

Effective Communication in Virtual Adversarial Collaborative Communities

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Abstract¹

Virtual communities, of which communication is a defining characteristic, play an increasingly important role in society. Effective communication helps to achieve common goals, but is hard to achieve in virtual communities in general. Those of the adversarial collaborative kind face many additional communication barriers. In these communities, not only the matching of objectives, but also of interests is complex. We study a case of a virtual adversarial collaborative community of which the common goal was to author reports to assess the amount of true consensus on forestry policies. We use discourse ethics theory to find a set of communication norms that are prerequisite for making communication in adversarial collaborative communities more effective. We use these norms to make some recommendations on the design of supporting communication systems.

1. Introduction

With the rise of the Internet, virtual communities are gaining importance as a new model for virtual collaboration, as demonstrated by the proliferation of research, education, and trade communities. In an increasingly networked society, with an exploding need for global and flexible ways of professional interaction, virtual communities are natural candidates to fill collaborative gaps in traditional, hierarchical organizations. Research communities were the first to discover the power of the Internet to facilitate their collaboration [25]. Student communities are natural candidates and eager adopters of modern networking technologies [57]. With the advent of more user-friendly and powerful web applications, business is also discovering the power of virtual communities. For example, virtual communities of consumption are affiliate groups whose online interactions are based upon shared enthusiasm for, and knowledge of, a specific consumption activity or related group of activities. Such communities allow consumers to critically evaluate products and companies to gather valuable data on product characteristics from loyal customers. [34].

Communities are crucial allies in defending the public interest. Communities of cooperation need to do for the public good what markets currently do on behalf of aggregated private interests [4]. These forms of civil society have discovered the bottom-up use of cyberspace, a space of distributed power, as a way to transform society [54]. Communities can revitalize public discourse, as Habermas, for instance, argues in this theory of communicative action [14]. Virtual communities, which are communities in which the interactions are mostly or completely mediated by ICT, are especially suited for this role in the modern world.

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What is a community? Communities are not just aggregates of people, temporarily interacting. A community has been defined as a group of people who share social interactions, social ties, and a common 'space' [34]; as a social network of relationships that provide sociability support, information, and a sense of belonging [69], and as a set of relationships where people interact socially for mutual benefit [58]. The key seems to be strong and lasting interactions that bind community members and that take place in some form of common space.

Communication is the lifeblood of communities. As early pioneers in virtual communities already observed: “a cyberspace is defined more by the interactions among the actors within it than by the technology with which it is implemented. [43]” Of course, communication is needed to coordinate actions, but it can also be a key output itself. For example, scholarly communities are facilitators of highly specialized forms of argumentation and debate [52]. Communities require a rich diversity in communication forms, from informal chatting, discussing, debating, asking and answering questions, consoling, to advising and empathizing [47]. The norms that define these communities regulate what are acceptable forms of argumentation.

One of the main reasons communication in communities is so important, is the development of trust. Trust is essential social capital in a community. It develops when there is a history of favorable past interactions that lead participants to expect positive future interactions [48]. Trustworthiness is not achieved overnight, but grows out of iterative processes of interaction, observation, analysis and judgement in which the actors are local people, outsiders, and outsiders' peers [6].

All communities have at least a joint focus, and sometimes common goals. In communities of interest, such as many consumer communities, there is only a diffuse focus, which can be as vague as sharing a willingness to discuss common interests [5]. The pursuit of common objectives is much clearer in communities of practice. These are defined by a common disciplinary background, similar work activities and tools, and shared stories, contexts, and values [42]. The focus on their common set of activities or practices is tight [42, 5]. Examples are knowledge management communities, which act as custodians for a particular knowledge domain, nurturing the sharing and creation of practices and knowledge that is key to the achievement of both company and personal objectives [66].

Our focus in this paper is on communities of practice, as they can be useful instruments for achieving common goals. More in particular, in this article we explore communities of practice that focus on the public interest. Many of such communities exist, for example communities on sustainable development. These consist of many experts and stakeholders, often with conflicting interests. The communities are very knowledge-intensive, under high-time pressure, forced to work most effectively and efficiently because of a regular lack of resources, and with strongly evolving sets of goals, workflows, and organizational structures [33]. The communities can take many forms: from relatively uniform NGO communities to heterogeneous issue-networks in which organisations discuss a common issue (such as genetically modified food), acknowledge one another, and interconnect by multiple routes [41].

It is often assumed that communities, virtual or not, are harmonious, at least in intent. A classic example are self-help patient communities, in which patients not only exchange factual information, but also provide emotional support by communicating with others having similar physical and emotional symptoms [2]. However, especially for communities working for the public interest, this view is too naïve. In many communities, the interests of their members are to a certain extent opposed. In this

case, adversarial collaboration requires participants to come to agreement, and to effectively work together to produce a shared product that reflects the interests of the adversarial parties [8]. These adversarial communities play a crucial role in civil society. They are the bridges via which the many different stakeholders that need to be involved in finding solutions to complex problems related to sustainable development find common ground. If these communities are to be successful in their common goals, such conflicting interests are not to be suppressed, however, but acknowledged. Conflict is inherent in these communities, and communication support needs to be carefully tailored to deal with these potential sources of ineffective communication.

Of necessity, because of their international, interdisciplinary, and interactive nature, communities for the public interest are often virtual communities. A virtual community differs from other communities only in that its common space is cyberspace. Virtual communities therefore describe the union between individuals or organizations who share common values and interests using electronic media to communicate within a shared semantic space on a regular basis [56]. In virtual communities, the common space is provided by a suite of collaborative and communicative functionalities, ranging from simple mailers to advanced web applications [47, 63]. This functionality mostly consists of standard tools or components, so that information systems development becomes more a process of functionality selection than building whole new systems from scratch [55].

In communication systems design for adversarial communities, procedures and functionalities need to be carefully adapted to their sensitivities. In this paper, we investigate the communication norms that such communication systems should satisfy to allow for effective communication. We then give a critique of current systems designed to support collaborative communication, as proposed in the field of Computer Supported Cooperative Work (CSCW).

To illustrate the problematic of effective communication in adversarial collaborative communities, in Sect. 2 we first introduce BCFOR, a case on group report authoring for environmental consensus assessment. In Sect. 3, we more closely examine the public interest. Sect. 4 introduces relevant discourse ethics theory and some illustrative communication norms derived from this theory as implemented in the GRASS tool that evolved from BCFOR. Sect. 5 gives some recommendations with respect to communication systems design for virtual adversarial collaborative communities. We end the paper with conclusions.

2. Effective Communication: A Case on Group Report Authoring

In this section, we illustrate in more detail what effective communication in virtual adversarial collaborative communities means. We do this by investigating a case of a typical class of these communities: those working for the public interest. We first present the case of a virtual community that aimed to produce group reports to assess the amount of consensus on forestry issues. Next, we focus on the authoring process and the functionality used to support this process. Finally, we take a more theoretical perspective on the coordination of collaborative work.

