E-Collaboration: The Reality of Virtuality

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Abstract *— With the development of new technologies, and particularly information communication technologies (ICTs), teams have evolved to encompass new forms of interaction and collaboration. By focusing on the communicative dimensions of global virtual teams, this paper demonstrates that e-collaboration is more than a technological substitution for traditional face-to-face collaboration. It places special emphasis on the importance of structuring activities for balancing electronic communication during e-collaboration (i.e., videoconference, email, chat session, distributed use of group support system) to bridge cultural and stereotypical gaps, to increase profitable role repartition between the participants, and to prevent and solve conflicts. During the past four years, the authors have developed a project involving hundreds of participants from different national cultures working together for six weeks on a specific project. In this paper, we present our experiences and draw conclusions, giving special attention to the structure of the electronic communication required to support efficient virtual teaming in education and industry.*

Index Terms *— Collaboration, cross-cultural communication, culture, e-collaboration, face-to-face communication, group support systems, information communication technologies (ICTs), virtual teams.*

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Since the early research of Tarde [1] on the concepts of group and communication, most social scientists agree with the essential idea that to be a member of a group, individuals should share a common history [2] and that their relationship should be structured in a specific way [3]. Common fate, political events, status, role, and power repartition within a group are factors that were studied to better understand group functionality and productivity. The historical and structural dimensions of the concept relate intrinsically to the notion of national and professional culture, in the broadest sense, to the supra-ordinate concept of culture [4], [5].

With the development of new technologies, and particularly information communication technology (ICT), groups have evolved to encompass new forms of interaction and collaboration. The World Wide Web enables e-teams to work together and remotely on a project. ICTs such as videoconferencing, group support systems (GSSs), distance education tools (e.g., Blackboard, WebCT), and, more commonly, email have evolved exponentially. These electronic modes of communication support mainly decentralized networks of communication. The new metrics of time and distance modify human interactions and, indeed, turn the classic network of face-to-face relationships into a network of virtual relationships. The modification of the nature of human interactions is the immediate correlate of a faster spread of information supported by ICTs. New relationships between the individuals emerge and shape,

in a feedback loop, the existence and the mental world of each individual.

Virtual teams are a complex phenomenon with numerous technological and social perspectives that encompass a broad range of group and ICT issues. Research has only begun to sort out the implications of these issues on behavioral dynamics. Over a period of four years, the authors developed and implemented a project called HKNET (Hong Kong–Netherlands) involving 268 participants from different professional and national cultures working together for six weeks on a specific IT project. The first year was exploratory research on the role of national and professional cultures in a distributed learning project [6]. Over the next three years, we systematically applied interventions to address issues discovered in the first year. The four years of experience have revealed the complexity of e-collaboration and the need to shape e-interaction to avoid chaos and failure in virtual teams. We also had the opportunity to practice what we learned (and learn from what we practiced) in a variety of business settings.

This paper summarizes and synthesizes the learning of four years of the HKNET project and looks toward the future as well as reflecting on experiences with other business organizations. The three years of purposively designed interventions following our initially reported HKNET1 experiences confirm (albeit, in some cases, challenge), clarify, refine, and generally build upon our previous findings.

Literature Review

Research on technology-supported communication in distributed teams (see [7]) shows that, since the 1990s, most research in the field of virtual collaboration has sought explicative social factors and processes to provide a better grasp of the reality of virtual collaboration. Conclusions of the research indicate that national culture, trust, temporal coordination, process of leadership, network structure, and social influence are some of the explicative factors to success in distributed teams [8]–[12]. A Global Virtual Team in this sense is defined "to be a temporary, culturally diverse, geographically dispersed, electronically communicating working group" [8, p. 792].

In a congruent way, the efforts to turn into theoretical concepts the functioning of the distributed teams are built on traditional group theories. Indeed, and by definition, a global virtual team compile most of the classical face-to-face biases that effect multicultural group collaboration: social loafing [13], social conflicts [2], intergroup categorization [14], cultural diversity (e.g., [15]–[17]). What certainly makes the study of virtual teams challenging is the difficulty to build efficient and operational teams in the absence of synchronous face-to-face communication. Indeed, the low levels of social presence and interactivity are recognized as main factors of failure in virtual teams [18]. Montoya-Weiss et al. [10] report that communication and coordination difficulties create a potential for conflict.

