A Delphi Study Of Web-Enabled Technologies: Identification And Prioritization Of Critical Issues

Mehdi Khosrow-Pour, Penn State University at Harrisburg
Nancy Herman, Penn State University at Harrisburg
Girish Subramanian, Penn State University at Harrisburg
Mohammad Dadashzadeh, Wichita State University

Abstract

The role of the Internet as an enabling technology is critical to the strategic planning of national and local governments, educational institutions, hospitals, manufacturing as well as non-manufacturing companies, and increasingly, for small organizations as much as for larger ones. Like other technologies, the path to effective assimilation of Internet-based technologies has not been free of problems and challenges. This paper presents the results of a Delphi study to identify and rank critical issues for effective deployment of Internet-based technologies in organizations. The critical issues identified in this study provide valuable insights for formulating strategies for the overall utilization and management of Web-enabled technologies in organizations.

Introduction

*I*n the 21st century, IT industries will undoubtedly drive economic wealth. The innovations developed, and yet to be developed, by the computing, telecommunications, and consumer electronics industries will affect every organization and dramatically change our lives. Nothing can illustrate this emerging transformation better than the Internet.

Today, the Internet has made information a commodity. The ease of access typified in using a browser and the World Wide Web has led to the emergence of the corporate intranet as the preferred method of accessing corporate data. The Internet has changed television viewing habits replacing it in part with time spent surfing the Web, and, as such, has redefined advertising media and reach. The voracious demand for Internet access, in turn, has created a pull for changing size, shape, and capacity of computers. And, more importantly, the Internet has been changing our definitions of commerce and competitive advantage.

It is therefore not surprising that "the surge of interest in the World Wide Web with its potential commercial payoff has resulted in an explosion of information as organizations join in to publish and do business on the Internet" (Foo and Lim, 1997). Accompanying this surge is the emergence of socio-technical issues that warrant research and discussion. Roush (1995), as he likens the Web to a vast electronic mall, points out that "as the [Web] grows, it's encountering some very old-fashioned headaches: the mall's parking lot is full, pickpocketing is a constant hazard, and there's no directory for orienting oneself". Although this is a figurative descrip-

tion of some concerns, the language paints a vivid picture of important issues to be considered.

"The vision of the World Wide Web as a global computing platform is one aspect driving the evolution of the Web" (Berners-Lee, 1997). In a fundamental sense, the Internet is just a communication platform. Certainly, the concepts of being able to disseminate marketing information to a world-wide audience and to connect to the headquarters from constantly changing locations, as in the case of a traveling salesperson, are useful Web-enabled applications (Misic, 1994). But such utilitarian view only scratches the surface of the many emerging applications now enabled by the Web. Gardner (1997) observes "that a growing number of IT people are taking the lead" away from the marketing professionals. This is resulting in companies coming to the realization that the greatest payback will be in business processes and not simply in marketing brochures (Gardner, 1997).

Successful organizations are adopting and adapting the emerging Internet-based technologies to their own needs, answering business problems with solutions not even dreamed of only a few years ago (Prawitt & Romney, 1997). "Because of shifts in perception, the Web might finally become the glittering palace of information and electronic trading that some visionary industry pundits promised it would become as long ago as 1993" (Jacobs, 1998).

Misic (1994) believes that MIS needs to do more than simply provide access, but rather make access easy with complete support and a demonstrated value to fully utilize the vast collection of tools and services that the Internet has to offer. Trowbridge (1996) cites a report from Zona Research, Inc. which states that "the Intranet environment will prove far more commercially lucrative than the consumer Internet market, and they [Zona] expect the former to grow from approximately $4 billion in associated revenue to more than $31 billion in the next 3 years".

Clearly, the tidal wave, that is the Internet, will undoubtedly sweep every organization. as such, formulating an Internet and intranet business strategy must become an essential ingredient of strategic planning for every organization. To that end, it becomes especially important to identify and prioritize critical issues regarding utilization and management of Web-enabled technologies. This paper presents the results of a Delphi study conducted for this purpose. The Delphi technique provides a well-established methodology to elicit opinions and organize them using a panel of experts.

The remainder of the paper is organized as follows. A literature review provides a summary of the initial set of critical issues identified by the authors. The research methodology outlines the Delphi technique and the data collection approach. The results and discussion section presents the top ten critical issues identified through this research. Finally, conclusions and future directions for research are presented.

Literature Review of Critical Issues

As with any other technology, the Internet-based technologies present both opportunities and shortcomings that are better understood as the technology adoption phase accelerates. In order to clearly understand the total potential of these technologies, one must also assess their limitations, stipulations, and provisions in modern organizations. Among the many issues, problems and limitations of the Web-enabled technologies are:

Bandwidth Restrictions and Latency

The Internet backbone bandwidth, reflecting communication speed, is increasing at a rapid pace. Nevertheless, bandwidth will not be in unlimited supply. Despite increasing market penetration of high speed local loop technologies such as cable modems and DSL (Digital Sub-

scriber Line), a large percentage of the Web users run low-speed (56 Kbps) modems which in reality cause considerable delays in obtaining Web-based materials when the corresponding pages incorporate images, animation, and audio (Berghel, 1996 & Pitkow, 1996). A recent study by a popular server revealed that about 1 in 5 users were connecting with graphics turned off to eliminate the annoying latency of loading Web pages (Fox, 1996). Latency issues are also being experienced with some of the more popular Web sites. In this case, the slowness relates to the number of requests an individual Web server can handle at once (Roush, 1995). Since the Web has evolved into a multimedia intensive tool, gridlock has become an even bigger problem than it is for the other uses of the Internet.