2.1 Case: BCFOR

In 1993, the Global Research Network on Sustainable Development (GRNSD)² was formed. One of the objectives, stated in its Charter, was “to develop new and creative approaches to increase the quality of research and communication processes related to sustainable development.” Although the network is no longer operational, it spawned a number of groups that have been operational until quite recently.

One of these groups was the British Columbia Forests and Forestry Group (BCFOR). The group was formed after the government of this Canadian Pacific province decided to allow for clearcut logging in the Clayoquot Sound watershed in 1993. This decision was hotly contested. The conflict culminated in the arrest and conviction of criminal contempt of court of hundreds of people who blocked the logging roads. As such, there was a heavy public interest in the case (Fig. 1). To dissolve the conflict, the provincial government appointed a Scientific Panel to write a series of reports defining new land-use policies [59]. These recommendations were used to partially revise the initial land use decision. However, many claimed that important issues were not adequately addressed in the final version of the reports.



Fig. 1 Demonstration in front of B.C. Parliament Buildings, summer 1993

One particular suggestion for improvement of the research approach used by the Scientific Panel was that there should have been more emphasis on *contrasting* analysis of issues [22]. This seems a valid criticism, considering a tell-tale footnote remark in the 4th (March 1995) of the Scientific Panel reports: "The Panel's protocol is characterized by respect for one another, for different values, and for data founded both in scientific knowledge and traditional knowledge. *This respect enabled the Panel to be unanimous in its recommendations*" (our emphasis) [59]. However, if the values of the panel members, and the stakeholders they represent, are different, perhaps even incommensurable [10], then it is not clear at all why respect for these values would have to lead to unanimity in a scientific report that aims to make a comprehensive analysis of issues and positions. On the contrary, highlighting such differences of opinion might usefully contribute to further policy deliberation and decision making about land-use policy.

In the BCFOR group, Canadian and international members discussed issues related to forests and forestry. About 15 core members were quite involved in frequent and intense interactions for at least a year at the peak of the conflict, turning the initially loose group into a rather tight community. The community consisted of a

² <http://infolab.uvt.nl/grnsd>

range of stakeholders, from timber industry consultants and government officials to environmentalists. Initially, only a mailing list discussion was conducted in which issues were discussed as they were raised by participants. However, given their great public and personal interest in finding solutions to the crisis, the group members wanted to do more. It was decided after an intense e-mail discussion that the group should produce more tangible outputs that would help improve the quality of the public debate. The common objective would be to write a series of *group reports* in which forestry policies could be critically analyzed in a systematic way.

2.2 Group Report Authoring with GRASS

Group reports are prime examples of dialogic text. This type of text, contrary to traditional collaborative texts, reflects the involvement of multiple authorial voices [24]. This means that conflicting opinions all find their way in the text, not covered up as compromises, but retaining their original form and strength. Thus, any joint statements can be considered to have been produced in true consensus. This allows – or forces - policy makers to make more explicit and well-argued choices.

BCFOR was a prototypical virtual adversarial collaborative community, in which trust could easily be damaged. The proposed group report authoring process was therefore required by the community to meet two social constraints: it had to be both neutral and transparent [13]. *Neutrality* does not mean that individual opinions are free of bias. They cannot be. In public scientific investigations, not only the authors themselves are subjective, but additional subjective constraints are imposed by society, given that society is largely based on values and value judgments [37]. This strong subjectivity implies that in discussion and editorial procedures and the supporting systems, all voices are to be heard throughout, and authors are not forced into compromise. *Transparency* means that all processes and their outcomes should be easily observable by all stakeholders interested in doing so. Often, although public opinion itself is well known, public opinion *formation* is unclear [53]. In adversarial communities such intransparency is unacceptable.

After some relatively unsuccessful attempts, it turned out that using a simple mailing list for group report authoring purposes did not provide sufficient support. The list lacked some technological functionality, but, perhaps even more importantly, also did not satisfy the complex social constraints of this adversarial community. To develop a better communication system, the GRASS project was conceived [12, 27].

The purpose of the GRASS project is to develop an arena for credible societal discourse. Its aim is to produce concise group reports that give their readers an up-to-date and credible overview of the positions of various stakeholders on a particular issue. As such, these reports may play an important role in consensus assessment and catalyzing societal conflict resolution. In [27, 11], we described the objectives, process models, functionality, initial user experiences, and plans for the near future. We refer to this overview for more details, and only give a brief summary next.

2.3 GRASS Functionality

Group Report Structure

Each GRASS group report is subdivided into three main parts: (1) the problem description; (2) the sections; and (3) the report conclusion.

The *problem description* contains an introduction of the problem domain, the central issue that is the focus of the report, and a list of one or more key questions. The *sections* form the body of the report, in which the actual discussion takes place. Each section comprises a section introduction, the key question to be examined as well as a number of positions that authors can take. For each position, arguments pro and contra can be entered. An argument can also be linked to other arguments, thus forming an argument tree. A section is ended by the section conclusion, in which the various positions to the key question are summarized.

Each report is ended by a *report conclusion*, which summarizes the answers to the various key questions, and indicates areas for future research.

