Information Systems Development by US-Norwegian Virtual Teams: Implications of Time and Space

Suprateek Sarker (sarkers@wsu.edu)
Washington State University, Pullman, USA
Sundeep Sahay (sundeeps@ifi.uio.no)
University of Oslo, Oslo, Norway

Abstract

In this paper, we develop an understanding of how collaboration is possible among virtual team-members spread across the globe in time and space. We do so by interpretively examining communication patterns of virtual team-members located in the US & Norway, engaged in systems development projects for actual clients. A number of collaboration inhibitors are identified, along with strategies used by team-members to bridge the time-space divide.

1. Introduction

The use of virtual teams to accomplish work is becoming an important option for 21st century organizations[10]. Specifically, virtual teams are increasingly being used in the arena of software development [2]. While popular press continues to extol the virtues of virtual teams, researchers in the field have noted that not much is known regarding how virtual teamwork is carried out in practice [1], and how such work arrangements can be made effective [12]. Many of the commentators on virtual teams have observed that (effective) virtual teams are able to "bridge," "overcome," "cross," and even "transcend" the time and space divide among the members [10, 14]. Yet, a review of the literature reveals few serious attempts to examine the implications of time and space for virtual collaboration, and to unearth strategies to help virtual team members deal with the complexities of time and space. We seek to address this void in the literature in the context of globally distributed ISD teams. Specifically, in this study, we focus on the following question: What are the different challenges that time and space pose for virtual teams, and how do virtual teams deal with these challenges?

The rest of the paper is organized as follows. In the next section, we provide a description of the empirical approach, including the methodology and the project from which the empirical data was obtained. This is followed by a theoretically informed rich description of specific inhibiting features of time and space, and strategies used by teams to deal with them. Finally, we summarize key implications of the study.

2. Empirical approach

In this section, we provide a brief outline of the study setting and our methodology.

2.1 The study setting

In our study, the virtual teams were comprised of students from two universities working collaboratively to analyze a business information systems problem, converting it into a systems design, and then developing a full-fledged system (or, in some cases, a working prototype). The participants were students enrolled in ISD courses (Spring, 2001) in a Norwegian university (UN) and in an American (i.e., US based) university (UA). Typically, each virtual team consisted of 4-5 "internal" or "local" group members who were randomly matched with 4-5 "external" or "remote" members from the other university. A total of 8 virtual teams were formed, each consisting of about 8-10 members. The task assigned to each virtual team was to jointly define, design, and develop an information system for a real organization. In addition to developing/implementing the final system, each team was required to prepare a number of documents: 1) A Project Identification Document; 2) A Project Proposal; 3) A Preliminary Systems Requirement Document; 4) A Systems Design Document; and 5) A User Manual. Finally, team-members in each location also developed a Reflection Document, discussing the highlights of their project and lessons learned.

2.2 Methodology

Our methodology can broadly be described as a virtual ethnography [7] concerned with the study of interactions, especially texts, in cyberspace or virtual space. This study was undertaken by the coordinators, also the authors of this paper, "lurking" on the WebCT, observing the
interactions between the various actors, and occasionally posting project-related information, providing technical support, or moderating and intervening in situations of potential breakdown. Data was collected from two main sources: first, the communication transactions (messages posted, files shared, and chats), and second, each team’s local members’ reflections on their experience at the end of the project. In the next section, we provide a brief overview of the key ideas discussed in the relevant time-space literature, and present our interpretations.

3. Space, time, and virtual teamwork

Time and space have traditionally been linked through "place" [17], the notion of place being synonymous with "here and now," and implying the co-presence of human individuals engaged in interactions to structure social relationships among themselves [7, 15]. ICTs are increasingly being viewed as "disembedding mechanisms" [4] that can dissociate the place of interactions (as well as tasks) from space and time, thereby opening the possibility of "fostering relations between 'absent' others" [4, 11, 15]. It is this disembedding capacity of ICTs (particularly, the Internet) to rapidly facilitate the separation of social relations from (local) same-place same-time contexts that underlies much of the vision regarding virtual collaboration.

3.1 Space

Within this vision, the interactions occur not in physical spaces associated with places but in electronic spaces associated with information flows, where the emphasis is on connection among individuals rather than on relative distance among them [3, 7]. Many theorists contend that these electronic spaces become new localities "disembodied from their cultural, historical, and geographic meanings" [3] where new behaviors, language games, and other cultural practices are co-constructed over time [7, 9] in a manner that makes the location of individual participants irrelevant to the interactions. An alternate argument that could be made is that, in the context of virtual teams that remain in existence for relatively short periods and typically include multiple team-members from each location, the cultural, historic, and geographic meanings of place cannot really be detached from interactions in electronic space [9]. This is more so since "the salience of [one's] bodily presence" is related to the degree of authenticity and realism of his/her experiences, and the friction of distance among absent individuals participating in social interaction is not easy to overcome [11]. In summary, it appears that while connection (i.e., being "visible" on an electronic space) does, to some extent, enable the separation of interactions/tasks from place, it does not automatically achieve "locational transparency" for virtual team-members, a characteristic that is viewed as critical for effective virtual teamwork [2]. We now empirically examine the specific space-related concerns faced by virtual teams in our study.

