points

- ◆ Avoid cluttered page designs that make links hard to see.

- ◆ Make sure the most important links appear high enough on the page to be visible without scrolling, regardless of the resolution of the user’s monitor.
- ◆ When pages must scroll, provide visual cues to encourage users to scroll down to links that are below the scroll line.

Even when a page element indicates that it is hot, users will not benefit unless they view and notice the link. Links can become “lost” in the visual complexity of a Web page, one further reason to attend to the principles of layout and design.

Links will also go unnoticed if they appear below the scroll line and the user fails to scroll to these links, either because the user fails to notice that the page scrolls or else chooses not to scroll the page.

Nielsen points out an additional usability problem associated with navigation pages that require scrolling: “they make it impossible to see all the available options at the same time . . . users will have to make their choice of their next action without being able to directly compare everything” (2000, p. 115).

The problem of scrolling pages is difficult to address. One complicating factor is that scroll lines occur higher on the page for users with low-resolution monitors than for users with higher resolution monitors. It is possible to design only short pages that do not scroll on any machine, but there is significant risk here in severely fragmenting the content. A good design strategy, therefore, is to recognize that some scrolling will occur but to make sure that your most important links appear high enough on the page to be viewed without scrolling, regardless of the resolution of the user’s monitor.

This recommendation is echoed in various usability-based Web design guidelines (IBM 1999; Keeker 1997; Nielsen 2000). A related Microsoft guideline suggests techniques to induce users to read past a scroll line: "Break text in mid-sentence and/or use visual design cues to keep people reading past 'visual cliffs' or 'below the fold' (for example, the bottom of a page)" (Keeker 1997). One example of a visual design cue is positioning a graphic or table so the top portion shows above the scroll line. Users will be enticed to scroll to the additional content on the page, including any links that lie below the scroll line.

In addition, designers should be wary of page elements, such as horizontal rules located between sections of a lengthy page, that may suggest to users that they've reached the bottom of the page. Spool and others (1999) found that horizontal rules often make users think they have reached the end of the page. "Several sites used the lines to separate sections of content. Repeatedly, users did not scroll below these lines, even though they did scroll down other long pages" (p. 78).

1.3 Be sure that all links clearly indicate their destinations.

Key points

- ◆ Use layering techniques, such as adding supplementary text and mouse rollovers, when necessary to make the destination of text links clear.
- ◆ Use labels and mouse rollovers (created with an ALT tag) when necessary to clarify the destination of icon links. ALT tags are especially desirable because they can be recognized by text-only and text-to-voice browsers.
- ◆ Use link typing to indicate external links and links that initiate a process, such as opening a mail message window or starting a download.

All links must make clear their destinations, the node that the link will display. Unfortunately, links on many sites fail to achieve this basic requirement. Borges, Morales, and Rodriguez (1998) investigated users' ability to predict the destinations of 50 links randomly selected from 10 commercial Web sites. They found that "in approximately one fourth of the cases, the link names suggested a wrong idea about the content of a page" (p. 145). Even in well-designed Web sites, users will periodically follow a link to an unwanted node or will sit and ponder whether to follow a link. But designers should work hard to minimize these frustrating occurrences.

Text links In the case of text links, a key consideration is the number of words needed to adequately describe the link destination to a particular audience. When a word or short phrase will communicate successfully, the designer's job is easier. Lengthier phrases, while often necessary, may

Director's Office

Read a message from the Director.

Press Room

Get the latest news from the Mint.

Figure 3. A brief text link augmented with supplementary text.

cause problems. For example, designers may have trouble fitting the text into the limited space of a button on a navigation bar. Likewise, lengthy text links in a list of links can cause awkward and confusing run-over lines. Faced with these and related problems, designers may be tempted to condense text links until they cease to communicate adequately. (See the article by Spyridakis in this issue for a discussion of link text and text comprehension.)

One solution to the problem of lengthy text links is to write relatively brief links and augment them with supplementary text, as shown in Figure 3. This strategy often allows for more attractive visual design than is possible with lengthy links. Furthermore, it gives users the option of skipping the supplementary text if the link gives them enough information about the destination. A similar strategy is to create mouse rollovers (pop-up explanations), often implemented with JavaScript. Rollovers conserve screen real estate (the viewing area on the screen) and reduce visual clutter; the drawback is that the user must move the mouse over the link to get the supplementary information and even to determine that it exists. Both of these strategies are instances of the information-design strategy called "layering."

In a study of a computer-based information retrieval system, Lee, Whalen, McEwen, and Latremouille (1984) looked at the effectiveness of adding short descriptors to hierarchical index terms. For example, the term "General Interest Guide" became "General Interest Guide: News, Weather, Sports, Entertainment, Market Place, Employment, Travel, Leisure, Advice." The researchers found that while there was no consistency in the preferences of expert users, 80% of naïve users preferred pages with descriptors to those without. Furthermore, naïve users "performed significantly better on a page with descriptors than on a corresponding page without descriptors" (p. 1063).

Graphic links (icons) Most graphic links are icons. Potentially, icon links offer some significant advantages over text links. A familiar icon can be processed more quickly and easily than a text link. Many icons communicate across language barriers. Finally, icons can be made visually interesting and attractive, and can be incorporated into a Web site's overall visual design. These benefits, however, come with problems and pitfalls. For example, many icons

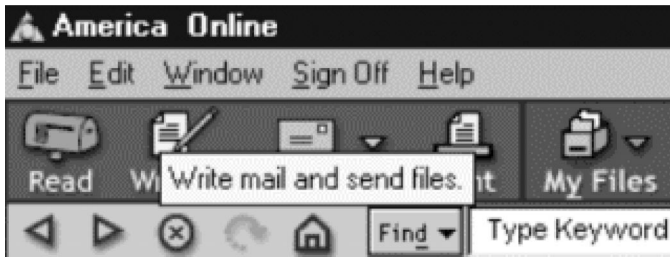


Figure 4. An icon with two additional layers of information: a label and a rollover label.

intended for an international audience fail to communicate across cultures. Further problems associated with the use of icons are described in the article by Williams in this issue.

