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Antonis C. Stylianou

University of North Carolina at Charlotte, astylian@email.uncc.edu

Walter L. Turner

University of North Carolina at Charlotte, wturner@earthlink.net

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HCI Requirements for eBusiness Computing

Antonis C. Stylianou, Dept. of IOM, Univ. of North Carolina at Charlotte, astylian@email.uncc.edu

Walter L. Turner, School of IT, Univ. of North Carolina at Charlotte, wturner@earthlink.net

Abstract

This paper provides an examination and categorization of Human Computer Interaction (HCI) requirements for the support of Electronic Business (eBusiness) and Electronic Commerce (eCommerce) in the context of intranets, extranets, and the Internet. The relationship of these HCI requirements to eBusiness is explored. Several methods are used to develop the requirements, including the application of grounded theory. The requirements uncovered are included in a framework to better enable the understanding of eBusiness requirements for the computer desktop.

Keywords

Electronic Commerce, eCommerce, Electronic Business, eBusiness, HCI, User Requirements, Internet, Intranet, Extranet, Usability

Introduction

Hewett, Baecker, Card, Carey, Gasen, Mantei, Perlman, Strong, & Verplank (1999) define HCI as an inter-disciplinary area drawing foremost upon computer science, but also drawing upon psychology, sociology, and industrial design. HCI is further defined as having science, engineering and design aspects. According to Hewett et al., HCI can be divided into four basic areas: use and context, human, computer, and development process. This is depicted in Figure 1, below.

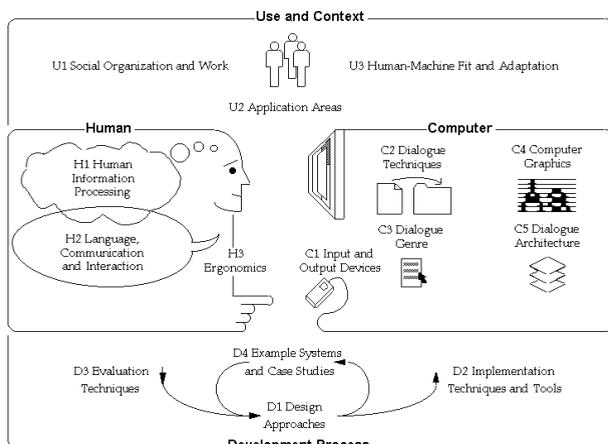


Figure 1 - Hewett et al.'s (1999) Area of HCI

Many studies of eBusiness have been done, as well as countless studies of Human Computer Interaction (HCI). To date, however, no framework for relating these two has been put forth. This paper attempts to develop such a

framework of categories, subcategories, and requirements for human computer interaction, via computer desktop, in order to better accommodate the demands of eBusiness. Such a framework will aid in the systematic improvement of the desktop interface, and serve as a basis for connecting various independent research efforts conducted on portions of the desktop interface.

Methodology

This research project was divided into the following six phases with the corresponding methodological approaches:

- Phase I - Review of eBusiness literature for any general requirements for HCI specifically noted.
- Phase II - Environmental scanning for HCI requirements for eBusiness.
- Phase III - Review of HCI literature for any requirements that can specifically be related to eBusiness.
- Phase IV - Use of grounded theory to develop prospective categories for HCI research and relating of these categories.
- Phase V - Archival research of eBusiness areas that fit the HCI categories from Phase IV for HCI requirements.
- Phase VI - Combination and sorting of all gleaned requirements into a framework.

For purposes of this paper, the definition of grounded theory put forth by Myers (1996, p. 1) is used: "Grounded theory is a research method that seeks to develop theory that is grounded in data systematically gathered and analyzed." Grounded Theory consists of many techniques that may be used in conjunction or as needed. The Grounded Theory techniques used herein as the basis for developing the requirements' framework via archival research are: conceptual ordering, open coding, axial coding, and theoretical sampling.