Cyberloafing

Surfing the Internet wasting time and accessing inappropriate materials, which has been labeled as cyberloafing, is becoming an important concern for employers (Prawitt et al., 1997). Studies show that once users become more familiar with the Web, the cyberloafing practice becomes a common phenomenon (Hills, 1996 & Frook, 1997). Cyberloafing can also take place in a different form where users receive unsolicited messages about all kinds of decent and indecent offers. In this case, the user is not searching sites to explore; however, in the act of reading the unsolicited e-mail message he or she can be tempted to explore inappropriate materials through easily provided hyperlinks. In the latter case, when the cyberloafing takes place at work by an employee of an organization, besides lost productivity, there is also the liability concern if cyberloafing involves the downloading of indecent materials. These actions can create liability vis a vis allegations of "harassment", "free speech", "privacy", "jurisdiction", and even "copyright infringement" (Sampson, 1997).

Equity

Some have argued that the Web will bring forth a better democracy within the United States by returning the power to the people (Meeks, 1997). This may not come to pass if the issues of equity and demographic trends are poorly addressed. According to Pitkow (1996), of the users joining the Web, their estimated median income ($64,700 annually) is well above the national median of 36,950 as estimated by the 1993 U.S. Census and they are predominantly male (70%). Whether the explanations for the lack of utilization by some groups lie in the issue of availability, affordability, or usability remains a topic for additional research. However, all statistics clearly indicate that this technology is not equally utilized by all classes of the society in the U.S. as well as other countries. In the most recent version of the "Falling Through The Net," report available at www.ntia.doc.gov, in spite of governmental efforts on providing Internet access at schools and community centers, the *digital divide* had increased further between 1997 and 1998 in the United States.

Exposure Points

S more companies utilizing Web-enabled technologies incorporate the ability for remote access to their computer systems by their employees, there is a higher risk of information exposure (Prawitt et al., 1996). In other words, these emerging exposure points are inroads which can lead to sloppy data entry into the systems, as well as affording savvy hackers the opportunity to break into the systems where adequate control measures have not been applied.

Flooding of the Web with Content for Content's Sake

With the ease of access to the Internet and the availability of powerful Web development tools, there is an overabundance of *rich* pages on the Internet. Many of these *rich* pages, however, are information *poor*. Increasingly, organizations are beginning to view such content for content's sake as a wasteful exercise, and instead, are beginning to regard the organization's Website as a

means to facilitate business processes in marketing, production, logistics, and customer service (Gardner, 1997).

Inadequate Search Facilities on the WWW

Despite the many search engines sending their software robots to index the pages of the World Wide Web, much of the content on the Web remains unindexed. Inadequate search facilities and the lack of a high level query language for locating, filtering, and presenting WWW information remain important issues for effective use of the Internet (Foo et al., 1997). Some search engines search the document headers, some look for the document themselves, while others look for indices or directories. As a result, one can conclude that much of the information on the Web is accessible in a dynamic and a somewhat chaotic fashion. In a recent survey of Web users, 34.5% of the participants were not able to locate a site which was known to exist and 23.7% were not able to figure out how to return to a site that they had previously visited (Pitkow, 1996).

Maintaining the Integrity of Data

The task of keeping the organization's Website attractive and up to date is considered to be a costly issue facing many organizations. As a company's Website becomes more elaborate and complex, the task of maintaining and validating information included in the Website becomes much more costly and complex too. Ultimately, it could reach a point where maintaining and ensuring the accuracy of information becomes difficult (Foo et al., 1997). Inaccurate and out-of-date information included in the Website can contribute, in part, to poor decisions in the organization's business processes supported by the Website.

Security

The issue of Internet security is considered to be among the most important challenges faced by organizations as they Web-enable their business processes. Many security experts believe that the existing layers of security should be considered inadequate and, in some cases, fragile (Hodges, 1997). It is important to note, however, that security is a broad term. In some instances, the term security is related to privacy, while in other contexts the term refers to the integrity of data (Grimshaw, 1997). With the increasing use of the Internet for Electronic Commerce (EC), there are many serious efforts to address the challenges presented by the security issues and risks. Although there are perceived issues with security, especially related to EC, there is an unstoppable interest in utilizing the Web technology for EC (Liu et al., 1997).

