Establishing and maintaining an online community of academics: longitudinal evaluation of a virtual conference series

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Abstract: Initiated in 1996, the CybErg international conference series is the only online conference series in the field of ergonomics. Using virtual settlement theory and a model of online community evolution, this article reports on a 12-year longitudinal investigation of the five conferences in the conference series and whether they have been effective in establishing an online academic community and in internationalising the dissemination of knowledge and dialogue of this online community. The results suggest that the conference series is indeed a good example of an online community in an engaged state and has been largely successful in encouraging equality in the international distribution of contributors. This article concludes with new possibilities to enhance the conduct, knowledge production, dialogue, and processes of future online academic conferences.

Keywords: online conferencing; engagement; computer-supported cooperative work collaboration; knowledge transfer; virtual settlement theory; online community evolution.
1 Introduction

A virtual conference is any conference where the primary medium of presentation and interaction is the online environment. Usually, virtual conferences refer to the use of the web as the primary means of facilitating communication although, in principle, virtual conferences may also include email-conferencing, teleconferencing, videoconferencing, mobile-conferencing, chat rooms, and intranet discussions. Online conferences may be distinguished from other forms of online communication [such as ListServs (Hyman, 2003), blogs, newsletters, and journals] in that a virtual conference is used to facilitate an
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intensive period of interaction over a limited period of time such as an hour, a week, or a month (Anderson and Christiansen, 2004). The virtual conference formats found on the web are quite varied, from simple discussion forums (operating as nothing more than simple bulletin boards), to graphic-intensive virtual conferences that are highly interactive and graphically simulate everything from the registration foyer to the presentation hall. Some web-based conferences include multimedia presentations such as video and sound clips (e.g., webcasts and podcasts) of keynote speakers and other presenters. There are even instances of conferences that have attempted to use graphic multiple user domains (MUD’s) to create highly interactive conference experiences (Wang, 1999).

Previous published evaluations of virtual academic conferences (Anderson and Christiansen, 2004; Chu, 2005; Wang, 1999) have not conceptualised virtual conferences as continuing communities of practice. Instead, past evaluations have concentrated on the experiences with a single conference event; Wang (1999) evaluated the International Council for Distance Education’s (ICDE) 1995 conference and Chu (2005) evaluated the International Association for Development of the Internet Society (IADIS) conference on Web-Based Communities 2004. Anderson and Christiansen (2004) evaluated the ICDE 1992 and ICDE 1996 conferences but not as a coherent thread of community building. Instead, they argued that evaluation should be an integral part of any conference (online or face-to-face). Anderson and Christiansen (2004) did note that a two-year online tutoring skills (OTiS) Project developed into a community of practice, although this was arguably not an online academic conference. The current paper uses Jones’ (1997) virtual settlements theory to establish whether an online conferences series might be considered as a virtual community and Gongla and Rizzuto’s (2001) five-stage model of online community evolution to explore the maturity level of this conference series.

1.1 The CybErg conference series and research questions

This current paper evaluates the development, over twelve years, of an academic virtual conference series (CybErg) that has used the web for the dissemination of conference content and discussion. All academic conferences essentially have two aims; the first is to disseminate and (through discussion) create knowledge and the second is to develop social networks that might extend beyond the duration of the conference (Anderson and Christiansen, 2004). The CybErg conferences share these aims.

Whilst the CybErg conferences are the only regularly occurring (they are held triennially) virtual conferences in the field of ergonomics and human factors they should be viewed in context with other online initiatives in the ergonomics domain. There are a number of ergonomic discussion forums (ListServs or mailing lists) that have been operational for some time (e.g., Aus-Ergo, Biomch_1, Ergonomics-mailbase, and Ergoweb). These are discussion forums that are open all year round to registered users to discuss emergent topics of interest. The only other virtual ergonomics conference, CibErgo, was run by the Spanish-speaking ergonomics societies once in 2000.

CybErg2002Papers.htm), 2005 (http://web.wits.ac.za/NewsRoom/Conferences/CybErg/ CybErg2005/papers.htm), and 2008 (http://www.cyberg08.org/forum/) in the years preceding the face-to-face International Ergonomics Association Congresses. The format of the CybErg conference series was designed to simulate the primary academic programme of a face-to-face conference. The content of the academic programme was built around peer-reviewed extended abstracts, where the best quality abstracts were selected for expansion into full papers for ‘presentation’ during the conference. Paper presentations were roughly the same length as papers submitted to academic journals. Paper types at CybErg conferences have also included invited papers (e.g., focused sessions and keynote addresses) and symposia. The presentation and discussion has primarily been in asynchronous text and static image format (although synchronous text and voice discussions and the inclusion of asynchronous video material in conference papers have also been utilised). This ‘low-tech’ presentation format has been maintained to encourage participants, especially from less technologically developed parts of the World, to participate. Maloney-Krichmar and Preece (2005) found that “dependable and reliable technology is more important than state-of-the-art technology” (p.201) in maintaining membership and participation in an online health community.

This article examines three research questions:

1. Has the CybErg conference series established an online community?
2. If the CybErg conference series is an online community, at what stage of evolution is it?
3. Has the CybErg conference series met its academic aim of internationalising ergonomics knowledge production and dialogue?