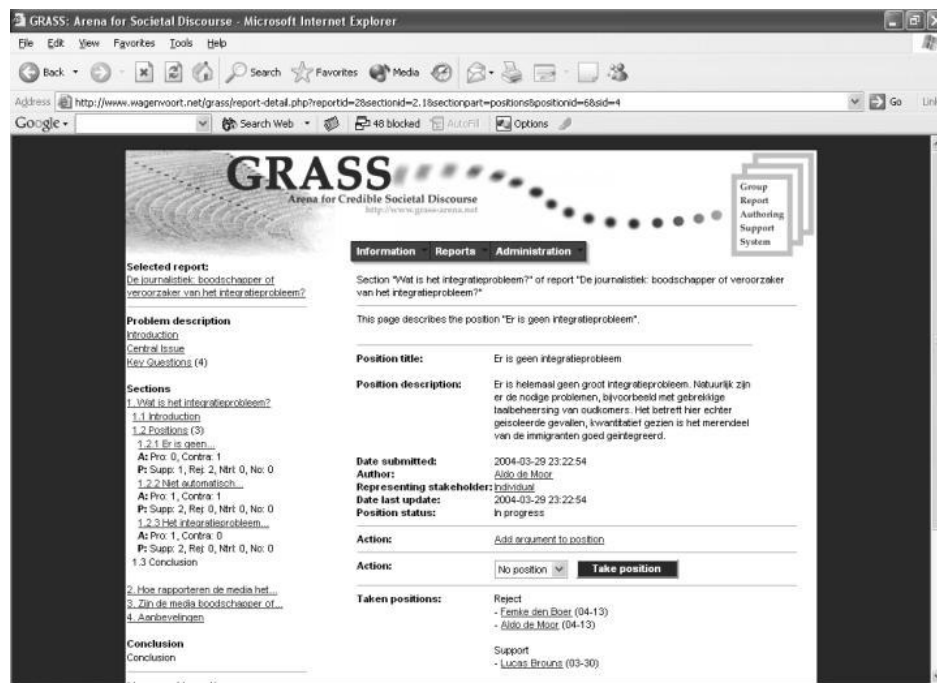


Fig. 2 The GRASS Tool

GRASS Functionality

A user has to register in order to become a report author. Several editor roles have been defined as well. Each editor role can be filled by one or more authors. Every author can become an editor, if desired. An overall report editor is responsible for editing the problem description and report conclusion parts. The report editor can also add new sections. A section editor is responsible for editing the section introduction and conclusion. In each section, authors can adopt or add new positions and add arguments pro or contra positions and other arguments. Positions taken can be modified continuously, reflecting the change of opinions held. Arguments, once made, cannot be changed, to prevent loss of discussion structure. An important feature

of GRASS is that stores all report elements in a database, which can be used to generate group reports in different formats. An example are tailor-made summary reports, for example listing all issues that cause much discontent, as measured by large variation in positions adopted. Reports consisting of positions and attached argumentation could be further organized according to stakeholder roles played by the authors, for example by presenting positions adopted by environmental organizations versus those taken by logging companies. The tool also has advanced and customizable notification functionality, thus allowing for awareness about changes to be increased.

GRASS has had a long gestation period, starting from an initial dissatisfaction with the limitations of e-mail for writing reports, via various intermediate prototypes, to the current version which is almost ready for large-scale use³ (Fig.2). With this authoring technology finally reaching maturity, time has come to build more systematic use cases. One focus case remains the ongoing debate in B.C. about the fate of the forests.

2.4 Coordinating Collaborative Work

As we have seen, one characteristic of collaborative communities is that they are focused on accomplishing joint objectives in a process of members working together. Ngwenyama & Lyytinen [44] provide the following definition of groupwork: “a web of coordinated social actions performed by the participants to achieve a joint outcome.” This definition refers to *coordinated* action. Evidently, there are many kinds of coordination. According to Malone and Crowston [39], coordination is the act of managing interdependencies between activities performed to achieve a goal. They also cite the definition of Holt [29]: coordination is composing purposeful actions into larger purposeful wholes. The bottom line for coordination is the existence of interdependencies, which can either be given, or derive from a goal-directed effort. Malone and Crowston identify the following types of interdependencies:

<i>Dependency</i>	<i>Examples of coordination processes</i>
<ul style="list-style-type: none"> • Shared resources 	“First come first serve”, priority order, budgets, managerial decisions (hierarchy), market-like bidding (markets)
<ul style="list-style-type: none"> • Task assignments 	
<ul style="list-style-type: none"> • Producer / consumer relationships 	
<ul style="list-style-type: none"> • Prerequisite constraints 	Notification, sequencing, tracking
<ul style="list-style-type: none"> • Transfer 	Inventory management (e.g. “just in time”, “economic order quantity”)
<ul style="list-style-type: none"> • Usability 	Standardization, ask users, participatory design
<ul style="list-style-type: none"> • Design for manufacturability 	Concurrent engineering
<ul style="list-style-type: none"> • Simultaneity constraints 	Scheduling, synchronization
<ul style="list-style-type: none"> • Task / subtask dependencies 	Goal selection, task decomposition

Table 1: Classification of dependencies [39]

³ <http://grass-arena.net>.

In a virtual collaborative community, we have to distinguish between two levels of dependencies. First, there are the dependencies between the stakeholders in the outside world that bring them together in the community. In the BCFOR case, this dependency derives from the fact that the forests of British Columbia are a public good, and one way of using it often excludes or at least hampers another. Second, there are dependencies created within the community by virtue of the collaboration. In the BCFOR case, these are dependencies that are part of the collaborative report writing and that can be of various kinds, if we use the Malone and Crowston typology above. The longer people work together, for example on a group report, the more of these dependencies will emerge and need to be satisfied by the communication system.

In adversarial collaboration, the interactions aimed at dealing with these dependencies take the form of *negotiation*. According to Putnam and Roloff [50], negotiation is a special form of communication that centres on perceived incompatibilities and focuses on reaching mutually acceptable agreements. A common distinction is between distributive and integrative negotiation [67]. The objective of distributive negotiation is to achieve an efficient compromise. The objective of integrative negotiation is to create a solution that satisfies all parties. Fisher and Ury [16] made a similar distinction between win-lose versus win-win negotiations and argue strongly in favour of the win-win approach. In [68], three types of negotiation are discussed, based on the way of communicating: norm-oriented, goal-oriented and document-based. In norm-oriented negotiation, the communication follows protocols or general rules that determine which communicative action is appropriate at a certain moment. In goal-oriented negotiation, the communication proceeds by disclosing and discussing the goals of the participants in an attempt to integrate them. Document-based negotiation makes use of a common document; the participants do not interact directly, but by contributing to the evolution of the document, for example, a business contract or a political press statement. Combinations of these types are possible, of course. The focus in the GRASS system is on document-based negotiation, although norms are important in identifying what functionality authors and editors are allowed to access in their work.

We have now explored the dimension of objectives in more detail. It is clear that there are many coordination complexities that need to be taken into account in the development of adequate supporting communication systems. However, as already hinted at by the interactions typically being a form of negotiation, paying sufficient attention to the various interests involved is essential as well. The fact that the public interest features prominently in such communities deserves further treatment.

3. Defining the Public Interest

A good society recognizes the importance of the public domain, and invests heavily in creating a civil order that reflects good social relations. Notions of production and consumption, however, have obscured the importance of association, the creation of common interests, as the whole basis of society. This association takes place in a good community, with mutual respect between different groups and lively dialogue about important issues [31]. It is not true that the public interest needs to suffer a tragedy of the commons by default. Very complex normative systems have evolved in many societies. For example, the elaborate system of rights and responsibilities which successfully governed the English medieval common for

centuries was capable of preventing and dealing with major conflicts that would have threatened the public interest [51].

The question now is: how can successful adversarial collaborative communities for managing the public interest come to be? Why would their participants interact at all? They all have their own interests and objectives, which somehow have to match for collaboration to emerge.

To better understand how private and public interests can be made to agree, the concept of stakeholder needs to be worked out. Adversarial communities for the public interest are composed of many stakeholders. Stakeholders are those who have an interest in a particular decision, either as individuals or as representatives of a group [15]. From this definition, some factors can be derived that complicate effective communication among stakeholders. First, all parties have their private interests to defend. This may lead to actions such as secrecy (not revealing all information to other parties), advocacy (pushing their own position as far as possible), and discovery (strategic revelation of partial information) [8]. Depending on the language game being played, such strategic behavior may be legitimate, for example in a commercial transaction or legal dispute. However, stakeholders often defend their private interests in illegitimate ways, sometimes even leading to sabotage of the collaborative process.