Paradoxically, the lack of face-to-face interaction may be one of central factors of success in virtual teams. In a global virtual team context, cues about *social influence are missing*. All participants have a chance to be judged by the team as a function of their performance rather than on more discriminatory and stereotypical cues (e.g., [19]). On the other hand, the lack of gestures and nonverbal cues limits the integration of feedback during the interaction and leads to complex and reiterative exchange of information (e.g., [20], [21]) that is, potential sources of conflict in virtual teams (see [10]). To attain benefits (and combat losses) of face-to-face interaction requires a rich portfolio of technological support and, more importantly, a strong sense of how to use different elements of technological support as a function of team dynamics. Toward that end, the HKNET project was initiated in 1998.

HKNET Project and Interventions

A virtual team project (HKNET) between the City University of Hong Kong (China), the Eindhoven University of Technology (The Netherlands), and Tilburg University (The Netherlands) was initiated in 1998 to explore remote collaboration leading to successful decision-making and problem solving in multicultural groups [6], [22]. Over the past four years, 268 students have participated. In the fourth year of the project (HKNET4), a team of French students from l'Ecole Superieure d'Administration de Grenoble (France) joined the project. The project is designed as a longitudinal study, and each new project, theoretical corpus, research problems, and measurement tools were adapted according to the results of the previous year. HKNET5 is currently under development.

HKNET Project Setup The HKNET project has been integrated into existing academic courses in software engineering, informatics, and management. The goal of the project is to make a valuable contribution to the knowledge of its participants by letting teams collaborate on a joint project on a specific IT-related subject resulting in a joint report. Students formed their own local team consisting of two to four members. Thereafter, local teams were allocated to global teams, each with a specific assignment. Examples of assignments were status and actions taken in Hong Kong versus The Netherlands

with software management in large projects issues, trends in embedded software, software quality control, labor shortages in the IT sector, and critical success factors for successful development of software.

By communicating with their overseas team members through group support technologies, the students gained experience in using these technologies and the team dynamics in multicultural teams. Participants used email, videoconferencing, and group support technologies to communicate synchronously and asynchronously. The time schedule was rigorous and short (six weeks). The task of the participants was to create a joint report comprised of a general introduction on the subject and a description of the situation in each country (Hong Kong/Asia, The Netherlands/Europe, France/Europe).

The educational objectives of the HKNET projects were to give students (i) an insight into software engineering, informatics, and managerial issues from a business perspective, and a better understanding of the differences between Europe and Asia; (ii) experience cooperating in a team with members from different cultures and backgrounds; and (iii) practice with several applications of groupware, which can be valuable to their study and future work. Readers are encouraged to see Vogel et al. [6] for additional details.

ICT Support A portfolio of ICT was used to support the virtual team productivity and effectiveness. At the base level, all participants had an email account at their disposal and web access as well as Microsoft Word and PowerPoint. A number of more specialized group support systems were made available to enable project interaction and structuring under different circumstances. For example, GroupSystems™ during the first three years of the project served as a shared group memory and a common environment for both synchronous and asynchronous brainstorming, discussion, voting, and report drafting (for details see [23]). Thin Client technology was used to supply all participants with internet connectivity to enable GroupSystems access from their homes and businesses as well as from their universities. Videoconferencing was also supported over the course of the project. ISDN videoconferencing was used to initiate the project as well as halfway through and in a concluding session. Microsoft NetMeeting was used for synchronous face-to-face contact on a more ad hoc basis.

Interventions In the spirit of socio-technological development in an action research context (e.g., [24]–[28]), we embarked on HKNET2, HKNET3, and HKNET4 with selected group characteristics and interventions intended to advance findings and address challenges noted in HKNET1 [6].

HKNET2: HKNET2 consisted of 57 students divided into nine teams with balanced Hong Kong–The Netherlands membership. The membership on each side was self-selected, but the joining of the two subteams to form a single team was random. Part-time MBA students from Hong Kong, full-time business engineering students from Eindhoven, and full-time MIS students from Tilburg University (a university located 30 kilometers from Eindhoven) engaged in a structured six-week project. As such, elements of professional as well as national culture prevailed. In this case, the Hong Kong students were especially experienced in working in multicultural teams, and the majority had significant remote collaboration experience.

Similarly to HKNET1, students attended lectures covering several subjects related to the team assignments prior to the project. However, special efforts were extended in HKNET2 to make topic material and student content background more common immediately preceding project kick-off (e.g., a Hong Kong session focused specifically on software engineering) to better orient the students and familiarize them more with the topic material. Class websites gave students at both sites access to common materials. These cross-cultural teams also had the opportunity to introduce themselves at the start of the project during a kick-off session, for which a high-bandwidth videoconference link between the two universities was established. After the introduction, all participants gained access to GroupSystems via the internet, the main collaborative tool for students to work on their project in a structured way. They could also use email and desktop videoconferencing via NetMeeting to communicate with their teammates as the project progressed.