1.2 Establishing an online community

While there have been previously published evaluations of online conferences (Anderson and Christiansen, 2004; Chu, 2005), no previous studies have attempted to define an online conference as an online community. Virtual academic conferences pose challenges for the development of a sense of community online, in that they represent communities which by definition only come together periodically. The question is whether such intermittently-formed groups demonstrate similar features of community development as seen in other online communities. de Sousa and Preece (2004) define an online community broadly as “a group of people, who come together for a purpose online, and who are governed by norms and policies” (p.580). Within this definition, there are three major components: the people (i.e., those who interact with one another who may have specific roles such as presenter, chairperson, committee member, etc.); the purpose (i.e., the shared focus or need that provides a reason to be in that community); and the norms (i.e., language and policies that determine the community structure and interaction). An online academic conference is closest to what Garrison, Anderson and Archer (2000) refer to as a ‘community of inquiry’ (p.88) – a community where learning and knowledge construction is the primary common purpose. People join online communities in order to access information of use to them and also to contribute to that body of information (Preece, 2001; Wise et al., 2006). Using Porter’s (2004) typology of virtual communities, the CybErg conference series is a member-initiated, professional virtual community (i.e., established by members of the community, remains managed by members of that
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community, and comprises professional ergonomists and human factors practitioners and researchers). The CybErg conference series might also be referred to as a ‘knowledge-based/collaborative learning community’ (Garrison et al., 2000).

Despite these descriptors the CybErg conference series may not have established a community. Within ‘Virtual Settlements’ theory Jones (1997) provides a set of four conditions to be met before an online presence or online group might be considered an online community.

1 A community requires a common-public space where the interaction can take place within a particular boundary (e.g., a website, a chat room, a discussion group, etc.) available to all community members (Jones, 1997; Liu, 1999). In other words, one-to-one interaction in cyberspace does not constitute an online community unless that interaction is shared in some common space (Jones, 1997).

2 A virtual community requires a ‘minimal level of sustained (and stable) membership’. Unfortunately, neither Jones (1997) nor Liu (1999) offer an explanation for what would be a minimum level of membership or the nature of the stability. Liu (1999) refers to ‘one or several core members’ over a ‘significant period of time’. Jones (1997) recommends that further research be conducted on the nature of membership stability.

3 A community must have a variety of contributors. Rather generously, Jones (1997) defines a minimum variety of contributors as ‘more than two’ (i.e., interaction between two people in a shared space over a period of time is not an online community). Variety was not defined in terms of any other criteria such as subject-area knowledge, exposure to the online group, ideology, or biographical indicators (i.e., age, gender, or nationality). Liu (1999) argues that the group needs to be larger than three to four individuals to constitute a community.

4 A community requires a certain minimum level of interactivity. Interactivity in this sense means that information cannot just be conveyed in a one-way direction, but that there needs to be some dialogue and co-construction of knowledge or identity. Following Rafaeli and Sudweeks (1997), interactivity refers to the fact that messages in a sequence relate to one another, in either a two-way (i.e., didactic or bilateral communication), reactive (i.e., additional later messages refer to earlier messages), or fully interactive (i.e., later messages recognise the reactivity) fashion. Neither Jones (1997) nor Liu (1999) provides any baseline measure for a minimum amount of interactivity.

Admittedly, Jones (1997) acknowledged that the specific aspects and quality of these four conditions will vary depending on the nature of the online community (e.g., an email list will have quite different requirements to internet relay chat or a commercial forum).

The current paper will examine evidence to determine whether the CybErg conferences have developed an online community. If the evidence does support the concept of a community, the results might provide benchmarks within the Virtual Settlement Theory for the consideration of online academic conferences as an online community in terms of size, level of interaction, and stability of membership.
1.3 Maintaining an online community

According to Maloney-Krichmar et al., (2002) “online communities evolve and change continually just like physical communities” (p.14). Gongla and Rizzuto (2001) describe a five-stage model of online community evolution. In the potential stage initial engagement is encouraged and developed. Usually a small core group is required to form relationships in order to move the community to the next stage. In the building stage the online community establishes a context and confirms the structures and procedures for the community. At the building stage, the core members share a common understanding about the purpose of the community and how it will function. Importantly, the core community members ‘remember’ the purpose and work to bring other members into the community. In the engaged stage the community grows in size or complexity. An important feature of this stage is that members of the community actively learn about how the community works and understand what they can learn from one another. At the active stage the community reflects on and analyses the value of the community. At this stage the community may try and expand its membership or build relationships with other communities. A characteristic of the active stage is a heightened level of collaboration where community members work to pool knowledge and address issues beyond the boundaries of the community. At the adaptive stage community members sense the external environment and accept that change and innovation is necessary. At this stage the community may introduce new processes, groups, or even new environments. An important quality of Gongla and Rizzuto’s (2001) model is that it is not a linear stage model. A community could stagnate, regress or disband at any of the stages. For example, Gongla and Rizzuto (2001) hypothesised that few communities could sustain themselves at an adaptive stage. Longitudinal investigations of commercially and professionally operated online communities suggest that communities do indeed progress, stagnate and regress (Maloney-Krichmar and Preece, 2005; Maloney-Krichmar et al., 2002; Schoberth et al., 2003).

