An Overview of ergosoft's Mental Modeling Method

Carol Adams and Jim Kleiss
ergosoft laboratories, inc.
3432 Greystone Drive, Suite 200
Austin, Texas 78731
512.372.8684 or info@ergolabs.com

Over the last several decades, human factors research has shown repeatedly that the organization of information in a user interface, or "information architecture," is a critical factor in usability. An unintuitive organizational structure makes it difficult for users to find information and impairs their ability to navigate effectively within the information space. The use of the information space seems difficult to them and they perceive the product or website as less useful as well as less easy to use. Items and functions of key interest to developers and marketers are often overlooked completely. Consequently, even products which are usability-tested and attempt to follow other user-centered design practices can emerge from development with significant usability flaws.

Problems with a product's information architecture are especially serious because they are generally difficult to fix after code development is well underway. A good analogy is that the information architecture provides the same sort of "floor plan" for a website that an architect's blueprint provides for a house. It is easy to change the blueprint before construction begins, but moving the kitchen from one side of the house to the other after the plumbing has been put in or deciding to add a second story after the first story has been framed are generally not economically feasible changes for the home builder. Similarly, significant changes to a website's information architecture late in the development cycle are generally not economically feasible for product developers.

The solution to this problem is to work from the beginning to make the information architecture fit the way the user thinks about the information space and available functionality. This can be accomplished through the use of "mental modeling" techniques, which are a family of formal methods borrowed from cognitive psychology. Mental modeling methods make it possible to identify the natural organizational structure for a product based on data users provide, prior to beginning user interface design.

Mental modeling techniques must use indirect methods because users are not able to reliably articulate meaningful relationships among the elements in a product's information space. **ergosoft's** method begins by presenting users with a set of information items representing the content available in the product's information space and asking users to make judgments about the relatedness among the items. The judgment data are then analyzed statistically to produce a representation of the user's mental model of the information space from which the items were drawn. The analysis yields a grouping structure in which conceptually related items are positioned near one another in the information space and items that are conceptually unrelated are positioned farther apart. This mental model forms an information architecture specification for a product which feels natural to users and is therefore easy for them to navigate within and use.

An information architecture developed using this method can be expected to significantly enhance information retrievability, within-site navigation, and perceived ease of use. Further, **ergosoft** has observed in several website usability studies that ease of navigation also affects the perceived usefulness of a site: users rate easily navigated sites as more useful as well as easier to use. Clearly, perceived usefulness is key to repeat visits and sustained use.

It should be noted that mental modeling studies do not and should not replace product usability tests. To return to the home building analogy, mental modeling studies merely provide a way to make the floor plan more likely to fit the needs of the human inhabitants of the home without expensive follow-up remodeling projects.

While an intuitive information architecture is a necessary precursor to good product usability, it is not sufficient by itself. As implementation choices are made - such as what types of user interface controls represent what kinds of functions, what terms are used to name these functions, and what specific interaction sequences are required of the user - these choices should be usability-tested, and the results of these usability tests should be fed back to development to improve the usability of the final product.

Statistical Analysis Overview

The basis of our method is psychological similarity data that are obtained by having people judge the degree of relatedness they perceive among a set of items. Relatedness is determined by having them sort the items into groups based on perceived similarity. Perceived similarity among items is treated as a measure of psychological distance.

The data are derived by assigning a value of 0 to every pair of items that are sorted into the same category. A value of 0 indicates high similarity and small distance. Every pair of items that are sorted into different categories is assigned a value of 1, indicating low similarity and large distance.

The matrices for individual users are summed to produce a group distance matrix. The largest value occurs if no user ever grouped a given pair of items together; this maximum value is equal to the number of users in the sample. The smallest value (0) occurs if all users grouped a given pair of items together.

The group distance matrix is submitted to cluster analysis, which computes distances among all the items based on the similarity data and links the two most similar items together to form a single item or cluster. It then recomputes the distances and continues linking the two most similar items at each stage of the process until all items have been grouped into a single cluster. The distances at which items are linked at each stage of the clustering process are examined to identify the point at which they begin to grow notably large. This indicates the point at which clusters have become conceptually dissimilar to one another. The number and composition of the clusters present at this point are optimal for consistency with distinctions that are psychologically meaningful to users.

The end result is a set of clusters that partitions the information space into conceptually distinct units. The items within each cluster (or unit) are optimally conceptually similar, but the clusters are optimally conceptually different from one another.