Utility, Usability and Likeability: Dimensions of the Net and Web

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Abstract: The explosive growth of the Internet and World Wide Web are well substantiated. The growth has no central origin but is a distributed social phenomenon emerging from the independent perceptions of many individuals and communities that the net and web have a high utility in attaining their objectives. However, the very loosely coordinated growth of net technologies have led to significant human factors problems, and modeling diffuse communities interacting through the net requires new human factors methodologies and theories. This article analyses the human factors of the net and web in terms of the standard dimensions of utility, usability and likeability.

1 Introduction

Shackel (1991) factors human factors issues along three major dimensions:-
- *utility*—will it do what is needed functionally?
- *usability*—will the users actually work it successfully?
- *likeability*—will the users feel it is suitable?

Shackel measures usability on four dimensions:
- *effectiveness*—performance in accomplishment of tasks—the access to potential utility
- *learnability*—degree of learning to accomplish tasks—the effort required to access utility
- *flexibility*—adaptation to variation in tasks—the range of tasks for which there is utility
- *attitude*—user satisfaction with system—the manifestation of potential likeability

In applying this analysis to the net and web one has to take into account that *utility* in a collaborative environment is not just for individual users but for communities. For example, the *accessibility* of a system to all members of the relevant reference community is a utility consideration. One has to take into account that *usability* is not intensionally defined in terms of compliance with human factors guidelines, but rather extensionally defined in terms of evidence of a high proportion of effective users. *Likeability* is a critical factor to user adoption of a technology, particularly in a competitive market place, but it is sometimes taken as a "subjective" dimension not subject to formal modeling. Trevino and Webster (1992) developed a formal model of likeability in the context of computer-mediated communication (CMC) using Csikszentmihalyi's (1990) concept of *flow* underlying the psychology of optimal experience, and Hoffman and Novak (1995) have recently applied it to the analysis of marketing through the web.

It is important to analyze the utility of a technology before one considers its usability. The analysis of what is "needed functionally" is fundamental to understanding the problems users have in fulfilling that need. The utility of email, for example, often appears so obvious that human factors analysis focuses only on the user interface. However, a deeper analysis of needed functionality will reveal that the support of discourse through a textual medium with no voice intonation, body language, and so on, involves complex human factors (Walther, 1992; Spears and Lea, 1994). The fact that the computer interface itself does not specifically support the 'netiquette' (Shea, 1994) aspects of electronic discourse does not mean that it is a human factors problem that can be neglected in system design. Minimally, it draws attention to the need for user guidance or training, and technically it suggests that tools that evaluate email in terms of the emotional loading of the words involved might be useful to users. Human factors studies of the net and web have to analyze the social expectations of the community within which the communication takes place, and the users' objectives in communicating. The computer system has no technical 'understanding' of these issues, but they determine the utility of a computer-mediated system as much as the lower layers, and failure by users to conform with the cultural norms or express their intentions effectively is failure of usability as much as is pressing the wrong icon to send the mail.

Tracking the individual learning curves of the major technologies that comprise the infrastructure of information technology provides a more detailed account of the present and future state-of-the art of the technologies underlying convergence. The base technologies of digital electronics, general-purpose computer architectures, software and interaction are mature and provide solid foundations for *computer science*. The upper technologies of knowledge representation and acquisition, autonomy and sociality, support product innovation and provide the beginnings of foundations for *knowledge science*. Well's dream of a world brain making available all of human knowledge is well on its way to realization and it is in the representation, acquisition, and access and effective application of that knowledge that the commercial potential and socio-economic impact of convergence lies.

Acknowledgments

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2 A Layered Protocol Model of the Human Factors of the Internet

The human factors issues discussed above can be analyzed in terms of the layered protocol models which have been developed to provide a conceptual framework for complex systems of people and computing services (Gaines, 1988). Figure 1 shows a 6 layer model that partitions each sub-system, person or computing service, into:

- A *cultural* layer which encompasses the milieu of the community within which the system operates and influences user intentions;
- An *intentionality* layer which encompasses the objectives of the agents operating within the system;
- A *knowledge* layer which encompasses the overt background knowledge necessary to translate agent intentions into actions;
- An *action* layer which encompasses the skills or services of the agents as they translate intentions into actions and communications;
- An *expression* layer which encompasses the encoding of actions or communications into a specific sequence of discrete acts;
- A *physical* layer which encompasses the encoding of actions into physical effects.