Schellens and Valcke (2005) found that over time discussions in asynchronous discussion groups were very task-oriented and remained task-oriented. They also found higher phases of knowledge construction in online discussions (compared to face-to-face groups) and that this level of knowledge construction increased as discussion activity increased. While the level of academic-related discussion may be high in asynchronous academic discussion, Matzat (2004) found that the online environment did not promote the development of intensive contacts between academic researchers. It is therefore possible that the online environment does not facilitate the development of social interaction because it does not provide sufficient richness of information processing cues to deal with ambiguity inherent in socially-related interaction (Daft and Lengel, 1986). A number of studies found that active membership in an online community usually declines over time (Joyce and Kraut, 2006; Maloney-Krichmar et al., 2002; Schoberth et al., 2003) as online community members lose interest and explore more physically interactive options. In general, communication in the online environment is considered to be poorer than face-to-face communication since nonverbal cues (e.g., tone of voice, voice inflections, body language, facial expressions) are poorly supported (Sproull and Kiesler, 1986; Walther, 1994). Of course, graphical emoticons and richer communication media (e.g., voice and video webcasts) have done much to reduce the ambiguity. Maloney-Krichmar and Preece (2005) found that a combination of long-term membership and newer participants was important for the sustainability of an online community.
1.4 Internationalising knowledge production and dialogue

An online conference arguably gives people on the periphery of cutting-edge research access to the principal researchers (Matzat, 2004), especially since keynote speakers are rarely directly accessible to people on the periphery at face-to-face conferences. Whittaker (1996) noted that discussions were more successful with a diverse range of participants implying that aspects such as the internationalisation of participation are important. Chu (2005) also advocates the importance of giving marginalised groups a ‘voice’ at academic conferences. In many parts of the world, internet access is both available and fairly cheap, meaning that the availability of information and resources are far more accessible. This should be tempered by two important points. First, access to reliable, high bandwidth technology in developing countries is often severely limited. Internet penetration rates in most countries in Africa, Asia, Eastern Europe, and South America are usually quite low in comparison to North America and Western Europe (Internet World Stats, 2008). For example, in Africa, internet penetration rates are an average of 5% compared to an average of 71% in North America and 60% in Western Europe (see http://www.internetworldstats.com/for more internet penetration rates from different countries). Further, information technology infrastructure in large parts of Africa, South America and South East Asia is highly unreliable, with poor telecommunications’ infrastructure, unreliable power sources, poor technical support, and long routes for information transfer. Second, in many developing countries the primary language is not always English making it difficult for participants to follow discussions and make their own contributions. In principle though, a virtual conference should be able to reach people who are unable to travel due to financial restraints, due to work or family commitments, or due to physical restraints. At the same time, a virtual conference does not prevent people from attending who do not have these restrictions. However, a virtual conference does eliminate those people who do not have internet access or do not have the requisite language or technology skills.

2 Methods

2.1 The context: CybErg conferences

At the 1996 CybErg conference there were 56 academic papers and 1,155 registrants. Registration was free and was facilitated by coordinating registration with two live conferences (the Human Factors and Ergonomics Society of the USA and the Human Factors and Ergonomics Society of Australia annual meetings). At the 1999 CybErg conference there were 55 peer-reviewed papers, seven invited papers and 130 registered participants. A minimal registration fee of US$75 was introduced to include the production of the conference proceedings on CD-Rom. An international scientific advisory committee was also introduced to regulate the quality of scientific papers and discussions. The 2002 CybErg conference had 58 academic papers, 13 invited papers (some of which were also peer-reviewed) and 110 registered participants. The registration fee of US$75 remained the same, as did the utilisation of an international scientific advisory committee. Registration discounts were offered to participants from industrially developing countries. Session chairs were appointed to stimulate quality discussion and to moderate and guide discussions where necessary. Wise et al. (2006) found that
participants were more likely to actively participate in moderated discussions. The 2005 CybErg conference had 75 academic papers, six invited papers, three keynote address papers and 162 registered participants. The registration fee was increased to US$100 for participants from industrially developed countries and registration discounts were again offered to participants from industrially developing countries. Session chairs were used again as moderators of discussions. The 2008 CybErg conference had 23 academic papers, six invited papers, and 244 registered participants. The registration fee was once again free. Session chairs were not used.

Discussions took place during a one-month ‘live’ period where registered participants and authors were invited to read the papers and to ask questions or to make comments, and to respond to these by means of an asynchronous text-based bulletin board. The one-month dialogue allowed in-depth discussions across a wide range of papers. Asynchronous postings allowed more time for the reflection which is so important in academic discourse (Preece, 2001) and may therefore be preferable to synchronous or face-to-face communication in generating critical discourse in learning environments (Garrison et al., 2000). In addition, participants could have attended and contributed to all the papers, not just those presented in non-parallel sessions (as sometimes happens at face-to-face conferences). There have also been various attempts to develop a social programme. The most enduring social aspect of CybErg conferences has been the inclusion of social discussion areas, allowing participants more freedom for social and general discussion. Other attempts at a social programme have included virtual tours, exhibition areas, synchronous chat rooms, and virtual ‘sun downer’ sessions (complete with links to local webcams). The conference organisers have systematically evaluated each of the previous CybErg conferences and the results of these evaluations have been disseminated at international conferences (Pollock and Straker, 2000; Pollock et al., 2002; Thatcher, 2006; Thatcher and James, 2003).