HKNET3: HKNET3 began with 61 students divided into 10 teams with balanced Hong Kong–The Netherlands membership similar to HKNET2. In HKNET3, part-time Masters of Science in Electronic Commerce (MScEC) students from Hong Kong and full-time business engineering students from Eindhoven and full-time MIS students from Tilburg University engaged in a structured six-week project. The Hong Kong MScEC students, unlike HKNET2, had a predominantly computer science background and thus were more homogeneous with their Dutch colleagues in terms of professional culture. They further had no special experience in working in multicultural teams, again unlike HKNET2. We, therefore, expected less professional culture difference but a continued significance in national culture differences.

In HKNET 3 (unlike HKNET2), special added attention was given to cultural orientation for the students. As such, a session via

videoconference conducted by a globally recognized cross-cultural facilitator exposed the students to issues in cross-cultural collaboration [29]. In HKNET3, attention was shifted toward cross-cultural dynamics and better understanding of determinants of successful interaction. Toward that end, special attention was given to antecedents that might enable prediction of successful interaction and/or particular areas to focus attention on in facilitating cross-cultural interaction.

HKNET 4: HKNET 4 deviated from HKNET 1, HKNET 2, and HKNET 3 by involving a third national culture. MBA students from l'Ecole Superieure d'Administration de Grenoble (France) were engaged in HNET 4 in addition to part-time Masters of Science in Electronic Commerce (MScEC) students from Hong Kong and full-time business engineering students from Eindhoven and full-time MIS students from Tilburg University. The 88 participants were spread across 13 teams, eight of them tri-cultural with the remaining five bi-cultural to enable comparison with prior HKNET team characteristics.

HKNET 4 followed the general structure of previous years but differed from HKNET 1, 2, 3 in terms of technology support. In HKNET 4, Blackboard was substituted for GroupSystems. Although limited in terms of some group support functionality (specifically, convergence culminating in voting), Blackboard is easily accessible through any web browser and enables attachments to be added to forum discussions. Blackboard also has "chat" functionality and a "whiteboard" to facilitate same-time interaction. HKNET4 also imposed a new challenge necessitating a higher level of coordination and technological ability. The virtual teams were asked to develop an e-report in the form of a web portal rather than a paper-based report.

FINDINGS

A variety of data was collected including content, exchanges, observations, and surveys. Pre-test and post-test questionnaires were administered to each HKNET2, HKNET3, and HKNET4 participant to compare and contrast the impact of the different group characteristics and intervention. Additional interaction data on both students and instructors were collected using GroupSystems through all phases outlined in Fig. 1. Further, the projects were graded on criteria that emphasized demonstration of collaboration in creation of a joint report. Vogel et al. [6] provides additional detail on HKNET1. Rutkowski et al. [22], provides details and relevant statistics relating to HKNET3. In this paper, we integrate findings across HKNET 1, 2, 3, and 4 to provide a synthesized and robust set of results indicative of virtual team dynamics and ICT support effectiveness.

We will use the "onion skin" model, illustrated in Fig. 2, to summarize our findings and provide salient examples to illustrate key points. The model is qualitative but is based quantitatively on our experiences with four years of HKNET and other industrial experiences with virtual teamwork. The model distinguishes multiple categories of problems that can be encountered in virtual teamwork. Each category becomes a barrier to effective interaction and a hurdle to be cleared. Some of these are addressed through technological approaches while others through social approaches and others through a mix of the two. The layers we have experienced are motivational, context preparation, technological, interaction, structure, process, national cultural background, professional background, and creative content formation.

We suggest that problems and issues proceed from the outside inward, i.e., you will not even get to creative solutions on the content if you have substantial barriers imposed by the other layers. It is our experience that one layer of problems makes the next layers somewhat invisible. For example, if the technology still causes problems, one does not see or experience the other layers of problems at their fullest. Once this layer of problems has been removed, the next relevant layer comes in sight, such as interaction problems. Resolving the problems with virtual teams is like peeling an onion. We will now provide detail based on our accumulated finding over four years on each of these areas in turn.

