### Table 10. Organizational facilitation factors *(Source: developed for this study)*

<table>
<thead>
<tr>
<th>Organizational Facilitation Factors</th>
<th>Brief Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating imperatives</td>
<td>Organizations should create imperatives to push end users to ask for help from KMSs and use the systems.</td>
</tr>
<tr>
<td>Cutting off old means</td>
<td>Organizations should cut off old means, by which end users used to get knowledge and slowly push people to use the KMS.</td>
</tr>
<tr>
<td>Having rigor</td>
<td>Organizations should have rigor and discipline in using KMSs to help ensure end users use the systems.</td>
</tr>
<tr>
<td>Monitoring system usage</td>
<td>Organizations should monitor end users’ usage of KMSs to enhance the acceptance and use of the systems.</td>
</tr>
<tr>
<td>Promoting success stories and best practices</td>
<td>Through promoting success stories and best practices arising from the use of KMSs, more and more end users will be encouraged to get involved and be part of the systems.</td>
</tr>
<tr>
<td>Satisfying needs continuously</td>
<td>Organizations should keep end users interests in KMSs by providing what they want.</td>
</tr>
<tr>
<td>Making KMS a part of business</td>
<td>Organizations should infuse KMS into their business and have it become a part of the business routine.</td>
</tr>
<tr>
<td>Making use of KMS a part of end users’ organizational life</td>
<td>Organizations should make use of KMS a part of the end users’ life in the organization.</td>
</tr>
<tr>
<td>KMS personalization</td>
<td>In the future, predefined user options in KMSs will be modified to meet the needs of individual users (Desouza, Awazu, &amp; Ramaprasad, 2007)</td>
</tr>
<tr>
<td>KMS customization</td>
<td>In the future, predefined user options in KMSs will be modified to meet the needs of a collected setting (i.e., a team or organization) (Desouza et al., 2007)</td>
</tr>
<tr>
<td>KMS invention</td>
<td>In the future, add-ins or using existing functions for novel purposes will be created in KMSs (Desouza et al., 2007)</td>
</tr>
</tbody>
</table>

### Table 11. Dimensions of realized benefits *(Source: developed for this study)*

<table>
<thead>
<tr>
<th>Realized Usefulness</th>
<th>Brief Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creativity</td>
<td>KMSs have helped our organization create new services and innovation, which individuals could not do on their own.</td>
</tr>
<tr>
<td>Productivity</td>
<td>KMSs have helped our organization enhance productivity (i.e., simplifying workflows, speeding up the projects).</td>
</tr>
<tr>
<td>Cost and time reduction</td>
<td>KMSs have helped our organization save time and money for organizations through avoiding “reinventing the wheel.”</td>
</tr>
<tr>
<td>Knowledge building</td>
<td>KMSs have helped our organization build up end users’ knowledge base and increase their knowledge, that is, learning from others’ experience and knowledge.</td>
</tr>
<tr>
<td>Avoiding same mistakes</td>
<td>KMSs have helped our organization reduce the chances for mistakes and mediate the risks.</td>
</tr>
<tr>
<td>Effectiveness</td>
<td>By providing access to appropriate knowledge, KMSs have helped individuals in our organization do their job better.</td>
</tr>
</tbody>
</table>
HYPOTHESES DEVELOPMENT

This section develops hypotheses as per the proposed research model (see Figure 4). Dishaw and Strong (1999) suggest that task characteristics/requirements have strong effects on system utilization. In addition, Davis’s (1986) TAM proposes that external factors, such as task complexity factors, will influence KMS adoption by affecting perceived benefits (usefulness) and user friendliness (ease of use). It is also believed that the increasing demand of knowledge reuse, complexity, and overloaded knowledge will trigger end users’ adoption of KMSs.

The preceding discussion results in the following hypotheses:

**Hypothesis 1a:** “Task Complexity” factor positively influences the “Perceived Benefits” of KMSs.

**Hypothesis 1b:** “Task Complexity” factor positively influences the “Perceived User Friendliness” of KMSs.

Individual differences play important roles in determining MIS success and are important determinants of MIS success (Zmud, 1979). Individual

---

<table>
<thead>
<tr>
<th>User Friendliness</th>
<th>Brief Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple to learn and use</td>
<td>Our KMS is simple to learn and use and has simple procedures.</td>
</tr>
<tr>
<td>Cheap to learn and use</td>
<td>Our KMS is reasonably cheap to learn and use.</td>
</tr>
<tr>
<td>Speed</td>
<td>Our KMS is up to speed and is quick to get knowledge that end users are after.</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Our KMS is available and accessible to everyone in the organization. End users are able to access everything they need and want to know.</td>
</tr>
<tr>
<td>Quality of knowledge</td>
<td>There is always accurate and updated knowledge in our KMS.</td>
</tr>
<tr>
<td>Security</td>
<td>Our organization has appropriate security measures in our KMS to prevent unauthorized access.</td>
</tr>
<tr>
<td>Complexity of knowledge</td>
<td>Knowledge in our KMS is properly structured, organized, and stored. End users can easily retrieve required knowledge from the system (Desouza et al., 2005).</td>
</tr>
<tr>
<td>Risk of knowledge</td>
<td>Our KMS has mechanisms in place to mitigate risk and uncertainty of using someone else’s knowledge (Desouza et al., 2005).</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Adoption</th>
<th>Brief Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge and expert information search</td>
<td>In the future, end users will keep on using KMSs to search for required knowledge and information of experts who have required knowledge.</td>
</tr>
<tr>
<td>Communication with knowledge holders</td>
<td>In the future, end users will keep on using KMSs for communication with knowledge holders.</td>
</tr>
<tr>
<td>Knowledge sharing</td>
<td>In the future, end users will keep on using KMSs for sharing knowledge.</td>
</tr>
<tr>
<td>Contribution to the systems</td>
<td>In the future, end users will keep on making contributions to the systems by putting in their own knowledge.</td>
</tr>
<tr>
<td>Codifying and storing knowledge</td>
<td>In the future, end users will keep on using KMSs to codify and store knowledge.</td>
</tr>
<tr>
<td>Knowledge creation</td>
<td>In the future, end users will keep on using KMSs to create new knowledge.</td>
</tr>
<tr>
<td>KMS use habit</td>
<td>In the future, use of KMSs will be become automatic for end users when they are searching for required knowledge (Limayem, Cheung, &amp; Chan, 2003).</td>
</tr>
</tbody>
</table>
differences have also been found to be important in explaining the acceptance and successful implementation of IS (Igbaria et al., 1995). Past research has indicated that the individual/end user characteristics/differences are important factors in explaining/predicting the adoption of innovations (A1-Khaldi & Wallace, 1999; Agarwal & Prasad, 1998, 1999; Brancheau & Wetherbe, 1990; Igbaria et al., 1995; Iivari, 1995; Jackson, Chow, & Leitch, 1997; Larsen & Wetherbe, 1999; Leonard-Barton & Deschams, 1988; Liker & Sindi, 1997; Moore, 1987; Morris & Ventatesh, 2000; Rogers, 1995; Thompson, Higgins, & Howell, 1994; Venkatesh, Morris, & Ackerman, 2000; Zmud, 1979; among many others). People’s acceptance of the system is critical to the success of KMSs. An effective way to increase KMS acceptance is involving users in system development (Hahn & Subramani, 2000). If the norm in the organization is to use the KMS to search for the needed knowledge, there is an expectation that every one should use the system. Particular individuals who do not use the system before embarking on the tasks put themselves at odds with the culture in the organization (Brooking, 1999).

Hence, it is hypothesised that:

**Hypothesis 2a:** “Individual factors” positively influence the “Perceived Benefits” of KMSs.

**Hypothesis 2b:** “Individual factors” positively influence the “Perceived User Friendliness” of KMSs.

Gold, Malhotra, and Segars (2001) suggest that knowledge infrastructure capability (technology, structure, and culture) along with knowledge process capability (acquisition, conversion, application, and protection) is an essential precondition for effective KM. The unconditional support of top management and knowledge-sharing culture and reward systems to participate and contribute to the KMS are also important factors for effective KMSs and successful implementation of KMSs (Ma & Hemmje, 2001). Davenport, Long, and Beers (1998) suggest that one of the most important determinants of the successful KM projects is a knowledge-friendly culture, where people have a positive orientation toward knowledge, people are not inhibited in sharing knowledge, and the KM project fits with the existing culture.

Past research finds that organizational factors have significant impact on the adoption of innovations (see Belassi & Fadalla, 1998; Evansiko, 1981; Franz & Robey, 1986; Grover, 1993; Kim & Srivastava, 1998; Kimbley & Lai, 1997; McGowan & Madey, 1998; Rai & Bajwa, 1997; Sarvary, 1999; Sultan & Chan, 2000; Thong, 1999; Thong & Yap, 1995; Yap, Soh, & Raman, 1992; among many others). In addition, Davis’s (1986) TAM proposes that external factors, such as organizational factors, will influence KMSs diffusion by affecting perceived benefits and perceived user friendliness.

Therefore the following hypotheses are proposed:

**Hypothesis 3a:** “Organizational factors” positively influence the “Perceived Benefits” of KMSs.

**Hypothesis 3b:** “Organizational factors” positively influence the “Perceived User Friendliness” of KMSs.

Organic growth plays an important role in putting a KMS into an organization since it makes end users interested in the system. Also, it gives them the capability to use the system through sufficient training and self-learning. Organizations should also persuade and educate people to use the system. One of the most difficult tasks in implementing a KMS is to make end users understand that adoption and use of the system will bring benefits not only to the organization but also to themselves. In addition, Davis’s (1986) TAM proposes that external factors, such as organic growth, will influence KMSs diffusion by affecting perceived benefits and perceived user friendliness.
The previous discussions lead to the following hypotheses:

**Hypothesis 4a:** “Organic growth” positively influences the “Perceived Benefits” of KMSs.

**Hypothesis 4b:** “Organic growth” positively influences the “Perceived User Friendliness” of KMSs.

TAM (Davis, 1986, 1989, 1993; Davis et al., 1989) and other related studies such as Venkatesh and Davis (2000); Igbaria et al. (1995); Adams et al. (1992); Szajna (1996); and Igbaria et al. (1997) have identified PEOU as an important determinant of system acceptance and use via PU. PEOU has a direct and positive impact on PU.

Kim Sbarcea, the knowledge manager in Phillips Fox, which is the first law firm in Australia to have a KMS with state-of-the-art technology, feels that a KMS must be user friendly: “...Simply put, we needed a means of accessing the knowledge we possess and making it available, simply and easily, to the lawyers and support staff who need it, when they need it” (Phillips Fox, 1998). Davenport and Glaser (2002) suggest that knowledge-sharing programs often fail for the reason that they make it harder, not easier, for people to perform their tasks. Furthermore, Bhattacherjee (2001) finds that users’ confirmation of their initial use of ISs has positive impact on their intention of continued use of the systems.

Therefore the following hypotheses are proposed:

**Hypothesis 5:** “Perceived User Friendliness” of KMSs positively influences the “Perceived Benefits” of KMSs.

**Hypothesis 11:** “Realized User Friendliness” of KMSs positively influences the “Realized Benefits” of KMSs.

Bansler and Havn (2002) suggest that expectations/perceptions are key factors in determining an organization’s and individual’s decision about whether or not to adopt a new KMS. Gray (2000) believes that individuals’ perceived value of KMS has direct relationship with their use of KMSs. In addition, the theory of diffusion of innovations, the TRA, and the TAM all propose direct impacts of perceptions on intention to use the system. As a result, it is proposed that perceived benefits and perceived user friendliness have direct impact on KMSs adoption. Bhattacherjee (2001) also finds that users’ confirmation of their initial use of ISs has positive impact on their intention of continued use of the systems.

As per the previous discussions, it is hypothesized that:

**Hypothesis 6:** “Perceived Benefits” of KMSs positively influence the “Adoption” of KMSs.

**Hypothesis 7:** “Perceived User Friendliness” of KMSs positively influences the “Adoption” of KMSs.

End users will adopt and use KMSs on a voluntary basis, as forced-use of the systems is not ideal. End users will also use the KMS when they see the value of using the system. Also, when people are forced to use the systems they frequently use them in ways that do not benefit organizations (Bansler & Havn, 2002). In addition, perceived voluntariness focuses on the end users’ perceived voluntary adoption and use of KMSs.

The previous discussions lead to the following hypotheses:

**Hypothesis 9:** “Voluntary use” of KMSs positively influences the “Adoption” of KMSs.

**Hypothesis 15:** “Voluntary use” of KMSs positively influences the “Continued Use” of KMSs.

Subject norms reflect the social influence that may affect a person’s intention to use KMSs. People often take action based on their perceptions of what others think they should do. Literature (Liker & Sindi, 1997; Lucas & Spitler,
1999; Thompson, Higgins, & Howell 1991) has found that subject norms are positively associated with individual's acceptance of new technology. Huber (2001) suggests that there is considerable ignorance in the literature on the impacts of the social-psychological forces such as the need to adhere to social norms, the need to comply with organizational norms (the right thing to do), the need for recognition, and so forth on knowledge sharing and participation in the KMSs. As a result, there is a great need for future research to explore this area.

The previous discussions results in the following hypotheses:

**Hypothesis 8:** Use of KMSs via organizational “norm” positively influences the “Adoption” of KMSs.

**Hypothesis 14:** Use of KMSs via organizational “norm” positively influences the “Continued” use of KMSs.

Sustained use of KMSs by end users is often a challenge faced by many organizations. For the purpose of achieving end users’ sustained use of the system, organizations should create imperatives to push them to ask for help from KMSs and use the systems; should cut off old means by which they used to get knowledge and slowly push them to use the systems; and should monitor end users’ usage of KMSs to enhance the acceptance and use of the systems. Through promoting success stories and best practices arising from use of KMSs, more and more end users will be encouraged to get involved and be part of the systems. Organizations also should retain end users’ interests in KMSs by continuing to provide what they want; infuse KMSs into their business so that they become a part of the business routine; and should make use of KMSs a part of end users’ life in organization.

One of the most frequently asked questions about KMSs is “how do you know people will use them”? (Brooking, 1999, p.128). Instead of compensating employees for sharing their knowledge, organizations should make end users understand that the use of KMSs is part of their job and is a part of culture—“the way we do things around here” (Brooking, 1999, p.128). Gray (2000) suggests that increased employee knowledge specialization arising from the use of KMSs will result in the increased use of the systems. In addition, the theory of diffusion of innovations, the TRA, and the TAM all propose direct impacts of perceptions on intention to use the systems. As a result, it is proposed that perceived benefits and perceived user friendliness have direct impact on continued use of KMSs.

The previous discussions result in the following hypotheses:

**Hypothesis 10a:** “Organizational Facilitation factors” positively influence the “Realized Benefits” of KMSs.

**Hypothesis 10b:** “Organizational Facilitation factors” positively influence the “Realized User Friendliness” of KMSs.

**Hypothesis 12:** “Realized Benefits” of KMSs positively influence the “Continued use” of KMSs.

**Hypothesis 13:** “Realized User Friendliness” of KMSs positively influence the “Continued Use” of KMSs.

**Future Directions And Conclusion**

This chapter develops a research model for investigating the factors influencing end users’ adoption and continued use of KMSs—a topic that has not been well explored in the literature but represents a primary concern of KMSs. The research model was designed to explore the factors influencing the adoption and continued use of KMSs. Future research could test the entire research model. Parts of the model could also be extracted and investigated in detail. Another interesting future study could be to look at the
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differentiation among the types of KMSs adopters. According to Rogers’ (1995) theory of innovation diffusion, there are five types of adopters. The first to adopt a KMS are the innovators, who adopt it because of its intrinsic values, including perceived user-friendliness/perceived ease of use. Later, the early adopters adopt it since it is able to provide competitive advantage. Only then, the early majority adopt it for pragmatic reasons, such as return-on-investment, cost, and benefit. They are followed by the late adopters and conservatives, who wait until the system is very well established. Future studies could also do longitudinal studies to have a better understanding of the process of adoption and continued use of KMSs, conduct a comparison study between large organizations and small and medium-sized enterprises (SMEs), and investigate the adoption of KMS in different countries.

The model, including both of its main constructs and sub-factors/dimensions, can be taken as they are or fine-tuned to do a comprehensive survey by the researchers of a KM area. Organizations that are embarking on KMSs can use the constructs and factors of the study and do an internal audit to find out how they fare in terms of KMS implementation with respect to these constructs and factors. The proposed model also provides guidelines of KMS adoption and diffusion (continued use) to practitioners and KM consultants. Our immediate plan is to test the proposed research model by surveying end users of KMSs in Australian organizations.

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Thong, J. Y. L., & Yap, C. S. (1995). CEO characteristics, organizational characteristics and


Selected Readings
Chapter XVI

Classifying Web Users: A Cultural Value-Based Approach

Wei-Na Lee
University of Texas at Austin, USA

Se Jung Marina Choi
University of Texas at Austin, USA

Abstract

In today’s global environment, a myriad of communication mechanisms enable cultures around the world to interact with one another and form complex interrelationships. The goal of this chapter is to illustrate an individual-based approach to understanding cultural similarities and differences in the borderless world. Within the context of Web communication, a typology of individual cultural value orientations is proposed. This conceptualization emphasizes the need for making distinctions first at the individual level, before group-level comparisons are meaningful, in order to grasp the complexity of today’s global culture. The empirical study reported here further demonstrates the usefulness of this approach by successfully identifying 16 groups among American Web users as postulated in the proposed typology. Future research should follow the implications provided in this chapter in order to broaden our thinking about the role of culture in a world of global communication.

Introduction

As the adoption of media technology such as the Internet rapidly spreads around the world, communication across cultures increases. Individuals from diverse cultural groups interact with each other regardless of physical distances. On the one hand, such increased communication between cultures might facilitate cultural convergence on the global scale (Kincaid, 1988; Rogers & Kincaid, 1981). On the other hand, online technology’s capability to offer individualized communication might further fragment the global culture as people with similar values, outlooks, and interests across the world pursue their personal agendas via the decentralized electronic media (Choi &
Classifying Web Users

Danowski, 2002).

Culture has been a focal issue in global communication. More specifically, cultural similarities and differences have been considered the key to understanding cross-cultural human interactions. Extensive research to date has provided ample evidence of differences between cultures in terms of communication styles and messages. Implicit to this line of research is the assumption that members of a culture are likely to exhibit a pattern of social perception and behavior common within the culture, but different from that of another culture. Given this paradigm of conceptualizing culture, most cross-cultural comparisons are made at the national or cultural level, that is, between nations or cultures, while overlooking potential variations among individuals within a culture.

In today’s fast-changing media environment, people are exposed to various cultures through a multitude of channels and formats. While still adhering to the dominant values of the culture in which they belong, people these days rely on multiple frames of cultural reference simultaneously to construct their individual cultural orientations. For these reasons, it would be too simplistic to assume that everyone in the same culture displays the same pattern of thinking and behavior. In fact, individuals’ cultural orientations within the same culture could vary widely (Campbell, 2000). Therefore, a thoughtful investigation of today’s technology-mediated global culture needs to start from exploring fundamental cultural value orientations at the individual level.

Foremost among the major dimensions of cultural orientations are individualism and collectivism. Generally considered as polar opposites of each other, individualism emphasizes the concept of self, whereas collectivism focuses on other-directedness. Departing from this dichotomous view, recent research has suggested a more in-depth conceptualization of individualism and collectivism where, depending on whether equality (horizontal) or hierarchy (vertical) is underscored, the following four types of orientations can be identified: (1) horizontal individualism (uniqueness), where one can be unique and independent while still maintain status equality with others; (2) vertical individualism (achievement), where one strives to be the best and enjoys privileges that come with it; (3) horizontal collectivism (cooperativeness), where interdependence and equality in status are valued; and (4) vertical collectivism (dutifulness), where people submit to the social hierarchy ascribed by their in-groups (Triandis, 1995, 2001; Triandis & Suh, 2002).

Initial empirical evidence supports the viability of this four-way typology in detecting differences across national cultures (Nelson & Shavitt, 2002) and individual differences within a single culture (Lee & Choi, 2005).

Understanding similarities and differences in cultural orientations is the key for successful global online communication. Since the Web has emerged as an ideal medium for tailored communication for people across the world, it is imperative to obtain a baseline understanding of cultural values held by those who are users of the Web. As cultures increasingly interconnect on the Web and national borders gradually vanish, these insights will help prepare us for a future world community that is likely to be dominated by technology-mediated communication. At this juncture, research on cultural values in global communication should focus on the individual, not the nation or culture. Therefore, based on the aforementioned four-way typology, the goal of this chapter is to propose and empirically demonstrate a comprehensive classification framework for assessing cultural orientations at the individual level.

To accomplish the goal, this chapter first explains individualism and collectivism as dimensions of culture, and reviews relevant research developments in this area. Then, a thorough explanation of an in-depth typology that encompasses sufficient complexity to reflect cultural differences among individuals is provided. Next, this chapter reports results from an empirical study that classified and compared Web users in the U.S., using the
proposed individual level typology. This chapter concludes with implications of the findings and directions for future research.

**THE CONCEPTUALIZATION OF INDIVIDUALISM AND COLLECTIVISM**

The constructs of individualism and collectivism have been widely regarded as instrumental in helping explain differences between cultures. This can be seen from the vast amount of literature employing these ideas to account for differences in communication patterns and content, business practice, and preferences for communication styles and persuasive message appeals (Cho, Kwan, Gentry, Jun, & Kropp, 1999; de Mooij, 1998; Hall, 1984; Han & Shavitt, 1994; Hofstede, 1983, 1984; Miracle, Chang, & Taylor, 1992). The following sections provide a review of the defining characteristics of individualism and collectivism, and the conceptual advancements in this area.