Data Analysis/Findings

Phase I - Twenty-five eBusiness journal articles were examined for HCI requirements that were specifically set forth. Of the articles examined, only Shaw and Yadav (1997) explicitly define any HCI requirements for eBusiness. They define the central HCI requirement for eBusiness as multiple modality, which is: "the ability to adapt to different user interface environments imposed by the user." They also indicate, when there are bandwidth restrictions, that the successful eBusiness application that uses web pages as its interface must handle various types

of browsers as well as pure text as its interface. Finally, Shaw and Yadav define stringent security and scalability as key requirements of eBusiness, both of which would need to be supported by a computer desktop.

Phase II - Thirty newspaper and magazine articles on eBusiness topics were examined in this phase through environmental scanning. Very little was found about HCI requirements for eBusiness. Information was found on portals and their relationship to desktops. According to eMarketer (1999) knowledge portals (Internet or intranet based access to knowledge) will become the desktop. Oracle, IBM, and Microsoft are positioning portals as the next generation development platforms. (Foley, 1999a) Oracle's Portlet Framework will provide discussion group access as well as calendaring. Some of the services will be built into the portal by Oracle, while others will be added by third parties. Hot Office Technologies Inc. is offering a suite of web-based services such as calendaring, email, and chat. (Foley, 1999b) Thus, we see that the former situation of a desktop for HCI that runs a browser for web access may be disappearing in favor of a web-browser based desktop/portal through which users can perform tasks.

Phase III - Twenty-five HCI documents were reviewed for possible association with eBusiness or eBusiness requirements. For the most part, there was no direct connection. For some articles, there was no direct connection because they appeared before eCommerce or eBusiness found its way into the general vocabulary. In the case of other articles, there simply seemed to be no grounding of the articles in the business drivers behind the research.

Whittaker, Swanson, Kucan, and Sidner (1997) described the connection between groupware and support for interpersonal interaction, both in the office environment and for geographically dispersed mobile workers. They also connected the use of desktop artifacts to serve as reminders of work to be done. Pankoke-Babatz and Syri Syri (1997, p. 187) connected groupware to "team-like cooperation" in the business setting.

Whittaker, Frohlich and Daly-Jones (1994) focused on the difficulties of geographically dispersed teams and connected the productivity of the teams to desktop video systems.

A computer desktop could better accommodate work groups. Bullen and Bennett (1990) connected groupware to workplace productivity and then went on to define the following requirements for groupware:

- Calendaring
- Email
- Group memory
- Manage documents
- Ability to transfer control of the groupware

- Ability to transfer data involved in the groupwork
- Groupware tools should parallel non-electronic activities

Perkowitz and Etzioni (1999) connected an adaptive web site to electronic commerce and they described the advantages of the adaptive capability both for the users and as a means of research by mining the clickstream data. Langheinrich, Nakamura, Abe, Kamba, and Koseki (1999) connected this adaptiveness (they refer to as "customization") to increased marketing effectiveness.

Phase IV - One hundred thirty one HCI related papers were selected. These papers were, in the most part, from various HCI and Collaboration conferences. However, some papers were drawn from other conferences, journals, and web sites. Selection of papers was based on an association with the computer desktop. This selection of articles was intended to be diverse in nature, and was, by no means, exhaustive.

As the selected articles were researched, three distinct categories began to emerge: *Collaboration* (38 articles), *Computer User Interface* (66 articles), and *The Internet, Intranets, and Extranets* (27 articles). These categories remained valid throughout the research. One of the categories, collaboration, was formerly listed as part of the HCI conferences.

Collaboration has grown large enough to merit its own conference, and thus, has not been included in Hewett et al.'s (1999) classification scheme for HCI (Figure 1). (However, it does overlap with Hewett et al.'s U1 – Social Organization and Work and U2 – Application Areas categories.) One of the annual ACM conferences, Computer Supported Cooperative Work (CSCW), is devoted strictly to the study of collaboration. Collaboration is also called by several other names: groupware, computer-mediated communication systems (CMCS), and shared environments.

The second category -- Internet, Intranets, and Extranets -- was not included in the HCI classification scheme in Figure 1, since the classification scheme in Figure 1 appears related to the computer based desktop and interaction therewith. (However, it does overlap somewhat with Hewett et al.'s (1999) U1 – Social Organization and Work and U2 – Application Areas categories.) Internet, Intranets, and Extranets is a category associated with remote or ubiquitous computing rather than their more traditional use in networking.