3.11 Distributed physical locations of members and clients. Virtual team-members are usually not all co-located (as in our case, team-members at UN were separated from their UA colleagues by several thousand miles), and this does not allow physical situatedness among the conversing individuals, an important pre-condition for meaningful face-to-face human interactions [5]. This lack of physical situatedness presents problems to individuals posting messages in asynchronous forums, in assessing if they have the attention of remote members (i.e., did they read it?) and also the nature of their reactions [12]. In addition, lack of co-presence makes it difficult to establish the human connection/coordination associated with bodily presence and social cues that have been viewed as fundamental to any cooperation in the pre-ICT era. The inability to physically verify the actions of remote members (other than communicative actions on the shared electronic space or outcomes such as deliverables) also seems to breed a sense of uncertainty and suspicion in some cases. To add to this, virtual team-members not only have to deal with the distributed locations of each other, but also the fact that clients are not co-located with some, and in some cases, with any of the team-members. This makes it exceedingly difficult for the virtual team-members to comprehend the clients' expectations and context, something that is fundamental to successful ISD. As one team observed: "Things may be blindly obvious to the team-members who are on-site with the client [that] may be very difficult to grasp for the remote team. This places additional responsibility on those team-members who have the opportunity to talk directly to the client."

3.12 Some strategies for dealing with the distributed locations of team-members/clients. Sharing "placeless space" as an alternative to sharing place: As described earlier, the technological solution for team-members not being able to be present in the same physical place is to allow them to occupy the same electronic space. In our case, team-members moved seamlessly in their own physical places (where they sometimes interact face-to-face with their local members) and the three "placeless" electronic spaces [3] available to their teams - the first being a local space or enclave on WebCT for members of each location, the second being a global space where members could post messages, chat, and share files with all members of the team, irrespective of location, and the final one being the space where members from any location could invite client(s) to interact with the team.
Using the shared space, however, does not imply that the space (of place) is “transcended,” but rather indicates a transformed notion of spatiality, defined by “connection” and not by “distance” [7]. While a “connection” between remote members may be achieved through the shared electronic space, the distance with respect to understanding still persists, at least initially. For the electronic connection to facilitate effective communication, rather than co-presence, the pre-condition becomes virtual presence, where the electronically-linked members may not see each other but are conscious of each others' presence as well as routines by monitoring electronic channels. Virtual presence was automatically signaled technologically by the chat program, which listed all members participating in synchronous chat-sessions (although there could be issues regarding the authenticity of identity of a chat participant). However, in an asynchronous setting, to indicate and infer virtual presence, teams used norms for indicating anticipated breaks in virtual presence and also for notifying the receipt of remote members' messages.

Using synchronous and media rich technologies to create the sense of “social presence”: A large majority of participants in the virtual team project indicated their belief that the use of videoconferencing could help them put "face to the name" and thus facilitate the development of stronger human connection than mere text-based communication. However, one team made a very interesting observation regarding the limits of videoconferencing in creating social presence: "The videoconference...did not feel like a normal face to face meeting. Because of the lack of eye contact we did not know when they watched us. Therefore, it was difficult to say "hello"... In fact, it felt more like watching television...we did not know when we had their attention." Making Communication & Work Processes Visible to All Concerned Irrespective of Location: As mentioned earlier, one of the inhibitors of collaboration across locations is the fact that it may be difficult to verify if remote members are actually engaged in producing the deliverables that they have been charged with. Some teams in our study attempted to address this issue by voluntarily posting detailed minutes of local members' meetings so that remote members could stay up to date with what their team-members across the Atlantic were up to. Another team developed and implemented a work-practice of documenting the name of the member who contributed to a given deliverable, along with the date and description of the precise nature of contribution.

3.13 Diversity in ethnic/national cultures. Conversation language & style: Historically, language has been bound to the physical location of the inhabitants. While processes of globalization may be diffusing some of the physical rootedness of language, the cultural identity of an individual is still inextricably tied to his or her native language. Individuals, even those having fluency in multiple languages, ultimately have strong preference for conducting business in their own language [16]. In our case, English was chosen as the official language for pragmatic reasons -- Americans could not communicate in Norwegian, while the Norwegians had competency in English (but not a preference for it). While no hegemony of English language was intended, at some level, the asymmetries in language competency resulted in a disadvantage for some UN members. For example, one of them said: "We felt constrained by always having to express ourselves in English. Not all of us have that much experience in expressing ourselves in English." Another team stated: "[UA] members responded much faster than we did... we had to concentrate on what was going on in the chat and what we were writing ourselves... when the activity was rather hectic, we experienced that we were writing a message about a topic that no longer was discussed." Also, some UA members came across as being unsympathetic to their remote members, implicitly considering English as a global standard [2]. This led some UN members to complain that UA members tended to ignore the fact that English was not their first language. Ironically, many UA members often felt at a serious disadvantage, given their complete reliance on English language alone. During virtual team-meetings, on many occasions, some UN members switched to Norwegian language for side conversations. This made the UN members feel uncomfortable and excluded, as below:

UA Member 1: "How is the system progressing..."