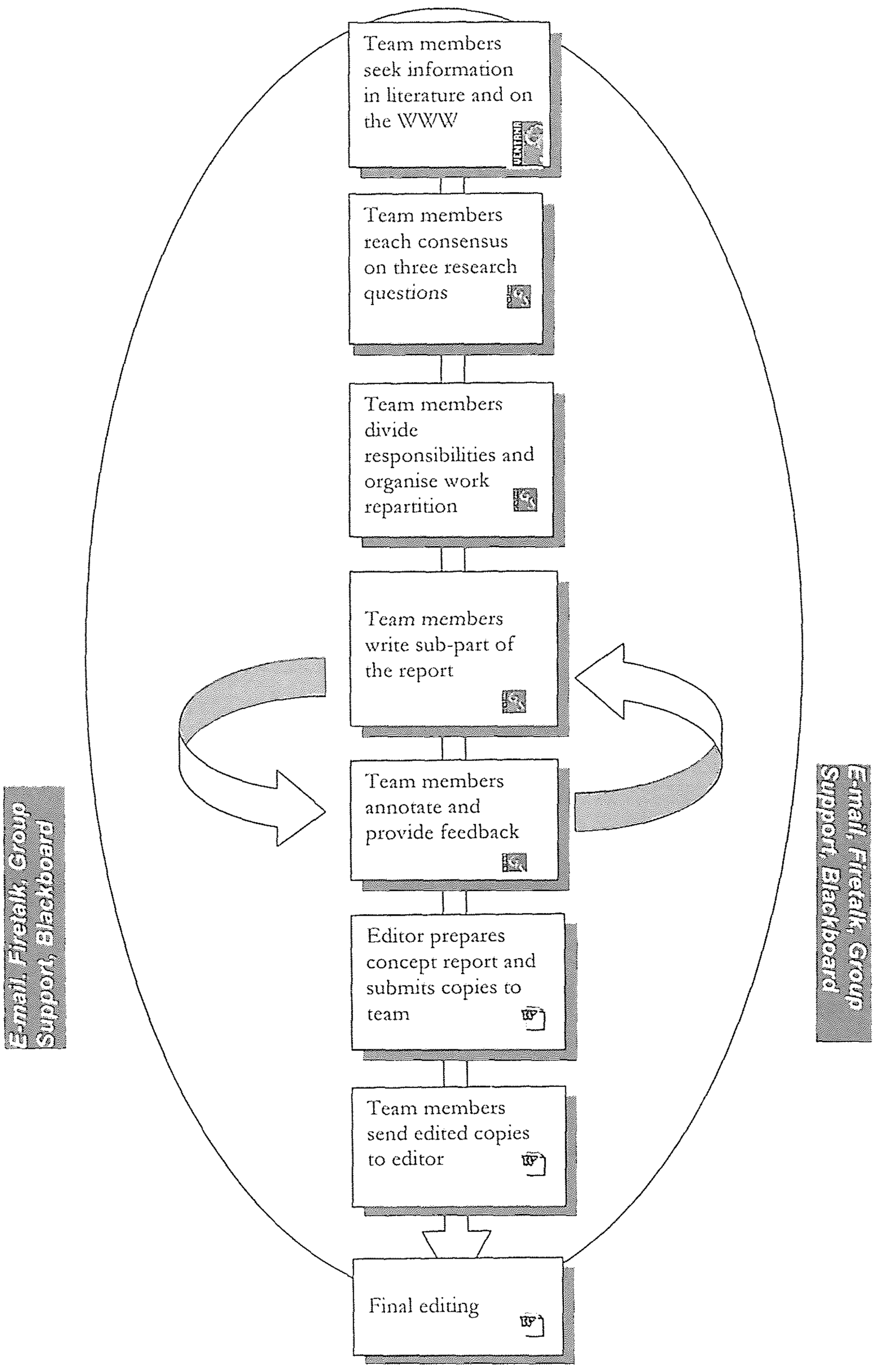
Motivational issues revolve around the question, "Why should we be doing this in the first place?" and making explicit rewards and expectations. In all, this involves generating interest and buy-in on the part of the participants such that benefits are perceived. Motivation can stop a virtual team project before it even begins. Motivation can be both extrinsic and intrinsic. According to Deci and Ryan [30], increased conceptual learning, creativity, flexibility, positive emotional health, and higher self-esteem have all been associated with intrinsically motivated activity. When intrinsically motivated, students tend to employ strategies that demand more effort and that enables them to process information more deeply [31]. On the other hand, a good dose of extrinsic motivation and rewards is also generally useful and, in fact, can work hand-in-hand with intrinsic motivation.