System Incompatibilities

The issue of system incompatibilities has become an increasing concern as Internet growth outpaces standardization efforts. The incompatibilities between client-side scripting technologies such as JavaScript, VBScript, ActiveX and Java are a common source of annoyance as the supposedly browser-independent HTML language becomes more and more browser-dependent. The situation is worsened by the incompatibilities in streaming media standards as well as electronic payment systems. In many cases, cross-platform compatibility is not always available in all of the emerging technologies which can result in difficulty when trying to make them function in unison (Prawitt et al., 1997).

Unauthorized Use of Computer Resources

Today's emerging interconnectivity technologies have presented opportunities for computer misuse which were not previously possible (Prawitt et al., 1997). The Boeing corporation recently has begun reviewing the issue of URL filtering of objectionable material (Frook, 1997). According to the Computer Fraud and Abuse Act, computer usage in excess of one's level of authorization can result in personal liabilities for any harm caused (Sampson, 1997). Many com-

panies are finding that a best solution to this issue may not exist. For example, Boeing has decided that "restricting site access is a cumbersome management process, but unrestricted access to public Web sites could open the company up to legal issues" (Frook, 1997).

User Ignorance and Perceptions

The lack of adequate understanding of the Internet and its usage and risks has been a contributing factor in maintaining secure systems.

Modern information systems are comprised of many different components of distributed hardware, software, and data maintained on different locations by different systems. According to Prawitt & Romney (1997), while it is becoming increasingly critical for users to exercise sound control practices, most are not adequately trained to do so.

Web Performance Tracking

With the explosive growth of Web applica-

Table 1: *A Summary of Critical Issues of Web Technologies According to Existing Literature*

Issue	Brief Explanation
Bandwidth Restrictions and Latency	Low-speed data transition caused by slow communication device such as a modem.
CyberLoafing	Surfing the Internet, waiting time and accessing inappropriate materials.
Equity	Not equally utilized by all classes of society.
Exposure Points	Sloppy data entry as well as breaking into the system due to lack of adequate control measures applied at every remote control.
Flooding of the Web with Content for Content's Sake	Web sites that do not offer effective and useful information.
Inadequate Search Facilities on the WWW	Inadequate search facilities with lack of a high level query language for locating filtering, and presenting WWW information.
Maintenance and Integrity of Data	Keeping up with the task of maintaining and validating information included in Web sites.
Security	Treats risks and misuse of the system (e.g., e-mail risks, false store fronts, industrial espionage, information vandalism, ISP linkage alterations, viruses and Webware).
System Incompatibilities	Lack of available crossplatform compatible communication networks.
Unauthorized Use of Computer Resources	Use of the Internet resources for personal use.
User Ignorance and Perception	Lack of user understanding of security risks and control.
Web Performance Tracking	Keeping track of systems performance and effectiveness.

tions, services, traffic volumes and contents, a management void has been created. If the performance and availability of the Web services are not managed and information cannot be accessed quickly, it is likely the user will jump to a competitor's site which results in the loss of business (McConnell, 1997). "To achieve peak performance, the IT department must harmonize many critical elements, including the transport network, its Featured Sites service levels, Web server hardware and software, and the information content" (McConnell, 1997).

Research Method

To learn more about the critical issues related to the utilization and management of Web-enabled technologies modern organizations, a study was conducted. The Delphi method was utilized to assess the validation of the existing critical issues identified in the review of literature and to identify other critical issues.

In the early 1960s, RAND researchers Helmer, Dalkey, and their colleagues introduced the Delphi technique designed to improve the use of expert opinion through polling based on three conditions: Anonymity, Statistical display, and Feedback of reasoning (Bright 1972). The Delphi technique is an elegant intuitive method of developing a consensus. The technique is used in forecasting; however, it should not be considered a forecasting technique as it combines the perceived wants or needs of the participants in an attempt to predict what will be (Cetron, 1969). The method employs polling of participants for the systematic solicitation of expert opinion. The method is executed via a carefully designed program of sequential individual interrogations, typically by questionnaire, interspersed with information and opinion feedback (Cetron, 1969). The method rests on the "assumption that a prediction upon which the majority of a category of people questioned can agree has greater credibility than the surmise of an individual" (Blohm & Steinbuch, 1972). The

feedback of the input forms is the sole means of internal group communications in the Delphi process (Linstone & Turoff, 19775). This concept eliminates the committee activity due to the lack of open discussion, thus reducing "the influence of certain psychological factors, such as specious persuasion, unwillingness to abandon publicly expressed opinions, and the bandwagon effect of majority opinion" (Certon, 1969). The Delphi methodology incorporates the polling of experts and from the ensuing data develops a consensus which can be used for planning purposes (Certon, 1969). When the predications sought are directed toward technical development, the subjective opinions of experts predominate (Blohm & Steinbuch, 1972).

The first task of the study was to select a group of experts on the subject of this research who could participate in the study. The main criterion for selecting experts was the research credentials with regard to their publications in the area of web-enabled technologies. Initially a group of 57 experts were identified for possible participation in this Delphi study. Upon generating of the list of experts, an invitation was sent to each requesting their commitment to participate in the study. The invitation also included a brief description of the research objective, the Delphi technique, and anticipated time requirements of the study for their planning purposes. Seventeen individuals (30%) out of 57 experts responded to the invitation and agreed to participate in the study.