UN Member 1: "If you have any questions about implementing of prototype, you can ask [..]

UN Member 2: "logger du inn på ifi canalen som vanlig?" /* Do you log on to the UN channel usually? */

UA Member 1: "they are bosses. ☺

UN Member 1: "[UA member 2]: ja" /* yes */ /* UA member is silent and not feeling too sure of himself */

UN Member 3: "We are not quite sure how to generate the master time schedule..."/ back to familiar language */

UA Member 1: The master time schedule will have...

The Norwegian and US members also showed quite distinct differences in their styles of communication. In particular, UA members made observations such as: "The Norwegians tended to be more abrupt and forthright," and "...they [UN members] spoke in a short, abrupt, and blunt manner" and this seemed to, at least initially, create some uncertainty among UA members, who, in UN members' opinions, tended to be more verbose and exaggerated in their communications, freely using adjectives like “great” and “wonderful.” Some UA members reported their surprise at how informal UN members were which " allowed us to express ourselves in a freer manner without fear of offending someone." Similarly, UN members of a team, felt that their remote
members were "nice guys," and added: "Americans.. [seemed] more positive by nature, while we are more reserved. This became apparent in the way they gave comments to our work, like "great work," "excellent," and so on... This was nice in the beginning, but we would have liked to get some critical response as well."

Festivals and holidays: Festivals and holidays form a central aspect of national (and related ethnic) cultures, that could have implications for virtual teamwork [2]. Not only are the origins and (religious) significance of these cultural events different, but these holidays are also occasions where members of the culture are routinely involved in certain socially meaningful rituals and practices. These could include the yearly skiing trip, a visit with extended family, a turkey dinner, participation in religious activities, fasting, and so on. In our case, UA members had their week long "Spring Break" around the middle of the project. Similarly, the UN members had their "Easter Break" lasting over 10 days during the "crunch time" in the project, when they were unavailable, both in a physical sense (due to lack of availability of IT infrastructure in locations) and also in a mental sense (a much awaited break!). Some teams failed to plan for these breaks, and members of such teams often could not relate to why remote members should have such long breaks (despite the deadlines) while others worked.

3.14 Some strategies dealing with Diversity in Ethnic/National Cultures. Demonstrating cultural familiarity and solidarity: Some of the teams appeared very effective in establishing a social bond among team-members by relating ones own biographical details with places and incidents that the remote members could identify with, as is illustrated in the following exchange: UA member: "I am a proud Norwegian-American. My grandfather spoke fluent Norwegian, and we fly the Norwegian flag on certain holidays."

UN member: "I've [visited] the US twice.. My husband.. is going back to SF.. next month, what he's going to bring back is a lot of..chocolate chip cookies, in Norway you..got.. long beautiful fjords, yes, but no real cookies :)"

Some members used the other's language in their attempt to bridge the cultural distance, e.g., starting a message with "Vi ville gjerne ha to welcome you to the project" [We wholeheartedly welcome you] and ending it with "Vi gleder meg a treffe Dem" [We look forward to meeting you]. Another related tactic used by many teams was to intersperse conversations on (relatively) universal themes such as weather, tourism, job prospects, etc. between substantive discussions.

Being culturally sensitive: Two tactics appear to be helpful in avoiding breakdowns due to language use and unfamiliar style of carrying out conversations. First, to give the benefit of doubt as demonstrated by a team who stated: "Another .. problem we faced was the tone of communication by our [UN] members.. this is something that we just took as a cultural difference and did not take as an offence." Second, was to recognize differences in the language games associated with the two places [9], and to avoid the use of language/expressions that remote members were not familiar with, or in case of an unavoidable language switch, make an immediate clarification about the nature of side-conversations. Being sensitive to the other's festivals, holidays, and cultural practices rooted in place by inquiring and reading about them, is obviously fundamental to successful teamwork in general involving people of different cultures. Virtuality demands an even higher level of vigilance, anticipation, and altercentricism in dealing with these cultural differences, because a remote member is not really engulfed in the culture as a visiting collaborator might be. Instead, the virtual team-member is merely a recipient of electronic symbols from an alien culture through the computer screen, while being immersed within a different local culture. Thus, a genuine effort is needed to "read" symbols including texts (e.g. "excellent") created in remote cultures not in a routine taken-for-granted manner, but through deliberate use of the hermeneutic circle [13].