2.2 Evaluation data

To examine whether the CybErg conferences were an online community we evaluated patterns of registration across the conferences; geographic distribution of attendees, discussants and authors; and discussion participation (including a content analysis of the discussion postings). To determine the stage of evolution of the CybErg conferences we examined the distribution of postings, ratings of paper and discussion quality and discussion participation. To evaluate the internationalisation of CybErg knowledge we looked at the geographical distribution of registrants. These data were drawn from log files and participant surveys.

2.2.1 Log file data

The log file data were automatically gathered using server web logging facilities. Logged interaction data included the number and geographical distribution of registrants, the proportion of registrants who actually ‘attended’, and the average number of days that registered participants visited the conference website. In addition, later versions of the discussion software enabled data logging of the actual discussion postings including the number of postings, the nationality, and the proportion of delegates who made comments. Where possible (the content of discussions for the first three conferences were unavailable at the time of this analysis) other data were extracted from the actual
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discussion postings including the number of discussion and topic postings and the
nationality of the registrants making postings. For technical reasons log file data for
registrants’ interaction with the discussion sessions could not be gathered for the earlier
CybErg conferences (i.e., 1996 and 1999). Details on the nationality of the authors of the
papers were extracted from the conference proceedings. Although the log file data were
time-stamped, this data does not necessarily provide an adequate indicator of the time
spent viewing each webpage and hence these data have not been included in any analysis
presented here. Time-stamps also include transmission time from the host to the user’s
computer (which was quite variable depending on download speeds) and actual time
spent ‘reading’ (where the registrant might actually have been engaged in other activities
simultaneously).

2.2.2 Post-conference subjective evaluation forms

The post-conference subjective evaluation forms were distributed (and returned) via
e-mail to all registrants towards the end of each conference. Evaluation forms from 1996
(N = 136; 13% response rate), 1999 (N = 32; 22% response rate), 2002 (N = 37, 32%
response rate), and 2005 (N = 100; 63% response rate) were analysed. Information from
the evaluation forms included ratings of the quality of papers, ratings of the quality of
discussions, and perceptions of the level of interaction at the conference. Ratings
throughout the questionnaire were given on ordinal scales (e.g., ratings of quality were
scored on a scale of ‘much better’, ‘somewhat better’, ‘about the same’, ‘somewhat
worse’, ‘much worse’ – comparing the virtual conference to face-to-face conferences).

2.2.3 Content analysis of the discussions

The purpose of the content analysis was not to provide in-depth interpretations of the
discussion content. Instead a surface content analysis was conducted whereby the
discussion points were classified into one of three categories in order to determine the
degree of interactivity. Liu (1999) argues that any form of bilateral communication is
evidence of interactivity. At the lowest level of interactivity were initial discussion
postings that either initiated a discussion point that was not on a specific conference
paper or were postings from one of the paper’s authors encouraging discussion (these
were considered to be the equivalent of an extension of the conference paper). At the
moderate level of interactivity were discussion postings that asked questions or made
specific comments about a particular conference paper. In essence these types of postings
demonstrated interaction with the conference paper (where the conference paper might be
considered to be an extended version of an initial posting). At the highest level of
interaction were discussion postings that responded to an earlier posting. There were
examples of two-way didactic, reactive, and fully interactive discussions (Rafaeli and
Sudweeks, 1997) in this category. This analysis was conducted for the two most recent
conferences where the discussion full postings were available.
3 Results

3.1 Has the CybErg conference series established an online community?

Results are presented against the four criteria set by Virtual Settlements Theory.

3.1.1 Criteria 1: interaction occurs within particular boundaries accessible to community members

The CybErg websites clearly provided virtual space within which community members participated. The interaction between registrants primarily occurred in the social and academic asynchronous text discussion with Figure 1 showing an example of this interaction. Other examples of CybErg discussions have also been published as illustrations of the type of discussions that take place at the conferences (see Straker, 2003; Thatcher, 2005). The discussion forums were only accessible to registered participants and were bounded by a specific URL (or a mirror site in 1999).

Figure 1 Example of a discussion thread on the role of online conferences

<table>
<thead>
<tr>
<th>Author</th>
<th>Topic: Why low participation?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Member #62</td>
<td>[Participant #42], Here are some thoughts the paper brought forth. Rich media. One of your motivations was to provide access to poorer participants. And indeed, that may have backfired (you seem to suggest that possibility). Here is an alternative: organise a conference that uses rich media and thus enhances virtual presence (and thus participation), but that at the same time enables graceful degradation for the poor. That is, the poor may not get to feel the same presence, but they should be able to follow the gist of the discussion (say, in text form) and participate in some degraded form (text again). Now, some will object that such an arrangement disfavours the poor (which indeed it does!) and that it is therefore unacceptable (debateable!).</td>
</tr>
<tr>
<td>Member #42</td>
<td>Hi [Participant #62], Part of the problem of running an information-rich conference is bandwidth. You need lots of it dedicated to the running of a conference. In exploring this option from our part of the world it just wasn’t possible. The majority of South Africa’s bandwidth comes from a single trans-Atlantic cable (the whole country’s bandwidth!!). We can purchase more bandwidth from satellite connections and other options, but this is very expensive and not a viable option at present. This may be feasible in the United States but would (unfairly, I believe) exclude all those people who have something useful to contribute but are limited by bandwidth.</td>
</tr>
</tbody>
</table>