Besides there being private interests, there is also a decision or public interest affecting all stakeholders. The public interest will only be safeguarded if an equitable and fair balance between the various stakeholder interests can be achieved [46]. However, when has such a balance been achieved? How can the end result be acceptable to participants? Often, only an unsatisfactory compromise is achieved, in which one of the participants has illegitimately gotten the upper hand [52].

Another factor complicating effective communication in adversarial communities for the public interest is that not all discussants are participating on their own behalf, but instead may represent the interests of others. This means that conflicts may emerge and secondary communication processes may be necessary.

Cohen et al. claim that in adversarial collaboration the problem is the widely diverging goals [8]. We argue, however, that in adversarial communities the real problem is the disagreement between interests, not objectives. In BCFOR, agreement was reached quickly that writing a joint group report in fair process, was a good way of building common ground. However, it was considered to be very important that the process in which this objective was to be achieved would be legitimate. The main issues of conflict and confusion thus revolved around how to balance the *interests*.

To position communities for the public interest in which effective communication is important, we classify communities along two dimensions. The first one is whether interests of community members are mainly shared or opposed. We call these communities harmonious and adversarial, respectively. The second dimension relates to the objectives. If there is just discussion without collaboration, we call them communities of interest, while collaborative communities aim to accomplish common objectives, such as the authoring of a group report. Our main focus in this paper is on adversarial collaborative communities.

To clarify the classification: we consider each of these two dimensions of interests and objectives to be a continuum: Interests can be more or less shared. At the one end of the continuum, interests are opposed, at the other end they are shared. Similar, for objectives. These can range from being individual objectives only to completely joint objectives.

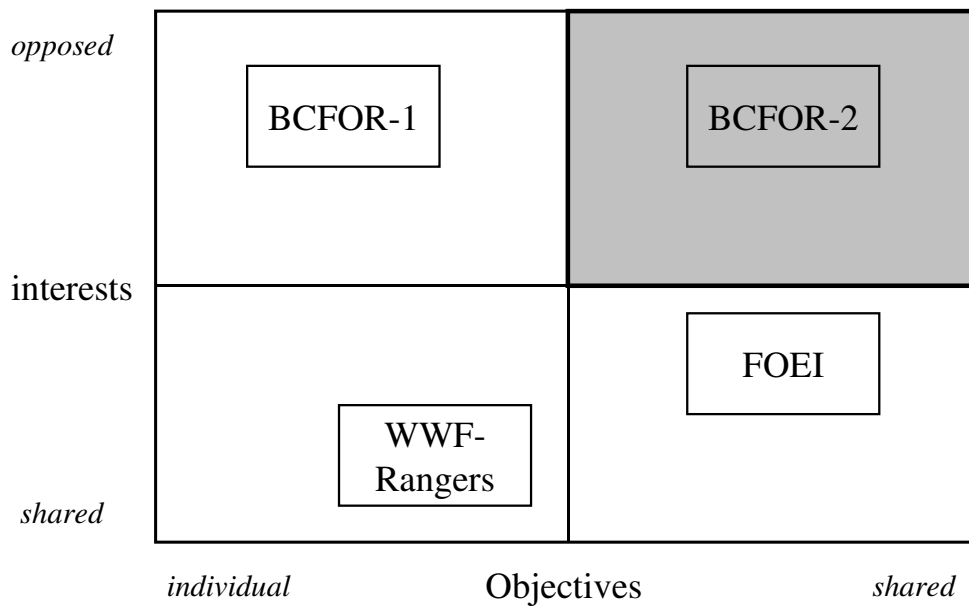


Fig. 3 Positioning adversarial collaborative communities

In Fig. 3, we have positioned four real communities in terms of the two classification dimensions. Ranging from less to more discordant, these are:

- *Shared interests / individual objectives.* These are communities where interests overlap, but no collaboration takes place. A typical example would be the World Wildlife Fund Ranger Club⁴. This is a club for and by children who share an - often passionate - interest in nature conservation. The focus is on information exchange and learning via discussion fora. There are also possibilities to get involved in actions. These are mostly oriented towards individual participation, however. For example, participants can send e-mails or donate money to support a particular conservation campaign.
- *Shared interests / shared objectives.* This is the situation where members have joint interests and collaborate on common goals. In general, these communities are more discordant than the previous type, because the working together leads to dependencies, for example, reputation and financial-wise, that may lead to misunderstandings and tensions. A typical example are the Friends of the Earth International (FoEI) campaign communities [33]. FoEI is a network of 68 environmental organizations worldwide, each working in its own country with local, community-based groups active in civil society (around 5,000 local groups in total). It is a grassroots network, where decisions are made by consensus, and work and authority are decentralized as much as possible. Campaigns are organized by communities of people working for FoEI member organizations. Thus, they share similar interests related to sustainable development and have common objectives, as many campaigns can only succeed by joining forces. Still, interests and objectives

⁴ <http://www.rangerclub.nl/>

do not completely overlap, as to a certain extent they compete for the same public attention.

- *Opposed interests / individual objectives.* In these communities, there often is the problem of strongly conflicting interests. One such community was BCFOR in its early stage. All members of the community shared their focus on the problem domain of B.C. forestry. They had very little shared interests, however. Also, there were no truly joint objectives, as the group mainly conducted unfacilitated, divergent discussion.
- *Opposed interests / shared objectives.* This is potentially the most discordant type of community. Not only do interests not agree, but those conflicts of interest will feature more prominently when members - try to - work together on shared objectives. BCFOR in its later stage is an example of such a community. In this stage, their interests were still as opposed as before. However, they now had a common objective: the writing of the group report. When working together, lack of trust is often a major problem.

Having positioned and illustrated communities for the public interest, we can now investigate the norms governing their communication processes in more detail. To theoretically ground this investigation, we look into various discourse ethics theories.

4. From Discourse Ethics Theory to Communication Norms

As we have seen earlier, Ngwenyama & Lyytinen [44] defined groupwork to be a web of coordinated social actions performed by the participants to achieve a joint outcome. However, they also claim that the social actions of groupwork are situated within and normatively regulated by the organizational context. Especially in virtual adversarial collaborative communities, where there is potential or actual conflict and many additional problems arise due to limited social context cues because of the medium used, it is important to realize what the regulating norms and motives are. In addition, note that “the organizational context” in this case is typically not a hierarchical organization but a loosely coupled community. We said that in adversarial collaborative communities essential interests are conflicting, yet simultaneously there are shared objectives (“mixed-motive tasks”). In such a context, the design of interactions and supporting systems needs to be done very carefully. Harris [23] discusses some theories of “universal pragmatics”, in particular Grice’s maxims and the theory of Habermas. Harris concludes that the usefulness of Grice’s work is limited, and that the work of Habermas is more promising, especially because of its political grounding. In this paper, we follow the line of Habermas.