3.15 Technology-related diversity. ISD traditions and skill levels: The literature on ISD indicates the existence of many different paradigms and traditions in ISD, related to different ideologies, geographical locations, technical sophistication, and business environment [8]. Virtual team-members drawn from different parts of the globe (or even different organizations within the same geographical area) can experience difficulties due to a mismatch of preferred design approaches and values, as well as technology platforms. For example, UN members of one team felt that UA members were not showing sufficient concern for the user's perspective in developing the system specifications: "We.. felt differences in how to approach the application specification...European software developers place greater importance on interaction with the client than their American counterparts." Fundamental differences in the preferred ISD design approach of the two sides were apparent: "[UA] part of the team and the [UN] part of the team had different educational experience. For example, the preference for design techniques was different. [UN] team members have a lot of experience in object oriented techniques as UML, and UA members more experienced with structured/data-oriented approaches." Another team observed: "We also experienced that the americans did the specification[s] very differently than we would have done.. It was difficult to read the specifications... that we had never seen before." In another team, there was a sense of annoyance at being sent diagrams in alien notations without proper explanations.
Lack of sensitivity to the differences in the educational backgrounds and ISD traditions, in some cases, resulted in inaccurate evaluations of remote members' skill levels: "...when the [UN] side made up an entity relationship diagram, it was very basic. It was missing all of the relationships and cardinalities. It was assumed by the [UA] group that everyone [in the UN side] knew how to make these diagrams the same way as we did." In another team, UA members reported that their UN partners seemed to focus on the aesthetics (color and layout of screens) before finalizing requirements, which was difficult for the UA members to adjust to.

ISD Language: Complexities in ISD related language surfaced as the same word sometimes conveyed fundamentally different meanings to the two sides. For example, even technical terms like prototyping and implementation meant different things to members in the two locations even though they were all informatics/IS students. A UA member explained: "We use the term prototype to describe the first release of a working system," while, for UN members, prototype seemed to imply "a series of interconnected GUI screens without functionality." A disaster due to this gap in understanding between the two sides regarding the scope of the project (to build a "prototype") was fortunately averted as this anomaly was discovered about three weeks before the final deadline. Similarly, for the UN team, implementation implied the coding phase of the project, while for the UA team, implementation referred to the process by which an IS is introduced and accepted in the organization.

IT infrastructure issues: Prior research on computer-mediated groups has made occasional reference to the linkage between physical location and the ability of individuals to access technologies, and thus, to the adoption and outcomes of use of different technologies. Since virtual teams draw members from different locations around the world, it is very likely that the IT infrastructure and the "computer languages" (Operating systems, programming languages, support tools, etc.) would not be identical, which could in turn, present difficulties in communicating, accessing and modifying shared documents, coding, and testing code, as experienced by participants in this project. In the cases presented here, the two sides had access to and expertise in very different technologies, as evident from the following quotations of UA members and UN members respectively: "[An] incorrect assumption that we made was that everyone in the world had a Windows operating system platform. For us, it is hard to imagine that not everyone uses Windows. While we used Windows, [UN] had Unix based platform. This created the problem of determining what program to use to turn in deliverables," and "We were aware that the state of Washington is Microsoft's headquarter, and we also heard from the [UA] members that their skills were often based on Microsoft products... As everyone knows, there is a Unix tradition at [UN]." This difference caused breakdowns in many teams in the early phases of the project, especially, when one side of the team could not modify documents created by the other side (struggle between .pdf and .doc). Near breakdown situations were also precipitated when the development technologies were being selected, with members of each side in many teams pushing for their preferred ISD technology (Windows vs. Unix/Linux, Oracle vs. Access or SQL Server, PHP versus ASP, etc.). The issue of cost to access the communication infrastructure also emerged in one team. Because of the 9-hour time difference, the most feasible time for scheduling on-line synchronous chats was early morning at UA and evening at UN. UN members of one team in particular indicated their lack of enthusiasm for such meetings: "Having chat sessions in the evenings meant that you would have to log on to the internet using a dial-up connection, which in turn meant extra costs. This is probably also a reason why we never did have the 'regular' chat sessions."

3.16 Some strategies for dealing with technology-related Diversity. Taking Inventory of levels and nature of ISD expertise: The starting point of dealing with diversity is to uncover it, and then decide how to harness it. Some of the teams attempted to do precisely this, by initiating a round of communication, where each team-member was required to state his or her areas of expertise. This input was later used to assign project tasks.