Participants learned they had to be intrinsically motivated to participate in HKNET teams. The definition of the tasks, the challenge to complete them, the degree of freedom to commit oneself, the autonomy provided by ICTs tools, task-centred leadership, and the attentive presence of the instructors are central to a successful collaboration and to its

appreciation. In HKNET 2, 3, and 4, we were more careful to balance extrinsic motivation in the form of percent of grade accorded to the project as well as providing additional feedback and making interim team results visible. In HKNET5, we expect to further intrinsic motivation through peer interaction in integration of team projects into an overall "book" format.

CONTEXT PREPARATION as an issue relates to the creation of common background materials and development of cultural awareness. As noted, in HKNET2 special efforts were extended to make topic material and student

Fig. 1. Process diagram of HKNET project.



content background more common immediately preceding project kick-off. Theses efforts were rewarded as students were able to focus more clearly on aspects of interaction and integration based on a foundation of common topic knowledge. Instructors noted fewer problems in group dynamics and a general sense of comfort as participants began to deal with project structure and requirements. Divergences can be overcome through stimulating the development of common terminology in the group.

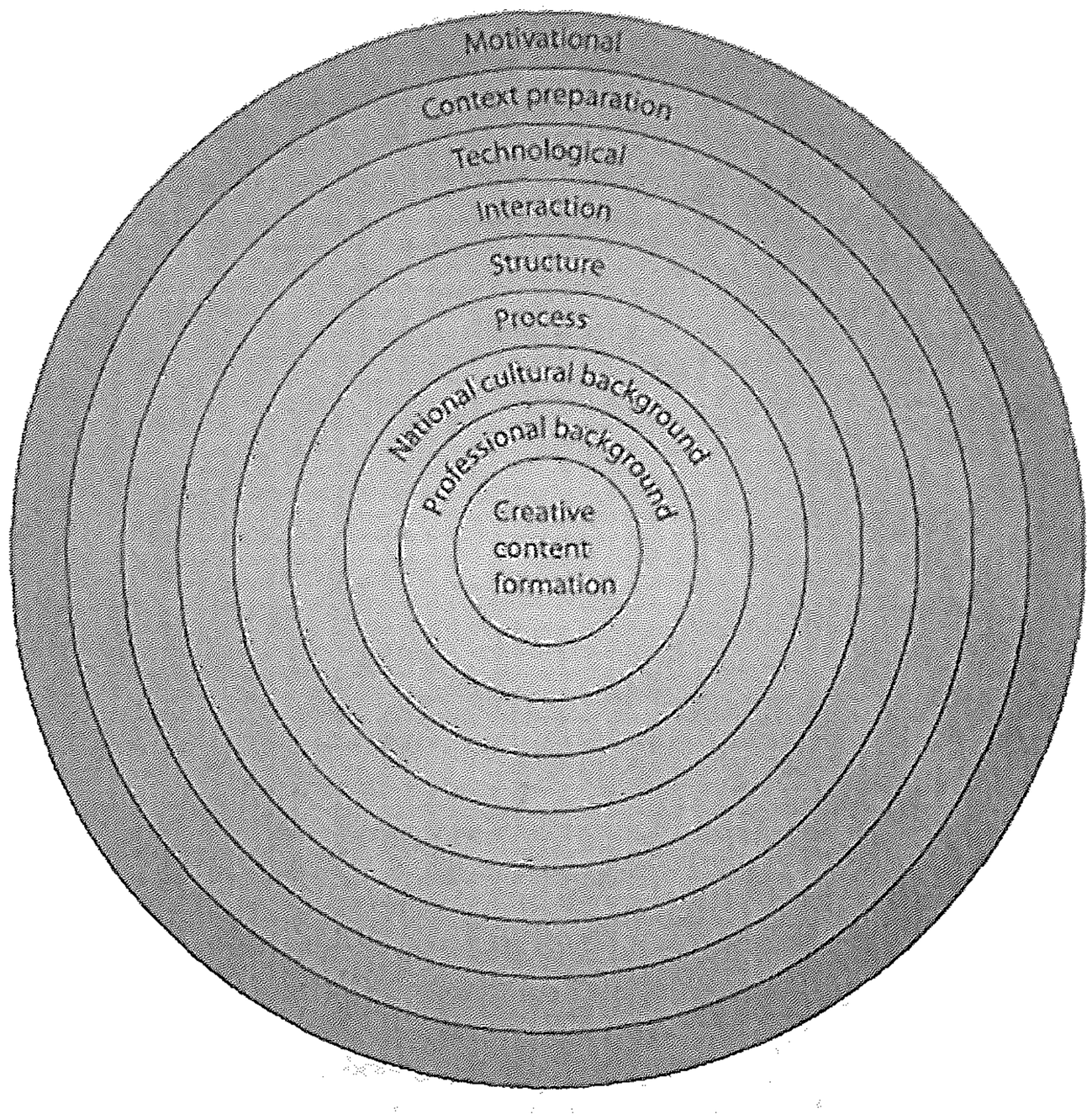
In HKNET3, as noted, special added attention was given to cultural orientation for the students via a videoconference conducted by a globally recognized cross-cultural facilitator. Although the session was well-received, we have no special evidence to suggest that this intervention made a difference. Rather, it tends to confirm the immortal words of the Chinese philosopher Lao Tzu who suggested that if you tell me, I will listen; if you show me, I will see; but if you let me experience, I will learn.