Source: From CybErg (2005)
3.1.2 Criteria 2: a minimum level of membership stability

Membership stability was examined using the patterns of repeat registration at CybErg conferences (see Table 1). Across the five conferences there have been a total of 1,640 different people who have registered for at least one conference. When looking at registrations at multiple conferences, the numbers are greatly reduced, with 77 (5%) people registered for any two conferences, 17 (1%) people registered for any three conferences, six (<1%) people who registered for any four conferences, and only six (<1%) people registered for all five conferences. These numbers are biased by the fact that the first conference had a large number of first (and only) registrations as registration for the first conference was free, available at booths at two national face-to-face conferences, and the concept of an online conference was novel (at the time). Using the post 1996 conference attendance data (N = 540 unique registrants) as a baseline there were six (1%) people who registered for the remaining four conferences, 15 who registered for three conferences (3%), and 58 (11%) who registered for two of the remaining four conferences. The pattern is similar when looking at consecutive conferences. From 1996 to 1999 there were 37 registrants who registered for both conferences; from 1999 to 2002 there were 21, from 2002 to 2005 there were 33, and from 2005 to 2008 there were 32 registrants for consecutive conferences. These results would suggest that there was a small core group of registrants who sustained the conference, a group of registrants who showed a high level of dedication to the conferences (attending more than one conference), and a larger group of registrants who made up the bulk of conference registrants but only attend one of the conferences.

<table>
<thead>
<tr>
<th>One conference only</th>
<th>Two conferences only</th>
<th>Three conferences only</th>
<th>Four conferences only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2002 + 2005: 15</td>
<td></td>
<td>2005 + 2008:</td>
</tr>
<tr>
<td></td>
<td>2002 + 2008: 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2005 + 2008: 16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Only 1: 1,530 Only 2: 77 Only 3: 21 Only 4: 6

Note: Six participants attended all five conferences.

3.1.3 Criteria 3: a variety of contributors

Registrants at CybErg contributed in two major ways –authoring papers and posting discussion comments.

Tables 2 and 3 show the geographic distribution of authors, attendees and discussants at the conferences. A registrant was considered to have ‘attended’ if they visited the
conference website at least once during the conference ‘live’ period. A registrant was considered to have been a ‘discussant’ if they made at least one discussion posting during the conference ‘live’ period. This geographical distribution of ‘discussants’ produces a similar pattern to that of the ‘attendees’ (i.e., marginally reduced participation from Asia/Pacific and Europe where English is not the first language, compared to all registrants). These data suggest that there was geographic variety in the contributors at the CybErg conferences.

Table 2  Geographical distribution of authors of conference papers

<table>
<thead>
<tr>
<th></th>
<th>North America</th>
<th>South America</th>
<th>Europe</th>
<th>Asia/Pacific</th>
<th>Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>56</td>
<td>124</td>
<td>15</td>
<td>33</td>
<td>7</td>
</tr>
<tr>
<td>1999</td>
<td>62</td>
<td>116</td>
<td>26</td>
<td>19</td>
<td>17</td>
</tr>
<tr>
<td>2002</td>
<td>71</td>
<td>141</td>
<td>19</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>2005</td>
<td>84</td>
<td>159</td>
<td>29</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>2008</td>
<td>29</td>
<td>66</td>
<td>13</td>
<td>5</td>
<td>17</td>
</tr>
</tbody>
</table>

Table 3  Geographical distribution of registrants (actually visited the conference website during the conference time) and the discussants (posting at least one discussion point)

<table>
<thead>
<tr>
<th></th>
<th>North America</th>
<th>South America</th>
<th>Europe</th>
<th>Asia/Pacific</th>
<th>Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Attendees'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>87</td>
<td>25</td>
<td>16</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>2005</td>
<td>120</td>
<td>29</td>
<td>22</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>2008</td>
<td>244</td>
<td>45</td>
<td>31</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>'Discussants'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>54</td>
<td>17</td>
<td>17</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>2005</td>
<td>83</td>
<td>23</td>
<td>20</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>2008</td>
<td>38</td>
<td>14</td>
<td>16</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: Due to technical limitations, this data could only be collected for the three most recent conferences.

3.1.4 Criteria 4: interactivity

Table 4 provides evidence of the interactivity at the two most recent CybErg conferences. A significant proportion of the discussion postings (65% in 2005 and 64% in 2008) could be directly interpreted as one of Rafaeli and Sudweeks’ (1997) interactivity dimensions. In addition, there were a smaller number of discussion postings that were directly related to one of the conference papers. It is argued that these postings are in fact reactive, since they reflect responses to material or knowledge already generated by one of the community members (i.e., a conference paper) and should therefore also be classified as interactivity. In total, most discussion postings could be classified as interactive (81% in 2005 and 78% in 2008).
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Interactivity during the CybErg discussions

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiating discussion not directly on paper (including author initiating on own paper)</td>
<td>19%</td>
<td>22%</td>
</tr>
<tr>
<td>Initiating new discussion based on a reading of the paper</td>
<td>16%</td>
<td>14%</td>
</tr>
<tr>
<td>Response to an earlier discussion point</td>
<td>65%</td>
<td>64%</td>
</tr>
</tbody>
</table>

Note: Due to technical limitations, this data could only be collected for the two most recent conferences.