4.1 Discourse Ethics

As is rather well known, Habermas proposed a series of validity claims which act as a set of general principles on which all communication is based and which can be called into question and “redeemed” by the other parties. These validity claims are based on *comprehensibility* (related to linguistic competence), *truth* (agreement on truth claim with respect to the object world), *truthfulness* (agreement on speaker’s sincerity) and *rightness* (agreement on normative social rules and relationships). The validity claims presuppose shared understanding (agreement on a situation definition, consensus) as the first premise of communication.

Habermas' concept of discourse ethics [20, 21] contains general rules for practical discourse leading to an ideal speech situation, in particular in situations of moral argumentation. The process of moral argumentation is particularly relevant to situations where social conflicts arise and to institutional discourse [23]. These rules guarantee discursive equality, freedom and fair play by not excluding anybody from participating, and by allowing them to challenge anything they deem important, while ensuring that nobody is prevented from exercising these rights. However, an important question is how to translate these ideals into actual conversation support for the real world [7, 18]. Habermas' discourse ethics are grounded in his theory of communication. Interestingly, the communication setting presupposes certain basic rules, even if in practice, we see these rules often violated. As Habermas claims, there is a "common core of morality in the normative pre-suppositions of communicative interaction" [21]. In the following, we summarize this core in our own words, related to the purpose of this paper. The basic rule is that participants must respect each other as communication subjects. It means that one must be able to give valid reasons for the communicative actions that one performs. This applies to both the speaker and hearer role. The speaker is not obliged to reveal everything she knows or wants, but when asserting something, or requesting some action, she should be able to give a valid reason (for each validity claim). The hearer is not obliged to agree with everything the speaker says, but he should listen and be willing to indicate whether he agrees or not (and why not). Another important rule implicit in the communicative setting is that in principle, the communication is to be interpreted in the context of the communication, which sometimes can mean complete confidentiality, sometimes giving the whole world access to the discussion. Exporting statements to other contexts cannot be done without the consent of the communicative actors. Within the context, however, communication should always be completely transparent. This list of rules is not meant to be exhaustive, but gives a good starting point for analysis.

As noted earlier, Habermas makes a distinction between communicative action and strategic action, although he qualified this distinction in later work. In communicative action, the coordination that is achieved is based on a shared situation definition, whereas in strategic action, the coordination is achieved as a result of the individual actions of the participants supposed to pursue their own goals, taking into account their expectations of the other participants' goals, and the signals they get about these via the actions of the other. Although this distinction makes sense at a conceptual level, it is not so easy to recognize it in practice [23]. For one thing, it does *not* mean that participants in communicative action necessarily pursue a common goal and participants in strategic action private goals, or that the goals in one case are harmonic and conflicting in the other. Also in the case of an adversarial discourse situation, the participants can coordinate their dependencies by means of communicative action. In this respect, we do not agree with Ngwenyama and Lyytinen [44] for whom negotiation necessarily implies strategic action. The distinction can also not be based on the linguistic form of the messages, or the use of so-called cooperative speech acts, although these may give indications on the attitude of the participants. However, what we can do is translate the ideals of discourse ethics into practical rules, and we can check whether these rules (communication norms) are adhered to or not. Therefore we propose the following criterion in this paper: a discourse is called communicative action if it follows the communication norms that are legitimate to the community, and is called strategic action if there is a norm violation. In other words, communication norms, properly defined, are a means by which communicative action

can be promoted and strategic action resisted. In the next section, we will illustrate the concept of communication norms with the example of GRASS.

4.2 Communication Norms in GRASS

Central in the group report authoring process is that there is some issue or topic being addressed in a process of argumentation between different participants. To ensure that discussion contributes to the common good, and does not become pathological, its social context needs to be clearly understood. After all, public discourse is about *making* an argument for a point of view, not *having* an argument [64]. Although discussion and debate may be relatively unproblematic as descriptions of interpersonal communication and opinion formation in small face-to-face groups, these processes need to be carefully designed when applying them to the larger-scale processes of public opinion formation [49]. Group report authoring, as a key form of interaction in adversarial collaborative communities, therefore requires that the definition of its design characteristics are sensitive to the social, or even societal context.

Heng and De Moor [27] formulated several key design principles for communications systems for group report authoring. Some of the most important ones are:

- **DP1:** the document should be neutral and transparent, reporting all the undistorted views of all the participants of the discussion.
- **DP2:** participants should take on responsibility.
- **DP3:** the goal is not contrived conclusions, but true consensus.

To operationalize the design principles, explicit communication norms can be formulated. Such norms on the one hand project the expected patterns for interaction that participants can use to anticipate, understand, and coordinate their interaction. On the other hand, they can be used to implement and exercise normative control. Thus, the norms designed into a communication support system can have a direct impact on the outcomes of the communication and collaboration process [1, 36].

In the GRASS case, communication norms define acceptable communication behavior for actors playing a role in the authoring process. Each norm has a deontic effect, indicating whether something may, must, or may not happen. Some norms focus on actor roles, others on document elements, and again other norms on the interaction processes between actors. GRASS incorporates many communication norms, to implement the various design principles. To illustrate, we describe the norms that implement DP1:

Neutrality

- **CN1:** Any interested user may register as an author.
- **CN2:** Any author may play any editor role.
- **CN3:** If more than one author plays a particular editor role, all authors playing that role must agree before any change to a report element they are responsible for may be made.
- **CN4:** Any dispute related to the authoring process may always be discussed by all authors in a public forum to which every author has access.

- **CN5:** Any common report element (such as report or section conclusions), after having been drafted by its responsible editors, must be approved by every author.

Transparency

- **CN6:** No unauthorized changes may be made to any report element.
- **CN7:** All authors must be notified of any relevant report element changes.
- **CN8:** All reports and their composing elements may be read by any user. This reader does not have to be an author.

In the case that one of these norms is violated, for example, if not all authors are notified of a relevant element change (CN7) or if a user is refused to register as an author (CN1), this is an instance of (conscious or non-conscious) strategic action. One way to avoid strategic action is to implement the norms into the system, so that it is *impossible* to violate the norms. Of course, this is not possible for every norm, and even if it is possible, it may have undesirable side effects. Still, it is worth keeping in mind that communication systems not only offer technical functionality (writing, e-mailing etc), but, through their functionalities, also be used as normative systems for guiding behaviour [36].

5. Communication systems design

In this section, we first give a brief overview of some communication systems for adversarial collaborative communities. We then discuss the implications of the theory put forward in this paper.