TECHNOLOGICAL as a category involves problems with access, performance, and availability of communication means. The first-year technical issues were expected to be dominant, and they were. This can be explained by the fact that the thin client technology used was new, and nobody knew how easy it was going to be to run the software with 70 participants all around the world. Additionally, connectivity was an issue, especially in Hong Kong, where the students worked part-time and had to log on from many places, such as their homes or their offices. Furthermore, the Hong Kong students in HKNET1 were deficient in tech ability, as noted in Vogel et al. [6].

Technological problems noted in HKNET1 were successfully dealt with in HKNET 2, 3, 4. Differences in participant technological background and ability were no longer present [22]. We also recognized that we needed a richer portfolio of support and not a single technology to accelerate cultural learning. In combination, email, videoconferencing, and flexible group support systems provide degrees of freedom to let problem solving more naturally occur and ways of working together to evolve and adapt. Characteristically, in the final appreciation of the HKNET4 project, one student noted, "It was a valuable experience to have the chance to use up-to-date technology such as video conferencing and virtual team tools." Technology noted as a problem in HKNET1 disappeared in HKNET2 as issues were addressed and, especially, as Hong Kong participants became more technologically astute.

INTERACTION as a category in our model addresses problems such as no communication for a long period. In HKNET1, we saw instances of communication leading to conflicts because members of the team felt

Fig. 2. Layers of problems associated with work in virtual teams.



disregarded. As technical problems apparent in HKNET1 were reduced to a marginal level in subsequent years, interaction was the most consistently noted problem. Once technology infrastructure was stable and presented no barrier to participation, the observed factors that determined team performance were social by nature. In virtual teams, each social factor is a potential hurdle that must be dealt with before a team can effectively perform its task. For example, as one student noted, "Continuous communication can usually avoid confrontation and resolve conflicts."

Recall that we worked to better orient the students and familiarize them more with the material and each other in HKNET2 as well as providing them with a better technological environment in which to interact. This was, indeed, successful from an operational perspective. The projects proceeded considerably more smoothly, and there was much less variance in team success. In HKNET1, two teams were deemed unsuccessful in terms of collaboratively completing their projects. Such was not the case in HKNET2 or in subsequent years. Interaction increased as motivational issues, context preparation, and technological issues were addressed resulting in fewer episodes of project dissonance.

STRUCTURE denotes ways of reducing variability in activities and procedural aspects of projects as well as use of technology. It is aptly called "scaffolding" in socio-cultural learning notation (e.g., [32]). Technology, when properly configured in support of appropriate processes with minimal critical structure, can provide a degree of freedom in helping multiculture teams achieve synergism and operate effectively and efficiently. Imposition of structure can help avoid chaos. It is especially important to recognize that structure may need to be dynamically adjusted to fit the characteristics of project phases and team composition.

In general, neither Hong Kong nor Dutch participants had experience in multicultural teams supported by other than email. By nature, email is extremely unstructured. Use of group support systems in the HKNET project enabled an opportunity to structure activities in a way that enhanced the probability of sustained progress in the majority of groups. This was generally well accepted; however, appropriate structure to some can be stifling to others. This became apparent in the context of some group interactions, especially in the context of tri-cultural interactions in HKNET4.

PROCESS as a virtual team issue includes differences of opinion about the approach to be followed as well as importance of activities such as planning. There were strong disparities in HKNET participant backgrounds, especially in terms of multicultural team experience. For example, in HKNET2, the Hong Kong participants were part-time MBA management students who, for the most part, worked in multinational settings. Their experience proved to be advantageous as the experience of the Hong Kong students prevailed in providing leadership in difficult situations.

In general, however, there needs to be synergistic people and technology roles. For example, rotating leadership as a function of team needs is a common occurrence. Further, a "shepherding" role adopted by some participants encouraged shy or recalcitrant participants. Overall, we can expect equifinality to occur (in the sense of multiple ways at arriving at the same solution) but need to promote the creation of an environment that is trusting and supportive.