**Individualism and Collectivism**

From an analysis of survey data collected from more than 50 countries around the world, Hofstede (1980) identified individualism and collectivism as one of the several fundamental dimensions of culture. He further demonstrated how these constructs can be characterized in people’s social perception and behavior. In individualistic cultures, typified as autonomous and independent, people’s personal goals are usually valued over the goals of their in-groups. Hence, people’s behaviors are primarily based on their own attitudes rather than the norms of their in-groups. In contrast, people in collectivistic cultures are interdependent within their in-groups, and the goals of their in-groups take priority over their own. Collectivists generally behave according to the norms of their in-groups, and place much emphasis on group harmony and hierarchy. In short, collectivists tend to do what is expected of them whereas individualists tend to do what they find personally fulfilling (Triandis, 1995).

Hofstede’s (1980, 1984) one-dimensional conceptualization places individualism and collectivism at the opposite ends of a continuum. A majority of the focus in research since then has been placed on explaining national differences using these constructs (Gudykunst & Ting-Toomey, 1988). In applications, comparisons are made by defining nations as residing at one or the other of those two extremes, or between them. Given today’s global environment and frequent border-crossing of people and ideas, however, the notion of a homogeneous population within a culture and the nation-based view of those constructs and comparisons may no longer hold true (Singlis & Brown, 1995). Put simply, not every person in an individualistic culture is an individualist. Nor does it mean that people in a collectivistic culture are all collectivists.

Research evidence over the years further suggests that the dichotomous conceptualization of individualism and collectivism in a bipolar manner is limited. There is a great need to expand the conceptualization from uni- to multidimensional in order to capture the complexity of cultural orientations and offer a comprehensive understanding (Singlis, Triandis, Bhawuk, & Gelfand, 1995; Triandis & Gelfand, 1998).

**Horizontal / Vertical Individualism / Collectivism**

Expanding on the above view, Triandis (1995, 2001) suggested that there are, in fact, different types of individualism and collectivism. Upon careful examination, for example, Korean collectivism is not entirely the same as the collectivism among the Japanese. The individualism in France is different from American individualism. Among the many dimensions that can further distinguish individualism and collectivism is the horizontal-vertical aspect of social relationships. In essence, both individualism and collectivism may be
horizontal (emphasizing equality) or vertical (emphasizing hierarchy). Underneath the horizontal orientation is the assumption that people see themselves as being essentially similar to others in their social relationships. On the contrary, the vertical dimension highlights hierarchy as the key to social relationships where people perceive themselves as being different from others. Adhering largely to Shintoism, the Japanese are highly egalitarian while exhibiting a very strong sense of cooperation. In contrast, social hierarchy is the guiding principle for attitude and behavior in Korea. Korean people have a tendency to value family and group hierarchy, and sacrifice their personal goals for group goals. Research has further shown that some individualistic cultures such as France and Sweden place more emphasis on equality by focusing on “doing one’s own things,” whereas other individualistic cultures such as the U.S. tend to emphasize hierarchy by embracing superiority.

From this conceptualization, four distinct types of cultures can be identified: (1) horizontal individualism (HI-uniqueness), where people strive to do their own thing and be unique; (2) vertical individualism (VI-achievement), where people strive to be distinguished and the best in competition with others; (3) horizontal collectivism (HC-cooperativeness), where people merge their selves with their in-group and underscore interdependence, harmony, and common goals with others; and (4) vertical collectivism (VC-dutifulness), where people submit to the authorities of the in-group and are willing to sacrifice themselves for their in-group (Triandis, 2001; Triandis & Suh, 2002). Although all individualistic people share the tendency of being independent and giving more priority to personal goals over group goals, in HI, people have little interest in acquiring high status, unlike those in VI. Likewise, in HC, people respect group goals, but do not simply give in to authorities, much different from those in VC.

While this four-way typology was suggested to help identify distinct prototypes of cultures, it also shows promise for an in-depth understanding of within-culture variations (Lee & Choi, 2005). At the individual level, however, the four types are often orthogonal and not mutually exclusive. In other words, people can and may exhibit a number of combinations of these cultural orientations. Given today’s global environment where cultures are increasingly fused via a variety of media technology, it is important to recognize the growing need for a more in-depth typology that captures the intricacy of cultural values.

Idiocentrism and Allocentrism

Shifting the focus from the group to the individual, the terms “idiocentrism” and “allocentrism” have been put forth to refer to personal individualism and collectivism, respectively (Yamaguchi, Kuhlman, & Sugimori, 1995). From this conceptual standpoint, a person’s cultural orientation is not automatically equated with his or her cultural or national membership. At the individual level of analysis, people’s cultural values may no longer coincide with the culture in which they belong. That is, there are idiocentrics (those who possess individualistic characteristics) in collectivistic cultures and allocentrics (those who show collectivistic orientations) in individualistic cultures (Triandis, McCusker, & Hui, 1990). In other words, both idiocentrics and allocentrics can and should be found in any given culture. However, the proportions of the two groups might vary given the dominant values at the national or cultural level (Triandis & Suh, 2002).

Based on the horizontal/vertical individualism/collectivism conceptualization and the need for individual level of understanding, a more thorough classification of cultural orientations is outlined in the following section.
Research evidence to date has demonstrated the utility of Triandis’ typology. Studies using the four prototypical patterns (HI, VI, HC, VC) to classify cultures generally assume that one particular type among the four prevails as the cultural orientation. In theory, however, people can have a mixture of attributes as defined by these four types simultaneously. Therefore, the original typology might not effectively describe all possible combinations of the various types of cultural orientations that people exhibit. A more comprehensive multidimensional classification, which identifies those pure types documented in the original conceptualization plus the hybrid types, should serve as a useful starting point to capture differences in individual cultural orientations.

Triandis’ distinction between horizontal and vertical individualism and collectivism is primarily developed for group-level comparisons. As an extension, the proposed individual-level typology classifies people based on the extent to which they exhibit patterns of attributes along *horizontal and vertical idiocentrism and allocentrism*. Since a person’s orientation can be assessed as either high or low on the four different dimensions, this expanded classification, presented in Table 1, identifies 16 possible individual cultural orientation groups. Below is a description of the major groups under this framework.

### Horizontal Idiocentrices and Vertical Idiocentrices

Horizontal and vertical idiocentrices are those individuals who exhibit idiocentric tendencies with either a horizontal or vertical orientation. They score high on horizontal or vertical idi-

### Table 1. Individual cultural orientation classification

<table>
<thead>
<tr>
<th>Group</th>
<th>Name</th>
<th>HI</th>
<th>VI</th>
<th>HA</th>
<th>VA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Horizontal Idiocentrics</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>2</td>
<td>Vertical Idiocentrics</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>3</td>
<td>Horizontal Allocentrics</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>4</td>
<td>Vertical Allocentrics</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>5</td>
<td>All-Around Idiocentrics</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>6</td>
<td>All-Around Allocentrics</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>7</td>
<td>The Horizontals</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>8</td>
<td>The Verticals</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>9</td>
<td>Bi-Idiocentric Allocentrics</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>10</td>
<td>Bi-Idiocentric Allocentrics</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>11</td>
<td>Tri-Idiocentric Allocentrics</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>12</td>
<td>Tri-Idiocentric Allocentrics</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>13</td>
<td>Tri-Idiocentric Allocentrics</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>14</td>
<td>Tri-Idiocentric Allocentrics</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>15</td>
<td>Null</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>16</td>
<td>Null</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>
ocentri...idiocentrics focus on self-development and self-reliance, whereas vertical idiocentrics are competitive and strive to be better than the rest.

**Horizontal Allocentrics and Vertical Allocentrics**

People who score high on horizontal or vertical allocentrism and low across all of the other dimensions are referred to as horizontal or vertical allocentrics. Horizontal allocentrics work toward group harmony and regard relationships among individuals in the group to be more or less equal. In contrast, vertical allocentrics put group goals above individual desires and obey social hierarchy closely.

**All-Around Idiocentrics and All-Around Allocentrics**

Although distinctions have been made between an orientation toward equality (horizontal) vs. hierarchy (vertical), people could still display both simultaneously. Those who are classified as high on both horizontal and vertical dimensions of idiocentrism, but low on both dimensions under allocentrism, may be regarded as all-around idiocentrics. With a focus on the self over groups, their social relations encompass tendencies toward hierarchy as well as equality. In other words, all-around idiocentrics keenly compete with others for status and recognition, as well as strive to be themselves and independent of others. Likewise, those who score high on both horizontal and vertical dimensions of allocentrism, but low on both dimensions of idiocentrism, are referred to as all-around allocentrics. Since their social relationships evolve around their in-groups both horizontally and vertically, all-around allocentrics strive for group harmony and hierarchy at the same time. For both all-around idiocentrics and allocentrics, the dominance of either the horizontal or vertical dimension could be a function of other factors.

**The Horizontals and the Verticals**

People who are predominantly horizontal or vertical in their orientation could behave with a mixture of both idiocentric and allocentric tendencies. They are referred to as the horizontals or the verticals. The horizontals are classified as high on the horizontal dimension under both idiocentrism and allocentrism, but low on both vertical dimensions. The opposite is true for the verticals. It appears that the horizontals and the verticals value equality and hierarchy, respectively, above and beyond their self or group orientation. With their deep-rooted view of hierarchy-centered social relationships, for example, the verticals respect the authorities in their in-group while endeavor to achieve high social status.

**Bi-Idiocentric Allocentrics and Tri-Idiocentric Allocentrics**

Bi-idiocentric allocentrics represent a portion of the population who simultaneously display attributes from two diametrically different dimensions. This group includes those who are high on vertical idiocentrism and horizontal allocentrism but low on horizontal idiocentrism and vertical allocentrism. In addition, people who score high on horizontal idiocentrism and vertical allocentrism but low on vertical idiocentrism and horizontal allocentrism also qualify as bi-idiocentric allocentrics. In a similar vein, tri-idiocentric allocentrics are people who are high on three out of the four dimensions and low on the remaining one. The level of complexity is significantly higher in this tri-idiocentric allocentric group and, consequently, it could be difficult to disentangle their attitudinal and behavioral differences based solely on cultural orientations.
The Null Group

Those who are equally high or low across all four dimensions are classified as the null group. Theoretically, it is plausible that some individuals simply do not exhibit a strong inclination toward any particular orientation. Likewise, some people might display an equally strong tendency toward all four orientations. Consequently, it might be a rather challenging task to comprehend these null groups’ cultural orientations due to their even predisposition along different dimensions. In this situation and other similarly complex situations outlined above, the proposed classification should be used in tandem with other cultural constructs in order to shed light on the multifaceted nature of individual cultural orientations.

Cultural Orientations And Global Communication On the Web

With the rapid diffusion of technology, the Web is quickly becoming a significant part of people’s daily lives. From information gathering to entertainment, from shopping to personal communication, the Web is omnipresent. As the penetration of the Web reaches the general population, the online population in the U.S. becomes demographically diverse (Schlosser, Shavitt, & Kanfer, 1999). Research evidence shows that this trend is occurring worldwide as well. Web users in different parts of the world become similar to each other in terms of their demographic characteristics and general Web use patterns (Chen, Boase, & Wellman, 2002). As a result, people within the U.S. are less similar to each other than they are to others outside the U.S. In other words, there could be more differences within a country than there are between countries.

The Web is a distinctive medium very much characterized by its ability to offer audience-controlled exposure, selectivity, and interactivity (Wolin, Korgaonkar, & Lund, 2002). Due to the unique nature of the Web, personal characteristics of Web users need to be taken into consideration in order to understand their social behaviors. Among the various demographic and psychological characteristics, Web users’ cultural orientations should be of prime importance in this endeavor.

In communications research, individualism and collectivism have served as a useful means to compare similarities and differences in styles and content across cultures (de Mooij, 1998; Hofstede, 1980, 1983). In addition, individualism and collectivism appear to be related to the distinction between low vs. high context. Generally speaking, low-context communication, which is usually straightforward, explicit, and direct, is common in individualistic cultures, whereas communication in collectivistic cultures is highly context dependent, typified by abstract, implicit, and indirect messages (Hall, 1976, 1984).

These constructs of cultural values offer viable means for examining differences in computer-mediated communication between cultures (e.g., Callahan, 2005; Wurtz, 2005). However, as the Web continues to facilitate intercultural flows of ideas and communication between people from all over the world in the forms of message boards, e-mails, newsgroups, and so forth, the need for a thorough investigation of cultural values at the individual level becomes more pertinent (Hewling, 2005). As Scollon and Wong-Scollon (2001) state, “Cultures do not talk to each other; individuals do” (p. 138). Differences in individual cultural orientations might be the most critical factor in understanding Web users from diverse cultures. In this light, the individual-level typology proposed in this chapter should serve as a useful tool for further scrutinizing cultural orientations and classifying Web users.
Classifying Web Users

the study

A Web survey with a sample drawn from an online panel of consumers in the U.S. was undertaken in October 2003 to provide empirical evidence for the proposed individual-level typology. The method and results of the study are reported in this section.

Method

Sample. Participants were recruited from an established online consumer panel consisting of Web users with diverse demographic characteristics. Those Web users participate in Web-based studies at regular intervals over a period of time for various rewards. The demographics of the online panel track well with the latest online population trend figures—consisting of predominantly female, young, non-Hispanic white, higher education and household income Web users (Pew Internet & American Life Project, 2005). Of the original 1,101 surveys completed, a total of 1,033 were included in the sample after eliminating incomplete surveys.

More than half of the respondents were female (58.5%). The average age of the respondents was 40 years old with a range from 23 to 80 years. Caucasians constituted the majority of the study participants (79.3%), followed by Hispanics (8.2%) and Asians (5.6%). Over half of the respondents were married (54.5%), while one-third (30.5%) were single. The respondents were relatively well-educated, with the vast majority of them having a college degree or higher (98.9%). In terms of economic status, 70.8% of the respondents were employed full time, and about half of the respondents reported an annual household income of $50,000 or higher. Table 2 provides a description of the sample characteristics.

Data collection procedure. An invitation e-mail announcement was sent to members of the online panel. The invitation e-mail contained a brief description of the study and directed panel members to the study site. All those who participated in the study were eligible to win a drawing of a $150 cash prize.

Measures. The questionnaire consisted of four main sections. In the first part of the questionnaire, respondents were asked to indicate how much time on an average weekday they used television, radio, newspapers, magazines, and the Web. Next, respondents’ cultural orientations were gauged via the four-way typology measures developed by Triandis (1995). As the scale, originally developed for group-level measurements, was deemed equally suitable for individual-level assessments (Lee & Choi, 2005), the measures were adopted without modifications. Each of the four dimensions was measured via a four-item, seven-point, Likert-type scale: (1) horizontal idiocentrism—HI, (2) vertical idiocentrism—VI, (3) horizontal allocentrism—HA, and (4) vertical allocentrism—VA. Measures tapping the cultural orientations included statements such as “I’d rather depend on myself than others” (HI), “It is important that I do my job better than others” (VI), “If a coworker gets a prize, I would feel proud” (HA), and “Parents and children must stay together as much as possible” (VA).

The third section of the survey examined respondents’ experience with the Web. An eight-item, seven-point, Likert-type scale asked for respondents’ beliefs about their Web skills and their perceived degree of challenges in their experience using the Web (Novak, Hoffman, & Yung, 2000). Respondents’ demographic characteristics such as gender, age, employment, annual household income, ethnicity, highest education level attained, and marital status were obtained toward the end of the survey. The specific items for the major constructs and their respective reliability coefficients are shown in Table 3.
Table 2. Sample characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Frequency</th>
<th>Percent*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>422</td>
<td>58.5%</td>
</tr>
<tr>
<td>Female</td>
<td>604</td>
<td>40.9%</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-29</td>
<td>260</td>
<td>25.2%</td>
</tr>
<tr>
<td>30-39</td>
<td>341</td>
<td>33.0%</td>
</tr>
<tr>
<td>40-49</td>
<td>151</td>
<td>14.6%</td>
</tr>
<tr>
<td>50-59</td>
<td>167</td>
<td>16.2%</td>
</tr>
<tr>
<td>Over 60</td>
<td>104</td>
<td>10.1%</td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>727</td>
<td>70.4%</td>
</tr>
<tr>
<td>Part-time</td>
<td>113</td>
<td>10.9%</td>
</tr>
<tr>
<td>Unemployed</td>
<td>187</td>
<td>18.1%</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>814</td>
<td>78.8%</td>
</tr>
<tr>
<td>Hispanic-American</td>
<td>84</td>
<td>8.1%</td>
</tr>
<tr>
<td>Asian-American</td>
<td>57</td>
<td>5.5%</td>
</tr>
<tr>
<td>African-American</td>
<td>14</td>
<td>1.4%</td>
</tr>
<tr>
<td>Native American</td>
<td>3</td>
<td>0.3%</td>
</tr>
<tr>
<td>Multiracial</td>
<td>20</td>
<td>1.9%</td>
</tr>
<tr>
<td>International</td>
<td>22</td>
<td>2.1%</td>
</tr>
<tr>
<td>Other</td>
<td>13</td>
<td>1.3%</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>313</td>
<td>30.3%</td>
</tr>
<tr>
<td>Married</td>
<td>560</td>
<td>54.2%</td>
</tr>
<tr>
<td>Divorced</td>
<td>59</td>
<td>5.7%</td>
</tr>
<tr>
<td>Living with someone</td>
<td>75</td>
<td>7.3%</td>
</tr>
<tr>
<td>Separated</td>
<td>6</td>
<td>0.6%</td>
</tr>
<tr>
<td>Widowed</td>
<td>11</td>
<td>1.1%</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>0.3%</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vocational/technical school (2 yrs)</td>
<td>1</td>
<td>0.1%</td>
</tr>
<tr>
<td>Some college</td>
<td>10</td>
<td>1.0%</td>
</tr>
<tr>
<td>College graduate (4 yrs)</td>
<td>579</td>
<td>56.1%</td>
</tr>
<tr>
<td>Master’s degree</td>
<td>283</td>
<td>27.4%</td>
</tr>
<tr>
<td>Doctoral degree</td>
<td>46</td>
<td>4.5%</td>
</tr>
<tr>
<td>Professional degree (MD, JD, etc.)</td>
<td>112</td>
<td>10.8%</td>
</tr>
<tr>
<td><strong>Household Income</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under $10,000</td>
<td>24</td>
<td>2.3%</td>
</tr>
<tr>
<td>$10,000-$19,999</td>
<td>25</td>
<td>2.4%</td>
</tr>
<tr>
<td>$20,000-$29,999</td>
<td>51</td>
<td>4.9%</td>
</tr>
<tr>
<td>$30,000-$39,999</td>
<td>105</td>
<td>10.2%</td>
</tr>
<tr>
<td>$40,000-$49,999</td>
<td>120</td>
<td>11.6%</td>
</tr>
<tr>
<td>$50,000-$74,999</td>
<td>173</td>
<td>16.7%</td>
</tr>
<tr>
<td>$75,000-$99,999</td>
<td>159</td>
<td>15.4%</td>
</tr>
<tr>
<td>Over $100,000</td>
<td>309</td>
<td>29.9%</td>
</tr>
<tr>
<td>Other</td>
<td>44</td>
<td>4.3%</td>
</tr>
</tbody>
</table>

Note: * The base of the percentages was the total sample size of 1033.
### Table 3. Specific items for the key measures

<table>
<thead>
<tr>
<th>Cultural Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Horizontal Idiocentrism (α = .64)</strong></td>
</tr>
<tr>
<td>I'd rather depend on myself than others.</td>
</tr>
<tr>
<td>I rely on myself most of the time; I rarely rely on others.</td>
</tr>
<tr>
<td>I often do “my own thing.”</td>
</tr>
<tr>
<td>My personal identity, independent of others, is very important to me.</td>
</tr>
<tr>
<td><strong>Vertical Idiocentrism (α = .66)</strong></td>
</tr>
<tr>
<td>It is important that I do my job better than others.</td>
</tr>
<tr>
<td>Winning is everything.</td>
</tr>
<tr>
<td>Competition is the law of nature.</td>
</tr>
<tr>
<td>When another person does better than I do, I get tense and aroused.</td>
</tr>
<tr>
<td><strong>Horizontal Allocentrism (α = .69)</strong></td>
</tr>
<tr>
<td>If a coworker gets a prize, I would feel proud.</td>
</tr>
<tr>
<td>The well-being of my coworkers is important to me.</td>
</tr>
<tr>
<td>To me, pleasure is spending time with others.*</td>
</tr>
<tr>
<td>I feel good when I cooperate with others.</td>
</tr>
<tr>
<td><strong>Vertical Allocentrism (α = .64)</strong></td>
</tr>
<tr>
<td>Parents and children must stay together as much as possible.</td>
</tr>
<tr>
<td>It is my duty to take care of my family, even when I have to sacrifice what I want.</td>
</tr>
<tr>
<td>Family members should stick together, no matter what sacrifices are required.</td>
</tr>
<tr>
<td>It is important to me that I respect the decisions made by my groups.*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Web Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Web Skills (α = .87)</strong></td>
</tr>
<tr>
<td>I am extremely skilled at using the Web.</td>
</tr>
<tr>
<td>I consider myself knowledgeable about good search techniques on the Web.</td>
</tr>
<tr>
<td>I know somewhat less about using the Web than most users. (R)</td>
</tr>
<tr>
<td>I know how to find what I am looking for on the Web.</td>
</tr>
<tr>
<td><strong>Web Challenges (α = .66)</strong></td>
</tr>
<tr>
<td>Using the Web does not challenge me. (R)</td>
</tr>
<tr>
<td>Using the Web challenges me to perform to the best of my ability.</td>
</tr>
<tr>
<td>Using the Web provides a good test of my skills.</td>
</tr>
<tr>
<td>I find that using the Web stretches my capabilities to my limits.</td>
</tr>
</tbody>
</table>
Results

Horizontal/vertical idiocentrism/allocentrism scale validation for individual-level differentiations. Because the group-level measures of horizontal and vertical individualism and collectivism have been previously validated for individual level of analysis (Lee & Choi, 2005), detailed discussion on the horizontal/vertical idiocentrism/allocentrism scale validation is omitted here. In brief, all of the items significantly loaded on the constructs that they were intended to tap into, although two items with a factor loading below 0.4 were dropped from further analysis. Table 4 reports the factor loadings of the indicators for each latent variable and the goodness-of-fit indices of the measurement model. Items for each construct were averaged to form an index score. The descriptive statistics of the four cultural dimensions are shown in Table 5, and the correlations among the constructs are reported in Table 6.