Improvising compromises: Several instances for improvisation [17], many towards a compromise solution, can be seen. For example, members of one location, after taking inventory of the skills of remote team-members, re-negotiated the scope and nature of the project with the client. The original project definition required the team to build a full-blown system using JAVA and XML, while members in the implementation team seemed to have skills in Visual Basic, ASP, and Access. Through the process of negotiation, team representatives convinced the client organization that a prototype made using the Microsoft technologies would still be valuable for the company for assessing its real information needs. Another interesting instance of improvisation was the creation of hybrid design diagrams by one team that integrated the ideas of UML Use Case diagramming as well as the traditional DFDs. In contrast, in another team, when UA members showed no interest in engaging in a discussion on UML because it was beyond the scope of their education, this seemed to infuriate the UN members. Yet another interesting example of improvisation was seen when a team, half (UN members) of which did not have convenient access to MS Word, and the rest (UA members) did not have easy access to Acrobat, decided to
use .txt format during the time both sides contributed to the document. Once the document was ready, it was converted to a .pdf format and submitted to coordinators.

Aligning frames of reference: To collaborate across traditions of ISD, and to improvise meaningfully, often it is necessary to have some level of understanding of the frames held by remote members [2]. In this regard, one of the teams requested that the UA coordinator deliver a lecture to UN members through videoconferencing on structured methods that UA members were familiar with, and the UN coordinator deliver a lecture of the Scandinavian tradition of design and Object oriented methods to the UA members. Unfortunately, this was not possible, primarily due to videoconferencing infrastructure mismatches. A few UA members did however try to obtain an understanding of the Scandinavian tradition of ISD by reading papers that the UA coordinator had made available as optional readings.

Transmit multiple carriers of meaning: Given the potential of electronic texts and diagrams to be distantiated, autonomized, and appropriated, and enacted in a different context differently [13], it is imperative that virtual team-members engaged in ISD use multiple modes of representation. Text or diagrams alone have generally proved to be unsatisfactory in conveying subtle meanings that are critical to the design over the internet, since the use of standardized representation symbols does not necessarily lead to identical interpretations [13]. As one team stated: "It is important to be very precise, and whenever possible add a drawing, a chart, a diagram or anything that clarify what you mean." Another team reported that the envisioned system "became very clear to UA members" after we delivered the screen shots" in addition to the textual narrative and design diagrams.

Celebrating, not denigrating, diversity: It is well known that team-members from all cultures (national or professional) may not be equally well-equipped to handle every social situation, including tasks [17]. Nevertheless, it is important for team-members to focus on strengths that remote-members bring to the table, rather than on their limitations. It is remarkable, that in most cases in this study, while ineffective teams continued to harp on their limitations. It is important to be very precise, and whenever possible add a drawing, a chart, a diagram or anything that clarify what you mean.

3.2 Time

Time is one of the most pervasive and yet elusive aspects of virtual teamwork. The management literature largely reflects an objective chronological view of time, and tends to reduce time to a material commodity, a resource that needs to be controlled and manipulated in a rational way [11]. Such a view tends to obscure the many subjective and non-commodifiable views of time that exist, and their implications [6, 11]. Our following analysis suggests objective as well as subjective interpretations of time need to be considered in dealing with many complexities of virtual teamwork.

3.21 Clock time and structuring of teamwork. Since time immemorial, time-keeping clocks have structured peoples’ lives. Our sense of temporality is shaped by both our physiological urges and through the internalization of shared conventions for structuring activities in the immediate society we are a part of [6]. Virtual team-work tends to challenge this sense of temporality as members have to work in what is not considered “normal work time” with collaborators located in other time zones and bound by alternative conventions. Individuals have to negotiate conventions regarding cooperative activities across geographical/social times while trying not to fracture local social processes:

UN member: "..tired" /* late evening in Norway */
UA Member: "Yep, still have class and work" /* day just getting started for UA members -- they have a lot on their minds */
UN member: "my body just want[s] to go to bed" /* late evening in Norway -- bedtime */ Chat sessions were usually held at night and UN members often complained about fatigue and the need to wait patiently for their UA counterparts to “wake up”: "At the beginning, we found the time difference, which is 9 hours between [UN] and [UA], very uncomfortable. In order to have chat sessions with the remote team, we had to "wait" for our remote team-members to wake up."

UA member: "...I'm little slow today....too early" /* early morning in the US */
UN member: "I know..."

...or were feeling the effects of other engagements:
UN member 1: "hello..."
UA member: "guess nobody from my group is up yet"
UN member 2: "little early on a sunday :)

explore all these opportunities and find the right ones. As our education is more technical, we think that the two parts of the team complemented each other." Another team that had a smooth collaborative process viewed that the differences as a “boon” since "we wouldn't have had the same breadth of skills in a single local team."
UA member: "That and there was a really big party yesterday for seniors" /* social events for all members in virtual teams not likely to be synchronized */

Then, UA member 2 enters, late for the meeting… others still haven’t shown up */

UA member1: "I’m not feeling good at all"
As a result of poor attendance of UA members and persisting effects of the previous night, not much was accomplished in the meeting, even though deadlines were fast approaching. The different biological and social rhythms, and the perceptions of how sympathetic (or not) the remote members were to individual needs in some cases led to problems in developing effective social relationships and to bitter feelings in some cases: "we tried to establish regular chat-session each week. This failed, mostly due to time difference problems. We also felt that [UA] members showed little consideration for which time would fit us." The UN members of another team reflected on a recurrent pattern of their UA members always being in a hurry to end the chat sessions due to other commitments: "When we had our [on-line chat] meetings, [UA] members had to go after about an hour.. and when their class was finished, it was part midnight here… we hardly did have the time to talk about the project. So trying to be funny or personal when [remote] members have to go. within a short time, would probably not make us socially bonded, quite to the contrary."