The next phase of the study was the data/opinion collection process from the group of the experts who agreed to participate. The process consisted of three (3) rounds of questionnaires sent to the participants. The initial round provided each expert in the group the alphabetical list of issues effecting the utilization of the emerging web-enabled technologies as it was developed from the initial review of literature. Table 2 lists the issues included in the initial questionnaire. These issues were presented in the literature review. Each expert was asked to

---

Table 2: *A List of Issues Included in the Initial Questionnaire*

- Bandwidth restrictions and latency (estimated delay)
- Equity (equal access to technology within society)
- Exposure points (each point of remote access represents a risk)
- Flooding of the Web with content for content's sake
- Inadequate comprehensive search facilities on the WWW
- Security and control
- System incompatibilities (cross-platform)
- Unauthorized use of computer resources (unproductive WWW usage)
- User ignorance and perceptions (lack of adequate training)
- Web performance tracking

---

rank the issues listed in the questionnaire using the nine-point Likert scale (0 = unimportant, 9 = very important). The experts were also asked to include any additional issues that they believe warrant inclusion in the list of critical issues of this study.

Results and Discussion

Upon receipt of all the responses, their rankings were reviewed to eliminate any overlaps and then grouped. The weights assigned by each expert served as the study inputs. From these inputs, the issues were ranked in the order

---

Table 3: *A Summary of Rankings of the Critical Issues During the 1ˢᵗ Round of the Delphi Study*

Ranking	Critical Issues	Mean
1	Bandwidth restrictions	7.41
2	Security	
3	Maintainability and integrity of data	7.07
4	Inadequate comprehensive search facilities	6.35
5	System incompatibilities	5.88
6	Web performance tracking	5.59
7	Equity	5.47
7	User ignorance and perceptions	5.47
8	Exposure points	4.29
9	Flooding of the Web with content	4.29
10	Unauthorized use of computer resources	4.06

Table 4: *A Summary of Additional Issues Identified by the Experts During the First Round of the Study*

- Hype
- Privacy and confidentiality agreements
- Low overhead e-payment facilities, "micropayments," so that advertising is no longer needed to cover costs of running servers and the content providers can sell information
- Use of metadata
- Global laws to deal with net crimes
- Required labelling of sites (not censoring, just labelling) which comes after having global laws in place for dealing with net crimes
- Failure of primary companies and their products to adhere to the standards that do exist (i.e., HTML and JavaScript)
- Expressability of HTML (ability to create documents that contain complex layouts)
- System utilization (what functionality of information sharing is best served on the Web)
- Access appliances that avoid computer software
- Unsolicited e-mail or spamming
- Lack of a standardized vector based graphic format for the Web

of the one with highest mean through the one with the lowest mean of ranking. Table 3 summarizes the ranking of the first round of the study.

As stated earlier, the expert panel for this study was asked to list any other issues that in their opinion should be included among the list of critical issue of web-enabled technologies. Table 4 lists a summary of the additional issues identified by the participants.

Upon completion of round one of this study, the list of issues with all their rankings and the list of the new issues identified during the first round were sent to the panel of experts for the second round of ranking. Again the experts were requested to review the list, make any additions necessary and rate each issue in light of the new ones added to the list. Note: Any participant whose round one scores on any issue were significantly distance from the panel's mean value was asked to write a brief explanation for the reasons for their position. Table 5

summarizes the results of the rankings of the issues forwarded to the panel of experts upon completion of the second round of the study.

The following additional issue was added to the list of critical issues during round two of the Delphi study:

"Ensure the continued existence of a global body for consensus standardization, non-proprietary."

The feedback provided to the panel in round three was similar to the previous rounds with the addition of the issue that was added to the list of issues at the end of round two. Upon receipt of the round three ratings, the data was analyzed and summarized. Table 8 lists a summary of the results of the ranking of issues by the panel of experts during round three.

The study yielded a list of 20 issues (Table 6), which have an impact on the emerging Web-enabled technologies. The final list was ex-

Table 6: *A Summary of Rankings of the Critical Issues*
During the 3rd Round of the Delphi Study

Ranking	Critical Issues	Mean
1	Bandwidth Restrictions and Latency	7.70
2	Low O/H E-payment Facilities	7.33
3	Security	6.78
4	Inadequate Search Facilities	6.67
5	Maintainability and Integrity of Data	6.11
6	Unsolicited E-mail (spamming)	6.11
7	Use of Metadata	6.00
8	Ensure a Continued Global Body	5.83
9	Privacy and Confidentiality	5.78
10	Equity(Equal Access)	5.67
10	Systems Incompatibilities (cross-platform)	5.67
11	User Ignorance and Perceptions	5.44
11	Required Labelling of Sites	4.67
12	Global Laws for Net Crimes	4.89
13	WebPerformance Tracking	4.67
14	System Utilization	4.44
15	Expressability of HTML	4.33
16	Exposure Points	3.88
17	Unauthorized Use of Resources	3.56
18	Flooding the Web with Content	3.44
18	Lack of Standardized Vector Graphics	3.44
19	Hype	3.22
20	Access Appliances That Void Software	2.75

panded from the original list of 11 critical issues, based on the additions offered by the expert panel members over the course of the study. The top ten issues are briefly summarized below.