3.2 If the CybErg conference series is an online community, at what stage of evolution is it?

Evidence of engagement includes the participation demonstrated in Table 5 as the number and nature of comment postings and in Table 6 as the total number of registrants. Table 5 shows the number of postings increased until 2005. The average number of postings per registrant also increased until 2005, as did the proportion of comments dedicated to scientific discussion. Engagement could also be demonstrated in participant perceptions of the quality of the conference (i.e., fulfilling their needs). The results from the post-conference evaluation forms demonstrated that an increasing proportion of participants perceived the papers to be superior to papers at face-to-face conferences and the discussions to be at least of the same quality as face-to-face conferences. In Table 6 it is evident that registration numbers steadily dropped over the first three conferences and then have been growing again over the last two conferences.

Table 5 Quantity and quality of papers and discussion comparing CybErg to perceptions of face-to-face conferences

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N postings</td>
<td>592</td>
<td>566</td>
<td>527</td>
<td>850</td>
<td>301</td>
</tr>
<tr>
<td>Ave. postings/registrant</td>
<td>0.5</td>
<td>3.8</td>
<td>4.6</td>
<td>5.3</td>
<td>1.2</td>
</tr>
<tr>
<td>Prop. discussion in scientific sessions</td>
<td>64%</td>
<td>76%</td>
<td>85%</td>
<td>88%</td>
<td>74%</td>
</tr>
</tbody>
</table>

Quality of CybErg papers:
- Superior to face-to-face conference: 38% 20% 54% 69% Not asked
- About the same as face-to-face conference: 49% 73% 43% 31% Not asked
- Worse than face-to-face conference: 13% 7% 3% 0% Not asked

Quality of CybErg discussion:
- Superior to face-to-face conference: 36% 62% 49% Not asked Not asked
- About the same as face-to-face conference: 34% 28% 45% Not asked Not asked
- Papers worse than face-to-face conference: 30% 10% 6% Not asked Not asked
3.3 Internationalising knowledge production and dialogue: has the CybErg conference series met its academic aim of internationalising ergonomics knowledge production and dialogue?

Table 2 demonstrates the international nature of the knowledge production by the distribution of authors. Table 3 demonstrates the international nature of dialogue at the two most recent conferences and Table 6 shows the international nature of conference registrants. In the first three conferences the number of countries represented at CybErg conferences dropped from 34 countries to 24 countries. Similarly, the number of participants steadily declined over the first three conferences (N = 1,078 in 1996, N = 149 in 1999, and N = 110 in 2002). These trends were reversed with 162 participants from 33 different countries at CybErg 2005 and 244 participants from 45 countries at CybErg 2008. Based on the log file data, a slight majority of registrants were from industrially developing countries in more recent conferences (i.e., 44% in 2008, 51% in 2005, and 57% in 2002, compared to 25% in 1999 and 12% in 1996). At CybErg 2005 there were 13 papers from Africa, 20 papers from Asia, eight papers (and one symposium) from Asia/Pacific, 16 papers from Europe, nine papers from North America and 14 papers from South America and Latin America. What is evident is that the geographical distribution of paper contributions and registrants has become proportionally more even.

<table>
<thead>
<tr>
<th>Year</th>
<th>N regist.</th>
<th>N countries</th>
<th>North America %</th>
<th>South America %</th>
<th>Europe %</th>
<th>Asia/Pacific %</th>
<th>Africa %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>1,155</td>
<td>34</td>
<td>42</td>
<td>3</td>
<td>24</td>
<td>29</td>
<td>2</td>
</tr>
<tr>
<td>1999</td>
<td>130</td>
<td>33</td>
<td>16</td>
<td>10</td>
<td>24</td>
<td>49</td>
<td>1</td>
</tr>
<tr>
<td>2002</td>
<td>110</td>
<td>25</td>
<td>16</td>
<td>9</td>
<td>13</td>
<td>36</td>
<td>26</td>
</tr>
<tr>
<td>2005</td>
<td>162</td>
<td>33</td>
<td>19</td>
<td>10</td>
<td>18</td>
<td>30</td>
<td>23</td>
</tr>
<tr>
<td>2008</td>
<td>244</td>
<td>45</td>
<td>31</td>
<td>10</td>
<td>14</td>
<td>38</td>
<td>7</td>
</tr>
</tbody>
</table>

From Table 2 it is evident that the numbers of papers accepted steadily increased until 2005, although the number of countries represented in the papers tended to fluctuate with the experience of the local organising committee (in 1999 the conference was organised for a second time in Australia and in 2005 the conference was organised for a second time in South Africa, whereas in 2008 the conference was organised for the first time in Malaysia). In general, there has been a steady decrease in the proportion of authors from North America and Europe.