Just as with text links, layering techniques can be used with icons, and it is often necessary or prudent to do so. To conserve screen real estate and reduce clutter, the designer may choose to label an icon with a mouse rollover—as discussed earlier in this article. One good way to provide rollovers for graphics is to use ALT tags. An important benefit of ALT tags is that the ALT tag text also identifies the graphic for people using text-only browsers and for visually impaired people using text-to-voice browsers. The icons in Figure 4 use both text labels and ALT tag rollovers.

Indicating the link type The idea of “indicating a link’s destination” can include indicating a category the link belongs to. We see this when designers indicate (sometimes with an icon) all links that trigger a particular media type (for example, video or audio sequences) or when external links are distinguished from internal links. Indicating a category is referred to as “link typing.”

A less common but very welcome kind of link typing is to distinguish links that initiate a process, such as starting a download, from links that display new content. For example, when a person’s name is a link, it is often unclear whether the link opens a mail message window or whether it leads to information about the person.

Bieber and others (1997) point out that typing links for such semantic categories as “example” and “explanation” is rare but highly desirable: “Semantically typed nodes and links help authors organize information more effectively and lend context for readers. Link types such as ‘explanation,’ ‘further details,’ ‘contrasting argument,’ etc., convey the relationship between the link’s destination and the current node” (p. 37).

2 MANAGING LARGE NUMBERS OF LINKS

Under Topic 1, we pointed out what is required to design an effective link. But of course Web pages generally contain

numerous links. Here we offer guidelines on managing large numbers of links. First we point out the need to design hierarchical structures with the best possible ratio of breadth to depth. Then we explain how designers can provide extra navigational freedom by supplementing the strict (tree-shaped) hierarchy with additional groups of links (often termed secondary links) and by occasionally allowing primary links to converge. The final and broadest guideline is that the interface should readily reveal the underlying structure of the Web site, the configuration of nodes and links.

2.1 Plan effective ratios of breadth and depth in Web site hierarchies.

Key points

- ◆ Within limits, it is best to favor breadth over depth in designing a hierarchy.
- ◆ To help users cope with breadth, consider grouping links under headings.

The great majority of Web sites are structured as hierarchies. An important consideration, therefore, in designing user navigation is the structure, or “shape,” of these hierarchies. This is usually understood in terms of good ratios of depth and breadth. Users, of course, do not directly navigate abstract hierarchies; they work with the buttons and text links on the interface. But the size and shape of a Web site’s underlying hierarchy determines the number and destinations of the links, and so a good hierarchy is the first step toward a good interface.

All things being equal, it is easier to design effective navigation for a small hierarchy, one without many nodes. As more and more nodes are added, the hierarchies must get deeper or broader or both (the most typical situation). Stated differently, there is an unavoidable tradeoff between breadth and depth: To keep hierarchies from getting too deep, you must make them wider. To avoid too much breadth, you must make them deeper.

Within limits, it is better to favor breadth over depth. The burden of having to negotiate more levels of depth is worse than scanning a longer list of links. A hierarchical Web site with 4,097 nodes, where the second, third, and fourth levels each contain 16 links ($16 \times 16 \times 16$), will be more easily navigated than a Web site with only 3,126 nodes where the levels are structured $5 \times 5 \times 5 \times 5 \times 5$.

The issue of breadth vs. depth was originally researched with regard to menu trees in software applications. Summarizing various studies, Shneiderman (1998) states “the evidence is strong that breadth should be preferred over depth” (p. 249). Larson and Czerwinski (1998) investigated optimal ratios for Web design using three 512-node hierarchies organized as follows: $8 \times 8 \times 8$, 16×32 , and 32×16 . They found that the two-level designs were preferable to the three-level design and that users “performed best with the 16×32 hierarchy and worst with the $8 \times 8 \times 8$ hierarchy. This

corroborates previous findings that demonstrated that increasing the levels of depth hurt user performance during search” (p. 29). The researchers, however, caution against increasing breadth to extremely large sizes.

Although researchers can determine highly navigable ratios, in practice the depth and breadth of any hierarchy is greatly affected by the constraints the designer faces in dividing the content into meaningful and usable groupings. So, for example, the natural divisions in the content may require one branch of a hierarchy to be shallower and one to be deeper than the other branches. Even so, designers should strive to achieve good ratios of breadth and depth when they devise a Web site’s hierarchical structure.

Designers may wish to group a large number of links under headings, thereby reducing the amount of scanning that is needed to choose a link. So, for example, the designer of the moderately large Web site shown in Figure 5 has grouped a list of 16 links into four categories, each introduced by a heading. (The headings can be envisioned as an extra level in the hierarchy, but a level that doesn’t require clicking.) The third heading with its single entry is slightly awkward. This example illustrates the practical problems designers face trying to group links into categories.

2.2 Supplement the primary links of a Web site with secondary links—when appropriate.

Key points

- ◆ Use shortcut links to provide quick access from the home page to important nodes located deeper in the hierarchy.
- ◆ Use systematic secondary links to connect a group of closely related nodes.
- ◆ Use associational links to indicate a special relationship between two nodes.

Hypertext theorists distinguish between links that define the main branches (the structure) of the hypertext system from those that do not (Conklin 1987; Parunak 1991). The links that define the main structure are called primary links. Hierarchies that consist only of primary links are very orderly, but they are also rigid and inflexible. For example, in a strict hierarchy, a user who has navigated to the bottom of one branch will have to return to the home page before exploring a different branch of the hierarchy. To provide more navigational freedom, designers very often create secondary links to augment the primary links. Secondary links are not necessarily minor links; in fact, they can be prominent and well traveled. Three kinds of secondary links are shown in Figure 6 and are explained below. These are shortcuts links, systematic secondary links, and associational secondary links.