Issue #1 – Bandwidth Restrictions and Latency (Estimated Delay)

The delay experienced by a user when a Web site is accessed is referred to as latency. This effect is often caused by either, the user having slower technology transmission devices, and/or the Web developer creating a site with bandwidth intensive multimedia output. This issue was ranked the most important issue to address by the panel of experts supporting this

study. The resulting mean score of the bandwidth restrictions and latency issue was 7.56 with a corresponding standard deviation of 1.33. This mean value places the bandwidth restrictions and latency issue as the most critical issue to address with regards to the emerging Web-enabled technologies.

Issue#2 - Low Overhead E-Payment Facilities

Low overhead e-payment facilities, micropayments, are needed as a service on the WWW so that advertising is no longer needed to cover the costs of running servers and so that the content providers can sell information. "Systems to handle micropayments - purchases of newspa-

pers or a single song, for example - are too small to be handled profitably using credit cards and are still under development" (Machlis, 1998). The process typically works whereby an account is opened with a micropayment system and the software required is downloaded to work with the user's browser. Digital Equipment Corporation has developed a system that "will eliminate minimum purchase requirements of 10 to 25 cents now imposed by other electronic payment methods, allowing users to buy and sell information profitably down to fractions of a cent" (Digital, 1997).

This issue was added by one of the expert panel members as part of the Round 1 response sheet. At the completion of the study, this issue received a mean ranking of 7.33 with a corresponding standard deviation of 1.94. Scoring slightly less than the issue of bandwidth restrictions, the issue of low overhead e-payment facilities is ranked as the second highest issue impacting the emerging Web-enabled technologies.

Issue#3 – Security

Security as discussed in the literature review in the previous sections, can be broken down into a concern over privacy and a concern over data integrity. At the outset of this research project, based on the volume of literature, I believed that security would be ranked as the most critical issue. The result of the study assigned a mean ranking of 6.78 with a standard deviation of 2.33. The security issue was ranked 3rd in terms of criticality.

Issue#4 - Inadequate Search Facilities on the WWW

Of course, the data available on the WWW is only of use to people and organizations if it is accessible. The search facilities, which currently exist on the WWW, are inadequate to return consistent, reliable results. According to Sliwa (1998), however, the emerging solution is XML (Extensible Markup Language). "XML makes

information in Web pages easier to find and index by assigning the information to specific categories via document tags" (Sliwa, 1998). This emerging Web technology, given final approval be the World Wide Web Consortium (W3C) in February 1998, provides "developers and content creators a new means for organizing information on the Web" (Gardner, 1998).

The expert panel of this study ranked this issue with a final mean value of 6.67 and a standard deviation of 1.41. This issue, in particular, demonstrated some movement toward a concurrence with a small deviation margin.

Issue#5 - Maintainability and Integrity of Data

With the vast amount of information that currently resides on the WWW, the task of maintenance required to ensure the integrity of the Web's data is monumental. This maintenance process is further compounded by the numerous links, which exist on current Web pages and the integrity of those extensions of your document. This issue was ranked in fifth place. This issue was assigned a mean value of 6.56 with a standard deviation of 1.88.

Issue#6 - Failure to Adhere to Standards

Failure of primary companies and their products to adhere to the standards that do exist (i.e. HTML and JavaScript) is an issue that was provided by one of the expert panel members. This issue is brought to the table primarily because companies which have monopolistic power, such as Microsoft, do not abide by those standards that exist in the computer arena often in an attempt to create their product as a new "standard". This issue ranked 6th in the listing of critical issues with a mean score of 6.11 and a standard deviation of 2.67.

Issue#7 - Unsolicited E-mail (spamming)

Spamming was added to the study by one of the experts. According to Highland (1996),

"flaming on the Internet is defined as a virulent and (often) largely personal attack against the author of a USENET posting". Those people who receive a few "flames" are not really inconvenienced by the extra mail. However, spamming occurs when an endless stream of mail is received which can overflow the user's mailbox and can even choke a T-1 network connection (Highland, 1996).

Spamming was ranked, as part of this study, with a mean score of 6.11 and a standard deviation of 2.71. Note that the mean ranking is the same as that assigned to Issue #6 - Failure to Adhere to Standards. The secondary sort parameter used to assemble the final ordered issue listing was standard deviation. The spamming issue has a slightly higher standard deviation and therefore, ranked after Issue #6.