Table 4. Factor loadings of indicators

<table>
<thead>
<tr>
<th>Factors</th>
<th>Indicators</th>
<th>Unstd.</th>
<th>Std.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Idiocentrism</td>
<td>I'd rather depend on myself than others.</td>
<td>1.00</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>I rely on myself most of the time; I rarely rely on others.</td>
<td>1.30</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>I often do “my own thing.”</td>
<td>0.74</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td>My personal identity, independent of others, is very important to me.</td>
<td>0.54</td>
<td>0.40</td>
</tr>
<tr>
<td>Vertical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Idiocentrism</td>
<td>It is important that I do my job better than others.</td>
<td>1.00</td>
<td>0.59</td>
</tr>
<tr>
<td></td>
<td>Winning is everything.</td>
<td>1.42</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>Competition is the law of nature.</td>
<td>1.04</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td>When another person does better than I do, I get tense and aroused.</td>
<td>1.07</td>
<td>0.53</td>
</tr>
<tr>
<td>Horizontal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allocentrism</td>
<td>If a coworker gets a prize, I would feel proud.</td>
<td>1.00</td>
<td>0.65</td>
</tr>
<tr>
<td></td>
<td>The well-being of my coworkers is important to me.</td>
<td>1.03</td>
<td>0.76</td>
</tr>
<tr>
<td></td>
<td>I feel good when I cooperate with others.</td>
<td>0.70</td>
<td>0.58</td>
</tr>
<tr>
<td>Vertical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allocentrism</td>
<td>Parents and children must stay together as much as possible.</td>
<td>1.00</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>It is my duty to take care of my family, even when I have to sacrifice what I want.</td>
<td>0.68</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td>Family members should stick together, no matter what sacrifices are required.</td>
<td>0.99</td>
<td>0.62</td>
</tr>
</tbody>
</table>

Note: All coefficients are significant (p < .001).

Goodness of fit statistics: $\chi^2 (71) = 561.07, p < .001, GFI = .93, AGFI = .89, CFI = .83, RMSEA = .08$

Table 5. Descriptive statistics of cultural dimensions

<table>
<thead>
<tr>
<th>Variables</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal Idiocentrism</td>
<td>5.39</td>
<td>0.92</td>
</tr>
<tr>
<td>Vertical Idiocentrism</td>
<td>4.03</td>
<td>1.05</td>
</tr>
<tr>
<td>Horizontal Allocentrism</td>
<td>5.72</td>
<td>0.84</td>
</tr>
<tr>
<td>Vertical Allocentrism</td>
<td>5.32</td>
<td>1.03</td>
</tr>
</tbody>
</table>

Note: All items were measured on a seven-point scale (N=1008).
Classifying Web Users

Table 6. Covariance and correlation matrix of the cultural dimensions

<table>
<thead>
<tr>
<th></th>
<th>HI</th>
<th>VI</th>
<th>HC</th>
<th>VC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal Idiocentrism</td>
<td>1.00</td>
<td>0.33**</td>
<td>0.01</td>
<td>0.03</td>
</tr>
<tr>
<td>Vertical Idiocentrism</td>
<td>0.52</td>
<td>1.00</td>
<td>-0.19**</td>
<td>0.09*</td>
</tr>
<tr>
<td>Horizontal Allocentrism</td>
<td>0.01</td>
<td>-0.32</td>
<td>1.00</td>
<td>0.29**</td>
</tr>
<tr>
<td>Vertical Allocentrism</td>
<td>0.04</td>
<td>0.13</td>
<td>0.39</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Note: * p < .01, ** p < .001
Correlations are in the lower triangle and covariances in the upper triangle.

Table 7. Number of people in cultural orientation groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Name</th>
<th>HI</th>
<th>VI</th>
<th>HA</th>
<th>VA</th>
<th>No. of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Horizontal Idiocentrics</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>39</td>
</tr>
<tr>
<td>2</td>
<td>Vertical Idiocentrics</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>29</td>
</tr>
<tr>
<td>3</td>
<td>Horizontal Allocentrism</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>48</td>
</tr>
<tr>
<td>4</td>
<td>Vertical Allocentrism</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>56</td>
</tr>
<tr>
<td>5</td>
<td>All-Around Idiocentrics</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>62</td>
</tr>
<tr>
<td>6</td>
<td>All-Around Allocentrism</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>102</td>
</tr>
<tr>
<td>7</td>
<td>The Horizontals</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>43</td>
</tr>
<tr>
<td>8</td>
<td>The Verticals</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>46</td>
</tr>
<tr>
<td>9</td>
<td>Bi-Idiocentric Allocentrism</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>Bi-Idiocentric Allocentrism</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>37</td>
</tr>
<tr>
<td>11</td>
<td>Tri-Idiocentric Allocentrism</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>30</td>
</tr>
<tr>
<td>12</td>
<td>Tri-Idiocentric Allocentrism</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>72</td>
</tr>
<tr>
<td>13</td>
<td>Tri-Idiocentric Allocentrism</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>69</td>
</tr>
<tr>
<td>14</td>
<td>Tri-Idiocentric Allocentrism</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>25</td>
</tr>
<tr>
<td>15</td>
<td>Null</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>68</td>
</tr>
<tr>
<td>16</td>
<td>Null</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>78</td>
</tr>
</tbody>
</table>

Note: (N=814 Caucasians)

Horizontal/vertical idiocentrism/allocentrism classification. Given the ethnic diversity in the American culture, differences in cultural orientations among different ethnic groups were examined first. While significant differences between respondents with different ethnic backgrounds were indeed observed, the relatively small sizes of several ethnic groups did not allow for meaningful comparisons across groups in further investigation. Furthermore, an ethnically homogeneous group of Web users was deemed appropriate for the purpose of assessing the utility of the individual-level typology for detecting within-culture variations. For further classification, therefore, the sample included a single majority ethnic group, 814 Caucasian respondents, after eliminating other small ethnic groups. The Web users in the sample were first divided into high vs. low groups on each of the four cultural elements using a median split. The median scores
Classifying Web Users

were 5.5 (HI), 4.0 (VI), 5.7 (HA), and 5.3 (VA) respectively. Using the proposed typology, these Web users were then classified into one of the 16 cultural groups depending on their locations along the four cultural dimensions.

Table 7 reports the number of respondents classified as belonging in each of the groups. In support of the viability of the individual-level typology for detecting within-culture variations, all 16 types of cultural orientations were represented and successfully identified among members of the single culture tested here. Surprisingly, among the 16 groups, all-around allocentrics appeared to be the largest cultural group with 102 people. The next major groups identified included two null and two tri-idiocentric allocentric groups, with the number of members ranging from 68 to 78. While 62 all-around idiocentrics comprised the sixth largest group, two other types of allocentrics followed as the next largest groups, with 56 people and 48 people classified as vertical allocentrics and horizontal allocentrics, respectively. Furthermore, fewer people were categorized as horizontal idiocentrics (39) or vertical idiocentrics (29) than the verticals (46) or the horizontals (43). Taken together, these results show that, contrary to the literature in which the U.S. is constantly characterized as a predominantly individualistic culture at the national culture level, collectivistic tendencies were commonly observed in the cultural orientations among American Web users at the individual level.

Table 8. Time spent with media on an average weekday

<table>
<thead>
<tr>
<th></th>
<th>Television</th>
<th>Radio</th>
<th>Newspapers</th>
<th>Magazines</th>
<th>The Web</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not use on a daily basis</td>
<td>38 (4.7%)</td>
<td>43 (5.3%)</td>
<td>227 (27.9%)</td>
<td>205 (23.8%)</td>
<td>1 (0.6%)</td>
</tr>
<tr>
<td>30 min.</td>
<td>68 (8.4%)</td>
<td>209 (25.7%)</td>
<td>320 (39.3%)</td>
<td>415 (54.7%)</td>
<td>84 (12.2%)</td>
</tr>
<tr>
<td>1 hour</td>
<td>87 (10.7%)</td>
<td>167 (20.5%)</td>
<td>153 (18.8%)</td>
<td>109 (8.7%)</td>
<td>120 (15.7%)</td>
</tr>
<tr>
<td>1 hr. 30 min.</td>
<td>68 (8.4%)</td>
<td>76 (9.3%)</td>
<td>33 (4.1%)</td>
<td>14 (1.2%)</td>
<td>78 (7.6%)</td>
</tr>
<tr>
<td>2 hours</td>
<td>155 (19.0%)</td>
<td>95 (11.7%)</td>
<td>33 (4.1%)</td>
<td>40 (6.4%)</td>
<td>145 (16.3%)</td>
</tr>
<tr>
<td>2 hr 30 min.</td>
<td>47 (5.8%)</td>
<td>31 (3.8%)</td>
<td>7 (0.9%)</td>
<td>0 (0.0%)</td>
<td>31 (2.3%)</td>
</tr>
<tr>
<td>3 hours</td>
<td>117 (14.4%)</td>
<td>36 (4.4%)</td>
<td>18 (2.2%)</td>
<td>16 (2.3%)</td>
<td>87 (11.6%)</td>
</tr>
<tr>
<td>3 hr 30 min.</td>
<td>21 (2.6%)</td>
<td>6 (0.7%)</td>
<td>0 (0.0%)</td>
<td>1 (0.0%)</td>
<td>11 (0.6%)</td>
</tr>
<tr>
<td>4 hours</td>
<td>82 (10.1%)</td>
<td>31 (3.8%)</td>
<td>7 (0.9%)</td>
<td>2 (0.6%)</td>
<td>65 (7.6%)</td>
</tr>
<tr>
<td>4 hr 30 min.</td>
<td>11 (1.4%)</td>
<td>5 (0.6%)</td>
<td>1 (0.1%)</td>
<td>1 (0.0%)</td>
<td>8 (1.7%)</td>
</tr>
<tr>
<td>5 hours</td>
<td>26 (3.2%)</td>
<td>23 (2.8%)</td>
<td>4 (0.5%)</td>
<td>0 (0.0%)</td>
<td>23 (2.3%)</td>
</tr>
<tr>
<td>More than 5 hr.</td>
<td>90 (11.1%)</td>
<td>87 (10.7%)</td>
<td>6 (0.7%)</td>
<td>5 (1.2%)</td>
<td>155 (20.3%)</td>
</tr>
</tbody>
</table>

Note: The base of the percentages was the sample size of 814 Caucasians.
Classifying Web Users

Of note was that there appeared to be a large number of people who exhibited both idiocentric and allocentric orientations, belonging in bi-idiocentric allocentrics or tri-idiocentric allocentrics. Consistent with previous theoretical discussion on the potential influence of the global culture in the Web environment, the Web users examined in this study indeed fused a combination of cultural values across the vertical/horizontal and the idiocentric/allocentric dimensions to guide their social perception and behavior. In summary, within a seemingly homogenous cultural group, the diversity of individuals’ cultural orientations was observed using the individual-level typology.

Characteristics across cultural groups. In the next phase of the analysis, media use, Web experience, and demographic characteristics of the people classified into the different cultural groups were examined. When asked to indicate the amount of time spent on an average weekday watching television, reading magazines and newspapers, listening to the radio, and using the Web, a great majority of the respondents reported using all of the media on a daily basis. The media use patterns appeared to be relatively consistent across the groups, and no significant differences between the groups were observed. Not surprisingly, the Web was the most popular media, with about 19% of the respondents using it for more than five hours a day, followed by television, radio, newspapers, and magazines. Table 8 reports respondents’ time spent with each of the media. Additionally, respondents’ perceived skills and challenges pertaining to the Web were assessed. Respondents’ self-judged Web skills were quite

<table>
<thead>
<tr>
<th>No.</th>
<th>Group Name</th>
<th>Gender</th>
<th>Employment</th>
<th>Marital Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Female</td>
<td>Male</td>
<td>Full-time</td>
</tr>
<tr>
<td>1</td>
<td>Horizontal Idiocentrics</td>
<td>24</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>Vertical Idiocentrics</td>
<td>13</td>
<td>15</td>
<td>27</td>
</tr>
<tr>
<td>3</td>
<td>Horizontal Allocentrics</td>
<td>31</td>
<td>17</td>
<td>31</td>
</tr>
<tr>
<td>4</td>
<td>Vertical Allocentrics</td>
<td>33</td>
<td>23</td>
<td>38</td>
</tr>
<tr>
<td>5</td>
<td>All-Around Idiocentrics</td>
<td>41</td>
<td>21</td>
<td>52</td>
</tr>
<tr>
<td>6</td>
<td>All-Around Allocentrics</td>
<td>64</td>
<td>36</td>
<td>61</td>
</tr>
<tr>
<td>7</td>
<td>The Horizontals</td>
<td>30</td>
<td>13</td>
<td>32</td>
</tr>
<tr>
<td>8</td>
<td>The Verticals</td>
<td>21</td>
<td>25</td>
<td>35</td>
</tr>
<tr>
<td>9</td>
<td>Bi-Idiocentric Allocentrics</td>
<td>5</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>10</td>
<td>Bi-Idiocentric Allocentrics</td>
<td>23</td>
<td>14</td>
<td>22</td>
</tr>
<tr>
<td>11</td>
<td>Tri-Idiocentric Allocentrics</td>
<td>12</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>12</td>
<td>Tri-Idiocentric Allocentrics</td>
<td>48</td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>13</td>
<td>Tri-Idiocentric Allocentrics</td>
<td>24</td>
<td>45</td>
<td>50</td>
</tr>
<tr>
<td>14</td>
<td>Tri-Idiocentric Allocentrics</td>
<td>20</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>15</td>
<td>Null</td>
<td>37</td>
<td>30</td>
<td>46</td>
</tr>
<tr>
<td>16</td>
<td>Null</td>
<td>53</td>
<td>25</td>
<td>59</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>479</td>
<td>331</td>
<td>573</td>
</tr>
</tbody>
</table>

Note: The three highest numbers per each group are highlighted in bold type.
Classifying Web Users

high with an average rating of 5.85 on a seven-point scale, whereas they perceived the Web as not very challenging, displaying a mean score of 2.90.

As summarized in Table 9, people from the different cultural orientation groups showed similar demographic characteristics as well. Across almost all of the demographic categories, all-around allocentrics were identified as the major type of cultural orientation. This is similar to the overall rankings of the groups. One exception was that single people were mostly all-around idiocentrics, whereas the two most common cultural orientations among married people were all-around allocentrics and vertical allocentrics. Of additional interest was that among those who worked full time, all-around idiocentrics were identified as the second frequent type, following all-around allocentrics.

SUMMARY

Understanding culture is central to global communication because it serves as a meaningful platform that helps articulate communication needs and delivery for people around the world. As the penetration of the Web increases and technology-mediated communication proliferates, cultural gaps between countries and regions are often said to become narrower. Yet, multiplicity, as opposed to uniformity, of cultural values is still commonly observed. The decentralized and individualized nature of today’s media technology might have resulted in further fragmentation of people’s cultural orientations, since reinforcements from others with similar views and preferences could be just a click away. Perhaps cultural convergence takes place between like-minded people across nations, whereas divergence of cultural values might be witnessed among people within a country. A thoughtful investigation is warranted to unravel the dynamic role of communication technology in culture change.

In today’s global environment, geographical perimeters are blurred and people are exposed to many different cultures through various means. Global trends, growing communication between cultures, and shifting frames of cultural reference make the scrutiny of individual cultural orientations a pressing issue. Based on recent conceptual developments of individualism and collectivism, an in-depth typology classifying individual cultural orientations is proposed in this chapter. Altogether, 16 individual groups are delineated. This theoretical classification was tested with a sample of American Web users where all 16 groups were identified. While appearing homogeneous on the surface with the same national membership and ethnicity, as well as similar income and education levels, Web users in the study showed a wide assortment of cultural orientations as postulated by the classification typology. This empirical evidence provides the much-needed impetus for future research using a cultural value-based approach to understanding users of technology-mediated communication around the globe.

Three general theoretical issues are evidenced from the proposed classification and empirical findings. First, the simple fact that the individual-level typology was successfully implemented suggests that, in today’s highly interconnected world, it is necessary to start assessing cultural level constructs at the individual level. Other cultural value dimensions such as power distance, uncertainty avoidance, and long-term orientation might also benefit from this approach.

Second, given today’s global environment, people with complex cultural orientations are not only common but should be expected. This can be seen from the identification and prevalence of the horizontals, the verticals, and the bi and tri-idiocentric allocentrics in the study. These groups were theoretically derived and empirically verified. This observation further illustrates the importance of an individual-level approach to understanding the role of culture in
global communication. Finally, because of the complex mixing of cultural value orientations in some groups, it might be necessary that the proposed classification be further explored in conjunction with other constructs such as communication context dependency and situational variations, to name but a few. Among the multitude of cultural values characterizing the groups, for example, a certain dimension might become particularly pertinent depending on the context. This endeavor will help propel valuable progress toward a comprehensive framework of culture and global communication.

Certainly, the individual cultural value orientation approach does not negate the need for group-level comparisons. In fact, group-level comparisons are of practical concern because operationally they provide effective means for the differentiation and implementation of cross-country communication, both in terms of content and format. After applying the proposed classification to individuals, comparisons of dissimilar groups within and similar groups across countries or cultures are possible. The traditional national or cultural borders are no longer an issue of concern in this conceptualization. Future research should follow the implications provided in this chapter in order to broaden our thinking about the role of culture in a world of borderless communication.

**References**


Hofstede, G. (1983). Dimensions of national cultures in fifty countries and three regions. In


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Chapter XVII

mCity:
User Focused Development of Mobile Services Within the City of Stockholm

Annette Hallin
Royal Institute of Technology (KTH), Sweden

Kristina Lundevall
The City of Stockholm, Sweden

Abstract

This chapter presents the mCity Project, a project owned by the City of Stockholm, aiming at creating user-friendly mobile services in collaboration with businesses. Starting from the end-users’ perspective, mCity focuses on how to satisfy existing needs in the community, initiating test pilots within a wide range of areas, from health care and education, to tourism and business. The lesson learned is that user focus creates involvement among end users and leads to the development of sustainable systems that are actually used after they have been implemented. This is naturally vital input not only to municipalities and governments but also for the IT/telecom industry at large. Using the knowledge from mCity, the authors suggest a new, broader definition of “m-government” which focuses on mobile people rather than mobile technology.

Introduction

All over the world, ICT technologies are used to an increasing extent within the public sector. For cities, ICTs not only provide the possibilities of improving the efficiency among its employees and its service towards tourists, citizens, and companies; it is also an important factor in the development of the city and its region, as ICTs today generally are considered to constitute the driving force of economy and social change (Castells, 1997). It is also argued that ICTs can improve efficiency, enhance transparency, control, networking and innovation (Windén, 2003). Thus, several cities
are involved in projects concerning the development, testing, and implementation of ICTs. A few examples include Crossroads Copenhagen in Denmark, Testbed Botnia, and TelecomCity from the cities of Luleå and Karlskrona in Sweden. Within all these projects, triple-helix-like organizations are used involving the local municipality or national government, the local university, and the locally-based companies (Jazic & Lundevall, 2003).

Also within the City of Stockholm, there is such a project—the mCity Project. This was launched by the City of Stockholm in January of 2002, with the aim of organizing “the mobile city” through the implementation of relevant ICTs. The mCity Project consists of several small pilot projects, focusing on identifying needs in the community and creating solutions to these. In this chapter, we intend to describe this project, its organization, work processes, and the results. We also discuss the experiences made and how the project can serve as an inspiration towards a broader understanding of “m-government”.

**brie Fly About the City of Stockholm**

The City of Stockholm is Sweden’s largest municipality with about 760,000 inhabitants, but is, compared to other capitals in the world, a small city. Due to the Swedish form of government, Stockholm—as well as all other Swedish cities—has large responsibilities, including child care, primary and secondary education, care of the elderly, fire-fighting, city planning, and maintenance, and so forth. All these responsibilities are financed through income taxes, at levels set by the cities themselves, with no national interference. The operational responsibility lies, in the case of Stockholm, on 18 district councils and on 16 special administrations, depending on the issue. Through 15 different fully-owned or majority-interest, joint-stock and associated companies (hereafter called “municipal companies”), the City of Stockholm also provides water, optical fibre-infrastructure, housing (the City of Stockholm has the largest housing corporation in the country), shipping-facilities (the ports in the Stockholm area), parking, tourist information, the city theatre, the Globe Arena (for sports, concerts and other events) etc. In total, the city has an organization comprising 50,000 employees, and a yearly turn over of 31.5 billion SEK, which is equivalent to about 5 million USD. For the City of Stockholm, it is only natural to engage in ICT projects of different kinds, as this could be expected to have both financial and pedagogical benefits within this large organization—just as it had for other public organizations in Sweden (Grenblad, 2003).

In fact, ICT projects are encouraged by the City of Stockholm through the Stockholm “E-Strategy”. This is a visionary and strategic document, issued by the City Council in the beginning of 2001 which—among other things—firmly states the role of the citizen as the central figure for all activities in the city organization; the development of mobile technologies to enhance flexibility, as well as the importance of the city acting to aid Swedish ICT industry (The City of Stockholm’s E-Strategy, 19th of February 2001). It is the City Executive Board which is responsible for implementing the resolution of the City Council, but the “E-Strategy” document also points to the responsibility of the management of the different district councils, special administrations, and municipal companies for the strategic development of ICTs within each organization. The document also describes the function of “the IT Council”, which is to ensure that the e-strategy is implemented in a good way within the municipal organization, that is, not as a separate strategy, but in close contact with the activities for which the organizations are responsible.
BACKGROUND, ORGANIZATION, And Go Als

The idea of mCity was born in 2000 when the former EU Commissioner Martin Bangeman suggested a cooperation between European cities in order to stimulate the use of the upcoming 3G network and its services. In January 2001, a workshop was held with representatives from a number of major cities, telecom operators, vendors, and investors. A project proposal was submitted by Bangeman, suggesting that a few other European cities—Stockholm, Bremen, and Berlin among others—should start a holding corporation in order to develop and sell 3G services. However, this collaboration project did not become a reality. Instead, the City of Stockholm decided to proceed with a smaller scale project—mCity.