NATIONAL CULTURAL BACKGROUND as a layer in the "onion skin" model is indicative of problems caused by different attitudes toward group behavior or openness in communication that is deemed acceptable or tolerable (or otherwise) by participants from other national cultures. At first, there was little reference to cultural differences as a source of problems. The technological problems and lack of interaction dominated the problems perceived by the teams in HNKET1 and HKNET2 in particular. Other problems related to national culture may have been there but were not yet visible or prominent in the context of group interactions that emerged especially in HKNET4.

At a fundamental level in the HKNET project, we learned that national culture is more malleable than expected. Cultural differences can be overcome and can become a springboard for innovative collaboration. Individuals belonging to diverse cultures, who interact virtually, modify their pre-existing cognitive schemes and meta-knowledge toward a more tolerant perspective. As summarized by one participant, "I have learned to be considerate, especially when working with teammates with different cultures, working styles, and expectations."

PROFESSIONAL BACKGROUND as a category reflects different ways of working (e.g., engineers versus accountants). On the surface, one would imagine that commonality in professional culture would induce harmony in group interactions. Such is not always the case. For example, HKNET3 participants were more similar in terms of professional culture. Although we thought this would result in more team harmony, Hong Kong participants changed their opinions about themselves, but not their opinion about the Dutch participants which, by the way, did not fit with Dutch self-perceptions [22]. Hong Kong participants did not release their preconceptions about the Dutch even though they saw themselves differently at the conclusion of the project. This is

especially interesting given the general perception of Hong Kong as a city that quickly adjusts to change. It also did not align with prior HKNET experiences.

In terms of recognizing cultural characteristics, the HKNET2 Hong Kong participants were much better than the HKNET3 Hong Kong participants and somewhat better than the HKNET2 Dutch participants even though they were radically different in terms of professional culture. The HKNET2 participants, courtesy of their different professional background and experience, were less defensive and better equipped to deal with the demands of the situation in terms of cultural convergence. The HKNET2 participants were more effective in working together and generating creative results. Higher levels of tension among the HKNET3 groups resulted in a "virtual murder" within one of the teams that had not previously been encountered in HKNET1 or HKNET2. The virtual murder happened after the students had submitted their final report. The report was good, but the students started a bitter online argument about the distribution of work and the trustworthiness of their remote partners. This came to a head during the closing videoconference when one party demanded an apology from the other party.

CREATIVE CONTENT FORMATION is associated with differences of opinion with regard to the actual content of the deliverable and, more importantly, lack of integration and synergism resulting in an especially noteworthy solution. The ICTs that support a decentralized network of communication between participants coming from different cultural and professional backgrounds facilitate divergent thinking, fluency of information spread, and thus association of new ideas. Those cognitive, but social, activities are important factors to creativity. As one Hong Kong student noted, "These experiences helped me to develop myself, to be more considerate and creative."

Creative content can be particularly elusive. To some extent, it is accentuated by bringing together more cultures. This was illustrated in HKNET4 (which had four national cultures rather than three) where special creativity was illustrated in the construction of websites in addition to paper-based reports. On the other hand, the additional cultural perspectives is not without cost. Communication and coordination difficulties can easily wipe out opportunities for creative content formation.

Future research and experience with virtual teams will give us more information as to whether the onionskin model is useful for the problems perceived by virtual teams. It could be an explanation for the fact that different virtual teams experience different problems with working in virtual teams. It could also explain why members within a team have completely different perceptions of the problems they are facing. The different perceptions can have a disruptive effect on the teams since some members may be fighting technology problems while others are convinced the process should be addressed.

Virtual Meetings in Industry: Implications and Example

In the past three years virtual meetings in business have become standard business. Unfortunately, practical experiences reported in the literature are rare (e.g., [33], [12]) and typically concern small groups of 5 to 15 participants with the length of the meetings varying classically from a couple of hours to six weeks [34]. Some of the authors of the current paper, beyond their participation in the HKNET project, are familiar with the organization of virtual meetings in business. The aim of this section is to present, rather than to describe in detail, how the lessons learned during the four years of the HKNET project have been applied into practice.

Use the meeting metaphor in distributed work. A practical common point of reference in business is the meeting. All business people are used to terminologies such as *agenda*, *deliverables*, and *meeting report*. In order to structure activities over time, an agenda is the most effective meeting metaphor and is essentially embedded in the GSS software that was originally developed in the meeting room [23]. The main scarce resource these days is attention deficit [35]. Therefore, the metaphor of the agenda keeps the attention of the team player on the task to fulfill and assure specific contributions of the participants at different points in time. The focus of the participants' attention is implicitly articulated around interim deadlines, for example, to submit research questions until Monday and evaluate the questions on Tuesday.