The third category, Computer User Interface, contains the areas identified in Figure 1: C2 – Dialogue Techniques, C3 – Dialogue Genre, C5 – Dialogue Architecture, U2 – Application Areas, U3 – Human-Machine Fit and Adaptation, and D1 – Design

Approaches. No articles were classified that matched Hewett et al.'s (1999) H2, H3, C4, D2, D3 or D4 areas.

The three categories that emerged from the application of grounded theory techniques are clearly different in name and scope from Hewett et al.'s (1999) classification scheme. However, as can be seen from the subcategories that emerged from the categories, they will be very useful in looking at eBusiness for comparable categories.

As the articles in each category were related to each other, subcategories began to emerge. The subcategories for each major category are listed below in Tables 1, 2, and 3. Subcategory names in the various categories were given the same name as comparable subcategories in other categories, e.g. Agents. Some categories represent several topics, e.g. Usability, which includes special needs and globalization (i.e., interface use in a global economy, capable of supporting various languages and currencies).

Table 1 - Collaboration Subcategories	
Subcategory	HCI Literature References
Email	Belew & Rentzpepis (1990); Goldberg, Safran, & Shapiro (1992); Whittaker & Sidner (1996)
Web-based	Brandenburg, Byerly, Dobridge, Lin, Rajan, & Roscoe (1998)
Video Conf.	Greenhalgh & Benford (1995); Han & Smith (1996); Issaacs & Tang (1993)
Workflows	Poltrock & Grudin (1998)
Calendar	Palen (1999)
Toolkits	Dourish (1998); Roseman (1992); Roseman & Greenburg (1996)
Agents	Bond (1990); Greif (1994); Nardi, Miller, & Wright (1998)
Workspace/ Team Room	Ginsber & Ahuja (1995); Gutwin, Roseman, & Greenburg (1996); Lindstaedt (1996); Roseman & Greenburg (1996)
Awareness / Adaption	Doorish & Bly (1992); Gutwin & Greenburg (1996); Gutwin & Roseman (1996); Gutwin, Greenburg, & Roseman (1996); Honda, Tomioka, Kimura, Ohsawa, Okada, & Matsushita (1997); Nomura, Hayashi, Hazama, & Gudmundson (1998)
Groupware	Bowers & Rodden (1993); Blythin, Hughes, Kristoffersen, Rodden, & Rouncefield (1997); Eveland, Blanchard, Brown, & Mattocks (1994); Hill & Brinck (1994); Olson & Teasley (1996); Olson et al. (1996); Poltrock & Grudin (1998); Robbert (1997);
Newsgroups	Resnick, Iacovou, Suchak, Bergstrom, & Riedl (1994)
Small Screen / Mobility	Belloti & Bly (1996); Myers, Steil, & Gorgivlo (1998)
Multimedia	Hoadley & Hai (1993); Nicol, Yechezkal, Paschetto, Rush, & Martin (1999)