The following goals have been specified for the mCity Project in Stockholm:

- **To improve the working environment for the employees of the City of Stockholm.** By putting people in the center and letting them lead the development of mobile services, they will help develop services that will ease their own work tasks and their everyday lives.

- **To increase the quality of services for citizens.** The mCity Project strives to improve the service of the city to its citizens and visitors by improving the work environment for employees and by introducing citizen-specific solutions.

- **To stimulate the regional business (IT/Telecom).** By developing new solutions in collaboration with industry, new opportunities for the ICT industry within Stockholm, and throughout Sweden are developed, thereby creating a strong home market for companies in Stockholm.

- **To reinforce Stockholm’s profile as an IT capital.** By developing new and useful mobile services, Stockholm’s reputation as a leading IT capital will be further reinforced.

- **To spread the good example.** By working with small-scale test environments and small-scale tests, the results can be duplicated if successful. By involving the end users closely in the project, sustainability is ensured. An effect of more deeply involved users is that the users themselves become spokespersons for the services and actually help spread the word.

During its first year, the project was located in one of Stockholm’s district councils, which meant close contact with the end users. The project manager felt, however, that in order to keep up with the ICT development in other parts of the city, the project would be better off if it could be located more centrally in the organization. Since then, the project has been moved closer to the central administrative organization in the city.

The project organization of mCity is described in Figure 1. The Steering Committee, organized with representatives from different parts of the city, for example the IT Department and the City of Stockholm Executive Office, make strategic decisions about budget issues, what projects to initiate, and so forth. Different heads have chaired the Steering Committee during the course of the project. There are also members from the Stockholm IT Council in the Steering Committee, to ensure that the mCity Project follows Stockholm’s E-Strategy. The different pilot projects are initiated together with district councils, special administrations, or municipal companies which undertake the responsibility of local project management in each case. The mCity Project Manager is in charge of initiating and setting up the local projects in collaboration with the local project management and then keeps track of the day-to-day development of the projects. He/She is also responsible for collecting and spreading information about the projects, and for preparing the meetings with the Steering Committee as well.
as implementing the decisions of the Steering Committee. In their work, he/she can also use the Think Tank, to which a number of companies within the mobile technology industry belong, to ask for advice concerning technology or market requirements/development. Finally, a researcher from KTH, the Royal Institute of Technology, has been responsible for documenting the project.

**WORKING PROCESS**

Within the mCity Project, services for both private and public sectors are tested and thereafter developed in a larger scale if proven relevant. The services are operated and tested in “small islands” because it makes it easier to get close to the users and to change the tested services if something needs to be improved. Using this model, mCity has been able to connect groups with specific needs with companies developing mobile services that can satisfy these needs.

End-user needs, that is, the needs of citizens, visitors and employees within the City of Stockholm, form the starting point of every initiative within mCity—see Figure 2. One way of creating situations where users can make their voices heard is by initiating hearings, focus groups, interviews, and so forth. In some cases, the mCity Project Manager has been involved in this first part of the process; in other cases, the local management of the different district councils, special administrations, or municipal companies take the initiative of formulating an application, specifying the need. The exact details of the working process have shifted, depending on the organizational setting of the project.

In the next step, the mCity Project management uses their Competence Network to form a group with technical expertise to which the user’s need is presented. The group ponders about the possible technical solutions suitable to solve the problems and in this process, the end-users’ knowledge of ICTs, their workload, and the financial/techni-

![Figure 1. Organization of the mCity Project](image-url)
benefits of the services developed in relation to the concrete needs of users, are of high interest and hopefully, it is also possible to measure the added value. End solutions should be easy to use—it should be almost intuitive to understand how to use the provided service. This is one reason for why simple technology is mostly used in mCity Projects—technology is seldom the problem, the focus is rather on what to introduce and how to introduce it. To summarize, the working process can be described in three keywords:

- User-oriented
- Benefit-driven
- Simple

It should be pointed out that mCity primarily does small-scale pilot projects; when these have been launched, it is the responsibility of the district councils, the special administrations, or the municipal companies involved to decide whether to keep running the project, to enlarge it, and also to take the full operational and financial responsibility for the future project.

PILOT PROJECTS

mCity has started and financed several pilot projects since its launch in 2002. Different user groups are in need of different services and the largest segments identified are people who work, live in, and visit the City of Stockholm, as shown earlier in Figure 2. Through the pilot projects, these segments have been further specified, as described in Figure 3: tourists, students, SMEs, commuters, and city employees.

Tourists

The very first project within mCity was carried out in 2002 for tourists, when the official event database owned by Stockholm Visitors’ Board was made available via mobile Internet. The city
mCity wanted to do this in relation to its 750th anniversary which was to be celebrated that year, and it was decided that something new should be tested, which is why WAP was chosen.

A few years later in 2004, another service targeting tourists was developed by mCity. This time the development process was conducted by a group of talented students taking a project course at the Royal Institute of Technology. This project, tourism, was initiated by the Art Council at the Cultural Administration in order to find new ways of making information about Stockholm available through new technology. The result, a Web site with information on statues, art objects, and buildings of interest is available via mobile or fixed Internet on the address, www.explore.stockholm.se. The server recognizes if the user is accessing the Web site from a PDA, a laptop, or a mobile phone. By using XML functionality, separate interfaces for the different devices are shown, giving the user the best experience possible depending on the device used.

On the Web site, it is possible to search by the name of an object, a location, or a street. It is also possible to list all attractions within a city district. One can also make a guided tour through the Web site, and making this accessible for others to benefit from. Naturally, the personal tours have to be authorized by an administrator in order to filter non-ethnic information.

Students

mStudent is a joint project venture between the Federation of Student Unions in Stockholm (SSCO), the Stockholm Academic Forum, and the City of Stockholm within the framework of mCity. The objective is to develop mobile services which are useful to 80,000 students in the Stockholm region. For example, if students can receive an SMS telling them that a lecture has been cancelled, they might not have to come to the university campus at all that day, saving time to be better used for studies or other activities.

During the spring of 2003, 28 students from eight different universities and university-colleges in the Stockholm region participated in a feasibility study to identify a number of services interesting to students. This first phase of the project was carried out together with Telia, Ericsson, and Föreningssparbanken. The objective was to identify mobile services that would be useful to students in their everyday life. In order to really use the most of the students’ innovative minds, they were all given one of Ericsson’s most modern mobile phones and were allowed to use them without limitations. This made them experts on the available services and also good judges on new services.

Today, mStudent initiates and administers different forms of tests and evaluations of mobile
services in cooperation with businesses in Stockholm. The purpose is to encourage companies and universities to develop and use improved mobile services and thereby increase the quality of service to students as a group. The activities carried out are based on the list of mobile services that the students identified as interesting in the first phase; but apart from this, mStudent has also become a testbed which tests and evaluates all types of mobile services that can be useful for students. The “test pilots” are all students from Stockholm’s universities and university colleges, and mStudent gathers the students in focus groups for workshops, evaluations, and other activities. Some companies are already working together with student reference groups in order to gain feedback on their planned services.

SMEs

mCity has been involved in one project aiming toward higher use of mobile services among SMEs. In one of the shopping malls in central Stockholm, Söderhallarna, the stores can use the Internet and mobile technology to communicate, both with customers and the mall administration. The choice of Söderhallarna was not a coincidence. The property is actually owned by the City of Stockholm, and it is of importance to the mall administration to keep up with the technological development to be able to attract stores to the premises.

By working closely with the storeowners and the mall administration, mCity managed not only to improve the internal communication, but also to provide new ways of treating customer relations with the aid of mobile services. For instance, stores can now inform their customers of last-minute offers or arrivals of new products with SMS or e-mail. Also, customers can easier interact with some of the companies. One of the lunch providers receives the orders from their customers via SMS. This increases the probability of preparing the food on time when not having to take orders on the phone. The technology is also used by the Head of Marketing for the mall, in order to create VIP offers to customers, and to communicate with SME owners and other mall staff, such as janitors.

Commuters

Up-to-date traffic information, provided by the City of Stockholm and the Swedish Road Administration among others, is today available on the Internet site, www.trafiken.nu. The information can be reached via WAP and Internet, but more ways of accessing the information have been developed. To make traffic information available regardless of place or time is important since it brings the choice to commute at a given time to the commuter. The commuters can improve their itinerary and choice of transportation based on the information about the current traffic situation.

mCity is involved in several pilot projects within the traffic area all initiated with a pre-study to find out what kind of information commuters are interested in and would benefit from. In one project, mCity has financed the development of the use of dynamic voice to present information available on the Internet site. The synthetic voice starts reading the new information when a commuter calls a special telephone number available from both fixed and mobile telephones. In another project, commuters are able to subscribe to information on specific routes. The commuter submits information about specific time spans during which he/she is interested in knowing about traffic disturbances on a Web page. As soon as something happens on the route of interest on the specific time span, an SMS is sent out with this information.

Employees

mCity has initiated several SMS management systems within the municipal organizations of Stockholm. Even though the technology used
often is the most basic one, the impact has been extensive. Three examples of SMS solutions developed within mCity are described in the following sub-sections.

**Schools: Absence Management**

A few compulsory and upper-secondary schools have been provided with an absence management system. By keying in their social security number and a four-digit code, pupils can report themselves absent into an automated solution provided by the school. The information is then automatically sent as an e-mail or an SMS to the teachers, thereby reducing administrative work. The flow of information between the school and the parents is also improved since parents may receive an SMS when the child skips class or when parents should remember to pack extra clothes for special extracurricular activities.

**The Care Sector: Scheduling Services**

Within the care sector, scheduling is a time-consuming effort. Now, staff can plan and book time slots through the Internet, and changes can be made by management through SMS. Positive effects with the solution is that staff motivation has increased and the Head of Staff can now work with core activities as the administrative workload is reduced. This solution was tested together with the SMS solution described next.

**The Care Sector: Substitute Management**

Within the care sector, a group SMS service has been implemented to facilitate substitute management. Instead of trying to reach substitutes through regular phone calls, managers can send SMSs to groups of staff, saving several hours every time. This creates better opportunities for planning, resulting in less stress for care staff and great financial benefits for the City of Stockholm. Also, managers have discovered the possibilities of encouraging staff through group SMS; an occasional “Have a nice weekend!”, or the like, is very much appreciated by the staff working in mobile care units, not seeing much of their colleagues and managers when spending much time out in the field.

This SMS system has been so successful that it has now been made available to all employees within the City of Stockholm to use and benefit from. An interesting fact is that as more people are getting the opportunity to use the system, new areas of use are discovered every day by the users themselves.

**MCITY ExPERIENCES**

Looking at the mCity Project, it is clear that by focusing on and involving users who traditionally are considered underdeveloped within the field of ICTs, mCity reduces the digital divide. Areas like education and the care sector present great potential for municipalities and ICT companies as large savings of time and money can be made when administrative tasks are simplified. Also, by focusing on the areas with largest potential, one can increase average levels of use and knowledge of ICTs in the organization, even if simple technology is used. Thus, even the use of SMS might be an important step toward the use of more advanced mobile services (Williamson & Öst, 2004).

By involving the end user early on, the development process becomes more time consuming. On the other hand, there seems to be a higher chance of successful development and implementation. The involvement of end users in the development of mobile services leads to the appreciation of the users who feel that their experiences are valuable and have real impact. It is important to note that the “end user” is the very person who will use the system in the end, not his or her supervisor or manager. Thus, in small-scale projects, it is often
necessary to involve several levels of management, involving the ones who will use the system, the ones who can oversee work processes, as well as the ones who will pay for the system.

It is not always easy to involve people with limited skills and knowledge in technology in projects involving technology. Some people are also more skeptical of changes than others; they may have gone through several organizational changes within a short time span, or might not be interested in revising their working processes at all. This is especially obvious when implementing new technology. Thus, it is important to recognize that technological artefacts are as much social as technological objects, affecting people’s way of life as time and space are changing (Brown, 2002; Glimell & Juhlin, 2001; Urry, 2000).

In order to involve the end users, the project must be presented in a way which makes it come across as a project which will lead to obvious changes for the better and not primarily as a technological project. “We’re not necessarily positive to technology per se, but we are positive to all new projects and ideas that will improve our work”, a manager involved in the SMS project for substitute management stated in an interview (Hallin, 2003).

The information generated through the process also provides the companies involved with valuable input on user behavior and preferences. To engage companies in an m-government project like mCity has been very rewarding for all parties, but even though the pilot projects have been too small to make it necessary to issue invitations to tender, a discussion about the delimitations of working together with the private sector in development projects has taken place within the Steering Committee. This discussion has been similar to the general discussion going on in Sweden, as several public institutions find that the Public Procurement Act makes innovation in the area of public e-services difficult (Grenblad, 2003). In Sweden, there are not many precedents concerning these kinds of simple and quick forms of cooperations between the private and the public sectors. Clear directives as to how and when companies should be involved are needed.

A final lesson from the mCity Project is that simple technology offers great possibilities. mCity has not per se been interested in testing new technology just for the sake of testing new technology; the effects should be real and readily measurable, as described previously. This said, new technological inventions may also be tested and used, as has been the case within the mStudent Project and within the early tourist project. The clue is to always have in mind who is going to use the service. Students are in the forefront when it comes to usage of technology, and tourists also tend to be open minded to use new technology when travelling. Administrators in elderly care or in the school sector might not be as mature in their use of ICTs.

The choice of technology is also often subjected to other types of limitations. When developing new systems based on new technology, you have to be able to answer a lot of questions. One is whether the service should be available for all or just for a small group of people. In the case of mCity, this has been a difficult aspect since all services are tested on a small scale, enlarged when proving relevant. In small-scale environments, technological integration is not really necessary, but when making a service available on a larger scale, it is. In the projects in elderly care and in school administration, this was clearly evident. When making the group SMS project a large-scale implementation, integration to several internal programs was necessary, such as the mail system and the identification portal. This was not impossible, but of course involved more work and thorough consideration.

In a municipality, it is also necessary to consider the cost of implementing new technology. The new services have to deliver lowered cost or some other kind of gain for the city; developing services just for fun or because they are high-tech at the moment is not good enough.
Is mCity an m-government project? Generally, “m-government” is defined as “a subset of e-government”, involving the use of mobile/wireless applications in the public sector, making the public information and services available anytime, anywhere (Lallana, 2004). According to this definition, it could be questioned whether mCity is an m-government project, as there are pilot projects with other goals than the one stated earlier. The mStudent Project, for example, aims at improving the life for students in the Stockholm region by introducing new mobile services from different providers, and in the SME project, small- and middle-sized companies and their customers benefit from the mobile service introduced.

It is clear that the City of Stockholm through the mCity Project takes a broader grip on the task of providing people with the possibility of accessing public information and services, by also taking on a pedagogical role of encouraging people to use ICTs in different areas of city life, and by stimulating the ICT industry to develop new applications as well as rethink old applications. In order to understand this approach we must establish the relationship between the mCity Project and the municipal and national ICT strategies as well as the project’s relationship to the vision of Stockholm as an IT capital.

**mCity in Relation to Municipal and National Strategy**

As described previously, the Stockholm E-Strategy is the policy document according to which the ICT work in the city is done. On its very first page, the document points out that the globalization process inevitably will lead to a new Europe where Stockholm will face tougher competition from other European cities, and that in order to face these challenges, the use of ICTs is an important factor. “IT must help to make Stockholm more attractive by securing the city’s long-term goals that Stockholm should continue to be a fine place to live and work in” (The City of Stockholm’s E-Strategy, 19th of February 2001).

The “E-Strategy” of Stockholm is, on a municipal level, what the “24/7 Agency” is on the national level. The “24/7 Agency” was issued in 2000 by the Swedish government, aiming at extending the public sector’s use of ICTs, making services available 24 hours a day, 7 days a week (The 24/7 Delegation). The vision entails all parts of the public sector—municipalities, county councils as well as central government—and is the Swedish government’s way of trying to cope with expected demographic changes leading to a larger aging population which will demand more of a public administration with fewer employees. At the same time, citizens in general are expected to demand more value for money and a growing internationalization is thought to increase the competitive pressure on public bodies. The development of e-government in Sweden is a way of meeting these challenges (Lund) and the belief of the 24/7 Agency is that the Swedish administrative model, with independently managed central government agencies, is a factor for the success of rapid development of digital applications and e-services (Lundbergh, 2004).

Swedish authorities primarily call for the most appropriate services, not specific technologies. Thus, the name of “the 24/7 Agency” places focus on the time aspects of service-provision—public services should be provided around the clock—not on specific technologies. The question “how” is subordinated, as, “Accessibility, irrespective of time of day and geographical location, may be achieved through a range of established service channels” (Östberg, 2000). Also, the Stockholm E-Strategy is on purpose called the “E-Strategy”, and not the “IT-policy”, in order to shift “…focus from IT to activities and show [...] how enhanced integration of electronic services (‘e-services’) can develop the municipality’s work” (The City of Stockholm’s E-Strategy, 19th of February 2001).
According to this, the E-Strategy does not prescribe certain technologies, but only points at different areas that the city should work with: Internet, information management, mobile technologies (in general), and so forth.

**mCity and the Vision of Stockholm as an IT Capital**

The mCity Project not only aims at developing technology which make the city available around the clock. It is also a project used to enhance the image of Stockholm as an IT capital; an image based for example on the fact that Ericsson and other major players within the ICT sector have their development offices within the area. According to the Stockholm E-Strategy, IT can play an important role in making Stockholm an attractive city for people to live and work in, and therefore, the city must take an active part in creating business opportunities for ICT companies.

One of the goals stated in the E-Strategy is to, “Be one of the most attractive municipalities for relocation, start-up and running of businesses, in competition with the foremost European cities” (*The City of Stockholm’s E-Strategy, 19th of February 2001*, p. 14).

Through the mCity Project, the city has given several ICT companies in the Stockholm area the opportunity to test ideas, develop new applications and market themselves in and outside the country—naturally, in compliance with the Public Procurement Act. This strive to encourage local development conveys an entrepreneurial stance which might be perceived as contrasting with the managerial practices of earlier decades which primarily focused on the local provision of services, facilities, and benefits to the population (Harvey, 1989). However, when cities find themselves competing on a global—not only on a national—arena, a new kind of city management develops, involving proactive management of the images of the city as a management tool. Today, city managers are not only active administrators of the traditional areas of responsibility (Czarniawska, 2000) and the “branding” of the city involves much more than producing colorful brochures (Ward, 1998).

**mCity and M-Government**

As described earlier, the mCity Project aims at creating “the mobile city”, as this is thought to be a good place for people to live, work, and spend their holidays in, since mobility means flexibility. But this does not necessarily mean that the project only deals with the development of mobile technologies, which makes information and services of the City of Stockholm available. “Mobile” here does not refer to the technology, but to the people using it, and “the mobile city” is the city where people have the flexibility to do what they want, where and when they choose. The mobile city can be achieved by the city becoming a role model, using mobile technology for its own activities, for example in schools, in homes for the elderly, or through mobile services which give commuters information about traffic, but also by stimulating the use of mobile technology in general, for example by encouraging students in the Stockholm area to ask for and use mobile services.

It is also obvious, that for mCity, the traditional m-government definition is not sufficient, as the city itself is not limited to its municipal organization. As we have showed earlier, the projects within mCity involve cooperation with both national institutions (for example, within the traffic projects), regional institutions (for example, within the mStudent Project) as well as private companies. Thus, rather than focusing on technology or the municipal organization, mCity focuses on people, and to see this project as an m-government project is to broaden the definition of m-government from only encompassing the use of mobile/wireless applications in the public sector, making the public information and services available anytime, anywhere. And rather than having the municipal organization as the starting point
for its activities, the city, as it is perceived by its citizens, visitors, and employees, is the unit from where the project takes off. Thus, we suggest a new definition of m-government:

A public body which supports the mobility of its people, by providing its services when and where the people need them, and by supporting the development of whatever wireless technologies are needed, and the education of people in these.

THE FUTURE OF M-CITIES

It has been argued that the organizing capacity of a city determines whether the city will be able to develop in a sustainable way, and that the ability to include ICTs is becoming a more important aspect of the organizing capacity of cities (Winden, 2003). This, we believe is true.

Once a small, local initiative, mCity has grown into a project which covers many application areas. Through the project, it has become clear that mobile services can help Stockholm simplify routines, minimize administration, save both time and money, and make life a bit easier for people thus contributing to a better working and living environment by improving the service quality offered by the city. These results further strengthen the notion that the building of m-government is important, probably not only for cities, but for all public bodies. But in order to be successful, a people’s perspective has to be adopted and the traditional borders of the public body might have to be challenged. To start with people rather than with technology or with the organization, is an important prerequisite for success.

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www.e-devexchange.org/eGov/mgovdefn.htm


**Endnotes**

1. All of Sweden has about nine million inhabitants.


3. The City Council is the supreme decision-making body in the City of Stockholm, consisting of 101 members from the six parties represented in the council, and are elected by the Stockholmers every 4th year.