4 Discussion

4.1 CybErg as an online community: virtual settlement theory

The CybErg conference websites offer an obvious virtual common-public-space for the online community. At the first and most recent CybErg conference, entry to this common-public-space was free, but was still bounded by a website with the presence of academic papers and a specific discussion bulletin-board structure. For the other CybErg conferences, entry to the common-public-space was through payment of a registration
fee. This would allow paid registrants to access the academic papers and to participate in the text-based, asynchronous, online discussions. Unlike many other types of online communities (Liu, 1999; Maloney-Krichmar and Preece, 2005; Schoberth et al., 2003), the CybErg conferences’ common-public-space was also time-bound with access to the discussion forums only being allowed for a period of one month.

In terms of membership stability, the data presented evaluates the online conference series over a twelve year period. While there were only six members who participated in all five conferences there were also six people who missed only one conference and a further ninety-eight people who attended more than one conference. Unfortunately within virtual settlement theory, Jones (1997) and Liu (1999) do not provide any specific criteria for sustained membership other than rather vague descriptors such as ‘reasonable number’ and ‘significant period of time’. We would argue therefore, that the conditions of sustainability (twelve years) and stability (approximately 30 registrants participated in consecutive conferences and a core group of six people who attended all five conferences) have been met. This would satisfy Liu’s (1999) criterion of ‘one or several core members’.

The CybErg online community also has a wide variety of contributors. Variety of communicators was poorly defined in Jones’ (1997) original conceptualisation of Virtual Settlement Theory. However, from the data presented it is evident that there are multiple contributors (both for the academic papers and for the discussants) from different regions of the world. The CybErg conferences also possess contributors who were highly active and those who preferred to remain as ‘observers’ or ‘lurkers’. The data presented conceptualises variety as geographical diversity, although we are also aware that there are a wide variety of other possible indicators (i.e., area of expertise, research interests, experience with technology and online communities, gender, language preferences, and background education) for which we did not have data.

Interactivity is demonstrated in the CybErg conferences, as shown by the high proportion of discussion postings (Table 4) which might be classified under one of Rafaeli and Sudweeks’ (1997) interactivity categories. Although not specifically mentioned in the results there are also discussion postings that refer to earlier CybErg conferences and to papers presented at previous CybErg conferences that demonstrate interactivity between CybErg ‘sessions’. A deeper content analysis of the discussions may provide further evidence for the different levels of interactivity according to Rafaeli and Sudweeks’ (1997) definition, but this analysis has not yet been conducted. Huntley and Thatcher (2008) have conducted a partial analysis of 262 postings from 30 discussion threads during CybErg 2005. The results of their analysis suggested that there are postings at all levels of Gunawardena et al.’s (1997) interaction analysis model, including examples of summarising agreements between participants, illustrating ways in which thinking or knowledge has changed during the interaction, and identifying areas of disagreement or similarity. While this data was not presented in this analysis, it provides further evidence of deeper levels of interactivity within the online community. We have not analysed whether this occurs across conferences.

4.2 Evolution of the CybErg online community

From the data presented here there appears to be evidence for all stages in the development of an online community similar to those identified by Gongla and Rizzuto
At the first CybErg conference (Pollock et al., 2002) there was a small core group (four conference organisers) who established the website and solicited the first conference papers enabling others from around the world to come together in a common space. This represents the building stage of Gongla and Rizzuto’s (2001) model. The second conference (Pollock and Straker, 1999) followed the same structure and processes as the first conference. While the number of registrants dropped off significantly (from 1,155 to 130) the number of contributions to the community (i.e., the number of papers and the amount of discussion per registrant) actually increased. Maloney-Krichmar and Preece (2005) noted that new participants were an important component in maintaining an online conference. A larger core group of 37 registrants who had also attended the first conference ensured that the online community maintained a community memory. This conference reflected Gongla and Rizzuto’s (2001) building stage. The continuation of the basic format and processes of earlier conferences at the third conference (Thatcher and James, 2003), as well as the continued increase in the number of conference papers and discussion postings per registrant, demonstrated an engaged stage. The core group (a new organising committee) also tried to actively recruit people from different regions of the world (see Table 6, although this was at the expense of registrants from Europe and North America). CybErg 2005 (Thatcher, 2006) saw the trend of decreasing participation at CybErg conferences reversed. The core group of each conference has published reflections and analyses of the community (Pollock et al., 2002; Pollock and Straker, 2000; Thatcher, 2006; Thatcher and James, 2003) demonstrating the active stage. Further, the increasing perception that the online conference was a better medium than face-to-face conferences is indicative of Gongla and Rizzuto’s (2001) engaged stage where members of the community are showing evidence of learning from one another (i.e., they characterise the quality of discussions and papers within an academic conference as the same or better than a face-to-face conference). The CybErg community has also regularly changed its core organising group to build capacity and to inject new ideas into the community. This might be a weak demonstration of the adaptive stage.