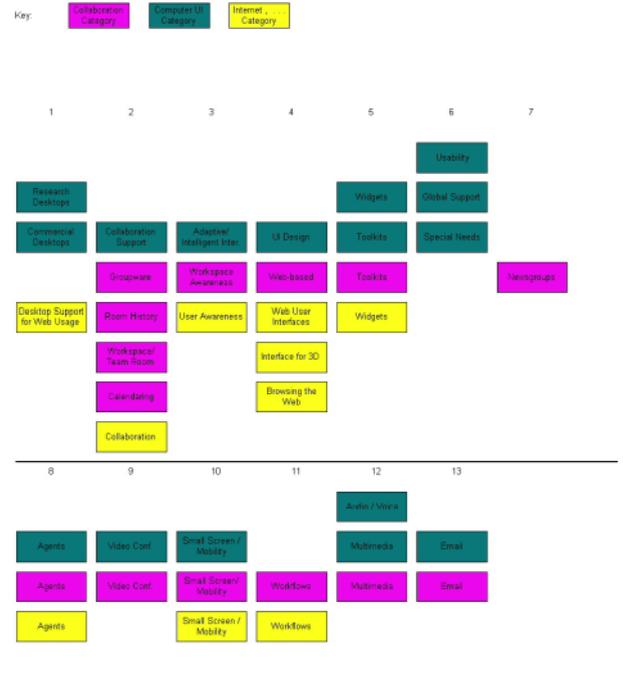
Table 2 - Computer User Interface Subcategories	
Subcategory	HCI Literature References
Commercial Desktops	Card, Genter, Nielsen, Henderson, & Morman (1995); Dzida, Freitag, & Valder (1991); Farrand (1993); Johnson, Roberts, Verplank, Smith, Irby, Beard, & Mackey (1989); Ludolph & Perkins (1998); Lundell & Anderson (1996); Microsoft (1999c); Sullivan (1996)
Awareness / Adaption	Crow & Smith (1993); Benyon & Murray (1993); Birnbaum, Horvitz, Kurlander, Lieberman, Marks, & Roth (1997); Hefley & Murray (1993); Kuhme (1993); Meyer, Yakemovic, & Harris (1993)
Agents	Moran, Cheyer, Julia, Martin, & Park (1997)
Usability	Fernandes (1995); Hopper, Hambrose, & Kanevsky (1996); Kerkovitz (1994); McMillan (1993); Noirhomme-Fraiture & Vanderdoncki (1993); Oosterhold, Kusana, & Vries (1996); Rappin, Guzdial, Realf, & Ludovice (1997); Raskin (1997); Russo & Boor (1993); Vrendenburg (1999)
Research Desktops	Arai, Machii, & Kuzunuki (1995); Dey, Abowd, Pinkerton, & Wood (1997); Fertig, Freeman, & Gelernter (1996); Isaacs, Tang, & Morris (1996); Kerr, Markley, Soontag, & Trower (1995); Michelitsch (1996); Ullmer & Ishii (1997); Wood, Dey, & Abowd (1997)
Toolkits	Myers (1995); Taylor, Nies, Bolcer, MacFarlane, & Anderson (1995); Vanderdonck (1994); Wolber (1997)
Small Screen / Mobility	Rekimoto (1996)
Multimedia	Buchanon, Zellweger, & Pier (1993); Chiu & Wilcox (1998); Degen, Mander, & Salomon (1992); Gordon, Kedar, & Domeshek (1996); Grasso, Ebert, & Finin (1998); Hudson & Smith (1996); Maybury (1994); Mills, Choen, & Wong (1992); Resnick & Virzi (1995); Whittaker, Hirschbert, & Nakatani (1998)
Video Conf	Webster (1998)

Widgets	Baecker, Small, & Mander (1991); Baudisch (1998); Bauersfeld & Slater (1991); Berlage (1994); Byrne (1993); Fitzpatrick (1998); Henderson & Card (1986); Moyes (1994); Rogers (1995); Sears & Shneiderman (1994); Ware & Lewis (1995)
UI Design	Mullet & Sano (1994); Mulligan, Altom, & Simkin (1991)
Email	Hudson & Smith (1996); Marx & Schmandt (1996)
Collaboration Support	Dewan & Choudhary (1991); Tollmar, Marmolin, & Sundblad (1994); Streitz, Geibler, Haake, & Hol (1994)

Table 3 - The Internet, Intranet, and Extranet Sub-categories	
Sub-Category	HCI Literature References
Workflows	Grather, Prinz, & Kolvenbach (1997); Lavana, Kletawat, Brglez (1997)
Agents	Barrett, Maglio, & Kellem (1997); Thomas & Fischer (1997)
Collaboration	Brandenburg et al. (1998); Greenburg & Roseman (1996); Kobayashi, Shinozaki, Sakairi, Touma, Daijavad, & Wolf (1998); Lieberman, Van Dyke, & Vivaqua (1999); Sarwar, Konstan, Borchers, Herlocker, Miller, & Riedl (1998)
Browsing the Web	Andrews, Eick, Foley, & Ruh (1996); Card, Robertson, & York (1996); Debevc, Meyer, & Svecko (1997); Gloor (1991); Jones & Cockburn (1996); Kandogan & Shneiderman (1998); Sugiura & Koseki (1998)
Interface for 3D	Mohageg, Marrin, Kent, Mott, & Isaacs (1996)
Desktop Support for Web Usage	Marais & Bharat (1997)
Small Screen / Mobility	Jones, Marsden, Mohd-Nasir, Boone, & Buchanan (1999)
Awareness / Adaption	Palfreyman & Raden (1996)
Web User Interfaces	Amento, Hill, Terveen, Hix, & Ju (1999); Bouvin (1999); Fox, Gribble, Chawathe, Polito, Huang, Ling, & Brewer (1997); Neilson & Wagner (1996); Rice, Farquhar, Piernot, & Gruber (1999)
Widgets	An & Li (1998)