Apply sandwich structure when possible. The HKNET project showed the importance of establishing trust and creating momentum early on with the support of the so-called "sandwich structure." This is preferably done in a face-to-face meeting with all the team members present. The sandwich in virtual meetings consists of at least three parts:

The Kick-off: Trust is built and the project takes off. It is easier to form a virtual team in a business environment than in the HKNET project. The participants already share a common business culture and a common terminology since they typically operate within the same company or industry. It is less important to get acquainted in a business context since most participants in virtual teams already have met before. The main goal in the start-up of

a virtual team in a business environment is the definition of a common goal for the project. On the other hand, dealing with different professional cultures (i.e., participants from different parts of the organization) can lead to greater conflict than we observed in the HKNET project with diverse national culture (i.e., attribution of problem to national differences). Indeed, the only instances where we have had major problems in starting up virtual teams in practice is where company politics influenced the participation in the teams to the extent that participants were not interested in contributing. Personal motivation and incentives play a determining role in predicting how people will behave as group members [30]. The initial meeting can be supported by a videoconference if it is not possible to meet face-to-face. The involvement of the sponsor of the virtual team, preferably a senior manager adopting a coaching leadership attitude, is important to assure that participants will spend the necessary time in their virtual team.

The Virtual Filling: Much of the work is done remotely. The agenda is the main tool to structure the virtual filling of the sandwich. Other tools are email and phone calls to stimulate people to participate. Anonymity is a way to encourage people to contribute their ideas and comments more freely. The comment contents are free to stand on their own and identification with a group member becomes a separate attribute. Evaluation of all the generated ideas systematically by subteams reduces extreme pooling effect and social loafing.

The Closure: Final product is delivered and presented and e-collaboration is celebration. The closure of the project is preferably done face-to-face. This is beneficial since the participants know they will meet at the end of the project and feel more responsible toward each other's contributions. Moreover, this allows the remote participants to socially communicate and exchange thoughts, creating a common history for the virtual team. This should make things easier for the next collaboration. For example, the impact of a face-to-face closure of virtual teams in software inspections was measured and indicated that the fact that participants were required to submit their contributions electronically before the meeting increased the effort spent in the individual preparation [36].

Use videoconferencing in cases of conflict. As one senior manager pointed out to us: "I know the other participants. If I want to see their face, I can put a picture on my desk." If it is really important to get to know one another, participants will travel. Videoconferencing is a key when conflicts arise in virtual teams. Since it is difficult to travel every time a conflict is suspected, one can act by means of a videoconference with some or all team members. It is important, however, to provide high-quality connectivity especially in cases of a conflict. Moreover, it is better to spend more money on videoconferencing at specific points in the project than to provide a low-quality connection all the time.

Enforce synchronous communication. The technology allows working asynchronously all the time. In HKNET1, we did not pay specific attention to the mix of synchronous and asynchronous work. This negatively affected the effectiveness of the teams and the cooperation within the teams. Timely feedback is critical, especially in the early phases of a project when trust has to be built. Proposing an idea or a way of working without anybody responding to the idea for days does not motivate team members to participate. Synchronous work should be enforced for at least an hour a week. We have experienced that more progress can be achieved in one hour of synchronous work per participant than in many hours of asynchronous work. This holds especially for the early phases of the project. Synchronous work is also of great value to get a social process going in a team.

CONCLUSION

After just a few years' practice in the virtual world, we learned more about the reality of virtuality that we could write about. The development of new e-modes of communication is changing the nature of group collaboration, its functionality, and its productivity. Metrics, such as distance between group members or time zones, no longer form an obstacle to multicultural and remote collaborations. The fact that electronic modes of communication rely on a fast spread of information and decentralized communication networks stimulates both problem solving and creative activities. A decentralized communication network is not a synonym for chaos. Once the basic technical barriers have been removed, the main issues to deal with are organizational and social. First, the paper concludes that the organizational structure required to support human e-interactions is central to efficient e-collaboration. Second, the paper concludes that virtual meetings and collaboration are much more than a technological substitution for the traditional face-to-face meeting. Indeed, selecting the appropriate sets of ICTs, structuring the group processes, building trust, and supporting decision-making are subtle activities that go far beyond sitting someone behind a screen in an experimental setting and telling him, "OK, you can talk now."

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