5.1 CSCW and Communication Systems

Traditionally, CSCW and so-called Group Decision Support Systems (GDSS) failed to take into account the political aspects of group work [3]. Too often, the assumption is made that group work is always harmonious and information is a neutral concept. However, most information is subject to strategic misrepresentation and unconscious bias [40]. Disclosing information is also not neutral and it cannot be expected that subjects disclose something if they do not see the benefit of that for themselves. In a study of Lyytinen et al. [38] about the use of GDSS tools for diplomats, it was found that the tool had to be used in a non-standard way if it was to be used at all. Firstly, it was out of question to use anonymous communication, which is often favoured in the GDSS literature for group brainstorming and voting. Secondly, the archival properties of the system should be used with great care, as the participants did not want to make any statement during the discussions if they knew that these were stored and could be used to pin them down later.

One step on the way to the design of effective communication systems for adversarial collaborative communities is the idea of issue-based information systems (IBIS). Issues act as organizing principles for collaborative work, transcending individual conversations [26]. An IBIS allows its users to identify questions, develop the scope of positions in response to them, and assists in creating discussions [35]. Using an IBIS, stakeholders can conduct conversations about complex or 'wicked' problems, by structuring the creation and handling of 'issue nets' [9]. Issue nets have

three main types of nodes: *issues*, *positions*, and *arguments*. Many refinements of nodes and the types of links have been created in the applications developed. Some IBIS are generic and domain-independent, others are tailored to the needs of a particular domain. Examples of early generic IBIS-tools are gIBIS and HyperIBIS. gIBIS is a graphical hypertext system with as its main interface elements a browser and a structured node index [9]. HyperIBIS is a simple text version of an IBIS, which can distinguish between deontic issues (should?), factual issues (what?), instrumental issues (how?), explanatory issues (why?) and conceptual issues (definitions) [30]. One domain-specific IBIS, especially designed for research purposes is the Scientific Collaboration System [32]. SCS pays much attention to representing knowledge. It uses an ordinary database to store this knowledge and make it accessible to its users. Types defined include *hypothesis*, *claim*, and *argument*. It allows research fields to be modelled as object classes, and organizes these fields in a class hierarchy. Issue nets are then mapped to one or more of these hierarchies. Queries on this knowledge base enable, for example, interdisciplinary viewpoints on the same problem to be obtained.

These early IBIS systems focused much attention on developing and using – often complex – representations. There was only little attention for the way in which these systems were to be *used*, let alone how they could be made effective. This is changing, as modern IBIS become more sensitive to their context of use. Zeno, for instance, is a second-generation, Web-based IBIS tool [19] which helps to mediate in conflicts. One purported application is that it can be used to democratize public policy making processes. A human mediator indexes documents according to the underlying argumentation model. By allowing for the preferences and value judgments expressed in messages to be modelled and by using a reason maintenance procedure, the tool can indicate which of the alternative solutions proposed meet selected proof standards or decision criteria. Although still using complex representation and reasoning schemes, Zeno pays much more attention to usability issues than the earlier generation of IBIS tools. It meets several practical design requirements: widely available across platforms, inexpensive access, and a very intuitive user interface.

Zeno is a sophisticated tool with a clear purpose of supporting planning processes. In contrast, D3E⁵ is a whole *kit* of functionalities, which allows users to build their own document authoring tools. It supports the creation of sites that can be used to publish web-based documents, and that have integrated discourse facilities and interactive components [62]. Along these lines, new forms of online-publication processes are possible, which involve authors and readers in the review process much more interactively, for instance.

5.2 Discussion

Although the Internet has great potential for increasing the quality of democratic life, not much attention has so far been paid to the systematic design of communication systems for the public good. As Noveck states it: “There is a marked absence of spaces for deliberative, independent, thoughtful dialogue among ‘wired’ citizens, confronting new ideas and people in the course of civil conversation.” Accordingly, “we need to devise a ‘public architecture’ in cyberspace to take advantage of the communications potential” [45]. Our design approach for communication systems based on key design principles and derived communication norms could be helpful in drawing up such an architecture.

⁵ <http://d3e.open.ac.uk>

The newer generations of communication tools are getting increasingly sophisticated in their support for adversarial collaborative communities. However, the theoretical grounding for many of these methods is still unclear. By analyzing their implicit communication norms using a discourse ethics-like theoretical lens, potential sources of conflict and communication distortions can be detected. This may help improve the diagnosis of existing systems (“why did this collaboration fail?”) and the design of new systems that better match communicative ideals [28].

We have only presented a small sample of ‘constitutional’ norms, which are directly derived from Habermas’ discourse ethics. Many other ‘bylaw’ norms could be conceived, for example to deal with the drawbacks of efficiency and time-constraints, which discourse ethics does not address. One efficiency norm could be to allow only a limited amount of space to make one’s argument, or a certain deadline before which an argument must have been made. Other issues, such as group cohesion, leadership, and socio-emotional issues also need to be represented in norms and ensuing designs in order to build truly useful systems. Group dynamics theory and the literature on computer-mediated communication (e.g. [17, 61]), amongst much other work, can be a source for these additional design constraints. These efficiency, group, and design aspects, however, are outside of the direct scope of this paper, although they need to be addressed in future work.

Design choices will not be trivial and often difficult trade-offs will be necessary. For example, traditional GDSS systems often favour anonymous discussions, to increase productivity and sometimes also to de-politicize the discussion. In adversarial communities, anonymity must be used with care, however. For example, in an IBIS kind of system, it may be possible to anonymize the issue list, since every participant is allowed to raise an issue, and if it is deemed relevant by one participant, that is sufficient for including it. However, anonymizing the claims can severely hamper effective discussion, because if someone makes a claim, he or she should be ready to support it. This also applies to counter-arguments. This example makes clear that the design of a complex communication system that is both useful and legitimate is not straightforward.

We already stressed the trust-building function of legitimate public communication systems. This trust is not only important for making public discourse more credible. It can also benefit the standing of the participating stakeholders. Legitimacy and accountability of participants in societal debates, such as non-governmental organizations, requires a careful design of their information and communication systems [65]. Careful analysis of which norms to apply and how these norms are to be embedded in concrete system functionality is also essential for this purpose.

Although we have focused on virtual communities for the public interest, lessons learnt here should have wider applicability. For example, adversarial communities also exist in legal conflicts, where lawyers of different parties often have to work together on resolving a dispute. An interesting case is also formed by the so-called Alternative Dispute Resolution initiatives that try to mediate in a conflict between individuals before it must be raised to the legal level. Virtual adversarial collaborative communities, and their properly designed communication support systems, may be very useful.

6. Conclusions

We started this paper by acknowledging the importance of virtual communities for the public interest. In these types of communities it is important to clearly identify the degree to which objectives and especially interests of community members agree. Based on these dimensions, communities can range from the harmonious to the adversarial, and from communities of interest to truly collaborative communities. In this paper, we focused on adversarial collaborative communities, as these are key potential instruments for societal conflict resolution and change.