Shortcut links to lower-level nodes Very often, an important node is located on the third or fourth level of a

Mint Products

- PRODUCT CATALOG
- 50 STATE QUARTERS™
- NEW DOLLAR COIN
- COMMEMORATIVES
- BULLION
- MEDALS

Coin Production

- MINT TOURS
- MAKING OF COINS
- SPECIFICATIONS
- MINTMARKS

Discovery Vault

- DOWNLOADS

About the Mint

- PRESSROOM
- DIRECTOR'S OFFICE
- HISTORY
- FUN FACTS
- JOBS

Figure 5. A Web site with ample breadth on the home page (<http://www.usmint.gov>).

Web site’s hierarchy or, in the case of a large Web site, is located at a still deeper level. Moving this node near the top of the hierarchy for better access would disrupt the overall logic of the hierarchical organization. A better plan is to provide a shortcut link from the home page to the important node. A designer should seriously consider adding a shortcut link when server logs or other forms of user feedback show many users working their way down to a particular lower-level node or when a node that should be visited seems to be missed by most users.

The designers of the Port of Seattle Web site (Figure 7) have used shortcut links (shown in the box in the upper left corner labeled “Latest News”) to provide direct access to three timely topics: construction projects, the newsletter, and Y2K issues. Users can also reach this content by navigating down the hierarchy. Rossi, Schwabe, and Lyardet (1999), in their article on design patterns on the Web, have named this use of shortcut links the “News” pattern.

Systematic secondary links Systematic secondary links connect a group of closely related nodes. Very often these are sibling nodes. So, for example, a designer may believe that users who choose the Products branch and then choose the node for a particular product may also be

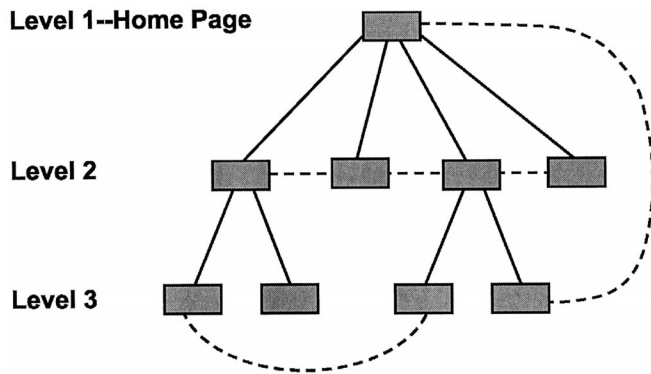


Figure 6. The primary links are shown with solid lines. Three kinds of secondary links are shown in dotted lines: a shortcut link from Level 1 to Level 3, an associational link connecting two nodes on different branches at Level 3, and a group of systematic secondary links connecting siblings at Level 2.

interested in the company’s other products. This designer, therefore, would connect all the product nodes with a set of systematic secondary links.

Secondary links, however, make a Web site more complex. Designers, therefore, need to balance the value of adding more navigational freedom against a more cluttered and confusing interface. If each product was intended for a different market, there would be much less justification for connecting them with systematic secondary links.

Associational links Associational links are “one of a kind” links that designers build to connect related nodes. Very often

these associational links perform the valuable function of calling the user’s attention to a relevant node in a distant region of the hierarchy (or in another Web site). These links must be visually distinct from both the primary links and the groups of systematic secondary links. The more important the associational link, the more prominent it should be on the interface. (From a theoretical perspective, shortcut links can be regarded as a kind of associational link.)

2.3 Allow branches of a hierarchy to converge—when appropriate.

Key points

- ◆ Allow branches of a hierarchy to converge on a single node when the node fits logically under two (or more) branches and you anticipate that large numbers of users will look for it in both places.
- ◆ When the basic structure of a Web site is a strict hierarchy, limit the use of converging branches so as not to obscure the user’s perception of the hierarchical structure.
- ◆ For large, complex Web sites (in particular e-commerce sites), it is often useful to allow branches to converge in an extensive and systematic manner with many nodes appearing at the bottom of multiple overlapping hierarchies.
- ◆ Write nodes in converging branches in a modular style so that they fit the context of both branches.

As noted in Guideline 2.2, one way to add navigational freedom to a strict hierarchy is to add secondary links. Another technique is to allow branches of a hierarchy to converge on a single node. This is distinct from building secondary links, for the node is the child of two converging



Figure 7. A group of shortcut links (<http://www.portseattle.org/seatac/default.htm>).

primary links. We distinguish below between small- and large-scale convergence of branches.

Converging branches on a small scale This technique is usually employed when one node or just a few nodes in an otherwise strict “tree” hierarchy fit logically under two or more branches so that some users will look for the node under one branch while others will look under another branch. Rather than frustrate half the users, the designer can place the node under both branches. The node, however, must be written in a highly modular manner; it must fit the context established by each branch.

In the (hypothetical) municipal Web site depicted in Figure 8, some users are apt to look for information about the Old MacKenzie Homestead on the Parks and Recreation branch and others on the Historic Preservation branch.

It is important to note that the use of converging branches obscures the user’s perception of the fundamental hierarchical structure. This technique, therefore, should be used sparingly.

Converging branches on a large scale In many Web sites, branches converge in an extensive and systematic manner with many nodes appearing at the bottom of multiple overlapping hierarchies. Often designers must provide multiple views of the same content to support different user tasks. For example, a Web site promoting a conference might invite users to access information on the presentations by subject area, speaker, level of sophistication (novice, intermediate, advanced), or time schedule. Similarly, an online clothing store may have a set of links for clothing types that converges systematically with links for brands. A customer, then, can find all the skirts, dresses, and blouses designed by Donna Karan. Likewise, an online bookstore will let users find books by title, author, subject matter, and perhaps other categories as well. From the design perspective, it does not matter that in these large e-commerce Web sites pages are generated from databases as users invoke them. Navigation and the user’s perception of structure are independent of the underlying Web technology.

