A Social Context Model for Discussion Process Analysis[1]

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Abstract

Computer-mediated discussion processes play an important role in achieving sustainable development. However, when part of authoring complex documents, these discussions have so far not been very effective. One reason is that in the design and application of the information tools supporting discussion, the social context is not sufficiently taken into acccount. We outline a social context model for discussion process analysis. The GRASS tool for group report authoring and the freeText tool for document review are authoring tools in which the social context of discussions is given explicit attention. Analyzing GRASS and freeText, we show how the model could be used to construct information tools that enable more effective discussions.

1 Introduction

Globalization leads to an increasing number of complex societal problems related to sustainable development. Their solution requires the involvement of ever more stakeholders, with often strongly opposing interests. Discussion processes play an important role in public debates, the development of alternatives, and political decision making. Many types of electronic discussion tools already exist, such as newsgroups, mailing lists and various web tools. However, so far, computer-mediated discussions have not been very effective in consistently fostering societal change. One important reason is that in the design and application of many tools, the social context in which the discussion processes are carried out is not sufficiently taken into account. This is especially important when the tools are used not only for discussing the pros and cons of issues, but also for the authoring of structured documents. We therefore define authoring tools as those discussion tools that are tailored to the effective authoring of structured documents.

In this paper, we aim to chart the social context of discussion processes, and investigate how it can be used in order to help in the development of discussions tools that are more effective for authoring. In Sect. 2, we start with an analysis of two tools used to support the authoring of group documents: GRASS and freeText. In Sect. 3, we analyze related work on discussion theory and tools. We present our social context model for discussion process analysis in Sect. 4. We then use this model in Sect. 5 to analyze and compare the functionality and application of GRASS and freeText. We

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conclude the paper by indicating some future research on how the model could be used to construct information tools that help foster more effective societal discussions.

2   Authoring as an Effective Discussion Process

Co-authoring documents is an essential activity to make society more sustainable, as many social, environmental, and developmental issues are examples of 'wicked problems'. These problems are very hard to formulate and solve and their resolution requires input from many stakeholders and disciplines (De Moor, 1998). Authoring is a good example of a goal-oriented communication process, in which multiple authors collaborate on a joint work. In complex discussions, editorial unity needs to be achieved, while at the same time a wide variety of author perspectives needs to be preserved (Harasim and Walls, 1993).

Many tools exist that support discussion processes. These tools are increasingly Web-based and thus accessible to many, having great potential for achieving sustainability purposes. One typical example is The Fence[4], which allows people to launch and participate in debates on myriads of topics, often counting hundreds, sometimes over a thousand contributions. However, although these tools are useful to have stimulating exchanges and help in the formation of individual opinions, they are not very effective when it comes to systematically producing well-defined outputs, such as structured documents. One important reason is that the social context of the discussion is not much taken into account.   However, if the social context is neglected in the design of discourse norms, procedures, and tools, it is likely that participants will not adopt the design or not apply it towards intended uses (Aakhus, 1999). In this paper, we present a model that can be used in the analysis of the role that discussion tools play in focused communication processes like authoring. By clarifying the social context of these tools-in-use, the authoring processes they support can be made more effective.

We next present two typical examples of discussion tools for authoring purposes, in which the social context of the discussion processes they enable plays an important role: the GRASS tool for group report authoring, and the freeText tool for document review.

2.1   Group Report Authoring: GRASS

In 1993, the Global Research Network on Sustainable Development (GRNSD) was formed. One of the groups it spawned was the B.C. Forests and Forestry Group (BCFOR)[5]. This computer-mediated group consisted of Canadian and international members, ranging from timber industry consultants to environmentalists. The group aimed to produce group reports in which forestry policies in the Canadian province of British Columbia could be critically analyzed, by systematically presenting and contrasting all points of view.

Such a group report is an example of a truly *dialogic text*, in which not one, but many authorial voices are heard. These texts are not written with a single monotonic *group*

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[4] http://www.thefence.com
[5] http://infolab.uvt.nl/grnsd/bcfor

voice, but instead reflect many different perspectives in the same document, while possessing enough structure to be comprehensible (Harrison and Stephen, 1992).

Not only the *structure* of the group report, but also the authoring *process* has complex requirements. Such a process should conform to what Habermas in his theory of discourse ethics calls the ideal speech situation, in which practical rules of discourse guarantee discursive equality, freedom, and fair play (Chambers, 1996). However, operationalizing these ideals into conversation support that actually works is not trivial.

Producing structured reports while still using only simple mailing list functionality turned out to be unsuccessful. Although a topic for the report was successfully chosen using an extensive voting process with significant group participation, the subsequent authoring process was never concluded.

To overcome the complex technical and organizational hurdles, the ongoing GRASS (**G**roup **R**eport **A**uthoring **S**upport **S**ystem) project was initiated[6]. GRASS is to provide a balanced mix of information tool functionality and organizational procedures. The overall objective is to help produce concise group reports that answer specific questions. Much attention is paid to the group report structure, which consists of three main parts: a research problem, several sections, and a conclusion. Within the sections, positions can be taken on issues and addressed in argument threads. Different authoring roles are distinguished, such as report and section editors, authors, and readers. Not only the writing of the report itself, but also the dissemination of the results to societal stakeholders, such as the general public and various organizations, is supported. Furthermore, social constraints should be satisfied like the neutrality of the document and the transparency of the authoring process (De Moor and Weigand, 1996).