In addition, clock times were mixed up, causing coordination problems because of different local times as well as the different days on which clocks were changed to accommodate daylight savings: "There was a misunderstanding due to time difference. There was one week when [UA] side did not.. show up for two separate chat sessions. We [i.e., UN] wondered why, and in the end one from [UA] pointed out.. we had turned our clocks one hour forward due to Norwegian summer time. So the [UA] side had turned up, only an hour later than us!"

Another disadvantage of time differences noted by a number of teams was that concurrent development of the system was not possible. Finally, the negative social meanings surrounding temporal delays in response from virtual members, in the form of silence, were quite significant, as the following quotation reveals: "...silence was interpreted as negative from our point of view. We were repeatedly asking for information about what we were going to develop.. response time was long. Thus we felt very much on our own." Another team, that seemed to be working steadily up to this point, experienced a near-complete breakdown on account of non-response. In the words of UA members: "During our Spring break, almost all our members took off and nobody replied to our Norwegian members’ posting. They were frustrated. When we were back from our vacation, the only thing we could do was to apologize… we also learn[ed] that timely responses are very important." UN members of the same team commented: "It does not increase our trust when we get no response on postings, the responses come late… just leaving for vacation.. without notifying their remote members in any way about the delay? As one of our local members put it: At this time I thought UA members were just completely stupid. [Lack of response] was perceived as a confirmation of their lack of commitment…"

To summarize, we describe four kinds of challenges arising for virtual teamwork on account of time, as seen from the perspectives of both an objective chronological clock time and social meanings associated with clock time: a) Different physiological cycles and social activity schedules exist in different time zones that are relatively deeply embedded and thus difficult to change. Perceived lack of sympathy to these different rhythms can be a bone of contention and an issue in developing relationships. b) Local clocks are set at different times, and time adjustments are done on different days in Europe and the US. This could lead to missed synchronous meetings or missed deadlines. Such missed deadlines often get interpreted as a lack of seriousness or commitment. c) Work cannot progress in parallel if there are significant time differences among virtual team-members. d) Silence or unexpected delays in replying tends to cause anxiety as it is interpreted negatively, associated with attributions of incompetence, and a lack of commitment and caring. This is serious enough to occasion a breakdown of even functional relationships. These differences created complexities in allowing work to proceed in parallel and/or present challenges in co-ordination. With the passing of time, teams however started developing interesting strategies to deal with these challenges, and we discuss some of them below.

3.22 Strategies for dealing with challenges of clock-time. Just as mature individuals "learn to organize temporal experience in accordance with particular social and cultural processes" [6], competent teams use ICTs along with "social ingenuity" to deal with delays in response and clock time differences, and in some cases, turn them into an advantage. The following strategies seemed effective:

Managing Time Translations: While synchronous ICTs allow individuals in different time zones to communicate in "real time," such meetings require coordination through careful time translations. The following example shows how teams dealt with different local times:

UA Member 1: "Team UN: If you’re available to chat, please give us a time that works well for you."

UN Member 1: ".. we think we are 8 hours ahead of u. what about tomorrow night (from my point of view) at 6 o’clock."

UA Member 2: "[Chatting] is a great idea… the only problem is coordinating a time for all of us to meet. I looked up the time difference and as far as I can tell it
appears that [UN] is 9 hours ahead of [UA]. To make it a little easier this is the time conversion:

<table>
<thead>
<tr>
<th>6am</th>
<th>3pm</th>
</tr>
</thead>
<tbody>
<tr>
<td>7am</td>
<td>4pm</td>
</tr>
<tr>
<td>8am</td>
<td>5pm</td>
</tr>
</tbody>
</table>

---------------------------" /* etc. */

UA member 2: "We all need to meet to chat. Can everyone meet Thursday Feb. 22 at 7:30am [UA] time that's 4:30pm [UN] time."

UN member 2: "This chat meeting at Thursday is okay for me. I suppose this is 16.30 Norwegian time, but correct me if I am wrong (4.30 PM is in the afternoon, isn't it?)." /* The meaning of PM isn't as universal as assumed! */

After teams had managed to get an initial handle over the time differences, and had understood the need to coordinate, they were, in general, able to organize meetings with ease, by routinizing the convention of stating all times in both UA and UN times. Interestingly, in the case of one particular team, based on the suggestion of UN members, the UA clock time was used for coordination purposes by both sides throughout the project, to avoid the possibility of any confusion. Such routines seemed to work satisfactorily, till clocks were adjusted, and some of the teams were not alert to the different times for the changeover. One team handled this changeover effectively because of the vigilance of some individuals:

UN member: "... By the way, in Norway we have adjusted our clocks by 1 hour, so what used to be 16.30 is now 17.30. I am not sure if you have done that in USA...