There is solid theoretical basis for converging branches. Conklin (1987) notes that while hierarchical organizations are the result of “a few specific criteria,” a “solution to this dilemma is to allow the information elements to be structured into multiple hierarchies . . .” (p. 35). Similarly, Shneiderman and Kearsley (1989) point out that while strict hierarchies limit navigation, converging links provide “a much richer network of relationships” (p. 7).

2.4 Design the interface to readily reveal the underlying information structure.

Key points

- ◆ The interface should help users build a mental map of the node-link structure of the site.

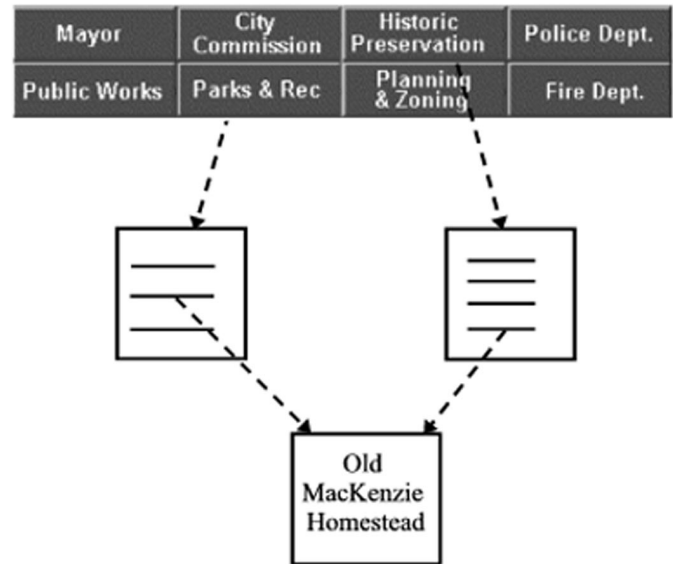


Figure 8. A node that can be accessed by two converging branches.

- ◆ On the home page, the links to the main branches of the hierarchy (primary links) should be prominent. Shortcut links and links to utility nodes (such as help and search) should be easily distinguishable from the primary links.
- ◆ On lower-level pages, the interface should enable users to readily distinguish links to the next level down in the hierarchy from various kinds of secondary links.
- ◆ Highlighting and markers in navigation bars and columns allow users to visualize the location of the current node in the hierarchy.

Web sites employ many interface features to support efficient navigation. These include navigation bars and columns, multi-level tables of contents, and systems of tabs. Whatever design choices are made, the goals should be to provide navigational freedom (discussed in Guidelines 2.2–2.3) and to enable the user to build a conceptual map of the nodes and links. That is, the interface should suggest the Web site’s underlying information structure. The information structure, in turn, helps users better understand the relationships among the ideas that appear on the various pages of the Web site.

This is not to say that users will necessarily care about the underlying structure; often they opportunistically look for promising links and click. On the other hand, users very often have a flawed or fuzzy understanding of a Web site’s domain, and the information structure clarifies categories and relationships in the domain. For example, high school seniors exploring the Web site of a large university may not

grasp the relationship among degree programs, colleges, and departments but will more likely succeed in reaching desired destinations if the interface reveals the way universities and university Web sites are organized.

Drawing on principles of cognitive psychology, Leslie Whitaker (1998) notes the need for “situational awareness” for successful navigation in the physical world and in the digital world. Situational awareness can be defined as the “continuous extraction of environmental information, integration of this information with previous knowledge to form a coherent mental picture, and the use of that picture in directing further perception and anticipating future events” (p. 65).

Along similar lines, George Furnas (1997) argues that users need a broad view of what lies ahead if they follow a certain pathway through a Web site. In addition to understanding the immediate destination of a particular link, users need a glimpse of what lies beyond that node, what options become available to them by following that pathway. “It must be possible somehow to read the structure to find good paths; the structure must be *view navigable*” (p. 371). In other words, every node should have a “residue” or “scent” throughout the site.

Revealing structure on the home page The home page (or, in other words, the top node of the hierarchy) is a special case in regard to navigation. All links on this page point “downward,” deeper into the hierarchy. The designer’s job, therefore, is to be sure that the interface reveals the different categories of these links.

Many of these links will be the entry points to the main branches. These should be prominent links. Note also that the semantics of the link text will be broad categories (for example, “Products”). Some links on the home page, however, will be shortcut (secondary) links that point (with more specific text semantics) to pages deeper in the hierarchy. The shortcut links should be readily distinguishable from the main-category (primary) links.

Another category of links are those that point to utility nodes. Utility nodes include the help page, the site map, and the search page (if it requires a dedicated page). In an e-commerce Web site, the “shopping cart” icon pointing to the checkout page (or pages) is another utility node. Links to utility nodes are usually repeated on all Web pages. It is useful to group utility links and separate them visually from the main-branch links and the shortcut links. Utility links usually take the form of icons that appear in a navigation bar located in the same place on each Web page.

Revealing structure on lower-level pages Lower-level pages are more complex than the home page. Especially in large Web sites, it is necessary to ensure that users can readily distinguish links to the next level down in the



Figure 9. A Web interface that does not clearly reveal the underlying information structure (<http://www.microsoft.com/kids/freestuff>).

hierarchy from various kinds of secondary links. The secondary links may include shortcuts to still deeper levels in the hierarchy and systematic secondary links, often located on navigation bars and columns, that provide lateral linking to sibling nodes or upward linking to the aunts (and parent) of the current node. Furthermore, there are associational secondary links that can point anywhere in the hierarchy as well as links to utility nodes. Note that on lower-level pages, the semantics of the link text will express all degrees of generality and specificity.