4. The City Executive Board consists of 13 members, who proportionally represent the parties in the City Council.

5. The Office of the City Executive Board.

6. The municipal company in Stockholm providing service to visitors.

7. The largest telecom operator in Sweden today known as TeliaSonera after a merge with the Finish company Sonera.

8. One of the major bank corporations in Sweden.


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Chapter XVIII
End–User Quality of Experience–Aware Personalized E–Learning

Cristina Hava Muntean
National College of Ireland, Ireland

Gabriel-Miro Muntean
Dublin City University, Ireland

Abstract

Lately, user quality of experience (QoE) during their interaction with a system is a significant factor in the assessment of most systems. However, user QoE is dependent not only on the content served to the users, but also on the performance of the service provided. This chapter describes a novel QoE layer that extends the features of classic adaptive e-learning systems in order to consider delivery performance in the adaptation process and help in providing good user perceived QoE during the learning process. An experimental study compared a classic adaptive e-learning system with one enhanced with the proposed QoE layer. The result analysis compares learner outcome, learning performance, visual quality and usability of the two systems and shows how the QoE layer brings significant benefits to user satisfaction improving the overall learning process.

Introduction

It is widely acknowledged that e-learners differ in skills, aptitudes and preferences, may have different perceptions of the same factors and some of them may have special needs due to disabilities. People also seek different information when accessing Web-based educational systems and may prefer certain learning styles. Therefore, various adaptive and personalized e-learning systems such as ApeLS (Conlan & Wade, 2004), WINDS (Specht et al., 2002), iClass (O’Keeffe, 2006), INSPIRE (Papanikolaou et al., 2003) and AES-CS (Triantafillou et al., 2002) were proposed.
End-User Quality of Experience-Aware Personalized E-Learning

in order to capture and analyze these user-related features, and personalize the educational material thus optimizing users’ learning experience.

With the latest communication-oriented devices like smart phones, PDAs, laptops and network technologies such as 3G, WiFi, IEEE 802.11 family of standards (IEEE802.11, 1999), WiMax, IEEE 802.16 family (IEEE802.16, 2004), e-learners can access personalized information “anytime and anywhere.” However, the network environments allowing this universal access have widely varying performance-related characteristics such as bandwidth, level of congestion, mobility support and cost of transmission.

It is unrealistic to expect that the personalized content delivery quality can be maintained at the same level in this variable environment. Rather an effort must be made to tailor the material served to each person to their operational environment including current network delivery conditions, ensuring high quality of experience (QoE) during the learning process.

QoE focuses on the learner and is considered in (Empirix, 2003) as a collection of all the perception elements of the network and performance relative to users’ expectations. The QoE concept applies to any kind of network interaction such as Web navigation, multimedia streaming, voice over IP, etc. Different QoE metrics that assess user experience with the systems in term of responsiveness and availability have been proposed. QoE metrics may involve subjective elements and may be influenced by any sub-system between the service provider and the end-user.

It should be noted that some adaptive e-learning systems have already taken into consideration performance features such as device capabilities, the type of access to the network, download time, etc. in order to improve learning QoE (Chou et al., 2004; Brady et al., 2004; Smyth & Cotter, 2002; Apostolopoulos & Kefala, 2003). However, these account for only a limited range of factors affecting QoE. Also, they were considered separately one from another, unlike the real life situation when there is a simultaneous influence on user interaction with the e-learning systems.

In order to address the effect the complex operational environment has on e-learning, a detailed analysis of the key factors that affect learner QoE was conducted. A QoE adaptation layer that extends the adaptation features of classic e-learning systems was proposed. It aims to provide high level QoE when users engage in a learning process via network environments with variable connectivity characteristics.

This chapter presents, in details, the proposed QoE layer in the context of a classic architecture for adaptive e-learning systems (AeLS). The most significant AeLS proposed to date are presented in the “Related Work” section that also includes a summarization of the methods most often used in AeLS evaluation. Results of a detailed experimental study that involved a well-known AeLS and a version of the same system enhanced with the proposed QoE layer are then presented. The consequent result analysis compares learner outcome, learning performance, usability and visual quality of the two systems and shows how the QoE layer brings significant benefits to the learning process. The chapter ends with conclusions.

Related Works

Adaptive E-Learning Systems (AeLS)

Most adaptive e-learning systems are adaptive hypermedia systems (AHS) with applicability in education. In general, AHS aim to help in any application area where the hyperspace is large enough and the system is used by heterogeneous groups of users that have different goals, knowledge, interests, preferences and tasks. Education is one of the major areas of AHS applicability that also includes: online information systems, online help systems, information retrieval, institutional information, and personalized views systems (Brusilovsky, 1996, 2001).
Adaptive e-learning systems (AeLS) in general and mainly Web-based AeLS have attracted considerable interest due to their potential to facilitate personalized learning. They are used by heterogeneous groups of students with different levels of knowledge on a particular subject. The goal of the students is to learn all the material or a reasonable part of it. These systems consider, as the most important feature of the user, the knowledge level of the subject being studied. In order to provide different content to different users and to the same user at different knowledge stages, the system "watches" the students during their learning process.

Before 1996, very few AeLS were developed and mainly in the form of lab systems built to explore some new methods that used adaptivity in an educational context (Brusilovsky, 2001). Examples include a hypertext-based system for teaching the C programming language (Kay & Kummerfeld, 1994), Anatom-Tutor, an intelligent anatomy tutoring system for use at university level (Beaumont, 1994) and ELM-PE, an on-site intelligent learning environment that supports learning of the LISP programming language through examples (Weber & Möllenberg, 1995).

After 1996, with the exponential increase in Internet popularity, the Web started to have an important effect on teaching and learning, mainly in higher education. Many online lecture notes or complex tutoring applications were distributed on the Web. The realization that there is a need to address heterogeneous audience of Web-based courses has led the development of a large number of Web-based AeLS, among which the most important are presented next.

ELM-ART

ELM-ART updated ELM-PE and provided live examples and intelligent diagnoses of problem solutions. Later on, new enhancements were added leading to the ELM-ART II (Weber & Specht, 1997). This system supports online exercises and tests, student-tutor communications via e-mail and student-student discussions via chat rooms. The exercises and tests results allowed the system to assess the student’s knowledge more carefully and to infer user’s knowledge state. In the next version of the ELM-ART, a multi-layered overlay model was introduced (Weber, 1999). Apart from the knowledge states, now users were able to declare knowledge units as already known. The users could change their associated student model whenever they wanted or switch back to the original state without any loss of information. The system was also extended with two new communication tools: discussion list and user group. The latest version of ELM-ART has been combined with NetCoach, an authoring tool for developing Web-based courses. With NetCoach (Weber et al., 2001), authors can create adaptive Web-based courses that are based on the multi-layered overlay model, that support different types of test items, and include all the communication tools mentioned.

InterBook

InterBook is a system for authoring and delivering adaptive electronic textbooks via the Web (Brusilovsky et al., 1996). It is an environment in which structured textbooks could be presented in a multiply navigable interface. All InterBook-served electronic textbooks have a generated table of content, a glossary, and a search interface. The system uses colored annotations to inform the user about the status of the node referred to by a link.

InterBook stores a domain model of concepts and their structure and an overlay model that helps the system to assess the user’s knowledge on different topics and is built based on user-visited pages. These models are used by the system to provide adaptive guidance, adaptive navigation support, and adaptive help. The system also provides different options to the user in the form of direct guidance via the "teach me" button that
links the most suitable nodes to be read in the current context. It also includes a glossary index of the concepts.

**AHA!**

AHA!, developed by the Database and Hypermedia group from Eindhoven University of Technology (De Bra & Calvi, 1998), does not offer support for developing and delivering adaptive courseware only, it is a general-purpose server-side Web-based adaptive system. However AHA! was exemplified and used in education for delivering adaptive university courses at Eindhoven. The first version was developed in 1998, based on the AHAM model (De Bra et al., 1999), and since then the system has undergone several revisions. AHA! includes a domain model, a user-model and an adaptation model. An adaptive engine both performs content and link adaptation and updates information in these models, based on level of user knowledge about concepts. User knowledge is accumulated while the users read pages and take tests. Content adaptation is performed based on the fragment variants technique. Unlike InterBook that uses link annotation only, **AHA! link adaptation is performed by using both link hiding and link annotation techniques.** The color scheme can be configured by the author and overridden by the user. The user is also allowed to choose between **link annotation and link hiding.**

More recently AHA! was enhanced with an authoring tool that implements the principles of LAOS authoring model for adaptive hypermedia systems proposed in (Cristea & de Mooij, 2003).

Since AHA! system is open source, one of the latest introduced and well-known, it was used for the tests presented in his chapter.

**INSPIRE**

Many researchers are trying to integrate learning styles in the design of their AeLS, along with the classic learner’s features such as goals/tasks, knowledge level, background, preferences and interests. **INSPIRE is an AeLS that monitors learner’s activity and dynamically adapts the generated lessons to accommodate diversity in learner's knowledge state and learning style (Grigoriadou et al., 2001).** It emphasizes the fact that learners perceive and process information in very different ways, and integrates ideas from theories of instructional design and learning styles.

With regards to the adaptive dimension of INSPIRE, the selection of the lesson contents and the provided navigation support are both based on the domain model of the system which is represented in three hierarchical levels of knowledge abstraction: learning goals, concepts and educational material (Papanikolaou et al., 2003). The system makes, also, use of a learner model (user model) in order to exploit learners’ knowledge level and individual traits (such as its dominant learning style) and to determine the appropriate instructional strategy. This strategy helps in the selection of lessons’ contents, the presentation of the educational material, and the annotation of hyperlinks in the domain hyperspace. Several levels of adaptation are supported: from full system-control to full learner-control. It offers learners the option to decide on the level of adaptation of the system by intervening in different stages of the lesson generation process and formulating the lesson contents and presentation.

**INSPIRE is used to support a course on Computer Architecture offered by the Informatics and Telecommunications Department, at Athens University, Greece.**

**JointZone**

**JointZone (Ng et al., 2002)** is a Web-based learning application in Rheumatology for medical students. It combines user modeling, domain modeling and adaptive techniques in order to deliver personalized Web-based learning.

**It uses keyword indexing and site layout struc-**
ture information for domain modeling giving a conceptual and structural representation of the content. This reduces the involvement of a domain expert in organizing and labeling the content.

The content of JointZone exists in the form of an online electronic textbook, which is illustrated with photo images and videos taken on various forms of rheumatic diseases. In an additional section, there are a total of 30 interactive case studies that simulate a variety of rheumatic clinical scenarios where students can actively engage in problem solving rather than being passive recipients of information. The cases are subdivided into three groups designated “Beginner,” “Intermediate” and “Advanced.” The layout of these cases differs according to the degree of expertise of the user. In JointZone, the user model captures two aspects of the students’ differences: individual browsing history and knowledge level in the Rheumatology domain. The model also involves the novel idea of using individual effective reading speed to better identify if a student has read a page. The user’s knowledge level is initialized based on his/her first entry registration details. This knowledge value evolves through the user engagement with the application, based on student performance in the case study. The adaptation uses two adaptive techniques: link hiding and link annotation. Based on these techniques and the information from the user model, different personalized features are provided such as: personalized reading room, personalized site map, and personalized topic map.

**AeLS Evaluation Methods**

The method mostly used in the evaluation of adaptive educational systems adopts a “**with or without adaptation approach**” (Karagiannidis et al., 2001) and considers that the evaluated system can have adaptive and non-adaptive versions. The experiments are conducted between two groups of learners, one working with the adaptive version of the system and the other—with its non-adaptive version. This conventional method of comparing the adaptive and non-adaptive versions of an application is highly debatable as it depends on how the non-adaptive version was obtained. Possibilities may involve an original system to which enhancements were added to obtain the adaptive system, a system resulted from the adaptive system by switching off its enhancements and a system that maintains only some of all adaptive features.

**Evaluation Strategy**

Looking from **evaluation strategy** point of view, two main directions were taken.

A first approach targets system evaluation **“as a whole”** and is very often used in education (Brusilovsky et al., 2001). The evaluation process focuses mainly on overall learner performance and their satisfaction related to the use of the adaptive system. This user satisfaction can be quantified by selected and measurable criteria. The most used criteria in the evaluation process are: task completion time, learning performance assessed by comparing the results of a pre-test and post-test, number of navigation steps, number of times the subjects revisited “concepts” they were attempting to learn, and user’s satisfaction reflected through questionnaires.

Recently, a novel **layered-based** evaluation of adaptive applications was recommended by a number of researchers such as Weibelzahl and Weber (2002) and Elissavet and Economides (2003). Unlike the previous approach, layered evaluation assesses the success of the adaptation by decomposing the system into different layers and evaluating them one by one. The different layers reflect various aspects and stages of the adaptation.

Although the proposed frameworks are described at different levels of granularity, the evaluation process was originally divided in two main phases: evaluation of the interaction assessment phase and evaluation of the adaptation decision-
making phase (Karagiannidis et al., 2001):

- **Layer 1: Interaction Assessment Evaluation.** This layer tests if the system detected the learner’s goals, knowledge, preferences, interests, and the user’s experience with the respect of hyperspace. It also assesses whether the assumption drawn by the system concerning characteristics of the user-computer interaction is valid.

- **Layer 2: Adaptation Making Evaluation.** Layer 2 tests if the selected adaptive technique is appropriate, valid and meaningful for learner’s goal or improves interaction for specific learner’s interests, knowledge, etc.

The division of the evaluation process into the two layers that also reflect the main phases of the adaptation may help to determine where the fault (if any) of the adaptive system may be and to target the solutions accordingly. For example, it can be the case that adaptation decisions are reasonable but they are based on incorrect system assumptions, or that the system assumptions are correct but the adaptation decision is not meaningful.

A more detailed approach that consists of a four-layer framework for adaptive system evaluation was proposed in Weibelzahl and Weber (2002):

- **Layer 1: Evaluation of the Reliability and Input Data.** This evaluation prevents unreliable input data to result in miss-adaptation.

- **Layer 2: Evaluation of Inference.** This layer evaluation test the inference mechanism in different environments under real world conditions

- **Layer 3: Evaluation of Adaptation Decision.** The idea of the evaluation is that if some user properties have been inferred, several adaptation possibilities exist. (e.g., with/without adaptive guiding, with/without link annotations).

- **Layer 4: Evaluation of Interaction.** In this case human system interaction has to be evaluated to prevent confusion and dissatisfaction of the users. Different objective and subjective measures are taken into account such as: system usability, solution quality, frequency of tasks success, number of required hints, etc.

When assessing AeLS, most often application usability, learner achievement and learning performance are considered. Next, they are discussed in details.

### Usability Evaluation Tests

One of the most important features of any software application is its usability. According to ISO 9241 standard, usability represents the effectiveness, efficiency and satisfaction that a software application offers to its users in a given context of use and task. In an educational environment the usability of software application is related to its pedagogical value. Although there is a large amount of knowledge related to educational software usability evaluation strategies, currently there are not well-defined techniques for usability evaluation of e-learning applications (Heines, 2000). This is mainly as e-learning is an area of relatively short history, users of e-learning tools can access them through various computer, network and social contexts and the characteristics of typical users of e-learning services can not be easily predicted.

Some of the most used methods proposed in the literature to be applied during the usability evaluation are: *query techniques* (interviews and questionnaires), *logging of user performance* in laboratory conditions, *timing and keystroke level measurements*, *subjects’ observation through adequate equipment*, *heuristic evaluation*, etc. These methods are applied during or after the subjects have interacted with the system when perform-
End-User Quality of Experience-Aware Personalized E-Learning

...ing one or multiple tasks. Usually the usability is analyzed through five major characteristics: usage efficiency, ease of remembrance, pleasant to use, easy to learn with and number of errors.

Questionnaires and interviews are the most widely used technique since they provide a quantitative measure of usability and they serve as an objective comparison of two systems. This technique offers a concise test of usability, it gets directly the users’ viewpoint and attitude and it is suitable for wide range of end-users, especially students. A big advantage is that it does not require the presence of an evaluator. In this context, Preece (2000) suggested a list of guidelines for creating questions for the questionnaires, currently widely used for the usability evaluation of the Web-based systems.

Heuristic evaluation is also a widely accepted method for diagnosing the system’s usability due to the fact that it can be completed in a relatively short period of time. This methodology involves an expert that evaluates the system using a set of recognized usability principles, called “heuristics” (Nielsen, 1994).

Learner Achievement Evaluation

Learning process evaluation should include assessment of quality and quantity of learning (learning outcome). Therefore, learner achievement (defined as the degree of knowledge accumulation by a person after studying a certain material) continues to be a widely used barometer for determining the utility and value of learning technologies. It is analyzed in the form of course grades, pre/post-test scores, or standardized test scores.

A course grade is a certification of competence that should reflect, as accurately as possible, a student’s performance in a course. There are multiple methods for assigning grades, such as weighting, distribution gap method, curve, percent grading, relative grading, and absolute standard grading.

Pre/Post test scores are also a viable methodology to assess the extent to which an educational intervention has had an impact on student “learning.” Pre-tests and post-tests are used to determine the subject’s knowledge prior and after the study, respectively.

Standardized tests scores give a “standard” of measure of students’ performance when a large number of students, often geographically distributed, take the same test.

Tests, quizzes or exams are methods used to evaluate students and assess whether they learned what is expected. Jacobs and Chase (1992) made a distinction between the three terms: tests, quizzes and exams, based on the scope of content covered. An examination is the most comprehensive form of testing. A test is more limited in scope, focusing on particular aspects of the course material. A quiz is very limited and usually is administered in fifteen minutes or less.

Among them, tests are most important in the evaluation of AeLS as they offer a feedback in the learning process, helping to optimise it and their results are the most reliable evidence that users have learned.

The evaluation based on tests, quizzes or exams may consist of five different types of test items:

- **Yes-No (True-False):** Users have to answer questions by selecting “Yes” or “No” only.
- **Forced-Choice:** Users have to answer by selecting only one of the alternative answers.
- **Multi-Choice:** Users have to answer by selecting all correct answers provided.
- **Essay (Free-Form)/Short Answer:** Users can type freely an answer to the question. Short answers are one to three paragraphs long.
- **Gap-Filling (Completion):** Users have to type in characters or numbers to complete a word or sentence.
Each type of test item has its relative strengths and weaknesses. Each has also a general value of difficulty and relevance for the tested concept.

Learning Performance Evaluation

Learning performance term refers to how fast a study task (e.g., learning task, searching for a piece of information or memorizing information displayed on the computer screen) takes place. The most used metric for measuring AeLS learning performance is study session time. The completion time for a study session is measured from the start of the session, when the subject logs into the system and starts to study, until the subject starts answering the questions from the evaluation test. Other metrics worth mentioning are: number of navigation steps performed during a study session, number of pages re-visited, average time spent per page for studying the information, and average access time.

QoE-AWARE ADAPTIVE E-LEARNING SYSTEM

Figure 1 illustrates the architecture of the proposed quality of experience-aware adaptive e-learning system (QoE-AeLS) resulted from the addition of the novel QoE layer to the classic AeLS. Apart from the QoE layer—represented in the figure with a different color and presented in more details in the following section, AeLS has four main components: domain model, user model, adaptation model and adaptation engine. These components provide adaptation functionality following the principles presented in the AHAM model (De Bra et al., 1999). Most adaptive e-learning systems based on AHAM include these components.

The domain model (DM) organizes the educational material in a hierarchical structure of concepts, among which logical relationships exist. At the lowest level, the concepts correspond to fragments of information. These fragments—stored in a Domain Database—are combined into composite concepts (also called pages) by defining relationships among them. Composite concepts may be further combined using relationships to eventually form more complex units of information. The content is selected from the DM and delivered to the learner based not only on these relationships, but also on learners’ characteristics.

The user model (UM) maintains and stores in a user database various demographic information.

Figure 1. Architecture of the quality of experience-aware adaptive e-learning system
End-User Quality of Experience-Aware Personalized E-Learning

related to the learner (e.g., age, gender, learner’s current goal and interest in the educational material), learner’s navigational history, etc. Both explicit (via registration) and implicit (through normal navigation and content selection) information is used to generate and update the UM. In order to construct UM, to analyze the user profile and to derive new facts about the user, different user modeling methods have been proposed. The most common ones are the overlay method (De Bra & Calvi, 1998; Pilar da Silva et al., 1998) and the stereotype method (Boyle & Encarnacion, 1994; Murphy & McTear, 1997). Lately, Bayesian networks have become popular for modeling user knowledge and goals and to identify the best actions to be taken under uncertainty (Nejdl & Wolpers, 1999; Conati et al., 1997).

The adaptation model (AM) provides the adaptive functionality of the system. The main goal is to define how content adaptation, navigation support adaptation and updates of the UM are performed. Condition-action rules are used to express the adaptation mechanism. These rules combine information from the UM and DM and determine how UM is updated and which information will be delivered to the learner.

The adaptation engine (AE) interprets the condition-action rules described in the AM, performs the content selection from the DM, creates the navigational support (links), and delivers a personalized Web page to the learner according to its profile built by the UM.

Qoe I AYer For Qoe -Aels

The proposed QoE layer includes the following components: perceived performance model, performance monitor and QoE adaptation unit.

The performance monitor (PM) monitors different performance metrics (e.g., download time, round-trip time, throughput, user tolerance for delay) and learner behavior-related actions (e.g., abort and reload requests) in real-time during user navigation and delivers them to the Perceived Performance Model.

The perceived performance model (PPM) models this information using a stereotype-based technique, probability and distribution theory, in order to learn about the learner’s operational environment characteristics, about changes in the network connectivity and the consequences of these changes on the learner’s QoE. The PPM also considers the learner’s subjective opinion about their QoE as explicitly expressed by the user. This introduces a degree of subjective assessment, specific to each user. Based on the gathered information, the PPM suggests optimal Web-based educational material characteristics (e.g., the number of embedded objects in the Web page, the dimension of the based-Web page without components and the total dimension of the embedded components) that will provide a satisfactory QoE. The PPM aims to ensure that the download time per delivered page, as perceived by the learner, respects the user tolerance for delay and stays within the user satisfaction zone (Sevcik, 2002; Bhatti et al., 2000; Bouch et al., 2000; Servidge, 1999, Ramsay et al., 1998).