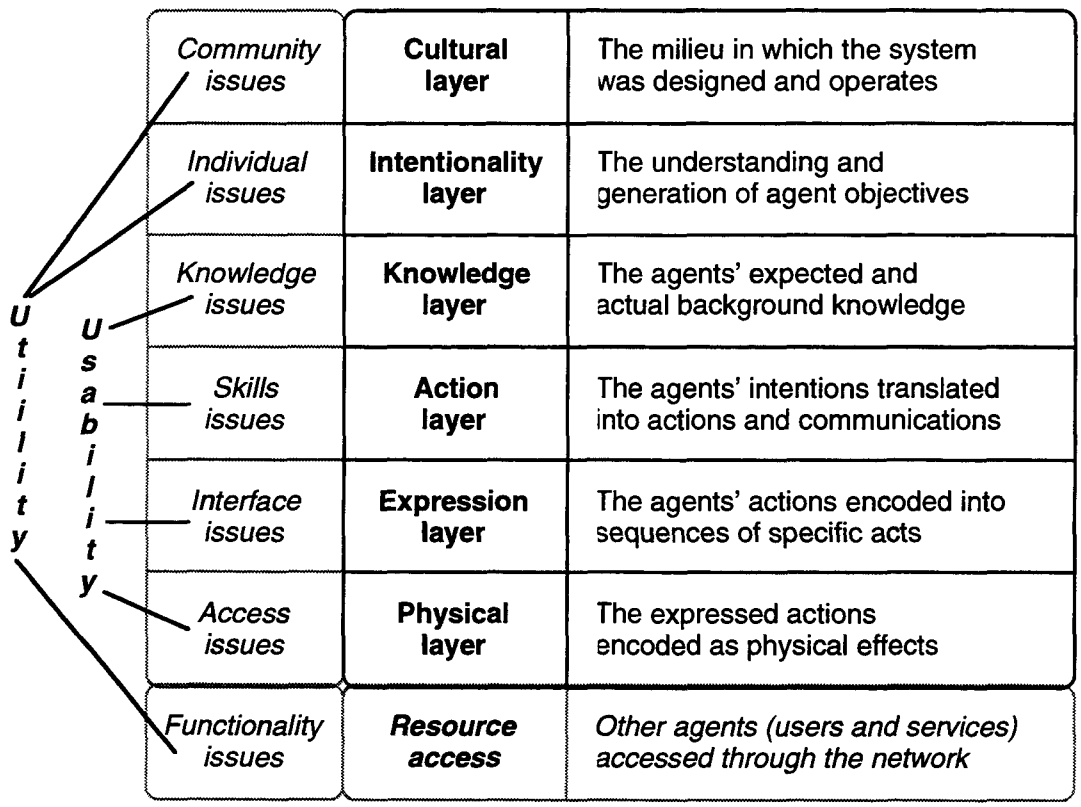

Figure 1 Layered protocol model for human-computer interaction

The action and expression layers are separated to allow actions to be conceptualized both as unitary abstractions and as the particular expression of those abstractions as a sequence of acts. For example auto-dialing may be conceived as a single psychological entity even though it may be expressed by a menu selection, dialog box click or command line text entry. The term 'agent' is used to cover both human users and computer services. At the current state of the art, the top three layers are design time considerations in developing computer services and only the three low levels are operational at run time, although the development of 'knowledgeable agents' as a computer technology is a major research area.

Multiple 6 layer models of users and 3 layer models of services may be combined to provide a model of a complex system in which users communicate with other users and services through a network at the physical layer, establishing 'virtual circuits' at the upper layers (Gaines, 1988). This is shown as "resource access" at the bottom of Figure 1 which subsumes the functionality that the agent can access through the network.

Shackel's *utility* can now be seen as an evaluation of the extent to which a user's intentions can be realized through processes accessing functionality available. For the net and web it is also appropriate to assess functionality in relation to a community's needs.