In the Web site shown in Figure 9, it is not immediately apparent that My Personal Tutor and the other products listed in the navigation column on the left belong to the Featured Products branch rather than to the Free Stuff branch. From the visual treatment, one might assume that there are just two branches on the navigation column: Free Stuff and Special Offers. In fact, Featured Products represents a third branch, but because the text is not hot, it has been given a different visual treatment. This leads to confusion. Is My Personal Tutor free? A further problem is that the “star” motif confounds the Featured Products and Free Stuff categories. One solution would be to move the Free Stuff button below the list of featured products. (In addition, the Kids Home text link should be visually distinct from the Featured Products links.) Users can ultimately figure out what is being offered as a free download and what isn’t. But the interface should better reveal the underlying information structure.

Another technique for revealing the structure to the user is to provide highlights or markers on the navigation



Figure 10. The reverse-out on the navigation bar indicates that the user is in the women's clothing branch, the triangular marker on the second-tier navigation bar indicates the lower-level branch for sweaters, and the triangular marker on the navigation column indicates spring cardigans (<http://www.gap.com>).

bar or column that allow users to visualize the location of the current node in the hierarchy (see Figure 10).

3 PROVIDING ORIENTATION INFORMATION

As noted previously, there are two aspects to following a link: departure and arrival. In Topic 1 we discussed how the designer supports the user's departure. Here in Topic 3 we offer two guidelines that focus on supporting the user on arrival at the new destination.

3.1 Provide clear, brief, and highly conspicuous orientation information on the home page.

Key points

- ◆ To become properly oriented to an unfamiliar Web site, the user needs to know the name of the site, the general purpose, and the sponsor. If the purpose and sponsor are clear from the context, this information does not need to be explicitly stated.
- ◆ Orientation information must be conspicuous. It should not be overshadowed by other elements, including advertising banners.
- ◆ Orientation information on the home page of a subsite should make clear the subsite's identity and purpose, and the relationship of the subsite to the main site.

It is natural to provide identifying information on the home page of a Web site. This is much the same as putting the title and author's name on the cover of a book. The importance of orientation information in text comprehension has been established by Bransford and Johnson (1972) and others. See the article by Spyridakis in this issue for

further discussion of orientation information and text comprehension. We now consider how orientation information supports Web navigation.

Although links are designed to indicate their destinations (Guideline 1.3), Web users often wish to confirm that they have indeed followed a relevant link (or else determine that the site is *not* relevant). Every Web user has followed many vague or misleading links to unwanted destinations, especially links generated by Web search engines. Therefore, unless the user is already familiar with your site, he or she arrives without complete confidence that the site will be relevant. The orientation information identifies the site and makes clear its purpose.

In general, what the user needs to know is the name of the site, the general purpose, and the sponsor. Not all this information needs to be stated explicitly. For example, Steinway, a world-famous brand, need only provide its corporate name in its familiar logotype (the visual representation of "Steinway") and most users, regardless of how they arrived, will recognize that they have reached Steinway's Web site and that the site is intended to promote Steinway pianos. Go Ask Alice (shown in Figure 11) is a well-known health-information resource for young adults. The phrase "Go Ask Alice," while engaging, does not itself reveal much information. But the purpose is readily apparent from the sponsorship of the Web site, presented in the tag line, and from the link labels making up the main branches of the hierarchy.

For information to fulfill the orientation role, it must be highly conspicuous—so that it is noticed immediately—and both brief and very clear—so that it may be processed



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Figure 11. Making clear the purpose of a Web site from the tag line and main links (<http://www.alice.columbia.edu/goaskalice/index.html>).

quickly. Prominent design elements such as banners, logos, and headings that carry orientation information are referred to as “identity elements.” One frequent design problem is that Web sites sell prime screen real estate as advertising space. So, for example, a gaudy advertising banner can overwhelm the site’s identity elements.

Another special issue is that many Web sites are comprised of semi-autonomous subsites. Jakob Nielsen defines a subsite as “a collection of Web pages within a larger site that have been given a common style and a shared navigation mechanism” (2000, p. 223). For example, the Web site of a university’s college of engineering is a subsite of the main university Web site. The home page of a subsite should not only make clear its own identity and purpose, but should make clear the subsite’s relationship to the main site and should normally link to the main site. Notice that Go Ask Alice, having a broad international audience, is not really a subsite of the Columbia University Web site.

Under special circumstances, designers may choose to withhold orientation information to establish a mood, or achieve a sense of drama or mystery. In such cases, the first page is often regarded as a preliminary “splash” page rather than the true home page of the Web site.

3.2 Provide orientation information on lower-level pages to support continued exploration of your Web site.

Key points

- ◆ Include the site name or logo on lower-level pages to maintain site identity.

- ◆ Use orientation elements to show differences among sections of the site while also providing continuity to the user’s experience.

We hope and presume that Web users will navigate from the home page of our Web site to lower-level pages. This further use of the site should also be supported by orientation information. For users who are navigating down from the home page, orientation information serves two roles:

1. Differentiating among sections of the site
2. Encouraging the perception of continuity from one page to the next

We should also remember, however, that some users will navigate directly to a lower-level page (bypassing the home page), especially when they follow a link from another Web site or from a search engine. For these users, orientation information on lower-level pages serves a different role: helping these users understand what site they’ve reached.

What elements provide orientation on lower-level pages? Logos and headings are among the most important orientation elements on lower-level pages, as confirmed by Omanon and others (1998). But we can also include any aspect of a Web site’s design that users can quickly process and use to make distinctions about difference and continuity.