The QoE adaptation unit (QoEAU) deploys a QoE adaptation algorithm (Muntean & McManis, 2006a) that uses PPM’s content-related suggestions. Its objective is to determine and apply the correct transformations (e.g., modifications in the properties of the embedded images and/or elimination of some of them and placing a link to the image location) to the personalized Web page. This is performed in order to match the PPM suggestions on the Web page characteristics and thus to provide high QoE during learning process.

Qoe-AWARe e-le Arnin G PROCESS

The main goal of the QoE-AeLS is to provide personalized material that suits both learners’ individual characteristics (e.g., goals, knowledge,
End-User Quality of Experience-Aware Personalized E-Learning

learning style) and their operational environment in order to ensure high QoE during learning process. Therefore the process of adaptation and personalization of educational material allows for both user-based and QoE-based adaptations. User-based adaptation selects those pieces of information from the DM for inclusion in a learner-tailored document, based on the user profile from the UM. QoE-based adaptation is applied when the delivery of the personalized document in given environment characterized by certain connectivity would not provide a satisfactory QoE. Based on the result of PM communication monitoring, PPM makes suggestions and QoEAU applies them in order to increase user QoE.

More details about the proposed QoE-AeLS architecture and QoE-aware adaptation process can be found in Muntean and McManis, 2006a, 2006b, 2006c.

**Evaluation of the QoE Layer**

The proposed QoE layer has been assessed through both simulations and qualitative evaluation in the educational area (mainly distance learning), when learners interact with the system in a variable residential-like low bit rate operational environment. Simulation-based testing results that show the benefit of using the QoE layer for delivering content in low-bitrate environments are presented in (Muntean & McManis, 2006a; Muntean et al., 2006). In order to perform qualitative evaluation, the proposed QoE layer was deployed on the open-source AHA! system (AHA, 2006), creating QoEAHA.

The experimental evaluation was performed in the Performance Engineering Laboratory, School of Electronic Engineering, Faculty of Engineering and Computing, at Dublin City University, Ireland. Two sets of task-based scenarios were developed and carried out in laboratory settings. The scenarios were created in order to provide real usage context for participants, as they would interact with the system in real study conditions.

The subjects involved in the tests were randomly divided into two groups. One group used the original AHA! system, whereas the second one used QoEAHA. The subjects were not aware of what version of the system they were using during the experiment. No time limitation was imposed on the execution of the required tasks. None of the students had previously used any of the two versions of the AHA! system and none of them had accessed the test material prior taking the tests. Therefore no previous practice with the environments was assumed for any of them. The material on which the students consisted of the original adaptive tutorial delivered with the AHA! system version 2.0.

Figure 2 graphically presents the network-based setup used for testing. It involved four PC Fujitsu Siemens desktops with single Pentium III (800MHz) processors and 128 MB memory each that acted as clients, an IBM NetFinity 6600 with dual Pentium III (800 MHz) processors and 1 GB memory as Web server and one Fujitsu Siemens desktop computer with Pentium III (800 MHz) processor and 512 MB RAM that acts as a router and has a NISTNET network emulator installed on it. NISTNET that allows for the emulation of various network conditions characterized by certain bandwidth, delay, loss rate and loss pattern was used to create low bit rate residential-like operational environments with bandwidth in the 56 kbps to 128 kbps range. For both groups of subjects, same network conditions were emulated between their computers and the AeLS. These setup conditions offer similar connectivity to that experienced by residential users. These conditions determined performance-related adaptations when QoEAHA version was used.

The goal of the experimental study was to compare the learning outcome and learning performance, system usability, visual quality and user satisfaction when AHA! and QoEAHA systems were used respectively.
Scenario 1: Interactive Study Session

The first testing scenario covered an interactive study session of one chapter from the adaptive AHA! tutorial and delivered a network with emulated 56 kbps connectivity. This experimental test involved forty-two postgraduate students from the Faculty of Engineering and Computing, at Dublin City University, Ireland as subjects. Before and after the subjects completed the study task, they were asked to take online evaluation tests in order to assess their knowledge levels.

At the start of the study session, the subjects were given a short explanation about the AeLS usage and their required duties. They were asked to perform the following steps:

1. Complete an online pre-test evaluation in order to determine subjects’ prior knowledge about the studied domain. It consisted of a questionnaire with six questions related to the learning topic.
2. Log onto the system and proceed to browse and study the material. Back and forward actions through the studied material were permitted.
3. Complete an online post-test at the end of the study period in order to determine the subjects’ level of knowledge. The post-test consisted of a questionnaire with fifteen questions that tested recollection of facts, terms and concepts from the supplied material. The students were not allowed to return to the studied material.
4. Answer a usability questionnaire that assessed system usability and user QoE level. It consisted of ten questions categorized into navigation, accessibility, presentation, perceived performance and subjective feedback.

In order to fully assess the subjects learning outcome, both pre-test and post-test were devised that consisted of a combination of four different types of test-items most commonly used in the educational area: “yes-no,” “forced-choice,” “multi-choice” and “gap-filling.” For time-related reasons, 6 questions were included in the pre-test evaluation as follows: 3 “yes/no,” 2 “forced choice” and 1 “multi-choice.” The post-test evaluation consisted of 15 questions: 5 “yes/no,” 6 “forced choice,” 3 “multi choice” and 1 “gap filling.” As the test-items have different degrees
of difficulty, different corresponding weights in the final score have been assigned for a correct answer as follows: one point for “yes/no” questions, two points for “forced-choice” questions, three points for “multi-choice” questions and four points for “gap-filling” questions. For incorrect answers no points were given.

As the maximum scores were 10 and 30 points for pre-test and post-test respectively, the final scores of both the tests were normalized and were expressed in the 0-10 range.

**Scenario 2: Search for Information**

The second testing scenario focused on a search for information and involved subjective visual quality assessment in the case with the worse network connection—28kbps. Since the QoE-based adaptation mechanism involves modifications on the properties of the embedded images, the goal was to assess whether the quality of content is good enough to perform the required task. The subjects were asked to look up for two different terms and to answer two questions related to these terms. The terms were described in the embedded images. Objective and subjective visual quality assessments that involved the measurement of the time taken to complete the task and questionnaire-based evaluation techniques were used. The subjective assessment on a five-point quality scale (1—“bad,” 2—“poor,” 3—“fair,” 4—“good,” 5—“excellent”) ascertained the impact of QoE-based content adaptation on subjects’ learning experience.

Scenario 2 involved twenty postgraduate students from the faculty of Engineering and Computing at Dublin City University, Ireland. The goal of these tests was to assess whether the resulted quality of images is good enough for the subjects to be able to perform the required task.

**Learning Outcome**

Learning outcome was analyzed in terms of pre-test/post-test scores of the two groups after a study session. Table 1 presents both pre-test and post-test scores resulted after the tests were performed according to scenario 1. Pre-test scores ($AHA_{\text{mean}} = 0.35$, $QoEAHA_{\text{mean}} = 0.30$) showed that both groups of students had the same prior knowledge on the studied domain. The mean scores for the post-test were 7.05 for the subjects

### Table 1. Scenario 1: Pre-test and post-test results

<table>
<thead>
<tr>
<th></th>
<th>Score</th>
<th>Mean</th>
<th>Min</th>
<th>Max</th>
<th>St.Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pre-test</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHA!</td>
<td>0.35</td>
<td>0.0</td>
<td>2.0</td>
<td>0.55</td>
<td></td>
</tr>
<tr>
<td>QoE AHA</td>
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<td>0.0</td>
<td>2.0</td>
<td>0.53</td>
<td></td>
</tr>
<tr>
<td><strong>post-test</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHA!</td>
<td>6.70</td>
<td>4.30</td>
<td>9.30</td>
<td>1.401</td>
<td></td>
</tr>
<tr>
<td>QoE AHA</td>
<td>7.05</td>
<td>4.60</td>
<td>9.00</td>
<td>1.395</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2. Scenario 2: Post-test results (answers found in embedded images)

<table>
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<th></th>
<th>Score</th>
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<th>Min</th>
<th>Max</th>
<th>St.Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>post-test</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHA!</td>
<td>6.40</td>
<td>2.0</td>
<td>10.0</td>
<td>3.25</td>
<td></td>
</tr>
<tr>
<td>QoE AHA</td>
<td>6.30</td>
<td>2.0</td>
<td>10.0</td>
<td>3.15</td>
<td></td>
</tr>
</tbody>
</table>
that used QoEAHA and 6.70 for the AHA! group. A two-sample t-test analysis on these values does not indicate a significant difference in the marks received by the two groups of subjects (α = 0.05, t = –0.79, t-critical = 1.68, p(t) = 0.21).

Since answers for three of questions from the post-test questionnaire have required the subjects to study the images embedded in the Web pages, an analysis of the students’ learning outcome on these questions was also performed. After the scores related to these three questions were normalized in the 0 to 10 range, the mean value of the students’ scores was 6.3 for the QoEAHA group and 6.4 for AHA! group. More details about these results are presented in Table 2. A two-sample t-test analysis, with equal variance assumed, performed on the two sets of results indicates with a 99% level of confidence that there is no significant difference in the students’ learning achievement (t = -0.08, t-critical = 2.71, p(t) = 0.93, α = 0.01). This result is very important as an adaptive degradation in the image quality (up to 34% in size) was applied by the QoEAHA.

Therefore, it can be concluded that the addition of the QoE layer does not affect the learning outcome and that QoEAHA offers similar learning capabilities to the classic AHA! system, regardless of the characteristics of the operational environment.

### Learning Performance

The impact of the QoE-based content adaptation on the learning performance was assessed through the following metrics: study session time, study time per page and number of accesses to a page performed by a person. These metrics were analyzed and compared for both groups of subjects.

#### Study Session Time

The distribution of the study time taken by the students in order to accumulate the information provided during the first scenario using the AHA! and QoEAHA systems respectively is presented in Figure 3. One can notice that on average students that made use of the QoEAHA system (Average Study Time = 17.77 min) have performed better than the ones that used the AHA! (Average Study Time = 21.23 min) (see Table 3). The very large majority of the students that used QoEAHA (71.43%) performed the task in up to 20 minutes with a large number of students (42.87%) requiring between 15 minutes and 20 minutes of study time. In comparison, when the AHA! system was used, only 42.85% of the students succeeded to finish the learning task in 20 min. The majority of them (71.42%) required up to 25 minutes with the largest number of students (28.57%) in the interval 20-25 minutes.

In Figure 3, one can also notice that 9.5% of the students from group 1 (using QoEAHA) succeeded to learn in less than 10 minutes while none of the students from group 2 (using AHA!) had this performance.

#### Study Time per Page

In order to assess the results of the comparison between the two AeLS, in terms of study time per page, two Web pages, out of those stud-
ied by the students as part of scenario 1, were considered. These pages—denoted page 1 and page 2—included a higher number of embedded images and a larger amount of data to be delivered to the learner. Consequently, the subjects perceived long waiting periods when the AHA! system was used. QoEAHA decreased the access time perceived by the students but has also performed some degradation into the quality of the content. Therefore the study time on those pages was analyzed when the two systems were used with the first scenario. Study time per page was measured from the moment when the system has received a request for the page until a request for a new page was sent.

The results presented in Table 4 show that on average the students from group 1 (using QoEAHA) spent less time on both page 1 and page 2 for studying the information in these pages than the ones from group 2 (using AHA!). This observation was confirmed by statistical data analysis. By performing a two-sample t-test assuming unequal variances, for each of the two pages it can be said that there is a significant difference between the two groups’ means with a confidence level of 95%.

### Number of Accesses to a Page

Number of accesses to a page performed by subjects was also measured and analyzed for the same two pages. The average value of this parameter for page 1 was 1.43 when the QoEAHA system was used and 1.76 for the AHA! system, as presented in Table 5. Similar values were obtained for page 2: 1.38 and respectively 1.70. An unpaired two-tailed t-test analysis, with unequal variance assumed, has statistically confirmed with at least 92% confidence that there is a significant difference in the number of visits performed by

![Figure 3. Study time distributions for students involved in a learning task](image)
The effect of the version of the AHA! system used by the students had on the number of accesses to a page was investigated by analyzing the variability of the test samples. The results presented in Table 5 show that both standard deviation and variance of group 1 results are lower than the values corresponding to group 2 for both pages. An f-test analysis was performed to determine if variance between the two groups is statistically significant. The results confirm that group 1 and group 2 results do not have the same variance and the difference between the two groups’ variances is statistically significant.

It can be noticed that the group 2 results have a higher dispersion than those of group 1. Also a larger number of students (an average of 55%) that used the AHA! system (group 2) required more than one access to page 1 and page 2 for learning. At the same time, a large majority of students (an average of 65%) that used the QoEAHA (group 1) performed only one access to the same pages (See Figures 4 and 5). This shows that QoEAHA users have succeeded to focus better on the studied material. This is due to the fact that the material was delivered faster to the students and the students were constantly focused on the required task and therefore study time per page decreased by 16.27%. It is noteworthy that most of the QoEAHA group students [71.43%] finished the study in up to 20 minutes whereas only 42.85% of the AHA! students finished in the same period of time. Therefore, the QoE-aware AeLS has ensured a smooth learning process. This observation is also confirmed when assessing Number of Accesses per page [on average 19% decrease with QoEAHA than the result obtained for AHA!]).

### Visual Quality Assessment

Results on visual quality assessment confirmed that the controlled degradation of the quality of the content performed by the proposed QoE layer did not affect the functionality of the AeLS.

As seen in Figure 6, both groups of students succeeded to complete the “search for information” task presented in scenario 2 in similar periods of time and they answered the questions correctly. The information targeted by the task was
presented in the embedded images of two pages that have the biggest content size and QoEAHA imposed the highest level of image quality degradation as part of its adaptive process. For the worst operational environment case studied (28 kbps connectivity) QoEAHA applied a 57% size reduction to page 1 components and 18% for page 2 items. The subjective-based visual quality assessment investigated through a questionnaire shows that regardless of the high content reduction, the average quality grade given by the subjects to the QoSAHA system was 3.9, very close to “good” perceptual level, and only 4.4% lower than the average quality grade awarded to AHA! (4.3). This suggests that the cost of image quality reduction is not significant as far as user-perceived quality is concerned while at the same time yielding significant improvements in download time and learning performance.

**System Usability**

The system usability investigation was performed using an online questionnaire to which the subjects were asked to respond with grades on a 1-5 Likert scale. It can be noticed from Figure 7 that presents
the results to all the questionnaire’s questions that the QoEAHA system has provided improving subjects’ satisfaction, which was above the “good” level for all QoE-related questions: Q5, Q6, Q7 and Q9. These performance related questions assessed users opinion on the download speed, overall system responsiveness, and performance effect on learning and user satisfaction. The AHA! system scored just above the “average” level on these questions, significantly lower than the QoEAHA! This good performance was obtained in spite of the subjects using slow connection during the study session and not being explicitly informed about this. A two-sample t-test analysis on the results of these four questions confirmed that users’ opinion about their QoE is significantly better for QoEAHA than for AHA!, a fact stated with a confidence level above 99%, (p<0.01).

Finally, an overall assessment of the all questions from usability questionnaire when all ten questions were considered of equal importance shows that the students considered QoEAHA system (mean value=4.01) significantly more usable than the AHA! system (mean value=3.73). These results were also confirmed by the unpaired two-tailed t-test (t=2.44, p<0.03) with a 97% degree of confidence. This increase of 7.5% in the overall QoEAHA usability was mainly achieved due to the higher scores obtained in the questions related to end-user QoE.

By examining in details the provided answers (Figure 7), one can notice that only for the last question (Q10) AHA! has a slight advantage over QoEAHA while in most of the other questions QoEAHA received a higher score. Q10 is related to the user satisfaction with the quality of the provided images. The advantage of the AHA! system is justified by the fact that the QoEAHA system performs controlled image degradation in order to improve the end-user perceived performance. Yet, these image degradations did not disturb
the users since they scored this question with an average of 3.9, very close to the “good” level.

**Con Clusion**

This chapter describes a novel QoE adaptation layer for AeLS proposed as a solution for increasing end-user QoE. This QoE layer brings significant benefits when the personalized content is delivered to end-users that avail of Web services over various and changeable network conditions, by adapting the content to them.

The QoEAHA evaluation involved a comparison with the AHA! system in home-like low-bite rate operational environments. Different educational-based evaluation techniques such as learner outcome analysis, learning performance assessment, usability survey, and visual quality assessment were used in order to assess QoEAHA in comparison to AHA!. As the students received similar marks on the final evaluation test, regardless of the system used, it can be said that the QoE layer-enhanced system offers similar learning capabilities to the classic one. Results on visual quality assessment confirmed that the controlled degradation of the quality of the content performed by the QoE layer did not affect the functionality of the e-learning system.

At the same time, important learning performance improvements in terms of Study Session Time (16.27% decrease), Study Time per Page (13% decrease) and Number of Accesses to a Page (smaller) were obtained with the QoEAHA system. It is noteworthy that most of the QoEAHA group students (71.43%) finished the study in up to 20 minutes, while only 42.85% of the AHA! group students finished in the same period of time. In terms of system usability, the students thought the QoE layer enhanced system provided much higher user QoE than the classic one. Questions related to the other aspects of the system (e.g., navigation, presentation) achieved similar marks for both systems demonstrating that the QoE layer did not affect them.

In conclusion, the proposed QoE layer brings significant performance benefits to the users that access the adaptive Web content delivered in difficult network conditions.

**r eFeren C es**


End-User Quality of Experience-Aware Personalized E-Learning

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Chapter XIX
High–Tech Meets End–User

Marc Steen
TNO Information & Communication Technology, The Netherlands

Abstract

One challenge within the high-tech sector is to develop products that end users will actually need and will be able to use. One way of trying to match the design of high-tech products to the needs of end users, is to let researchers and designers interact with them via a human-centred design (HCD) approach. One HCD project, in which the author works, is studied. It is shown that the relation between interacting with end users and making design decision is not straightforward or “logical.” Gathering knowledge about end users is like making a grasping gesture and reduces their otherness. Making design decisions is not based on rationally applying rules. It is argued that doing HCD is a social process with ethical qualities. A role for management is suggested to organize HCD alternatively to stimulate researchers and designers to explicitly discuss such ethical qualities and to work more reflectively.

Human-Centred Design

Many organizations, both private and public, need to or want to innovate. Not for the sake of innovation itself, but in order to create new products, services, or processes that will create added value for their customers, for the end users of their products or services or for citizens. Developing innovations that match end users’ needs or wishes is especially (but not exclusively) problematic in the high-tech industry where many innovations are driven by technology push. A risk of technology push is that researchers and designers invent some product or service that nobody needs or nobody can use. One way in which researchers and designers try to match their innovation efforts to end users’ needs and wishes is to interact with them during an innovation project. They try to learn from them, to be informed or inspired by them. This can be seen as an attempt to narrow the gap between researchers and designers in their high-tech ivory tower vs. end users “out-there.”

My current interest is in researchers and designers activities. However, it is acknowledged that their work is only one half of the innovation process: end users also play crucial roles in adopt-
tion, domestication, and appropriation processes (Oudshoorn & Pinch, 2003, p. 11-16). Users and technology are “co-constructed” (ibidem); people influence technology and technology influences people, both designers and end users shape an innovation. However, I am currently more interested in how researchers and designers think and speak about end-users “out-there” (Latour & Woolgar, 1986), rather than being interested in any “real” existence of end-users or their “real” characteristics.

There is a broad variety of methods available for researchers and designers to involve (future, potential, or putative) end users in their projects, for example: participatory design (e.g., Schuler & Namioka, 1993) where people who will be using the system that is being developed are invited to cooperate during development, evaluation, and implementation of that system (such efforts are often related to workers’ emancipation); the lead-user approach (e.g., Von Hippel, 2005) where innovative users are seen as a source of innovation and are invited to help develop or improve a product (similar to participatory design, but with less emphasis on emancipation); fieldwork, inspired by ethnography or ethnomethodology, to study the social and cultural aspects of what people do, in order to design applications (often combined with participatory design, for example in the field of computer supported cooperative work) (Crabtree, 2003); contextual design (Beyer & Holzblatt, 1998), a method to observe people doing tasks in their natural context, with attention for their physical surroundings, the artefacts they use as well as their activities, communication, power and culture, and to articulate system requirements based on this; empathic design (e.g., Koskinen, Battarbee, & Mattelmäki, 2003), where researchers or developers try to get closer to end users’ lives and experiences, for example by observing their daily life or work, or role-playing some of their activities, and apply what they learn from that in the design process; codesigning (Sanders, 2000), a kind of participatory design where end users make things together with researchers and designers (the focus is on making things, and doing that jointly, rather than on saying things in interviews, or on being observed doing things); and usability engineering, a range of methods to evaluate and improve a product’s usability together with end users.

Such approaches are known in more general terms as human-centred design (HCD), which is characterized by four principles: (1) the active involvement of users for a clear understanding of user and task requirements; (2) an appropriate allocation of functions between users and technology; (3) iterations of design and evaluation processes; and (4) a multidisciplinary approach (ISO/IEC, 1999). One goal of HCD is to involve future or potential end users as early as possible: preferably from the start of a project, when problems are articulated, when the design brief is formulated, when directions for searching solutions are chosen so that end users’ input can optimally help to steer the project—rather than, for example involving end users at the end of a project for usability testing. Kujala (2003), in a review of various approaches for early user involvement, concludes that early user involvement has “positive effects on both system success and user satisfaction.” She is positive about ethnography-inspired field studies as a way to learn about end users’ needs and wishes and formulate system requirements (rather than asking them in interviews), and she is critical about whether designers have the necessary skills to conduct and interpret such fieldwork.

**STUDYING ONE PROJECT**

In many accounts of HCD projects, the relation between interacting with end users and making design decisions is not seen as problematic. It seems like taken for granted that such interactions lead to better decisions: “after the observations it was decided to prioritize problem x and make it central in the design process” or “during the
workshop solution y was chosen as a basis for further product development.” Such phrases seem to cover up what happens in-between interactions with end users and making design decisions. The process of HCD is often presented as a “black box” (Latour, 1987): a container that only shows what goes in (interactions with users) and what goes out (design decisions) and which covers up what happens in-between. However, it is easy to imagine that something happens in-between. Some filtering process happens, because researchers and designers do not straightforwardly follow everything that they see and hear from end users, nor do they do nothing with what they see and hear.