Shackel's *usability* can be seen as an evaluation of the extent to which users can translate their intentions into effective actions to access the functionality. It factors through 4 layers into:-

- Knowledge issues concerned with the background knowledge that the user has available through experience or training;
- Skills issues concerned with the user's capability to translate intentions into actions using the background knowledge as appropriate;
- Interface issues concerned with the facilities provide for the user to translate abstract actions into a sequence of acts;
- Access issues concerned with the provisions for the user to access the functionality specified through the sequence of acts.

Shackel's *learnability, flexibility and likeability* are non-functional aspects of usability that are manifest in each layer. Likeability is the least studied of the three because it has seemed a subjective matter with no behavioral model that can only be tested through questionnaire techniques. However, in recent years Csikszentmihalyi's (1990) concept of *flow* as the phenomenon underlying the psychology of optimal experience has been applied to modeling user satisfaction with CMC (Trevino and Webster, 1992). In their application of the model to flow phenomena in interaction with the web, Hoffman and Novak (1995) summarize the concept as:-

> *"Flow has been described as 'the process of optimal experience' achieved when a sufficiently motivated user perceives a balance between his or her skills and the challenges of the interaction, together with focused attention. Flow activities in the Web, specifically network navigation, facilitate concentration and involvement because they are distinct from the so-called 'paramount reality' of everyday existence."*

It is reasonable to propose that likeability correlates with a flow state in which a motivated user undertakes a task whose level of difficulty is at some particular level that suits their individual needs. Too low a level results in boredom and too high a level in anxiety, and the optimal level results in the intense satisfaction with the activity that Csikszentmihalyi terms flow.

In the flow model, likeability is not associated with a particular layer of the protocol but rather with the appropriate level of activity involving the protocol. This explains some of the paradoxical aspects of usability analysis—high usability does not imply high likeability, and many well-liked interfaces and systems are poor from a usability standpoint. From a flow perspective, a simple task which is boring through a highly usable interface may be enhanced in its likeability by decreasing the interface usability to present a greater challenge to the user.

Similar considerations apply to flexibility which generally increases utility but may decrease usability because it involves the use of the system in modes for which it was not designed. The dimensions of human factors evaluation are not monotonically related and there are generally trade-offs between them.

3 Defining Communities on the Internet and World Wide Web

The cultural layer at the top of Figure 1 itself requires partitioning when one considers the different forms of community supported through CMC. It is already been noted that at least three types of community need to be distinguished: the highly-coordinated, goal-directed *teams*; the more loosely coordinated *special-interest communities*, such as professional sub-disciplines; and the largely uncoordinated *Internet world at large* whose members have in common only the use of CMC. Figure 2 shows the layered protocol model extended to groups of agents grouped as specified.

For purposes of human factors analysis one needs a precise behavioral definition of these various form of community. How may they be differentiated conceptually and through empirical observation? One can regard a community as a set of individuals that provide resources to one another with the most significant dimension relating to the coordination of the community being that of the *awareness* of who is providing a particular resource and who is using it. In the tightly-coupled team, each person is usually aware of who will provide a particular resource and often of when they will provide it. In logical terms, this can be termed *extensional awareness* because the specific resource and provider are known, as contrasted to *intensional awareness* in which only the characteristics of suitable resources or providers are known.

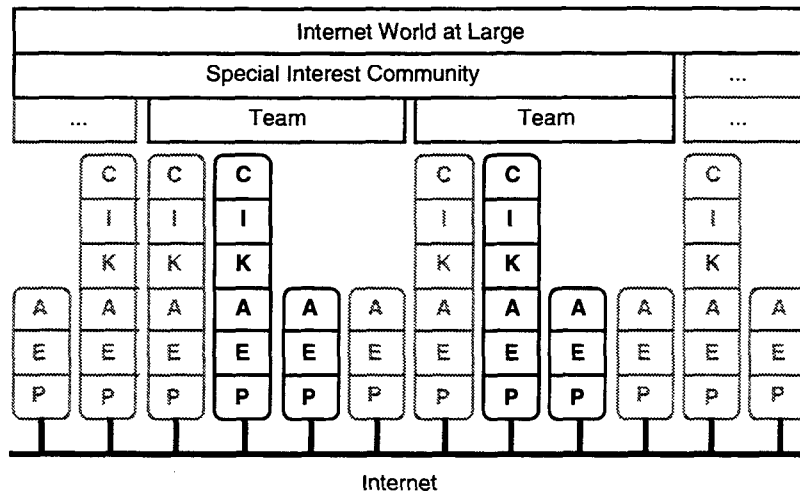

Figure 2 Communities within the layered protocol model
(3 layers represent computer services and 6 layers users, gray items represent an indefinite iteration)