Issue#8 - Use of Metadata

"The World Wide Web currently has a huge amount of data, with practically no classification information, and this makes it extremely difficult to handle effectively" (Marchiori, 1998). Systems can support knowledge management by establishing a metadata - information about information - standard so that users of data can get a handle on the raw materials that enables users to capture, store, and share knowledge that is gathered from many different sources (Dirt, 1998; Phillips, 1995). This is expected to be accomplished by adding to Web objects a metadata classification which will assist search engines and Web-based digital libraries to properly classify and structure the information on the WWW (Baer, 1996; Marchiori, 1998). This issue was contributed by one of the expert panel members in the first round of the study. The resulting mean ranking of 6.00 and standard deviation of 2.60 indicate that the issue has a place on the criticality list.

Issue#9 - Ensure a Continued Global Body

To better understand the background to this

issue, it is useful to note that it was added by one of the experts who currently is associated with the World Wide Web Consortium (W3C). The W3C is a global body that was founded to lead the World Wide Web to its full potential by developing common protocols that promote its evolution and ensure its interoperability. The W3C is an international industry consortium that provides services to WWW users and developers. The primary services offered by the consortium are:

- A repository of information about the World Wide Web for developers and users;
- Reference code implementations to embody and promote standards; and,
- Various prototype and sample applications to demonstrate use of new technology.

The emphasis on the issue incorporated into this study is, in general, to ensure that there is the continued existence of a non-proprietary global body for consensus standardization.

The mean ranking assigned was 5.83 with a standard deviation of 2.86.

Issue#10 - Privacy & Confidentiality Agreements

The privacy and confidentiality agreements issue was added by one of the panel experts in response to the Round 1 issue listing. This issue entails an aspect of the security issue in that a violation of a privacy or confidentiality agreement can infringe on the security of an information system. According to Roush (1995), the World Wide Web Consortium (W3C) is working on the security issue and has assigned a task force to address security measures, privacy and authentication targeted primarily at securing electronic commerce.

As discussed earlier, the primary purpose of this study was to provide statistical conclusions based on the consensus of the expert opinions related to critical issues of web-enabled

technologies. In addition to outlining the top ten issues, it is also important to address the consensus measurement of expert opinions. The measurement of consensus can take various forms. According to Linstone and Turoff (1975), in most Delphi studies, "consensus is assumed to have been achieved when a certain percentage of the votes fall within a prescribed range – for example, when the interquartile range is no longer than two units on the ten-unit scale". This type of measurement, however, does not present the information available from the distribution characteristics of the results. "For example, a bimodal distribution may occur which will not be registered as a consensus, but indicates an important and apparently insoluble cleft opinion"

(Linstone, et. Al., 1975).

An alternate approach is to analyze the opinion stability of the expert panel as a method of consensus measurement. This approach allows the analysis to focus on the opinion of the group rather than on the amount of change in an individual's response from one round to the next (Linstone, et. Al., 1975). Table 7 presents the results of a columnwise subtraction between the first and second, and the second and third round. The absolute values of the differences between each of the histograms form a total of the units of change. However, "since any one participant's change of opinion is reflected in the histogram differences by two units of change, net

Table 7: *Summary of Stable and Unstable Issues*

Issue #	Description	Rounds 1-2 % Change	Analysis	Round 2-3 % Change	Analysis
1	Bandwidth Restrictions	35%	Unstable	6%	Stable
2	Low O/H E-payment Facilities	N/A		17%	Unstable
3	Security	50%	Unstable	6%	Stable
4	Inadequate Search Facilities	45%	Unstable	6%	Stable
5	Maintainability and Integrity of Web Data	55%	Unstable	6%	Stable
6	Failure to Adhere to Standards	N/A		6%	Stable
7	Unsolicited E-mail (Spamming)	N/A		6%	Stable
8	Use of Metadata	N/A		6%	Stable
9	Ensure Continued Global Body	N/A		42%	Unstable
10	Privacy and Confidentiality	N/A		6%	Stable
11	Equity (Equal Access)	45%	Unstable	17%	Unstable
12	Systems Incompatibilities (cross-platform)	30%	Unstable	6%	Stable
13	User Ignorance and Perceptions	55%	Unstable	6%	Stable
14	Global Laws for Net Crimes	N/A		6%	Stable
15	Web Performance Tracking	55%	Unstable	6%	Stable
16	Required Labelling of Sites	50%	Unstable	6%	Stable
17	System Utilization	N/A		6%	Stable
18	Expressability of HTML	N/A		6%	Stable
19	Exposure Points	55%	Unstable	6%	Stable
20	Unauthorized Use of Resources	45%	Unstable	6%	Stable
21	Lack of Standardized Vector Graphics	N/A		6%	Stable
22	Flooding the Web with Content	40%	Unstable	6%	Stable
23	Hype	N/A		17%	Unstable
24	Access Appliances That Void Software	N/A		19%	Unstable

person-changes must be computed by dividing the total units of change by two" (Linstone, et. Al., 1975). Finally, the final percentage change is calculated by dividing the net change by the number of participants, or experts, utilized in the study.