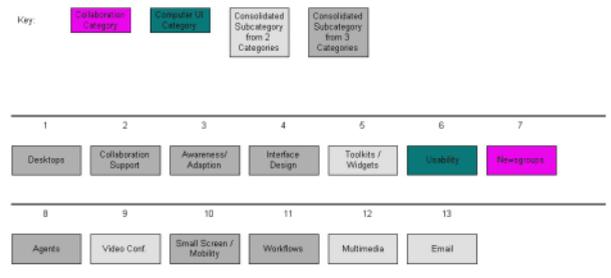
This is depicted below in Figure 2. All the subcategories except for Newsgroups aligned with other subcategories from other categories.

Figure 2 – HCI Subcategories – Initial Alignment



Next, the subcategories were combined into single representative categories for each column of aligned subcategories contained in Figure 2, above. The result is shown in Figure 3, below. The consolidation resulted in a reduction of the subcategories from the original forty subcategories to the thirteen subcategories shown in Figure 3.

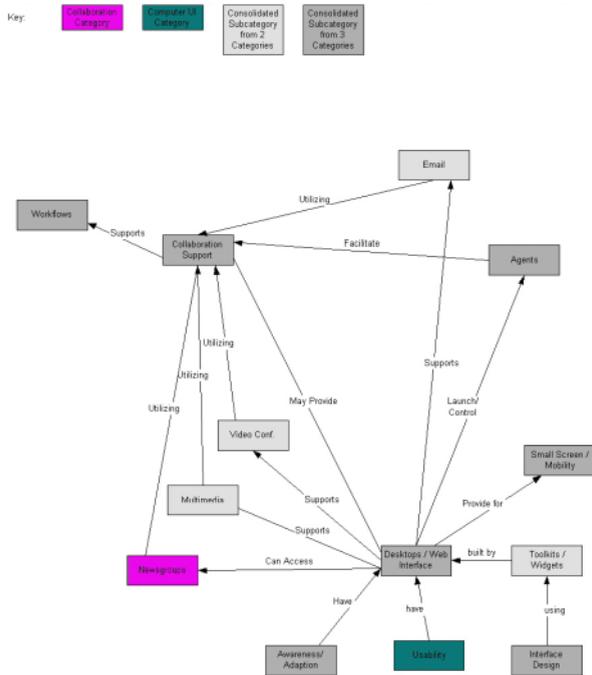
Figure 3 – HCI Subcategories – Consolidation of Categories



Comparison of the various subcategories suggested relationships between them. This resulted in the subcategory network (a grounded theory term) depicted below in Figure 4. This network shows the relationships between the various subcategories.

The various subcategories in the three categories (see Tables 1, 2, and 3 above) were aligned by similar content.

Figure 4 – HCI Subcategories – Network



Phase V - A review of eCommerce/eBusiness literature was conducted in this phase, using the consolidated HCI subcategories (Figure 4, above) as the starting point to see if the subcategories fit the eBusiness literature and if requirements for HCI could be gleaned from eBusiness literature within each subcategory. (This phase differed from previous phases in that categories were used as the starting point.)

Thirty-nine papers about eCommerce or eBusiness were reviewed in this Phase. Ten of the papers contained eBusiness/eCommerce requirements within the subcategories developed in Phase IV above. The result of this phase of the research is shown below in Table 4. Two of the subcategories, Awareness/Adaption (user perception and adjustment to the user’s needs and preferences) and Interface Design (designing a user interface) were not expressly listed in the literature reviewed although requirements for these subcategories may surface if a larger sample size were to be used.