We claim that to assess the value of communication systems for virtual communities, it is not sufficient to merely look at the functionality. First, it is necessary to determine the kind of collaboration required in the community. Subsequently, selected communication norms need to be made explicit and used to inform the design and diagnosis of the communication systems for such communities. Of course, there is a potential danger in prescribing communication behaviors through rigidly designed systems [60]. However, provided that sufficient criteria are given for which norms to make explicit, and that degrees of freedom are left where possible, making norms explicit can actually promote emancipatory discourse by improving legitimacy, accountability, and usefulness in communication systems for distributed discourse [70, 65, 45].

References

- [1] Aakhus, M. (1999), Science Court: A Case Study in Designing Discourse to Manage Policy Controversy, *Knowledge, Technology, & Policy*, **12**(2): 20-37.
- [2] Arnold, Y., Leimeister, J. M. and Krcmar, H. (2003), CoPEP: A Development Process Model for Community Platforms for Cancer Patients. In *Proc. of the 11th European Conference on Information Systems (ECIS), Napels, 2003*.
- [3] Bannon, L. (1997), CSCW: A Challenge to Certain GDSS Perspectives on the Role of Decisions, Information, and Technology in Organizations. In *Decision Support in Organizational Transformation* (Eds, Humphreys, P., McCosh, A. and Mayon-White, B.), Chapman & Hall, London.
- [4] Barber, B. R. (1995), *Jihad vs. McWorld: How Globalism and Tribalism are Reshaping the World*, Ballantine Books, New York.
- [5] Carotenuto, L., Etienne, W., Fontaine, M., Friedman, J., Muller, M., Newberg, H., Simpson, M., Slusher, J. and Stevenson, K. (1999), CommunitySpace: Toward Flexible Support for Voluntary Knowledge Communities. In *Changing Places Workshop, London, April 1999*.
- [6] Chambers, R. (1997), *Whose Reality Counts? Putting the First Last*, Intermediate Technology Publications, London.
- [7] Chambers, S. (1996), *Reasonable Democracy: Jürgen Habermas and the Politics of Discourse*, Cornell University Press, Ithaca.
- [8] Cohen, A. L., Cash, D. and Muller, M. (2000), Designing to Support Adversarial Collaboration. In *Proc. of CSCW'00, Dec. 2-6, 2000, Philadelphia*.
- [9] Conklin, J. and Begeman, M. L. (1989), gIBIS: A Hypertext Tool for Exploratory Policy Discussion, *ACM Transactions on Office Information Systems*, **6**(4): 303-331.
- [10] Darling, J. (1995), The Clayoquot Sound Biosphere Project, *Rain - Journal of the Clayoquot Sound Biosphere Project*, **June**.

- [11] de Moor, A. (2004), Strengthening Civil Society by Developing Stakeholder Communities Using Intermedia. In *Proc. of the Building & Bridging Community Networks: Knowledge, Innovation & Diversity through Communication Conference, Brighton, March 31-April 2*.
- [12] de Moor, A. and Aakhus, M. (2003), Argumentation Support: From Technologies to Tools. In *Proc. of the 8th International Working Conference on the Language-Action Perspective on Communication Modelling (LAP 2003), July 1-2, Tilburg*, (Eds, Weigand, H., Goldkuhl, G. and de Moor, A.), pp. 135-141.
- [13] de Moor, A. and Weigand, H. (1996), The Role of Social Constraints in the Design of Research Network Information Systems. In *Proceedings of Eco-Inforna '96, Global Networks for Environmental Information, Orlando, November 4-7, 1996*, pp. 672-677.
- [14] Debatin, B. (2002), From Public/Private to Public Privacy: A Critical Perspective on the Infosphere. In *Proc. of DIAC-02, May 16-19, 2002, Seattle*.
- [15] Digital Europe (2003), Making the NetWork: Steps towards a Sustainable Networked World. Forum for the Future, London.
- [16] Fisher, R. and Ury, W. (1981), *Getting to Yes: Negotiating Agreement without Giving In.*, Houghton Mifflin, Boston.
- [17] Forsyth, D. R. (1983), *Group Dynamics*, Brooks/Cole, Pacific Grove, CA.
- [18] Froomkin, M. (2003), Habermas@Discourse.Net: Toward a Critical Theory of Cyberspace, *Harvard Law Review*, **116**(3): 749-853.
- [19] Gordon, T. F., Karacapilidis, N. and Voss, H. (1996), Zeno: a Mediation System for Spatial Planning. In *Proc. of the ERCIM Workshop on CSCW and the Web, Sankt Augustin, Germany, February 7-9*.
- [20] Habermas, J. (1984), *The Theory of Communicative Action - Vol. 1*, Heineman, London.
- [21] Habermas, J. (1990), *Moral Consciousness and Communicative Action*, Polity Press, Cambridge.
- [22] Hammond, H. and Flavelle, A. (1995), Major Points from an Initial Analysis of the Reports of the Scientific Panel for Sustainable Forest Practices in Clayoquot Sound, *International Journal of Ecoforestry*, **11**(2-3).
- [23] Harris, S. (1995), Pragmatics and Power, *Journal of Pragmatics*, **23**: 117-135.
- [24] Harrison, T. M. and Stephen, T. (1992), On-Line Disciplines: Computer-Mediated Scholarship in the Humanities and Social Sciences, *Computers and the Humanities*, **26**: 181-193.
- [25] Harrison, T. M. and Stephen, T. (Eds.) (1996), *Computer Networking and Scholarly Communication in the Twenty-First-Century University*, State University of New York Press, New York.
- [26] Hartfield, B. and Graves, M. (1991), Issue-Centered Design for Collaborative Work. In *Collaborative Work, Social Communications and Information Systems* (Eds, Stamper, R. K., Kerola, P., Lee, R. and Lyytinen, K.), IFIP.
- [27] Heng, M. and de Moor, A. (2003), From Habermas's Communicative Theory to Practice on the Internet, *Information Systems Journal*, **13**(4): 331-352.
- [28] Hirschheim, R. and Klein, H. K. (2003), Crisis in the IS Field? A Critical Reflection on the State of the Discipline, *Journal of the Association for Information Systems*, **4**(5): 237-293.
- [29] Holt, A. W. (1988), Diplans: A New Language for the Study and Implementation of Coordination, *ACM Transactions on Office Information Systems*, **6**(2): 109-125.