For the purposes of this study, a 15% change level was used to present a state of equilibrium. Based on this criterion, each of the issues presented in Table 7 includes an analysis of the stability level achieved. In summary, all of the issues reached a stable opinion level with the exception of five of the issues. These five issues, marked by an unstable analysis status, did not achieve the group consensus measurement that the study was attempting to achieve. Since 79% of the issues did reach a stable opinion measurement, the study is thought to be successful in the identification and consensus classification of the critical issues associated with the emerging Web-enabled technologies.

Conclusion and Future Recommendations

The World Wide Web is a vast collection of linked documents that reside on computer systems around the world. It is an exciting technological time where new emerging capabilities are being brought forth to utilize the Web. In order for the Web to expand and grow, the critical issues, causing the current roadblocks, must be identified and prioritized.

The objective of this study was to assess critical issues and trends related to the utilization and management of Web-enabled technologies. The initial review of literature identified a set of 11 critical issues. Through the use of Delphi technique, these issues along with others identified by the panel of experts, were carefully assessed and evaluated in terms of their importance. Specifically, this paper identifies and prioritizes the primary ten critical issues that are impeding the further growth of Web-enabled technologies. Although the issue rankings were somewhat diverse in terms of a range of values,

the stability of expert opinion lends credence to the validity of study data. The study yielded four major conclusions.

A conclusion derived from the study results points to the fact that the most prominent critical issues are those which impact Electronic Commerce (EC). The evidence in support of this conclusion is seen in the top three stable issues ranked. Namely, bandwidth restrictions, security, and inadequate search facilities. Of the issues compiled in the list, these three are the primary ones impacting the further development, acceptance and utilization of electronic commerce capabilities. This phenomenon is logical from the perspective of the industry trend toward electronic commerce.

The study also revealed an implication about the lack of concern over individuals misusing the Web capabilities. The primary issues that support this are unauthorized use of resources and flooding the Web with content's sake. By virtue of the fact that the issues were included in the list implies that they have some merit, however, these issues were ranked very low in terms of significance. The ranking of these issues can be interpreted by the fact that many experts view the overwhelming services provided on the Internet as far exceeding its down side, and these kind of misuses always will be part of the system utilization and management.

A third conclusion of the study results is that the critical issues regarding Web-enabled technologies are business-oriented. Those issues pertaining to consumer concerns such as censorship of information available through the use of Web-enabled technologies did not appear as areas of concern in this study. This phenomenon is partly being driven by the compilation of business and academic oriented experts who participated in this study. However, the implication makes sense from the perspective of the strength and resources required by the business community to advance the Web technologies.

The final implication determined from this study deals with the results stability that were achieved utilizing the Delphi technique. The panel of experts were able to freely express their opinions and review those opinions presented by their colleagues in a manner that allowed them to provide consistency in their projections.

In order to address the issues brought to the forefront as a part of this study, certain future recommendations are outlined below.

Recommendation for Businesses

Businesses need to understand the implications of the top critical issues and work with formal bodies such as the World Wide Web Consortium (W3C) to develop remedies and solutions to these critical issues. Workable solutions especially in the realm of electronic commerce (EC) can be only developed with the active participation of the business community. Business can also speed the process by expressing their business desire and need to improve the capability of the technology prior to incorporation. On the other hand, businesses should also pay close attention to many of the issues that concern users of their web sites such as users' unhappiness with excessive delays in graphic presentation loading experiences on some Web-Pages. Perhaps by simplifying their websites, they can contribute to solving the issue of bandwidth (latency) until such time that much faster and efficient bandwidth channels are in existence.

Recommendations for Government

The recommendation most appropriate for government is to monitor closely, however, don't act hastily. The issues raised by the panel of experts in the study related to laws and governmental issues were "global laws for net crimes" and "required labeling sites". The ranking position of these issues, as well as the complexity of a potential solution, sends the warning to governments not to act in haste. The

solution to these issues must be developed by a global body that can accomplish a consensus as to the definition of what actions are considered acceptable, and what actions are not acceptable or should be considered as crimes. Furthermore, such a global body can also determine what authoritative action is enforceable in this realm.

Recommendation for Web-enabled Technology Users

The users of the Web-enabled technologies need to actively participate in the development of a body of solutions in dealing with issues of this technology. From the business point of view, the thrust behind the technology is not centered on the protection of the individual users' rights, privileges, or privacy. On the contrary, these technologies are being developed primarily for the increased effectiveness of industry today and of course, for monetary gain. Businesses are in search of ways to execute their business transactions with fewer errors (reduce costs of doing business) and fewer personnel (increase employee productivity) to stay competitive. Therefore, users can provide many recommendations that will address these issues while allowing them to express other concerns that should be examined by business, governments, and other groups involved in the overall utilization and management of the Internet.