It is also possible that the technology used for this conference series may not encourage the active and adaptive stages. Gongla and Rizzuto (2001) argue that communication technologies such as email, electronic messaging, and bulletin boards (the discussion medium at CybErg conferences) are sufficient to maintain a potential stage community but that other technologies are required to support higher stages. At the building stage, library, classification, and indexing tools are required to maintain this level. The repository of academic papers (and the menus used to locate these papers) acts as the technological facilitator of this level at CybErg conferences. At the engaged stage, expert webpages, language translation, and feedback tools are required to maintain this level. 'Expert’ webpages in the form of author webpages were provided at CybErg, but there were no language translation facilities, and the only feedback tool used was the conference evaluation questionnaire. If the CybErg conferences are to fully embrace this stage then more feedback and participant polling facilities need to be incorporated into the conferences’ online tools. At the active stage the technological tools required to reach and maintain this level include teamwork rooms, decision-making tools, and electronic meetings.

The increasing number of discussion postings (overall and per registrant) implies that registrants are becoming more familiar with the discussion medium and are more willing to contribute to the discussions. It is encouraging that the proportion of postings in the scientific discussion has been increasing (i.e., the increase in discussions has been
focused on the academic endeavour not only the social discussion). This finding is similar to other recent findings in online discussion groups (Matzat, 2004; Schellens and Valcke, 2005). However, Matzat (2004) argued that increased use of internet discussion groups were merely a ‘transmission of already existing knowledge’ (p. 225) not the production of new knowledge. In contrast, Schellens and Valcke (2005) found that online academic discussion is “very task-oriented, stays task-oriented and reflects high phases in knowledge construction” (p.957). They also found similar high levels of task-oriented communication that became more task oriented over time (88% to 94%) – compared to the CybErg conferences (64% to 88%) (Schellens and Valcke, 2005).

4.3 Internationalisation of knowledge production and dialogue

The data clearly demonstrate that this virtual conference has been effective in the internationalisation of research presentations and discussions, and in establishing broader international contacts by encouraging communication and research dissemination from developed to developing countries across a broad range of indicators of participation. The geographical distribution of conference registrants was more equitable than that of the Web-Based Communities conference reported by Chu (2005). Matzat (2004), in examining strong and weak contact and information dissemination effects of internet discussion groups, found that the benefits for peripheral and integrated researchers were equal, suggesting that the learning benefits from CybErg conferences are mutual for participants from developed and developing countries. Matzat (2004) also found that the online environment did not promote the development of intensive contacts between researchers since the online environment does not provide sufficient richness of information processing cues to deal with ambiguous and abstract concepts (Daft and Lengel, 1986). The number of social and research contacts established at CybErg conferences was not assessed, so it is difficult to determine how effective the CybErg conferences have been in allowing participants to develop and maintain intensive contacts outside of the conference sessions.

From CybErg 2002 onwards there was also a sharp decrease in the proportion of registrants from North America and Europe. This trend was quite disturbing given that ergonomics and human factors is well-established in these countries and one would expect more participation from countries that have large ergonomics’ society membership. The registrants at the CybErg 2005 and 2008 conferences were geographically more equal (increasing proportions of registrants from North America and Europe) but the USA, the UK, the Nordic countries, and Japan were still disproportionately under-represented given the size of their respective ergonomics societies. However, the recent global economic crisis and an emphasis on lowering carbon emissions might now make an online community a more attractive option.

4.4 Limitations

While the data provide support for the notion that an online conference can provide room for the development of an online community even though the intervening time period is quite long (three years between each conference), the research is not without limitations. First, a full content analysis of the conference discussions has not been performed (although Huntley and Thatcher (2008) have done some preliminary analysis of the
discussions for CybErg 2005]. A more detailed analysis of the general discussions may contain useful data about the development of an online community. Second, qualitative feedback was only received from some conference participants. As with all volunteer samples, respondents may have different experiences and characteristics to those who chose not to respond. Third, face-to-face conferences do not tend to collect (or do collect, but do not report) similar attendance and participation data. It is therefore difficult to determine whether these data represent something unique about online ergonomics conference communities or something about ergonomics communities in general. Fourth, we did not determine whether the CybErg conference stimulated contacts and discussions that took place outside of the bounds of the conference environment. It is possible that CybErg enabled contacts and collaborations that extended beyond the confines of a month period once every three years.

5 Conclusions

CybErg is well placed as a moderately sized online community. One could argue that too much growth (both in terms of the number of papers and the number of registrants) may result in information overload for participants. Matzat (2004), for example, argues that limited access to smaller groups of active researchers is preferable for knowledge production. Schoberth et al. (2003) suggest that as an online community grows in size, subgroups evolve, so if future CybErg conferences wish to grow they might do so through fostering subgroups. Maloney-Krichmar and Preece (2005) suggested that reliable technology is more important than the latest technology. On the other hand, Gongla and Rizzuto (2001) would argue that more interactive technologies such as feedback and polling facilities and decision-making tools are necessary to move to higher stages of community evolution. This low-technology versus high-technology debate must be carefully considered within the context of potential digital divides if the CybErg conferences are to continue attracting participants from less technologically developed regions of the world. This paper found evidence for all four criteria in Jones’ (1997) virtual settlement theory and provides some baseline measures for defining an online community. This paper also found evidence for all five evolutionary stages of an online community evident within the CybErg virtual conference series, with strong evidence for an engaged state. Finally the paper provided good evidence that the aim of internationalising ergonomics knowledge was met.

References