UA member: "... In regards to the time change, our time does not adjust until next Sunday, April 2nd..."

"Reclaiming" Time: Whenever individuals are faced with multiple, possibly conflicting demands of their time, the only solution is "adjusting the specific time locations of activities" [6]. Videotaping is an example of technology that facilitates time relocation by providing a means to record events in real time, so as to experience them at a future time [6]. Virtual teams in our study seemed to use two strategies to relocate times: first, through the use of asynchronous features of WebCT such as on-line forums, file sharing, etc. such that remote members and local members would not be constrained by clock time and could communicate "24 hours a day 7 days a week," and second, by requesting on-line chat transcripts from coordinators for members absent from meetings due to other pressing engagements.

"Reclaiming" Time: "Specialization and segregation" of work results in the loss of slices of time, which need to be reclaimed for obtaining efficiencies in work [6]. We found most of the teams segregated their tasks by allocating specialized responsibilities to the two locations. Clearly, teams that allocated analysis responsibilities to one location and development to another location experienced considerable loss of time with half the team not contributing for about half of the project life. In sharp contrast, the teams that kept both sides of the dyad involved throughout the project in both activities and successfully developed an integrative social structure for the entire team, could "reclaim" most of the time (that other teams lost). In general, such teams saw the 9 hour time difference as a "huge advantage": "After a chat session [in the evening, local time] our remote team had the whole day to deal with problems that arose... [UA], in the same fashion, received our reactions and work during the day at the beginning of daytime. From this principle, the usual daytime working period was extended to a kind of "continuous project development." In contrast, another team expressed regret for not taking advantage of the time difference owing to the lack of team cohesion and to the high degree of task segregation.

Routinizing interactions & developing social solidarity: Perhaps, the most critical aspect of managing uncertainty arising from temporal distance is through instituting norms relating to teamwork. While in most teams, members naturally developed the rhythm of communicating regularly and consistently with remote collaborators, some teams struggled. Articulating and adhering to formal set of norms appeared to be a useful strategy for such teams. For example, one team dealt with its continuing non-response/late response issue by proposing a “communication protocol.” At the end of the project, another member reflected on the breakdowns they had experienced: "It is probably necessary to establish an informal hierarchy and a set of norms for conducting virtual teamwork. Virtual teams are in need of more formal structure than face-to-face teams." Teams that had managed to develop a strong social relationship (through use of humor, etc) could comfortably tolerate silence from the other side, and did not need an explicit formulation of norms. They attributed delays to situational contingencies (e.g., lack of necessary client input and participation) rather than lack of care of the other remote members. Teams with a shared sense of identity across locations also dealt with silence more effectively than teams with fragmented identities ("us" vs. "them") [12].

3.23 "Timeless time" and structuring of teamwork. While it has been convenient for co-located members of traditional organizations to adopt a linear chronological view of time in the interactions, recent analysis of internet-based communication reveals that ICTs bring forth the possibility of "disordered temporal collage of jumbled tenses" [7]. As different events unfold in different time zones and are recorded/reported on the electronic media, the distinctions between past, present, and future tend to get increasingly blurred, resulting in "timeless time" [3, 7]. This disordering of time, which co-existed with the chronological passage of objective time [7], was experienced in two ways during the project: First, by team-members trying to sort through and make sense
of messages originating in different local times and addressing concerns that were either past or future for the other side. Thus, an individual travelling (i.e., reading through the space) is likely to experience temporal shifts, both positive and negative. Second, during "real time" synchronous chats, wherein questions, comments, and responses were often jumbled up, it becomes difficult to causally link a response with a question or a comment due to temporal and topical shifts. For example, the frustration expressed by one of the teams regarding chat sessions appears to reflect the inability to deal with the jumbled up sequence of texts: "[I]n face-to-face meetings you just don't start talking when someone else is talking, but during chat meeting everybody can say something all [the] time. This often caused several things to be discussed simultaneously... This wasn't an appropriate way of conducting project meetings."

3.24 Strategies for dealing with challenges of timeless time. Developing norms of synchronous messaging: Team-members of the above team proposed that they needed to implement "agreed upon rules of conduct" restricting topic shifts and disciplining the sequence of messaging in order to make these meetings more useful. Functioning in a polychronic manner: Drawing on the literature [16], we define polychronicity as the ability to handle multiple jumbled threads of conversations simultaneously. It is interesting to see that most teams were able to handle problems in the chats due to delays in typing, delays in message transfer across the Atlantic, and topic shifts with great ease, in our opinion, due to team-members' capability to switch among times and among topics seamlessly. Members of teams encountering difficulties seemed unable to act in a polychronic mode, or had a strong a priori preference for monochronicity.