Table 4 – HCI Requirements from eBusiness Literature		
Sub-category	eBusiness Literature References	Requirements
Workflows	Miers & Hutton (1999)	methods to control workers, enable organizational learning, routing of work, support business rules associated with process

Agents	Clarke (1993)	gathering of intelligence
	Davis, Matteis, Henderson (1998)	software agents
Collaboration Support	Bruno (1996)	push delivery, managing data, workflow support, data replication, encryption, digital certificate support, calendaring, scheduling, threaded discussion, rules based messaging
	Vishik (1997)	Collaboration, push delivery
	Stabell & Fjeldstad (1998)	support activity interdependencies, support teams of professionals, synchronize activities, standardization
	Miers & Hutton (1999)	collaborative support
Videoconferencing	Clarke (1999)	projected video, videoconferencing, interactive voice, video with sound
	Davis et al. (1998)	videoconferencing
Email	Stabell & Fjeldstad (1998)	Standardization, email service
	Clarke (1993)	compound document support of text, images, and diagrams, annotation with text or voice
	Miers & Hutton (1999)	transport mechanism to support flow of work
Multi-media	Vishik (1997)	Multimedia
	Clarke (1998)	Multimedia
	Clarke (1999)	projected sound, musical performances, images, photographs
	Davis et al. (1998)	interactive multimedia
News-groups	Clarke (1999)	News
Usability	Young, Malhotra, Sawy, & Gosain (1999)	easy to use interface
Desktops	Stabell & Fjeldstad (1998)	standardization
	“Introduction to Electronic Commerce” (1999)	display samples, display advertising, display catalogues
Small Screen / Mobility	Davis et al. (1998)	wireless applications
Awareness / Adaption		

Interface Design		
Toolkits / Widgets	Miers & Hutton (1999)	graphical construction kit

Phase VI - Using the HCI requirements for eBusiness uncovered during Phases I – VI above yields the consolidated list of categories and their requirements shown below in Table 5. Interface Design was removed as a requirement category since it was somewhat reflected in the usability requirement category and no specific reference to it was found in the eBusiness literature. It is possible for many, if not all of the eBusiness requirements in Table 5 to be satisfied by the desktop interface. However, only a subset may be applicable to any given desktop.

Table 5 – eBusiness Requirements Related To HCI	
Subcategory	Requirements
Workflows	methods to control workers, enable organizational learning, routing of work, support business rules associated with process
Agents	gathering of intelligence
Collaboration Support	push delivery, managing data, workflow support, data replication, encryption, digital certificate support, calendaring, scheduling, threaded discussion, rules based messaging, support activity interdependencies, support teams of professionals, synchronize activities, standardization, chat, manage documents, ability to transfer control of collaboration, ability to transfer data for collaboration
Videoconferencing	projected video, interactive voice, video with sound
Email	Standardization, compound document support of text, images, and diagrams, annotation with text or voice, transport mechanism to support flow of work
Multimedia	projected sound, musical performances, images, photographs, interactive multimedia
Newsgroups	News, discussion group access
Usability	easy to use interface
Desktops	Standardization, display samples, display advertising, display catalogues
Small Screen / Mobility	wireless applications, mobility support
Awareness / Adaption	multiple modality

General	Security, scalability, low speed link support, artifact reminders of work to be done, ability to mine clickstream data
Toolkits / Widgets	graphical construction kit

Conclusions

This study has created the beginning of a framework for relating HCI to eBusiness/eCommerce requirements within various categories. Much yet remains to be determined. Do the requirements change with a larger, less limited, sample size or by using more HCI papers in categories less related to eBusiness? Are some requirements more important than others? How do eBusiness requirements for HCI differ from more traditional HCI requirements for the computer desktop?

How does one's position affect their view of eBusiness requirements for HCI? How do commercial eCommerce requirements for HCI differ from those for personal eCommerce use? Are the categories valid for personal eCommerce use? Adaptive web sites were only examined briefly, how they should be supported at the desktop was not addressed.

It is hoped that this effort will serve as the basis for additional inquiries into this area and for an improvement in HCI, via the desktop, for eBusiness. Anyone setting out to create a new desktop or improve an existing desktop will need to give consideration to the requirements uncovered through this study if the desktop is to serve eBusiness well. Given the current numbers of desktops and the tremendous potential for eBusiness, any improvement in the computer desktop will have great value.

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