- [30] Isenmann, S. (1993), How to Deal with Wicked Problems Using a New Type of Information System. In *System Science: Addressing Global Issues* (Eds, Stowell, F. and West, D.), Plenum, New York, pp. 367-372.
- [31] Jordan, B. (1989), *The Common Good: Citizenship, Morality and Self-Interest*, Basil Blackwell, Oxford.
- [32] Kim, W., Suh, Y. and Whinston, A. B. (1993), An IBIS and Object-Oriented Approach to Scientific Research Data Management, *Journal of Systems and Software*, **23**(2): 183-197.
- [33] Kleef, R. and de Moor, A. (in press), Communication Process Analysis in Virtual Communities on Sustainable Development. In *Environmental Online Communication* (Ed, Scharl, A.), Springer.
- [34] Kozinets, R. V. (1999), E-Tribalized Marketing?: The Strategic Implications of Virtual Communities of Consumption, *European Management Journal*, **17**(3): 252-264.
- [35] Kunz, W. and Rittel, H. (1970), Issues as Elements of Information Systems. Institute of Urban and Regional Development, University of California, Berkeley.
- [36] Lessig, L. (1999), *Code : and other Laws of Cyberspace*, Basic Books, New York, N.Y.
- [37] Lindsay, R. (1995), Galloping Gertie and the Precautionary Principle: How is Environmental Impact Assessed? In *Science for the Earth: Can Science Make the World a Better Place?* (Eds, Wakeford, T. and Walters, M.), Wiley, New York, pp. 197-236.
- [38] Lyytinen, K., Maaranen, P. and Knuuttila, J. (1993), Unusual Business or Business as Usual: an Investigation of Meeting Support Requirements in Multilateral Diplomacy, *Accounting, Management and Information Technology*, **3**(2): 97-120.
- [39] Malone, T. W. and Crowston, K. (1994), The Interdisciplinary Study of Coordination, *ACM Computing Surveys*, **26**(1): 87-119.
- [40] March, J. G. (1991), How Decisions Happen in Organizations, *Human-Computer Interaction*, **6**: 95-117.
- [41] Marres, N. and Rogers, R. (2000), Depluralising the Web, Repluralising Public Debate - The Case of the GM Food Debate on the Web. In *Preferred Placement: Knowledge Politics on the Web* (Ed, Rogers, R.), Jan van Eyck Akademie, De Balie, Maastricht, Amsterdam, pp. 113-136.
- [42] Millen, D. R., Fontaine, M. A. and Miller, M. J. (2002), Understanding the Benefit and Costs of Communities of Practice, *Communications of the ACM*, **45**(4): 69-73.
- [43] Morningstar, C. and Randall Farmer, F. (1990), The Lessons of Lucasfilm's Habitat. In *Cyberspace. First Steps*. (Ed, Benedikt, M.), MIT Press, Cambridge, MA.
- [44] Ngwenyama, O. and Lyytinen, K. (1997), Groupware Environments as Action Constitutive Resources: A Social Action Framework for Analyzing Groupware Technologies, *Computer Supported Cooperative Work*, **6**(1): 71-93.
- [45] Noveck, B. S. (2000), Paradoxical Partners: Electronic Communication and Electronic Democracy. In *The Internet, Democracy and Democratization* (Ed, Ferdinand, P.), Frank Cass Publishers, London.
- [46] Plender, J. (1997), *A Stake in the Future: The Stakeholding Solution*, Nicolas Brealey Publishing, London.

- [47] Preece, J. (2000), *Online Communities : Designing Usability, Supporting Sociability*, John Wiley, Chichester ; New York.
- [48] Preece, J. (2002), Supporting Community and Building Social Capital, *Communications of the ACM*, **45**(4): 37-39.
- [49] Price, V. (1992), *Public Opinion*, Sage, London.
- [50] Putnam, L. and Roloff, M. (1992), Communication Perspectives on Negotiation. In *Communication and Negotiation* (Eds, Putnam, L. and Roloff, M.), Sage, pp. 1-17.
- [51] Ridley, M. (1996), *The Origins of Virtue*, Viking Press, London.
- [52] Rieke, R. and Sillars, M. (1984), *Argumentation and the Decision Making Process*, HarperCollins.
- [53] Sachs, H. (1995), Computer Networks and the Formation of Public Opinion: an Ethnographic Study, *Media, Culture & Society*, **17**(1): 81-99.
- [54] Sassen, S. (1998), *Globalization and Its Discontents*, The New Press, New York.
- [55] Sawyer, S. (2001), A Market-Based Perspective on Information Systems Development, *Communications of the ACM*, **44**(11): 97-102.
- [56] Schubert, P. and Ginsburg, M. (2000), Virtual Communities of Transaction: The Role of Personalization in Electronic Commerce, *Electronic Markets*, **10**(1): 45-55.
- [57] Schubert, P. and Koch, M. (2003), Collaboration Platforms for Virtual Student Communities. In *Proc. of the 36th Hawaii International Conference on System Sciences (HICSS-36)*, Hawaii, January 2003, IEEE.
- [58] Smith, M. (2002), Tools for Navigating Large Social Cyberspaces, *Communications of the ACM*, **45**(4): 51-55.
- [59] SPfSFP (1994-5), The Scientific Panel for Sustainable Forest Practices in Clayoquot Sound, Report Series. Cortex Consultants, Inc., Victoria, BC.
- [60] Suchman, L. (1994), Do Categories Have Politics? The Language/Action Perspective Reconsidered, *Computer Supported Cooperative Work*, **2**: 177-190.
- [61] Sudweeks, F. and Rafaeli, S. (1996), How Do You Get a Hundred Strangers to Agree? Computer-Mediated Communication and Collaboration. In *Computer Networking and Scholarly Communication in the Twenty-First-Century University* (Eds, Harrison, T. M. and Stephen, T.), State University of New York Press, New York, pp. 115-136.
- [62] Sumner, T. and Shum, S. B. (1998), From Documents to Discourse: Shifting Conceptions of Scholarly Publishing. In *Proc. of CHI'98: Human Factors in Computing Systems, Los Angeles, 18-23 April 1998*, ACM Press.
- [63] Surman, M. and Wershler-Henry, D. (2001), *Commonspace: Beyond Virtual Community*, Pearson.
- [64] Tannen, D. (1998), *The Argument Culture: Changing the Way We Argue and Debate*, Virago, New York.
- [65] Vedder, A. (2003), Internet NGOs: Legitimacy and Accountability. In *Electronic Government* (Ed, Traunmuller, R.), Springer, Lecture Notes in Computer Science 2739, Berlin, pp. 49-54.
- [66] von Krogh, G., Nonaka, I. and Aben, M. (2001), Making the Most of Your Company's Knowledge: A Strategic Framework, *Long Range Planning*, **34**: 421-439.
- [67] Walton, R. and McKersie, R. (1965), *A Behavioral Theory of Labor Negotiations*, McGraw-Hill, New York.

- [68] Weigand, H., Schoop, M., de Moor, A. and Dignum, F. (2003), B2B Negotiation Support: The Need for a Communication Perspective, *Group Decision and Negotiation*, **12**(1): 3-29.
- [69] Wellman, B. (2001), Computer Networks as Social Networks, *Science*, **293**: 2031-2034.
- [70] Winograd, T. (1994), Categories, Disciplines, and Social Coordination, *Computer Supported Cooperative Work*, **2**: 191-197.