A team can be treated from a *collective stance* (Gaines, 1994) as a single psychological individual that behaves as a compound role generated by the distributed activities of roles in a number of people. Each resource provider in a team has an *extensional awareness* of their actual resource users, and each resource user has an *extensional awareness* of the resource and who will provide it.

In a special interest community resource providers usually do not have such extensional awareness of the resource users, and, if they do, can be regarded as forming teams operating within the community. Instead, resource providers usually have an *intensional awareness* of the resource users in terms of their characteristics as *types* of user within the community. The classification of users into types usually corresponds to social norms within the community, such as the ethical responsibilities in a professional community to communicate certain forms of information to appropriate members of the community. Resource users in a special interest community may have an extensional awareness of particular resources or resource providers, or an intensional awareness of the types of resource provider likely to provide the resources they require. This asymmetry between providers and users characterizes a special interest community and also leads to differentiation of the community in terms of core members of whom many users are extensionally aware, and sub-communities specializing in particular forms of resource.

In the community of users at large, there is little awareness of particular resources or providers and only a general awareness of the rich set of resources is available. Awareness of the characteristics of resources and providers is vague, corresponding to *weak intensional awareness*.

These distinctions lead to human factors consequences in terms of the appropriate awareness mechanisms that need to be established on the network for the communities to function. In a team, resources may be identified precisely by location and name. In a special-interest community, resources may be identified by an intensional indexing scheme that classifies them in terms of the distinctions made by that community. In the community of users at large, resources may be identified both by indexing their content type using a wide variety of taxonomies and by indexing their actual content.

These distinctions are summarized in Figure 3, and it is clear that the classification of awareness can lead to a richer taxonomy of communities than the 3-way division defined. Analysis of awareness in these terms allows the structure of a community to be specified in operational terms, and in complex communities there will be complex structures of awareness. The coarse divisions into sub-teams and sub-special interest communities provides a way of reducing this complexity in modeling the community.

The differentiation of communities in terms of awareness draws attention to the significance of supporting various aspects of awareness in a CMC system. As noted above *resource awareness*, the awareness that specific resources or resources with specified characteristics exists, may be supported by various indexing and search procedures. However, there is also a need to support *chronological awareness* (Chen and Gaines, 1996), the awareness that a resource has changed or come into existence. These are major human factors issues in users coping with the net as a rich and rapidly changing system of resources.

	Team	Special-Interest Community	Community at Large
Resource Provider	Extensional awareness of actual users.	Intensional awareness of types of users.	No awareness of users, or only weak intensional awareness of types of users.
Resource User	Extensional awareness of actual resources and providers.	Extensional awareness of actual resources and providers, or intensional awareness of types of resources and providers.	No awareness of resources or providers, or only weak intensional awareness of types of resources and providers.

Figure 3 Communities distinguished by awareness

4 Dimensions of the Utility of the Internet and World Wide Web

In examining the utility of the net and web it is useful to classify all the major services in terms of the significant distinctions that determine their relative utilities as shown in Figure 4. It characterizes the major net services in terms of their utility for CMC, resource access or search. It sub-classifies CMC in terms of whether it is individual-to-individual discourse or community discourse; synchronous with the participants conversing in real time or asynchronous with substantial time delays in responses. It sub-classifies asynchronous community discourse by whether the channel is slow or fast, and whether the community is centrally registered or not. It sub-classifies resource access in terms of whether it is: a static resource or an interactive service; just fetched or presented when fetched; text or rich media. It sub-classifies search by whether it is: by resource name or content; by keywords or by change in contents; and whether the keywords are generated manually or automatically.