4. Conclusion

The objective of this paper was to tease out, through empirical interrogation, some of the implications that the two elusive concepts of time and space have for virtual teamwork. We have attempted to identify challenges arising out of time-space divide among virtual team-members, and strategies used to deal with the challenges.

Our study suggests that reducing the friction of locational and temporal distances requires attention to both the technical and the social components of virtual teams. While ICTs act as key enablers of distributed work, they, by themselves do not guarantee "locational transparency" or work "following the sun" [2]. The study reveals that ICTs do enable connectivity among distributed team-members for information exchange, and also replace the physical "space of place" with the electronic "space of flows" as the arena for conducting social exchanges [7]. However, it is worth noting that while electronic space does provide an alternate social context where new behaviors and cultural practices get shaped, the linkages between the body and the electronic interaction do not get erased, especially not in the short time spans of typical virtual team projects. Principles of social organization, most notably systematically developing a shared frame of reference and a sense of mutuality, is used to deal with "complications" arising from place-related differences in cultural aspects (especially language), personal biographies and competencies, and ISD related methodologies and preferences. Given how difficult it is to establish a shared frame and mutuality in communication even among those who are co-located, we wholeheartedly agree with scholars who contend that creating and sustaining a coherent connection among distributed (often fragmented) individuals occupying a shared electronic space presents a major challenge [15]. Conscious efforts on the part of virtual team-members and managers are necessary in line with some of the tactics described in the paper. As in the case of locational separation, addressing the complexities associated with temporal separation requires the use of ICTs as well as social devices. When time is viewed as an objective chronological counter, "following the sun" in software development seems trivial (through the use of technology to provide connectivity across time zones, time translations, and time relocations). Yet, the more enduring difficulties appear to arise from the mismatches between the physiological/social clocks and the objective real times, and the human experiences and interpretations of time such as duration of silence and dealing with disordered collages of time. In such cases, strategies based on social ingenuity and sensitivity such as formation of norms, synchronizing through the use of rhythms, developing social solidarity, and becoming comfortable with polychronicity are ones that virtual collaborators will have to rely upon for dealing with the complexities posed by time.

5. References


| TABLE 1: INHIBITORS AND ENABLERS OF VIRTUAL COLLABORATION ACROSS TIME AND SPACE |
|----------------------------------------|-----------------------------------------------|
| PRIMARY INHIBITORS | SOME ENABLING STRATEGIES FOR COLLABORATION |
| **TIME** |   |
| **Clock Time** |   |
| - Physiological and social rhythms different in different time zones. | Managing Time Translations and Time Adjustments |
| - Work cannot progress in parallel. | Relocating Time (through the use of asynchronous technologies, and chat transcripts) |
| - Need to wait for clarifications & feedback | Reclaiming time |
| - Confusion regarding reference to time and also during time adjustments | Routinizing interactions through social norms |
| - Silence | Building social solidarity to help tolerate silence |
| **Timeless Time** |   |
| - Jumbled sequence of chat messages | Operating in a polychronic mode |
| - Message threads switching between past and future | Adopting norms of messaging |
| **SPACE** |   |
| **Distributed physical location of members and clients** |   |
| - Lack of physical situatedness | Sharing “placeless space” dealing with the distributed locations of team-members and clients |
| - Lack of human connection | Using synchronous and media rich technologies to create an illusion of social presence |
| - Inability to verify actions in the local physical space of remote members | Making work processes visible to all concerned irrespective of their location |
| - Difficulty in comprehending client expectations and context |   |
| **Diversity in Ethnic/National Cultures** |   |
| - Preferred conversational language | Demonstrating cultural familiarity and solidarity (use of other’s language, and relating episodes in personal biographies to the other’s culture) |
| - Conversational styles | Being culturally sensitive (giving the benefit of doubt, avoiding the use of expressions remote members unfamiliar with) |
| - Switching to native language | Anticipating and planning for schedule conflicts due to cultural events and holidays |
| - Festivals and holidays | Hermeneutic reading of symbols |
| **Technology-related Diversity** |   |
| - Mismatch in ISD philosophies and approaches | Taking inventory of the levels and nature of ISD expertise of remote members |
| - Different levels in skills and training | Improvising a compromise (in technology platform, programming language, design philosophy, design methods, and productivity tools) |
| - Expertise in different technologies and techniques | Aligning frames of reference by seeking out sources of knowledge regarding remote members’ paradigms and approaches |
| - Mismatch in ISD language | Transmitting multiple carriers of meaning – text, diagrams, screen-shots to enable triangulation. |
| - Mismatch in IT infrastructure | Celebrating diversity by leveraging strengths |
| - Different economic drivers of technology use |   |