In regard to showing difference, designers should help users recognize what level and what branch of the hierarchy they have reached. One common orientation strategy is to indicate the hierarchical level of Web pages by using a smaller and less visually dominant version of the same basic element at each successive level. So, for example,

third-level pages are apt to have smaller headings than second-level pages. The semantics of the headings on each branch should make clear which branch the user is on, but visual cues, such as color coding, can be used to reinforce these distinctions.

In regard to continuity, designers should employ certain design elements, such as a logo and recurring colors or fonts, throughout the site. The perception of continuity subtly reminds users what site they are in and assures them they haven't inadvertently followed an external link and left the site (something that happens often on the Web). Furthermore, the perception of continuity (as long as it does not become tedious uniformity) can be made aesthetically pleasing and promotes a more coherent experience. Finally, a designer can more readily show difference against the backdrop of recurring elements.

A user navigating from the NPR home page (Figure 12a) to the second-level "Inside NPR" page (Figure 12b) will experience both continuity and difference. The main identity element, the banner heading, is repeated on the second-level page, but in a smaller size. The layout of the left navigation column remains the same, but the buttons on the second-level page are blue.

4 AUGMENTING LINK-TO-LINK NAVIGATION

In addition to navigating with conventional links, Web users make extensive use of special navigation features built into their Web browsers. These include the Forward and Back buttons, the History button, and the Home button. There are, however, important features that can be provided by Web site designers to augment conventional link-to-link navigation. Of particular importance are site maps, the search and index features, and a link to the Web site's home page. A site map provides a visual map of the content and structure of the Web site as well as instant access to each node that is represented. The search facility and the index also provide instant access to nodes, although they do not offer a global view. Finally, the link to the home page serves the crucial role of enabling users to quickly get a fresh start navigating the hierarchy. Topic 4 offers guidelines pertaining to these special navigation features.

4.1 Employ site maps to show the global structure of a site and to provide direct access to nodes.

Key points

- ◆ Site maps should show all branches of the hierarchy, although space limitations may limit the number of levels that are displayed.
- ◆ Site maps are more effective when they include a "You are here" (or "Last page visited") marker.
- ◆ When designers face too many constraints—if, for example, a designer can build only a small, rudimentary site map for a large Web site—it may be best to forego the site map entirely.

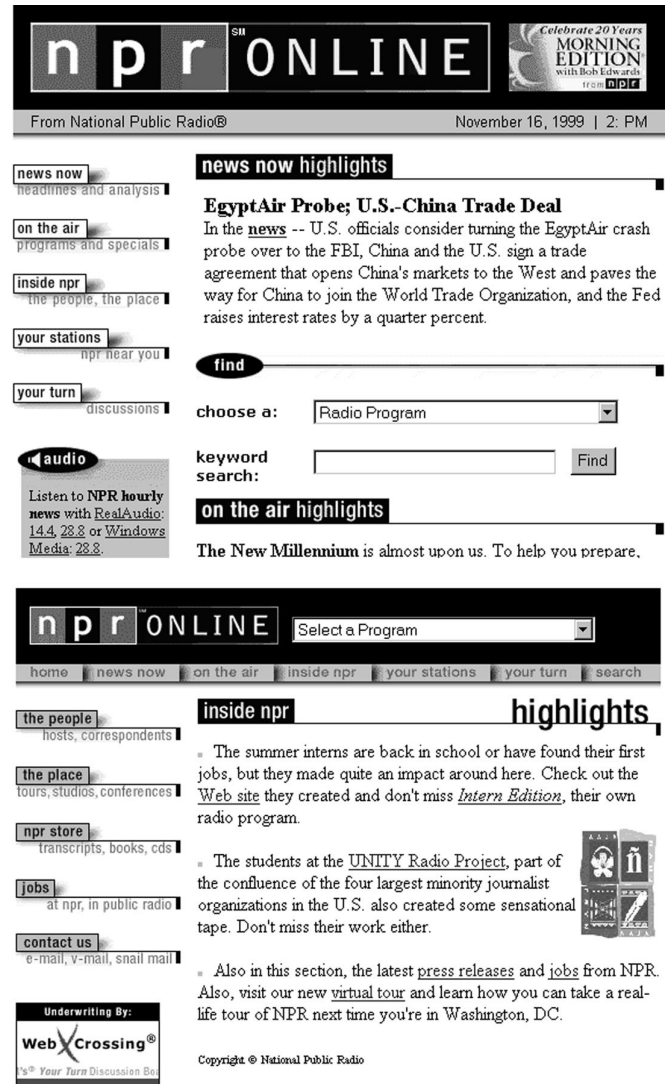


Figure 12 a and b. Figure 12a is the home page. Figure 12b, a second-level page, repeats elements from the home page but also employs differentiating design elements (<http://www.npr.com>).

As explained in Guideline 2.4, users should be able to build a conceptual map of the Web site they are navigating. That is, they should be able to grasp the underlying structure. This is one role of such interface elements as navigation bars, navigation columns, and systems of tabs. Site maps are intended to surpass other interface elements in this respect by displaying the entire node-link structure or, at least, a broad view of the node-link structure. For the



Figure 13. A site map that shows the second and third levels of the Web site hierarchy (<http://www.mgm.com/cgi-bin/cgi/sitemap.html>).

user, this global view is equivalent to perusing a city map rather than learning the layout of a city from a street view. Site maps, however, in contrast to maps of the physical world, are also global access devices: Once the user finds the desired destination on a site map, the user can get there with a single click.

Chen and Rada (1996) provide strong support for the use of site maps as part of their meta-analysis comparing and synthesizing 23 experimental studies of hypertext. They conclude that “graphical maps that visualize the organization of hypertext have significant impact on the usefulness of a hypertext system” (p. 126). They also note that graphical maps help to reduce the impact of differing cognitive styles and spatial visualization abilities among users (p. 140).