The major services classified are:-

- *Talk*, the facility for one user to send a message directly to the terminal of another user. This provides individual, synchronous computer-mediated communication.
- *Email*, the facility for one user to send a message to the mailbox of another user. This provides individual, asynchronous computer-mediated communication.
- *Internet Relay Chat (IRC)*, the facility for a user to join a chat group and send a message directly to the terminals of the group. This provides community, synchronous computer-mediated communication.
- *News*, the facility for a user to mail a message to a registered newsgroup archive and to access messages in the archive. This provides community, asynchronous computer-mediated communication. Because the archives are maintained on a local server and updated through a chain of servers the updating is slow, possibly taking several days.
- *List Server*, the facility for a user subscribe to a list server and mail a message to it which it mails to all members on the list. This again provides community, asynchronous computer-mediated communication. Because the mailing to the list is fast (except for moderated groups where the mail is manually checked), list servers provide more interactive discourse than news groups. However, the registration of news groups makes them easier to discover, and, for high-volume discourse, users may prefer that it is not posted to their mailbox.
- *Multi-User Dimension (MUD)*, the facility for a user to 'enter a dimension', communicate directly with others there, and leave and retrieve documents. This provides community, computer-mediated communication and text resource access.
- *Gopher*, the facility for a user to retrieve a text document from a hierarchically structured archive.
- *World Wide Web file access*, the facility for a user to retrieve multi-media documents from an archive through hypertext links embedded in the document.
- *Telnet*, the facility for a user to interact with a remote machine through a console window providing a command line interface. This provides remote interactive access to services based on text.
- *World Wide Web service access*, the facility for a user to enter information into an HTML form and transmit it to a remote server. This provides remote interactive access to services based on rich media.
- *File Transfer Process (FTP)*, the facility for a user to retrieve a file by site and name. This provides general file access but FTP clients generally lack the capability to present the files retrieved.
- *Internet Address Finder*, a service for a user to search for the email address of a person by their name. One of the problems of the net is the lack of an overall directory of users.

- *LISZT*, a service for a user to search for a list server by its name. This attempts to overcome the problem that there is no central directory of list servers.
- *Archie*, a facility for a user to search the net for files by name. This provides search facilities for files with known names.
- *Yahoo*, a facility for a user to search the net for resources by name and key word through a manually entered classification. This provides search facilities for resources specified by their name or type.
- *Alta Vista*, a facility for a user to search the net for resources by content. This provides search facilities for resources with specified content.
- *CHRONO*, a facility for a user to search a site through a list of changed resources in reverse chronological order. This provides search facilities for resources by recency.