References

1. Baer, Tony. (1996). I want my metadata. *Software Magazine*, 16(8), 53-60.
2. Berghel, Hal. (1996). The client's side of the World Wide Web. *Communications of the ACM*, 39(1), 30-40.
3. Berghel, Hal. (1997). Email – the good, the bad, and the ugly. *Communications of the ACM*, 40(4), 11-15.
4. Berners-Lee, Tim J. (1992). The World Wide Web. *Computer Networks & ISDN Systems*, 25(4), xx-xx.
5. Bhimani, Anish. (1996). Securing the com-

mercial Internet. *Communications of the ACM*, 39(6), xx-xx.

6. Bird, Jane. (1996). Untangling the web. *Management Today*, xx(xx), xx-xx.

7. Blohm, Hans and Steinbuch, Karl. (1973). *Technological Forecasting in Practice*. Saxon House/Lexington Books.

8. Bright, James R. (1972). *A Brief Introduction to Technology Forecasting Concepts and Exercises*. The Parnaquid Press.

9. Cetron, Marvin J. (1969). *Technological Forecasting A Practical Approach*. Gordon and Breach Science Publishers.

10. Charlesworth, Andrew. (1997). Internet Law and Regulation/Law and the Information Superhighway. *International Review of Law, Computers & Technology*, 11(1), 175-179.

11. Felton, Edward W. (1997). Webware security. *Communications of the ACM*, 40(4), 130-xxx.

12. Foo, Schubert and Lim, Ee-Peng. (1997). A Hypermedia database to manage World-Wide-Web documents. *Information and Management*. 31(5), 235-249.

13. Fox, Armando. (1996). Reducing WWW latency and bandwidth requirements by real-time distillation. *Computer Networks & ISDN Systems*, 28(7-11), 1445-1456.

14. Frook, John Evan. (1997). Helping Employees Get Hip to the Web. *InternetWeek*, xx(647), xx-xx.

15. Gardner, Dana. (1997). Top of the News: Web culture clash. *InfoWorld*, xx(xx), xx-xx.

16. Grimshaw, Andrew S. (1997). The Legion vision of the worldwide virtual computer. *Communications of the ACM*, 40(1), 39-45.

17. Hacker, Robert C. (1996). The real value of the World Wide Web. *Target Marketing*, 19(2), 30-32.

18. Higgins, Kelly Jackson. (1997). Dare to Webify your Back Office. *InternetWeek*, xx(679), xx-xx.

19. Hill, Richard. (1997). Electronic Commerce, The World Wide Web, Minitel, and EDI. *Information Society*, 13(1), 33-41.

20. Hodges, Mark. (1997). Building a bond of trust. *MIT's Technology Review*, 100(6), 26-27.

21. Jacobs, Ian G. (1998). Companies Get Wired For the Web – Internet VARs are leading their customers down a more viable business path. *VARBusiness*, xx(xx), xx-xx.

22. Linstone, Harold A. and Turoff, Murray. (1975). *The Delphi Method Techniques and Applications*. Addison-Wesley Publishing Company, Inc.

23. Liu, Chang, Arnett, Kirk P., Capella, Louis M., and Beatty, Robert C. (1997). Web sites of the Fortune 500 companies: Facing customers through home pages. *Information and Management*, 31(6), 335-345.

24. Machlis, Sharon. (1998). Micropayments aren't just chump change. *Computerworld*, 32(9), 37-39.

25. Marchiori, Massimo. (1998). The limits of Web metadata, and beyond. *Computer Networks & ISDN Systems*, 30(1-7), 1-9.

26. McConnell, John. (1997). The Next Frontier: Web Performance Tracking. *InternetWeek*, xx(693), xx-xx.

27. Meeks, Brock N. (1997). Better democracy through technology. *Communications of the ACM*, 40(2), 75-78.

28. Misic, M. (1994). Keys to success with the Internet. *Journal of Systems Management*. 45(11), 6-10.

29. Phillips, John T Jr. (1995). Metadata – Information about electronic records. *Records Management Quarterly*, 29(4), 52-55.

30. Pitkow, James E. (1996). Emerging trends in the WWW user population. *Communications of the ACM*, 39(6), xx-xx.

31. Prawitt, Douglas F. Romney, Marshal B. (1997). Emerging Business Technologies (list of new technologies and risks related to them). *Internal Audit*, xx(xx), xx-xx.

32. Presti, Ken. (1996). Corporate Intranet Growth Puts New Spin On World Wide Web. *Computer Reseller News*, xx(xx).

33. Rose, Lewis. (1996). Before you advertise on the 'Net – check the international marketing laws. *Bank Marketing*, 28(5), 40-42.

34. Roush, Wade. (1995). Spinning a better Web. *Technology Review*, 98(3), 11-13.

35. Sampson, Sandy. (1997). Wild Wild Web: Legal exposure on the Internet. *Sofware Magazine*, 17(13), 75-78.

36. Walsh, Jeff. (1998). Vector graphics gets major vendor boost. *InfoWorld*, 20(16), 59-60.

37. Weston, Randy. (1996). It's taxing to untangle Web commerce laws. *Computerworld*, 30(43), 28-xx.

38. Grimshaw, Andrew S. (1997). The Legion vision of the worldwide virtual computer. Communications of the ACM, 40(1), 39-45.

Notes