There are various ways to enhance basic site maps. One enhancement, endorsed by Nielsen (2000), is to provide a “You are here” marker, similar to the markers found on physical maps displayed in public buildings and malls. (Because a site map page usually replaces any previously displayed Web page, such a feature would be more accurately called a “Last page visited” marker.) Bieber and others (1997) describe various innovative site map designs, including local views and zoom features that enable the user to switch between views and examine in greater detail the part of the site map of current interest.

Site maps do have inherent limitations. First, they are inconvenient. Users need to switch from their current

page to display the site map, much as travelers in the physical world need to focus their attention on a physical map. Second, the relatively small viewing area afforded by computer monitors usually forces designers to represent only the first few levels of a Web site’s hierarchy. Local views and zooming, however, would surmount this problem. Finally, because most Web sites are modified on a regular basis, Web site owners often call for rudimentary site maps to reduce the cost of updating them. Figure 13 shows a rudimentary site map that displays the second and third levels of the hierarchy. This site map is easy to update.

Site maps should realize their full potential as better display technologies, better technologies for automatically generating site maps, and easier ways of adding “You are here” markers and other enhancements are developed. At the present time, when designers face too many constraints—if, for example, a designer can build only a small and rudimentary site map for a large Web site—it may be best to forego the site map entirely.

4.2 Provide a search facility or an index for direct access to content.

Key points

- ◆ A search facility should be provided in all but very small Web sites.
- ◆ The size of the site, the way the information is organized, and the information needs of the user should



Figure 14. The input interface of a search facility that allows significant user control (<http://www.altavista.com>).

be considered when choosing a search engine and customizing the search interface for the site.

- ◆ The search interface should typically be configured both for users who simply type a word or phrase and for those who wish to formulate more complex searches. The interface, however, should be optimized for the kind of searches that will most often be performed.
- ◆ Search results should be listed in the most appropriate order and should provide enough information about each Web page for the user to differentiate successfully among the choices.
- ◆ A quality index is likely to give better results than a search facility, but indexes are expensive and difficult to maintain. Consider using an index when the Web site is relatively small and the content is stable.

A search facility and an index both provide powerful alternatives to link-to-link navigation. Except when a Web site is very small, a search facility is almost always a highly desirable feature. Gary Marchionini notes that information seekers “apply different mixes of analytical [search] and browsing strategies” and “although people have an inclination to browse, analytical strategies are more efficient in large document collections” (1995, p. 8). Nielsen (2000) has observed that more than half of all users are “search-dominant”—that is, they try to use search as their first information-seeking strategy. Indeed, the prevalence of very large Web sites may well be leading users to make greater use of search facilities.

Unfortunately, using a search facility is often a frustrating experience. One problem is difficulty using the search interface. Designers, however, can usually exercise significant control over the search interface by their choice of a search engine and by customizing the search engine’s interface for the site. Design the search interface with regard to the size of the site, the way the information is organized, and the information needs of the users. The search interface should typically be configured both for users who simply type a word or phrase and for those who wish to formulate more complex searches. Complex searches include choosing a search zone (a specific portion of the Web site that will be searched) and Boolean operators (words such as *and* or

or that logically connect multiple search terms). The interface, however, should be optimized for the kind of searches that will most often be performed. It is also important to provide help or explanatory text for the search engine’s more advanced features.

Figure 14 shows the AltaVista search interface. Users can select whether to search the Web or other parts of the Internet, and they can limit the results of a Web search to information written in a specific language. The interface offers tips on how to phrase a query using simple Boolean operators. There is also an advanced search interface that includes complex Boolean operators and an option for specifying particular media types.

Some highly sophisticated search engines employ a natural language interface so that users can type queries in standard phrases and sentences. Although users still need to formulate a search strategy, they are spared the complexities of learning and using special search syntax.

The results list is another area where we should focus our attention. Search results should be listed in the most useful order. Rosenfeld and Morville (1998) list these alternatives for sorting search results: order of relevance; alphabetically by title, author, or other field; and chronological order (p. 115). Furthermore, the results list should provide enough information about each Web page (without useless information) for the user to differentiate successfully among the choices.

Indexes differ from search facilities in that the user scans a list of index terms (organized alphabetically) rather than formulating a query. A quality index will provide multiple index entries—in particular, synonyms—for each Web page so that users can find the information they need whether or not they know the exact terminology used in the Web site. A quality index is likely to give better results than a search facility; however, because of the considerable effort that is required, indexes are usually considered too expensive and difficult to maintain except when the Web site is relatively small and the content is stable.

4.3 Provide a link to the home page throughout the site.

Key points

- ◆ With only occasional exceptions, provide a link from every page to the home page.



Figure 15. Both the logo and the “Home” button take the user to the IBM home page (<http://www.ibm.com>).

- ◆ A convention is emerging in which a corporate logo is recognized as a link to the home page. Follow this convention if you have confidence that your users are familiar with it.
- ◆ If your Web site is divided into one or more subsites, provide links from every subsite page back to the subsite’s home page. It is also desirable to provide a direct link from the subsite pages back to the home page of the main Web site.

It is good practice to provide a link from every page back to the home page. This link serves several purposes. If a user gets disoriented, the user may want to jump directly to the home page because it is a familiar location. Even if the user is not at all disoriented, the user may want to go directly to the home page to begin a new information-seeking task and navigate down another branch of the hierarchy. This link also serves the user who has followed a link from somewhere outside your Web site directly to a lower-level page and now wants to use the home page for orientation.

Bachiochi and others (1997) noticed that users made frequent use of links to a Web site’s home page. “Home is a very important concept. When evaluators became lost they typically returned to the home page to reorient themselves” (p. 5). Similarly, Spool and others (1999) found that users often returned to the home page to find a link even if the link was available on the current page. They hypothesize that “Starting from a known place may help keep users from getting lost, or at least that’s their perception” (p. 31).