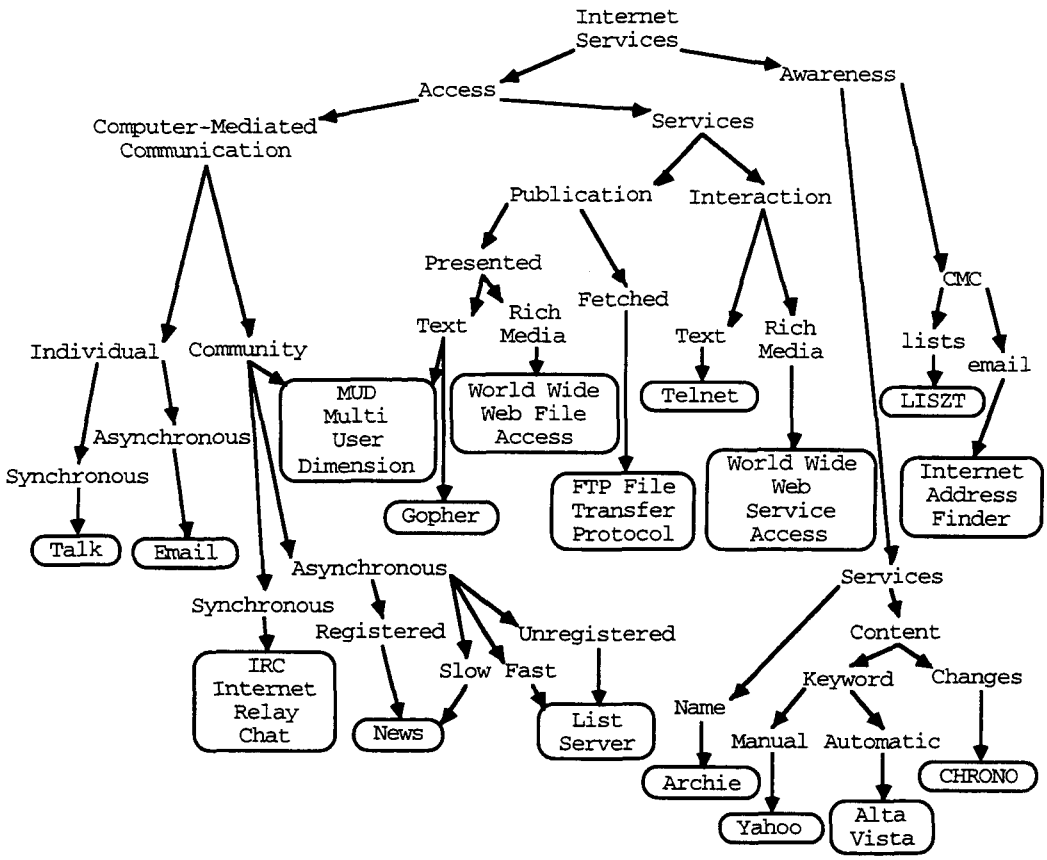

Figure 4 Distinctions characterizing the utility of various Internet services

5 An Example of a Usability Bug—Replying to a List

Significant usability problems have arisen in existing Internet technology. For example, a usability problem has been introduced into the operation of list servers by the use of email browsers to access them. Because of the length and complexity of the information, mail browsers generally show only abbreviated headers which are adequate for normal mail but problematic for mail from list servers. This is because the servers use a simple trick to allow a reply to a message from the list to be addressed to the list rather than to the originator. The Internet mail protocol allows both a "From:" field and a "Reply-To:" field to be specified in the mail header. In normal mail usage the "Reply-To:" field is absent and a reply is sent to the address in the "From:" field. In list servers the "From:" field is filled with the originator and the "Reply-To:" field is filled with the list server address so that replies go to the list. However, email browsers generally show the "From:" field as the origin of the mail, and it appears to the user as if they are replying to the individual who sent the mail to the list. This often leads to embarrassingly personal messages intended only for one person being mailed to the entire list. It would be better if email browsers were configured to show the "Reply-To:" field in preference to the "From:" field, perhaps indicating that the "From:" field is different.

Some list administrators set the "Reply-To" field to be the originator to avoid this problem, but this reduces the usability of the interface since most replies are intended for the community, and having to enter the list server address in a reply is an impediment to spontaneous discourse. Some list administrators overcome the problem by "moderating" their lists and examining each item of mail before authorizing it to go to the list. This is again a serious impediment to discourse since it introduces delays, taking the list turnaround time from minutes to days.

The usability problems created by email browsers' failure to represent the "Reply-To:" field adequately, and by attempts to fix this, may be seen as a conflict between the *knowledge* and *skills* layers in the layered protocol model. The user is required to disrupt the skilled activity of discourse by a knowledge-driven override. Email discourse is similar to vocal discourse in that when a person receives a message they may instantly conceive a reply. The emission of the reply vocally is mediated automatically without disruption of the chain of consciousness framing the reply. Hitting the "Reply" key in an email browser is a similar subconscious reaction made automatically without disruption of the process of composing a reply. However, having to remember or ascertain whether the reply is going to the originator or the list, and manually fix the address if it is not what is wanted, disrupts the composition of a reply.

The problems may also be seen as arising from the *flexibility* of the email browsers which enables them to be used as list server browsers. Flexibility is generally positive for utility because it widens the range of applications, but it is often negative for usability in that it involves operating the system outside the range of situations for which it was designed to be usable.

6 Conclusions

This article presents a framework for representing and analysing the human factors of the Internet and World Wide Web that applies the classical analysis in terms of utility, usability and likeability to the social environment of the net and web. A layered protocol model introduces a spectrum of distinctions ranging from culture through knowledge and action to physical access. Various forms of community are defined operationally in terms of types of awareness between resource providers and users. The dimensions of utility are used to provide a taxonomy of Internet services. Paradoxical trade-offs between utility, usability and likeability are illustrated as are some usability problems of existing Internet services.

Acknowledgments

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