My current interest is to open-up the “black box” of HCD. I am interested in how researchers and designers who work in the high-tech ICT industry, for example in research labs, seek interactions with end users, and how this informs or inspires their design process and decision making: how these interactions relate to the process of exploring and articulating of problems and of solutions. Furthermore, I focus on research and design as a social process (Bucciarelli, 1994). I focus on the interactions between people, rather than on the technological or economic aspects of research and design.

Such a study requires access to researchers and designers doing their work, and therefore I chose to study one project in which I work and of which I coordinate one part, and to conduct the study as “participant observer” (Easterby-Smith, Thorpe, & Lowe, 2002, p. 110-4). This project is sponsored by the Dutch Ministry of Economic Affairs and by the participating organizations, and its goal is to create concepts that will help businesses and organizations to develop and apply innovative information and communication technology (ICT). The project is positioned in the “fuzzy front end” of innovation (Koen et al., 2002). It is about articulating opportunities and creating concepts. This means that the project team members have a relatively large amount of freedom and responsibility concerning what problem to address or what direction to look for solutions—more than in regular product development, implementation, or market introduction projects.

People from different organizations and with various backgrounds work in this project. My study is confined to one part of the project in which we design and evaluate a new kind of telecommunication applications: we-centric applications. At the start of the project, there was only this vision of what we wanted to achieve with we-centric applications: to stimulate and to facilitate people to communicate and cooperate better with each other, especially among people who currently don’t communicate and cooperate enough with each other. During the project we further developed this concept, partly based on interactions with end-users, so that by the end of the project we were able to characterize we-centric telecom applications as follows. A we-centric telecom application is typically meant to be used on a mobile phone or smart phone, a handheld device that combines phone and basic computer functions, similar to a personal digital assistant. Furthermore, a we-centric telecom application would provide suggestions to communicate or cooperate with others, and has two key functions. These functions were not clear at the start of the project, but they emerged during its course: (1) it composes and presents a dynamic list of potentially relevant people, which is meant as a suggestion to communicate or cooperate with these people—this list is created automatically based upon searching for similarities in data on participants’ contexts and interests or preferences; and (2) it presents information about these other people’s contexts, which is meant to actually help communicate or cooperate with them—this “context information” may contain their “presence” (one can be “available,” “online,” “busy,” “away,” etc., similar to instant messaging) and a short explanation why this person is supposed to be relevant for you currently. Furthermore, we envision that a we-centric telecom application is
reciprocal: if A receives a suggestion to talk with B, then B receives a similar suggestion about A, and if A can see something of the current activities of B, then B would be able to see something of A’s likewise.

The project’s goal is to develop and evaluate *we-centric* application together with, and for, two target groups: (1) with/for police officers; and (2) with/for informal carers. These efforts are described in the next two sections.

**DESIGNING WITH/FOR POLICE ofFicers**

At the start of this part of the project, Albert—who works at an ICT expertise center, which is associated to the police organization and who is a former community police officer—proposed to support and improve the work of community police officers. The work of those kind of police officers consists largely of talking with various people, for example with shop owners, school administrators, people from the municipality, and building corporations as a way to serve citizens and to prevent crime. Their work is rather different from the work of emergency police officers, who react to emergencies and who would, for example, drive around with lights flashing. Albert wished to empower community police officers and to create tools for them to better communicate and cooperate with other people for their various tasks. This idea matched the goal to design a *we-centric* application.

Then Mandy, Dirk, and me—we work at two ICT research labs and the three of us are responsible for the design and evaluation of a *we-centric* application—and several fellow project team members accompanied one or more police officers during one working day. We did this to learn hands-on about police work, rather than from documents or from interviews. We made individual notes of their observations and then summarized these in the form of “personas” and “storylines” (e.g., Cooper, 1999). Based on our observations we created three personas, three typical police officers Ad, Bert, and Theo, and described, in the form of storylines, three typical working days of these police officers—see below for an excerpt:

**About community police officer Ad**

Ad is 45 years old and has been working for 20 years as a community police officer. Ad is married and has two children: a daughter of 18 and a son of 16. Five years ago, Ad and his family moved from Amsterdam to Haretown [in the countryside]. Amsterdam was becoming too hectic for him and he preferred quieter surroundings. [...] Monday 11:00 o’clock.

Ad is walking around in “his” area. He decides to go to the swimming pool to have a quick look how things are. The weather is beautiful and it will probably be very busy in the swimming pool. The last few days a group of teenagers has been causing a lot of trouble. Ad arrives at the swimming pool and looks for his contact person, John. John however appears to have a day off.

We portrayed Ad as relatively old and preferring quiet work, which is typical for some community police officers—so we were told. This is in contrast to a typical emergency police officer, who is younger and enjoys the thrills of emergency police work. Furthermore, we are suggesting that his work may be improved by a *we-centric* telecom application, which would send a notification to Ad that his contact person at the swimming pool is currently absent, so that Ad may decide to visit the swimming pool another time.

We then organized a workshop with the police officers whom we spent a day with, to discuss our observations and interpretations. During that workshop the project’s goal shifted from improving communication between police officers and other people *outside* the police organization, to improving communication and cooperation *within*
the police organization, mainly because opening-up communication and cooperation towards people outside the police is not desirable from a security perspective. Furthermore, the idea was developed to help community police officers to share their “implicit” knowledge with emergency police officers. Community police officers typically have a lot of knowledge about people and locations in their heads—not everything is made explicit in reports or databases—and such implicit knowledge may be helpful for emergency police officers who often lack such knowledge. A typical “use case” would be this: Emergency police officer Bert is sent to an address because of domestic violence. Without the application, he would enter this situation unprepared, but with it he would receive a suggestion to contact community police officer Ad, who was at that address for a similar incident just two days ago and who was not at his address for a similar incident just two days ago and who made some arrangements with these people. If Bert calls Ad, Ad can update Bert, quickly, of course. This idea also builds upon observations of the researchers at the Police Academy that community police officers and emergency police officers rarely communicate with each other on the street, and that their work could improve if they would.

The police officers’ manager wanted to participate in the workshop, which had several effects. At the start of the workshop, he became irritated about the storylines that we created. He was irritated because we portrayed his daily practice and problems as “children’s stories.” During the workshop he probably influenced what other police officers were willing or dared to say. And at the end of the workshop he pointed out that we “learned nothing at all about police work” in one-day observations. He suggested that we should do observations over a longer period.

Mandy, Dirk, and I then made sketches for a telecom application, which we dubbed PolicePointer. This application is envisioned to run on a smart phone. Its main function is to provide suggestions to contact other police officers who may have information that is useful for you, given your current task or context.

We organized two workshops for which we invited both community police officers and emergency police officers. We discussed the topic of knowledge sharing and our ideas and sketches for receiving suggestions to communicate with other police officers. During these workshops, the PolicePointer was further developed. It was discussed that emergency police officers may be reluctant to “waste time” contacting other people; their job is to react quickly. Therefore, a notification function was added: when Bert receives a suggestion to contact Ad, Ad simultaneously receives a notification, so that he may contact Bert proactively. Furthermore, the police officers mentioned that emergency police officers have knowledge what happens outside office hours and what happens in different areas and that this kind of knowledge may be useful for community police officers. We adopted that idea so that the project’s focus then became to support both kinds of police officers to communicate and share knowledge with each other.

With the help of fellow project team members these sketches were developed into a prototype (see Figure 1). This prototype was evaluated by five police officers during a field trial of two days, during which they used a smart phone with the PolicePointer on it. During this trial, very few incidents occurred, and, partly because of that, only few situations occurred in which the PolicePointer was perceived as having added value. Nevertheless, the participating police officers were positive about the PolicePointer, especially when they would receive suggestions for “unstructured” situations, situations for which there are no procedures and in which they must improvise, and when they would receive suggestions when they were in a relatively unknown area in which they don’t know many colleagues (yet). Interestingly, both project team members and police officers downplayed the prototype’s shortcomings during this trial: the hardware was too bulky, the login
procedure was too long, and the system responded too slow. We explained that these issues would be improved if the prototype were developed into a working product.

Looking at this design process, we see a mixture of participatory design (inviting end users during problem definition and solution finding), of the lead user approach (the police officers who participated in our project were selected based on their innovative behaviour or attitude), and of empathic design (project team members joined a police officer for one day). Furthermore, we can see that each interaction with police officers resulted in some shift of the project’s focus. This is in line with the goal of HCD: to let end users have influence upon the research and design and design process. The PolicePointer started as a tool for communication between community police officers and people outside the police, then became a tool for community police officers to share their knowledge with emergency police officers, and then became a communication tool between these two sorts of police officers.

However, we may also say that our focus on designing a we-centric telecom application gave us eye-flaps. In the process of going from an idea via sketches into a prototype, the PolicePointer gradually solidified. But in each step of the research and design process, the end users—the police officers—became less “real” and more “ideal.” In each interaction with them, we further modelled real police officers into ideal users of our product. We started with the goal to design a we-centric telecom application, a solution “in our heads” looking for a problem “out-there,” and we were happy that Albert found community police officers as a target group. We observed some police officers and wrote storylines about them, storylines that irritated one police sergeant, storylines in which we implicitly suggested that they should work differently, and that they should use our we-centric application. And we created a trial in which we managed to neglect the prototype practical shortcomings and instead focused on the PolicePointer’s theoretical, potential added value.
DESIGNING WITH/FOR INFORMAL CAREERS

Project team members Catherine and Edith, who work at a university’s medical department and who have years of experience in working with and for people with dementia and their informal carers, articulated this goal: to help informal carers who provide care to people who suffer from dementia and who live at home (not in an institution). In many cases, these people provide care to their husband, their wife, or one of their parents and such care is often needed fulltime. The ultimate goal is to improve the quality of life for both the person with dementia and the informal carer, by supporting the informal carer, so that he or she can better provide care and will feel less burdened or will be less likely to suffer from burn-out.

In order to better understand the needs of people with dementia and of their informal carers, Pauline, together with her colleagues Catherine and Edith conducted a large scale survey. Over 300 “dyads”—a person with dementia and his or her “primary” informal carer—were interviewed using several standardized questionnaires. This fieldwork took several months and Pauline presented their preliminary results several times during meetings. Typically, she would show a table with the “most frequently reported (unmet) needs of people with dementia and their informal carer”: “memory (40.5%); daily activities (17.9%); information about health and treatment for informal carer (17.3%); company (12.7%); psychic need of informal carer (12.3%) ....”

The other project team members, Annelies and Martin, who work at a new media lab, and Rachel, who works at an ICT research lab, are responsible for the design and evaluations of a user-centric application. Dementia and informal care are relatively new topics for them, and therefore they chose to do some additional observations and interviews. This caused friction within the team. Pauline suggested that they first study the literature and the results from their survey, and to do additional research only if they miss specific data. Furthermore, there were discussions about method. Pauline and her colleagues do a survey to obtain a statistically representative overview of people’s needs, whereas Annelies and Rachel want to get acquainted with a small number of people with dementia and their informal carers and to be inspired by them. This difference is also described by sociologist Haddon and designer Kommonen (2003), who characterize social scientists as being concerned with existing knowledge and studying and documenting reality, and designers as being concerned with originality, imagining alternatives and changing reality. There were several conflicts within the project team about doing a large, statistical representative survey vs. doing “interviews with only one or two people,” and about which method can be a basis for conclusions or decisions. Only after project team members had actually cooperated in interpreting each other’s data, were they able to cooperate constructively.

Based on the survey and on the additional interviews, a design focus was agreed upon to alleviate the burden of the informal carers, to support them in their “work.” In many interviews informal carers told that they experience taking care of a person with dementia as very demanding, especially if he or she is your husband, wife, or parent. Furthermore, the situation of a person who suffers from dementia cannot improve but only become worse. Such informal carers have to do everything alone: there may be nobody who offers help, or they may not dare to ask others for help.

Annelies, Martin, and Rachel, helped by Pauline, then started a user study. Four informal carers were invited to participate in a series of three interviews in their homes. In the first interview the project team members got acquainted with them and learned about their situation. Based on these interviews they created personas and storylines, in the form of “a day in the life of...” – see below for an excerpt:
High-Tech Meets End-User

About Ans and Simon
Ans (73 years) has dementia. Her husband Simon (76 years) is her “primary informal carer.” They have been together for 51 years. They have two sons, Johan and Pieter, and four grandchildren. They were born and raised in a rural part of the country. Simon had his own shop where he manufactured and repaired sails. He retired 12 years ago. Ans used to do the financial administration and took care of their two sons. She used to be very active; she did volunteer work and used to go for a bicycle trip once a week with the woman from next door.

Time: 5:30.
Ans is stumbling around in the house, which awakens Simon. He sighs and tries to sleep again. He went to bed late last night, because he wanted to finish reading his book. Ans is calling Simon. Simon gets out of bed and goes to help her.

Time: 06:15.
Simon brushes his teeth and dresses. Then he chooses clothes for Ans. He helps Ans to shower, then he helps her dry herself and dress. Helping her with the sleeves of her dress takes a while. Then Ans is dressed.

Ans is portrayed as a woman who used to be active and social. This shows us the woman she used to be before she got dementia and became passive and isolated. Furthermore, the situations of waking up early and helping Ans shower and dress suggest that Simon “suffers” from Ans suffering from dementia. He has to help her fulltime. This also suggests that we could help Simon, for example with a we-centric application, which may help to alleviate informal carer’s social and emotional needs.

In a second round of interviews, Rachel and Annelies read these storylines aloud and discussed these. Together with the informal carers, they identified several situations that the informal carers found relevant. After the interviews, Rachel, Annelies, Martin, and Pauline selected three situations to be used as input material for a concept development workshop with six project team members and with six additional “external” creative designers (not project team members). In this workshop, three groups worked in parallel, each on one of the three situations. One group developed an idea for an ICT application that matches people who look for help and people who offer help, which is meant to let informal carers support each other, practically and emotionally. The other two groups came up with a “domotica” application which monitors what the person with dementia does in the home and assists him or her; and a jewelry product with localization technology, which helps the person with dementia to return home if he or she gets lost outside.

The first idea was selected to be further developed because: (1) it is closest to the goal of designing a we-centric telecom application, it is about communication and cooperation; (2) it is a “mobile, context-aware and adaptive” application, which fits the project’s scope and goal; (3) it is similar to ideas developed previously by project team members and to the PolicePointer, which makes the design more comfortable; (4) and it seems most feasible to build a prototype of it within planning and budget. Making this decision was difficult because some project team members thought that the other two ideas were more interesting and creative. Furthermore, it was noted that the people behind the first idea were involved in the research process, they were “experts on informal carers’ needs,” whereas the people who came up with the other two, more creative ideas were people with little or no experience with dementia or informal carers.

In a third round of interviews, Rachel and Annelies discussed this first concept with the four informal carers who participated in the first two rounds of the interview, and with seven other informal carers. Questions that were discussed were How do you wish to invite informal carers
to participate? How would you like to form or control such a group of informal carers? How do you think participants can be motivated to offer and accept help? What kind of help requests would people ask of each other, for example structural or incidental? And should there be mechanisms to monitor how much help a person offers and receives? Based on these interviews, the following functional requirements for a we-centric telecom application—dubbed WeCare—were articulated: (1) an informal carer can ask for help by putting a “help request” in her online calendar; (2) an informal carer can offer help by filling in her online calendar (when she is available to help) and her profile (the kind of help she wishes to offer); (3) the system automatically matches the “help requests” in with other participant’s calendars and profiles; and (4) messages are sent to the person asking for help and the person offering help—these messages can be sent by e-mail or SMS or as entries in participants’ online calendars. Additionally, participants can post on a bulletin board: “help requested” and “help offered.”

The current plan is to build a prototype of WeCare and to evaluate this together with several informal carers, similar to how the PolicePointer prototype was evaluated. The prototype will include a database, which can be accessed via a webpage on their computer and also via their smart phone. The idea is that people will be able to do complex tasks, such as scheduling, while sitting at their computer, see Figure 2, and use a subset of the functionalities via their mobile phone or smart phone, for example when they are travelling.

In this design process we saw a mixture of participatory design (discussing possible problems and solutions with potential end users) of the lead user approach (the informal carers who participated were selected based on their use of computer, internet and mobile phone), and of usability engineering (discussing concepts and sketches with end users). If we look at how the interactions with informal carers influenced the design process, we see that the initial idea—to support informal carers to do their “work”—remained relatively stable. The interviews with

Figure 2. A mock-up of WeCare: A webpage on a computer

![Figure 2. A mock-up of WeCare: A webpage on a computer](image)
informal carers helped to make design decisions and to articulate functional requirements. However, during the interactions with the informal carers the concept was not critically questioned, and an attempt, in the concept development workshop, to come up with alternative ideas was not welcomed.

Furthermore, we can see that there was friction within the (relatively large and heterogeneous) project team: about which research methods to use (a systematic survey, which produces facts vs. informal interviews for inspiration) and about choosing a concept (a conservative concept vs. a more innovative concept). This contrasts with police officers’ case, where there was friction between the (relatively small and homogeneous) project team and the police officers, for example when the officers’ manager was irritated about “our” storylines about “their” practice. This draws attention to the importance of cooperation within the team in a human-centred design project: not only the interactions with end users, but also the interactions between people in a multidisciplinary team are important (cf. principle 4 of HCD).

In the next two sections, I will critically examine two assumptions that seem to be key in human-centred design (HCD): that researchers and designers can gather knowledge about end users’ needs, wishes and preferences; and that they can apply this knowledge to make appropriate design decisions.

These assumptions can be criticised from various angles: one can argue that end users are not aware of their needs, cannot articulate these, or do not want to or cannot speak about these (van Kleef, van Trijp, & Luning., 2005); that zooming in too much on a small group of end users will result in an over-customized product that will interest only a few (Stewart & Williams, 2005); or that paying too much attention to end users erodes the role of the designer, whose vision and creativity are essential (Hekkert & Van Dijk, 2001). Such effects can indeed be seen in the cases, for example when some of the police officers seemed to talk less freely with their manager present in the workshop; when the validity of making design decisions based “on interviews with only one or two” informal carers was disputed; and when the experts on the informal carers’ needs came up with a relatively conservative idea.

What is probably most striking is that the end users—the police officers and the informal carers—were most often absent in the process. The police officers were invited for several workshops and informal carers were interviewed, but they did not participate in design decision making. In project meetings, where design decisions were made, they were not present, but they were represented. Project team members portrayed them via statistics, which they constructed out of their survey, and via storylines, which they constructed out of their observations and interviews. The storylines are meant to portray the current situation (“is”), but in it were suggestions that these situations are problematic from a very specific angle, and that these situations can be improved by using our we-centric telecom application (“ought”).

Furthermore, the project team members acted as end users’ spokespersons, for example, when they discussed their needs, wishes, and preferences, and when they made design decisions, decisions which are meant to influence the product, which is meant to influence end users’ life and work. Representing end users has resembles the “configuring” (Woolgar, 1991) of end users, and the creation of “scripts” (Akrich, 1992) about end users. Parallel to the product which they create, researchers and designers create an image of what an end-user should look like and how he or she should use their product. Moreover, the gathering knowledge about and from end users and representing them is not a neutral activity (Rohracher, 2005, p. 16):
Representing users in design is by no means a simple and straightforward process, but continuously reshaped and negotiated by actors involved in the design process. [...] User representations are constructed and shaped by the interests, specific discourses and traditions of actors involved and often are also entrenched in material infrastructures or methods to investigate demand.

The process of representing end users is a process of mobilising resources to influence others through communication (Latour, 1987). When Pauline talks about her interviews with informal carers or when Mandy quotes what police officers said in a workshop, they mobilize these end users to make their point.

Gathering knowledge about the world around me, including other people, was also examined by Levinas. He wrote that when I gather knowledge I almost automatically reduce everything to concepts that are already familiar for me: I transmute the other so that it matches to my self (1996a, p. 11-12):

The knowing I is the melting pot of such a transmutation. It is the same par excellence. When the other enters into the horizon of knowledge, it already renounces alterity.

When I gather knowledge about another person, I make a gesture of grasping: I grasp what I see and hear of that other person, and pull him into my own world. Levinas uses words like “the concept or the Begriff” (1996b, p. 152, emphasis in original) to exemplify the “concreteness of the grasp.” The project team members could not escape this tendency of drawing others into their “melting pot.” Their own interests, ambitions, intentions, methods, and their creativity—their “selves”—make them filter what they heard, saw, and understood of “the other” during their observations, workshop and interviews. It is possible to imagine a HCD project in which researchers and designers do their observations, workshops and interviews according to the book, and then follow their own interests, ambitions, intentions and do what they had in mind already. The gesture of the grasp becomes poignant when constructing storylines or personas turns into a way of “involving users by simply excluding them. The users are instead represented by an archetype of a user” (Blomquist & Arvola, 2002).

Researchers and designers who study end users are not engaged in some neutral fact-finding activity, but in negotiating between different people’s interests and values. Explicitly or implicitly they are taking sides, they are making decisions all the time.

MAKING DECISIONS

A research and design project is about making decisions. There are many options open, many uncertainties, but at the same time, there are only few criteria or requirements to ground decision making. Nevertheless, one has to make decisions in order to proceed: create ideas, choose between ideas, turn an idea into concepts, choose between concepts, turn a concept into a prototype, and into a product. One proceeds by reducing “design space” gradually until one has one product. Explicitly or implicitly one must make decisions about what problem to address, about criteria to choose between problems, about what direction to search for solutions, about criteria to choose between solutions, etcetera. This makes research and design different from for example a study in social science or an engineering project.