There is an emerging convention that the corporate logo functions as a link to the home page. The IBM Web site, shown in Figure 15, takes a cautious approach by including a link labeled “Home” as well as the logo link. As the Web evolves and the convention becomes more established, the need for a separate Home link is likely to disappear.

When Web sites are divided into semi-autonomous subsites, designers should provide a link from each page on the subsite back to the subsite’s home page. It is also desirable to provide a direct link from each page on the

subsite back to the home page of the main Web site. Be sure, however, to make the destinations of the different home page links clear to the user.

QUICKLIST FOR WEB NAVIGATION

KEY CONCEPTS

Hypertext theory Hypertext theory helps us to understand Web site navigation and design. In hypertext theory, content is often envisioned as discrete chunks (nodes). Users follow links—they navigate—from one node to another. Each Web site can be considered a network of nodes and links within the vast network that makes up the World Wide Web.

Information structures Hypertext theory enables us to define various information structures, configurations of nodes and links. The main information structures are the linear and multipath sequence, the hierarchy, the web, and the matrix. By far the most prevalent structure is the hierarchy. There are, however, different kinds of hierarchical structures, and the other structures may be embedded within a hierarchical structure. These guidelines assume a hierarchically structured Web site.

Primary and secondary links Primary links define the main branches of the hierarchy and establish a strict, “tree-like” navigational structure. Greater navigational freedom can be added by allowing primary links to converge and by employing secondary links (shortcut links, systematic secondary links, and associational secondary links) to supplement the primary links.

1 DESIGNING AN EFFECTIVE LINK

1.1 Be sure that all links indicate that they are links.

Key points

- ◆ Well-established cues such as underlining and the raised “button” appearance should be used to indicate links. Do not use these cues for other purposes.
- ◆ Links can also be indicated by semantic meaning, layout, and formatting. These cues, however, are

less reliable and should be used with care.

- ◆ Graphics, other than icons, are usually not interpreted as links. A special cue, such as a text label, may be necessary to indicate the link.

1.2 Work to ensure that users will view and notice links.

Key points

- ◆ Avoid cluttered page designs that make links hard to see.
- ◆ Make sure the most important links appear high enough on the page to be visible without scrolling, regardless of the resolution of the user's monitor.
- ◆ When pages must scroll, provide visual cues to encourage users to scroll down to links that are below the scroll line.

1.3 Be sure that all links clearly indicate their destinations.

Key points

- ◆ Use layering techniques, such as adding supplemental text and mouse rollovers, when necessary to make the destination of text links clear.
- ◆ Use labels and mouse rollovers (created with an ALT tag) when necessary to clarify the destination of icon links. ALT tags are especially desirable because they can be recognized by text-only and text-to-voice browsers.
- ◆ Use link typing to indicate external links and links that initiate a process, such as opening a mail message window or starting a download.

2 MANAGING LARGE NUMBERS OF LINKS

2.1 Plan effective ratios of breadth and depth in Web site hierarchies.

Key points

- ◆ Within limits, it is best to favor breadth over depth in designing a hierarchy.
- ◆ To help users cope with breadth, consider grouping links under headings.

2.2 Supplement the primary links of a Web site with secondary links—when appropriate.

Key points

- ◆ Use shortcut links to provide quick access from the home page to important nodes located deeper in the hierarchy.
- ◆ Use systematic secondary links to connect a group of closely related nodes.
- ◆ Use associational links to indicate a special relationship between two nodes.

2.3 Allow branches of a hierarchy to converge—when appropriate.

Key points

- ◆ Allow branches of a hierarchy to converge on a single node when the node fits logically under two (or more) branches and you anticipate that large numbers of users will look for it in both places.
- ◆ When the basic structure of a Web site is a strict hierarchy, limit the use of converging branches so as not to obscure the user's perception of the hierarchical structure.
- ◆ For large, complex Web sites (in particular e-commerce sites), it is often useful to allow branches to converge in an extensive and systematic manner with many nodes appearing at the bottom of multiple overlapping hierarchies.
- ◆ Write the nodes in converging branches in a modular style so that they fit the context of both branches.

2.4 Design the interface to readily reveal the underlying information structure.

Key points

- ◆ The interface should help users build a mental map of the node-link structure of the site.
- ◆ On the home page, the links to the main branches of the hierarchy (primary links) should be prominent. Shortcut links and links to utility nodes (such as help and search) should be easily distinguishable from the primary links.
- ◆ On lower-level pages, the interface should enable users to readily distinguish links to the next level down in the hierarchy from various kinds of secondary links.
- ◆ Highlighting and markers in navigation bars and columns allow users to visualize the location of the current node in the hierarchy.

3 PROVIDING ORIENTATION INFORMATION

3.1 Provide clear, brief, and highly conspicuous orientation information on the home page.

Key points

- ◆ To become properly oriented to an unfamiliar Web site, the user needs to know the name of the site, the general purpose, and the sponsor. If the purpose and sponsor are clear from the context, this information does not need to be explicitly stated.
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Key points

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- ◆ The size of the site, the way the information is organized, and the information needs of the user should be considered when choosing a search engine and customizing the search interface for the site.
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- ◆ Search results should be listed in the most appropriate order and should provide enough information about each Web page for the user to differentiate successfully among the choices.
- ◆ A quality index is likely to give better results than a search facility, but indexes are expensive and difficult to maintain. Consider using an index when the Web site is relatively small and the content is stable.

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- ◆ A convention is emerging in which a corporate logo is recognized as a link to the home page. Follow this convention if you have confidence that your users are familiar with it.
- ◆ If your Web site is divided into one or more subsites, provide links from every subsite page back to the subsite's home page. It is also desirable to provide a direct link from the subsite pages back to the home page of the main Web site. **TC**

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