Roozenburg & Eekels (1995) argue that “design thinking” is different from other “logical” ways of thinking: deduction starts with premises and then one draws a conclusion (in mathematics); induction starts with several observations and then one speculates about a pattern (in natural science); and abduction starts with observing an effect and a process, and then one reasons backward to a
possible cause (in history). Contrastingly, design thinking or innovation starts with imagining a problem that seems worthwhile to try to solve, one simultaneously imagines possible solutions, and also criteria to choose between solutions, one may reformulate the problem or go looking for solutions in other directions, etcetera. Articulating the design problem and formulating the design brief are part of the design process. Imagining the problem and imaging the solution are intertwined. “The problem and solution co-evolve” (Cross, 2006, p. 80). A designer will try-out and play with solutions as a way of exploring the problem. This play with problem and solutions can be found especially in the “fuzzy front end” where problems and solutions are discussed iteratively.

This is different from how one (supposedly) conducts a study in social science—one starts with a question, develops a method, does the study, and interprets the data—or how an engineering project is (supposedly) done—one starts with a brief and then proceeds via steps of generating and choosing alternatives until one has an optimal solution. A research and design project starts with a bet: “No innovation, no invention develops without this initial bet” (Akrich et al., 2002, p. 219). Albert betted that designing a telecom application to support community police officers to cooperate better with others would be worthwhile. The project team members betted that designing a telecom application to support informal carers in their “work” by requesting and offering help would be sensible.

Derrida has a special way of looking at the making of decisions. He argued that only in a situation without rules, where one cannot use knowledge, logical rules, or moral rules can one make a decision (Derrida, 1995, p. 147-8):

The only decision possible is the impossible decision. It is when it is not possible to know what must be done, when knowledge is not and cannot be determining that a decision is possible as such. Otherwise, the decision is an application: one knows what has to be done, it’s clear, there is no more decision possible; what one has here is an effect, an application, a programming.

Making design decisions about what problem to focus upon, what end users to interview, how to interpret what they say, about which direction to look for solutions, and how to choose between alternatives can be called “impossible” decisions. Furthermore, Derrida said that only when one makes such an “impossible” decision, freedom and responsibility become possible (Derrida, 2001, p. 28):

A decision, as its name indicates, must interrupt, cut, rend a continuity, the fabric or the ordinary course of history. To be free and responsible, it must do other and more than deploy or reveal a truth already potentially present, indeed a power or a possibility, an existent force.

This freedom to choose may not be there in every project, but this freedom, which comes together with responsibility was there in the two cases studied. If we organize a research and design project in such a way that logical or moral rules steer the decision making, new possibilities are not possible—no innovation is possible. Innovation can only happen if we make “impossible” decisions, without rules. And the making of such “impossible” decisions make it possible to act freely and responsibly.

sel F And other

A key idea behind HCD, behind interacting with end users and behind multidisciplinary teamwork is that “other people” should be able to influence the project. What researchers and designers do in a HCD project can be seen as making moves towards the self or towards the other. They move towards the other when they listen to end users and try to understand their needs, wishes, and
preferences or when they listen to another project team member and try to understand what he or she says. Conversely, they move towards the self, when they view end users as raw material for their own creativity, when they study end users with their own methods and represent them within their own argument, or when they remind others about the project goal and focus and mobilize this project goal and focus to make their own point.

Researchers and designers are making movements in both directions, at different moments, in different situations. During an interview or workshop, they try to move toward the other and when they discuss their findings within the project team, they move toward the self. They even make these two movements simultaneously, for example when they decide that other people are in need and must be helped: they move towards the other who is (supposedly) in need and they offer help which fits within their own expertise and ambition, within the self. This movement is salient when these products are meant to empower end users, to help them change their behaviour in a (supposedly) beneficial direction: the Police-Pointer was developed to empower police officers to become more self-steering, rather than following hierarchical lines of command; and WeCare was developed to stimulate informal carers to share their tasks with others, rather than doing everything themselves.

Project team members made these movements in order to accommodate different demands upon them. I see at least three forces at work here.

Firstly, there is the self that demands them to use their expertise, their methods, their creativity. This is what they bring into the project. Dirk is clear and positive about team members having their own pet subjects: “Everybody has of course his own ideas which he wants to introduce” (Transcript 31 May 2006, p. 6). He provides examples of Albert who wishes to experiment with location technology and maps and of Barry who likes smart phones and who thinks of applying such smart phones almost regardless of the target group or the problem at hand.

Due to their ambition to develop a we-centric application the people working on the Police-Pointer learned slowly about what police work is about. It was only after several workshops with police officers that they were able to create something that is both interesting for police officers and for their own project. This focus on telecom brings the risk of missing the larger context of police work. During lunch, after one workshop, the police officers talked heatedly about their uniform’s trousers. They currently wear cotton trousers, and their managers want them to wear woollen trousers. But they do not want woollen trousers. They told us how easily you get blood or other stains on your trouser and that they are responsible for keeping their uniform clean. They can easily wash their cotton trousers, but they must bring such woollen trousers to the dry cleaner. Listening to such stories we could have learned more about power and culture and about how innovation works in a police organization. Moreover, there may be interesting parallels to draw between the introduction of woollen trousers and the introduction of something like the PolicePointer.

It was only during the field trial of the prototype that we were discussing in detail how the Police-Pointer may fit in the current police organization and culture. Before that, we had paid attention to communication and information as functional processes, which can be supported by ICT. If the police is currently organized top-down and reacts to incidents, how will police officers think and feel about the PolicePointer, which is meant to stimulate working more proactively and more self-steeringly?

The people working on WeCare used different methods to study and represent end users. Their focus on their own respective methods and their discussions about methods may have blurred their view on the end users. During one such discus-
tion, there was confusion about whose problem we are trying to solve. The table that summarizes the survey’s results has four columns: “reported needs” and “reported unmet needs” of people with dementia, and “reported needs” and “reported unmet needs” of their informal carers. Confusingly, many of the informal carers’ needs are “caused by” the needs of the people with dementia, for example needs related to “memory.” And trying to solve the informal carers’ needs is, of course, meant to help solve the needs of the people with dementia. During one such discussion, somebody remarked “Our need is to do something about that problem.” This draws attention to the researchers who are concerned with their own methods and interpretations, to designers who are concerned with their own creativity and ideas—and to the risk of altogether forgetting the end users. Another risk is that a focus on technology—often the self of researchers and designers—leads to a technological view: as if organizing the exchange of help between informal carers is a technical problem which needs to be solved through a technical solution.

Secondly, there are the end users, the others. The project team members tried to move towards the others, and the interactions with them influenced the project. Looking critically at the moves made towards the others, we saw that the end-uses were often not present, but represented. They are made part of one’s argument, and drawn towards the self. The project team members—probably unintentionally—reduced the otherness of end users.

In workshops the police officers talked about problems in their work, for example about how they balance conflicting roles or identities, such as being a “spider in the web,” being a “go-getter” on an emergency call, and being servant to larger bureaucratic processes simultaneously. Although these utterances appeared in meeting minutes, they were rarely explicitly discussed during decision making within the project team. The police officers’ otherness was also reduced when project team members turned their field notes into storylines. The notes described vividly how the different project team members experienced situations like arresting a thief, driving with lights flashing, wearing a bulletproof vest, or interviewing suspects. However, they omitted such descriptions when they made their storylines, which consequently became relatively sterile. They constructed the storylines with the project’s focus in mind and focused on situations where a we-centric application may be of value.

The informal carers’ otherness was reduced when the project team members applied questionnaires with pre-defined concepts to interview people and summarized their findings into one table. Interestingly, Pauline mentioned relatively late in the process of doing the survey fieldwork that almost all the interviewees were crying during the interviews. This fact was not told before nor was it asked about. Crying respondents was maybe not an apparent aspect of conducting and reporting a survey. The informal carers’ otherness was also reduced when we constructed storylines based on the interviews, privileging what we are interested in and overlooking other aspects. Rachel talked several times about how it moved her that an elderly lady, who was informal carer, found it hard to call upon others for help, but these emotions of Rachel and of this lady were lost in the translation into storylines.

Human-centred design is an attempt to move toward end users. But, since such projects are often multidisciplinary, and with different organizations participating, it is also an attempt to move towards other team members: people who have different backgrounds, positions and interests. Many attempts were made to move towards the other, but often one easily moved (back) to the self.

And thirdly, there is the context of the project. There is a project plan, on which the participating organizations had agreed upon, and in it is the goal to develop and evaluate a we-centric telecom application. I tried, on various occasions, in my role as coordinator of a part of the project, to influ-
ence my fellow project team members to focus on needs or problems that can be related to telecom (and to neglect other problems or needs) and to develop a telecom application (and to disregard other kinds of solutions). This can be illustrated by the observation that, during the development of the PolicePointer, we only became interested relatively late in the project in how police officers input and edit reports in their database. We became interested when and because we realised that we needed to understand “their” information process in order to make “our” telecom application work: the PolicePointer must access and match these reports in this database in order to make automatically generate its suggestions for the police officers to communicate. The development of WeCare was similarly steered by mobilizing the project’s scope and goal, for example, when during and after the creative session these criteria were put forward: it must be a we-centric application; it must be “mobile, context-aware and adaptive”; it must be similar to current ideas within the project team; and it must be feasible technically.

Although the project plan is text in a paper document, it can be brought alive. It can be mobilized when one team member refers to it, interprets it and makes it into a part of his or her own argument. This mobilizing is similar to how end users are represented and mobilized. The project plan is not part of any one of the project team members’ self, but it can be drawn towards the self.

In summary, project team members are moving in a space which spans between self and other. And in this space they move towards end users when they interact with them, or they pull them towards their selves when they represent them to make their own point. Similarly, they move towards fellow project team members or pull them into their own argument. And they move toward the project’s goal and scope, or pull it towards themselves to make their own point.

**SPEAKING ABOUT ETHICS**

Talking about self and other and making references to Levinas and Derrida is my way of arguing that human-centred design (HCD) is a social process which has ethical qualities. Furthermore, I would like to suggest a role for management in bringing these ethical qualities more to the fore.

In the two cases I described how researchers and designers interacted with end users and how they made design decisions, and I described their activities in terms of making “grasping” gestures, of making “impossible” decisions and as moving between self and other. I would like to argue that such actions have ethical qualities. My argument is not concerned with evaluating whether what researchers and designers do is morally good or evil, with suggesting that they should behave more “morally” or with suggestions to improve HCD.

The point which I wish to make is that ethics are happening in HCD—all the time, already. But these ethical qualities are rarely discussed explicitly. We act as if they do not happen, we marginalize such ethical qualities. My point is also not that moves towards the other are better or worse than moves towards the self. The two movements stand for the two “faces” of HCD: it is about meeting another person and trying to create something for this other person and about deploying one’s own creativity. Both moves are made, and both moves must be made.

I am interested in the ethics, which happen in interactions between people when researchers and designers interact with end users and with fellow project team members—whom they listen to, how they listen—and when they make design decisions – when they choose to focus on a certain problem or choose to develop a certain solution. I would like to ask questions like How much participation do I allow in “participatory” design? How much empathy do I have in “empathic” design? How central are people in human-centred design?

My suggestion can be seen as an attempt to “deconstruct” (Critchley, 1999; Derrida, 1991)
HCD, where I understand deconstruction as a “radical form of questioning text(s)” (Letiche, 1998, p. 125): providing a critical reading of what happens in a project and providing an alternative reading of that project. What would happen if these ethical qualities were brought more to the fore? What if managers, researchers and designers become more aware and explicitly discuss their selves, their own respective positions, their own expertise, methods and creativity? What if they become more aware and explicitly discuss how they relate to others, to what they hear and see from end users and from fellow project team members? What if they become more aware and explicit about how they move between self and other?

This suggestion can be positioned in a debate about the relation between ethics and science and technology studies (STS). Many social constructivist studies of technology in the field of STS can be criticized for not speaking (enough) about ethics, for their “lack of and, indeed, apparent disdain for anything resembling an evaluative stance or any particular moral or political principles that might help people judge the possibilities that technologies present” (Winner, 1993, p. 371). Recently Poel and Verbeek (2006) stimulated a debate between STS and ethics. They argue that, traditionally, engineering ethics has been concerned with studying the ethical consequences of developing or applying technology, and advocate that STS might help to conduct more situated studies of what people involved actually do, to “open the black box of technology” (rather than building theoretical arguments), and that, vice versa, engineering ethics “might help STS to overcome its normative sterility.”

My suggestion is in line with theirs: I suggest that researchers, designers, their managers, and others involved in a HCD project can be stimulated to reflect upon their practice and upon the ethical qualities of their practice. This could be a way of letting the other put into question my self, my spontaneity, my creativity (cf. Critchley, 1999, p. 5; Levinas, 1969a, p. 17), and it could be a way to help researchers and designers to act more freely and more responsibly. Responsibly in the sense that they can question their design decisions more explicitly and ask each other to respond to such questioning. And freely in that they can more consciously and explicitly choose between options. I think that many researchers and designers are currently attempting to do HCD, but that they are doing their projects as if they are doing social science or an engineering project. My suggestion is to conduct HCD differently, to conduct it more accordingly to what it already is—a process between people, with ethical qualities—to continue doing HCD, but more reflectively.

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**endnotes**

a I use “researcher” and “designer” for roles or for activities—not for people or for occupations. One person can at one time do research, “study something carefully and try to discover new facts about it”, and at another time do design, “decide how something will look, work, etc. especially by drawing plans or making models” (Oxford Advanced Learner’s Dictionary, 7th ed.). I am keen not to say “R&D” because that word is associated with an organizational job, function or department.

b I use “end-users” as a more readable alternative for “future, potential or putative end-users.” Nevertheless, it is strange to talk about end-users when there is not yet...
a product or service that can be used – it is currently being developed. Furthermore, I use “end-users” rather than “users,” to refer to people for whom a product or service is meant primarily or ultimately, and not to e.g. a repair-person, who may also use the product, or e.g. a decision-maker who may decide to install or implement the service. More details about this project are in a conference paper (Steen, 2006b).

Similarly, Lawson (1997, p. 121-7) argues that design problems cannot be comprehensively stated and require subjective interpretation, that the number of possible solutions is inexhaustible and no one is optimal, and that the design process is involves finding as well as solving problems and is a prescriptive activity.

I intend to talk about the ethical qualities of research and design. Not about the ethical qualities of applying or using the products that come out of that process.

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About the Contributors

Steve Clarke received a BSc in economics from The University of Kingston Upon Hull, an MBA from the Putteridge Bury Management Centre, The University of Luton, and a PhD in human centred approaches to information systems development from Brunel University—all in the United Kingdom. He is professor of information systems in the University of Hull Business School. Steve has extensive experience in management systems and information systems consultancy and research, focusing primarily on the identification and satisfaction of user needs and issues connected with knowledge management. His research interests include: social theory and information systems practice; strategic planning; and the impact of user involvement in the development of management systems. Major current research is focused on approaches informed by critical social theory.

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Peter Baloh is an assistant lecturer at Faculty of Economics Ljubljana University. His primary research focus lies in the areas of information systems, technological innovation and knowledge management, which are considered through the lens of successful implementation in various organizational settings. He has authored or co-authored three books and over forty articles, which were presented at international conferences, and were featured, published or are forthcoming in journals such as MIT Sloan Management Review, IEEE Software, Research-Technology Management, Journal of Organizational and End User Computing, Knowledge and Process Management, and Manager, among others. He serves on the editorial review board of International Journal of Knowledge Management. He has traveled the world and loved it.
About the Contributors

Jonathan P. Caulkins (PhD, operations research, MIT, 1990) does research and teaches quantitative analysis and decision modeling at Carnegie Mellon University’s Qatar campus and its Heinz School of Public Policy and Management in Pittsburgh.

Yvonne Dittrich researches and teaches as associate professor at the IT University of Copenhagen, Denmark. In 1997, after completing her PhD in computer science from the University of Hamburg, Germany, she built up research in cooperation with Industry at Blekinge Institute of Technology in Sweden. Her research combines software development as cooperative work, end-user development, and use oriented design and development of software. Her current work addresses the development and evolution of software products.

Douglas A. Druckenmiller is an assistant professor in the Department of Information Systems and Decision Sciences at Western Illinois University. Dr Druckenmiller received his PhD in management information systems from Kent State University. His research focuses on development and testing of software to support facilitation processes involving causal mapping, agent-based modeling and simulation tools, systems dynamics modeling and thinking, group support systems (GSS) and virtual meeting technologies. He is currently principle investigator of a major international dual-degree project in business and technology involving multiple United States and European Union partner universities. He has more than 35 years of collaboration engineering experience, and has published several journal articles in the area of group decision support and problem formulation in journals such as The International Journal of Intellegence, Technology and Planning, FUTURES, and Journal of Information Systems Education.

Jeanette Eriksson is a lecturer and researcher in software engineering at Blekinge Institute of Technology in Sweden. Her research area is within tailorable and flexible systems. Her research interests include exploring how to reflect different user aspects in software architectures to achieve software that adapt to altered conditions and requirements in the end user environment. She is also interested in how to involve end users in the technical design process of adaptable software.

Jeremy Fowler has a Bachelor of Computing (Honours) degree from La Trobe University and is currently completing his Master of Science (by research) degree at the same institution. His current research involves the investigation of the interaction between the cultural and known success and failure factors within an information system that went from failure to success during its development. It is hoped that this research will help to improve our understanding of information systems development failure through better understanding of the interactions that occur between the cultural and known success and failure factors.

Pat Horan is a senior lecturer in the Department of Computer Science and Computer Engineering, Bendigo Section, of La Trobe University. She holds a PhD in education from Monash University. Her research interests include information systems education, information systems failure and success, and soft systems approaches to systems development.

Erica Layne Morrison (MSPPM, CMU, 2005) received her MSPPM degree from Carnegie Mellon’s Heinz School and is now a consultant in public sector practice for IBM’s Public Sector Supply Chain practice.
Victor R. Prybutok is a regents professor of decision sciences in the Information Technology and Decision Sciences Department and director of the Center for Quality and Productivity in the College of Business Administration at the University of North Texas. He received, from Drexel University, his BS with High Honors in 1974, a MS in bio-mathematics in 1976, a MS in environmental health in 1980, and a PhD in environmental analysis and applied statistics in 1984. He is a senior member of the American Society for Quality (ASQ) and active in the American Statistical Association, Decision Sciences Institute, Institute of Electrical and Electronic Engineers, and Operations Research Society of America. Dr. Prybutok is an ASQ certified quality engineer, certified quality auditor, certified quality manager, and served as a Texas Quality Award Examiner in 1993. Journals where his published articles have appeared include *The American Statistician, Communications of the ACM, Communications in Statistics, Data Base, Decision Sciences, European Journal of Operational Research, IEEE Transactions on Engineering Management, MIS Quarterly, OMEGA: The International Journal of Management Science*, and *Operations Research*. In addition, he is in *Who's Who in American Education and Who's Who in America*, and *Who's Who in the South and Southwest*.

Ly Fie Sugianto holds Bachelor of Engineering (H1) degree from Curtin University and Doctor of Philosophy from Monash University. She has been appointed as an expert of international standing by the Australian Research Council College of Experts. At Monash, Dr. Sugianto lectures and supervises doctoral students in e-commerce. She has researched and published extensively (70+ refereed articles) in the fields of e-commerce, DSS, B2E portal and deregulated electricity market. She has also received several grants for deregulated markets and information systems research. Her research reflects her ongoing interests in the study and development of support tools and techniques for intelligent decision making.

Dewi Rooslani Tojib holds Bachelor of Business Systems (H1) and Doctor of Philosophy (PhD) from Monash University, Australia. Her PhD research has focused on the development of a scale to measure user satisfaction with business-to-employee (B2E) portals. She is currently a research fellow in the Department of Marketing at Monash University. While she is still continuing her research on B2E portals, she has extended her research exposure to consumer behavior research and experimental designs. Her research has been published in a number of academic and practitioner journals as well as presented in several international conferences. Her research interests include electronic business, mobile commerce, consumer shopping behavior, user satisfaction measurement, web-based Information Systems, scale development and validation.

Marvin D. Troutt is a professor in the Department of Management & Information Systems and in the Graduate School of Management at Kent State University, Kent, Ohio. He is a fellow of the Decision Sciences Institute. He received the PhD in mathematical statistics from The University of Illinois at Chicago in 1975. His publications have appeared in *Management Science, Decision Sciences, Journal of the Operational Research Society, European Journal of Operational Research, Operations Research, Decision Support Systems, Naval Research Logistics, Statistics*, and others. He received the 2005 Distinguished Scholar Award at Kent State University. He has served as the director of the Center for Information Systems at Kent State University and the Rehn Research professor in Management at Southern Illinois University, Carbondale, Illinois. He served as visiting scholar in the Department of
About the Contributors

Applied Mathematics at the Hong Kong Polytechnic University during 1994-95. His current interests include supply chain management, applied probability, and applied optimization.

**Timothy Weidemann** (MSPPM, CMU, 2004) received his MSPPM degree from Carnegie Mellon’s Heinz School and is now a consultant in public sector practice for Fairweather Consulting.

**Randall Young** is an assistant professor in the Accounting and Business Law Department at the University of the University of Texas – Pan American. He earned a PhD in business computer information systems from the University of North Texas, a master’s of accountancy from Abilene Christian University and a BBA in finance from the University of Texas at Arlington. His research interests include IT infrastructure, IT auditing and information security management. He has published in *Information Resource Management Journal*, *Information Systems Management*, and *Journal of Organizational and End User Computing*.

**Lixuan Zhang** is an assistant professor in the Hull School of Business at Augusta State University. She holds a MS in management information systems and Master of Business Administration from University of Oklahoma and a PhD in business computer information systems from University of North Texas. Her current research interests include IT personnel management, IT ethics and security and human computer interaction. She has published in *Journal of Information Technology and Management*, *Information Systems Management*, *Journal of Organizational and End User Computing*, and *Information Resource Management Journal*.
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