2.2   Document Review: freeText

As a second example, we look at freeText[7], an online tool for the review process of a draft report. It was developed for the Programme for International Co-operation and Conflict Resolution (PICCR) of the FAFO Institute for Applied Social Science in Norway. In 2001, FAFO and the Norwegian Institute of International Affairs (NUPI) organized a forum on gender and decision making in post-conflict transitions, having over 30 participants from international organisations, governments, NGOs, universities, and research institutes.

The forum did not intend to build consensus, but rather to explore the complexity of the issue. The report produced therefore had to represent the various views of the participants as expressed during the forum. Initially, a draft report was sent out by e-mail and on paper, soliciting individual comments. The editors faced the task of collecting all feedback and then tracing it back to the relevant parts of the document.

Using the freeText tool, however, participants could directly comment on report elements, thus substantially alleviating the editorial process. Furthermore, using the tool, participants were able to view and reply to each other's comments, thus engaging in

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[6] http://infolab.uvt.nl/grass. An in-depth evaluation of the communicative issues of this case can be found in (Heng and De Moor, in press).

[7] http://www.drostan.org/projects/fafo

dialogue. This all allowed the editors to have better access to the participants as a group, ensuring the report captures the views expressed most accurately.

Having presented two authoring tools in their context of use, we now continue with an overview of theory and tools relevant to our development of a social context model.

3   Discussion Theory and Tools

The term *discussion* has different meanings. One interpretation is that it is the consideration of a question in open and usually informal debate, another one that it is a formal treatment of a topic in speech or writing (Merriam-Webster). Central is that there is some issue or topic being addressed in a process of argumentation between different participants. The formality of this conversation may differ, however. This is important, as it affects the degree of structure that can or should be provided by supporting tools. Also, the argumentation process needs to be well-understood, not only at the basic level of discussing for or against a point, but also regarding its pragmatics, meaning what social effects it has. 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 (Tannen, 1998).

A classic model of argumentation is that of Toulmin (1958). His model is based on three principal elements: claims, evidence for those claims, and warrants linking these elements. Although useful to conceptualize the way people argue, it – and many other more sophisticated discussion and argumentation theories - do not answer the question how to design tools that provide argumentation *support*. In the rest of this section, we examine the functionality of some well-known discussion tools.

3.1   Discussion Tool Functionality

One step on the way to the design of effective discussion support tools is the idea of issue-based information systems (IBIS). Issues act as organizing principles for collaborative work, transcending individual conversations (Hartfield and Graves, 1991). An IBIS allows its users to identify questions and develop the scope of positions in response to them, and assists in creating discussions (Kunz and Rittel 1970). Using an IBIS, stakeholders can conduct conversations about complex or 'wicked' problems, by structuring the creation and handling of 'issue nets' (Conklin-Begeman 1988). 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 (Conklin and Begemann, 1988). 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) (Isenmann, 1993). One domain-specific IBIS, especially designed for research purposes

is the Scientific Collaboration System (Kim et al., 1993). 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 still 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 (Gordon et al., 1996) 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, D3E[8] 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 (Sumner and Shum, 1998). In this way, new forms of online-publication processes are possible, which much more interactively involve authors and readers in the review process, for instance.

Summarizing, ever more advanced functionalities are becoming available in the newer generations of discussion tools. However, the need for and application of these functionalities are still unclear. In order to use these functionalities more effectively, a systematic analysis of their social context of use is needed. We next provide our social context model that can be used to this purpose.

4 A Social Context Model for Discussion Process Analysis

The case descriptions of the GRASS and freeText tools demonstrate the complexity of the role of discussion processes in complex applications such as authoring.

Our goal is to increase the effectiveness of discussion processes, so that authoring can result in documents that contribute to the goals of the community of authors, like societal conflict resolution. It is important to realize that these documents are no longer merely a paper-based transport mechanism for pre-formed ideas, but rather a medium for negotiation within communities, with multiple and complex links between document and discourse (Brown and Duguid, 1996). Such collective document negotiation or

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[8] http://d3e.open.ac.uk

interpretation can reduce complexity by helping participants to tackle an ill-structured problem systematically. It does so by focusing attention on a subset of issues and by providing a vocabulary in which to conduct the joint interpretive discourse (Shum and Selvin, 2000). Furthermore, experience shows that such document-driven discourse structuring can only work if practices are appropriately co-evolved with technologies and representations, requiring clearly defined socio-technical strategies for their deployment (Shum and Selvin, 2000). Thus, authoring entails much more than just starting and supporting some discussion threads, such as envisaged in the basic IBIS paradigm.

Building on the theory and tool analysis of the previous section, and generalizing from the cases, we now outline our social context model for discussion process analysis. The model has two dimensions: a communication process *context* and a communication process *structure*. The context dimension focuses attention on the context of the discussion process, and is expressed in terms of the type and level of the communication process in which the discussion is embedded. The communication process structure dimension describes the configuration of the particular elements needed to make up the communication process.

4.1   The Communication Process Context

Not all communication processes simply concern the stating and replying of messages. They ultimately serve higher process goals. For example, one such a basic discussion process may be used to explore territory, another one to search for alternatives, and a third one to discuss difficult issues (Antunes and Ho, 1999). Journalists may cross-examine the authors of the group report, etc. We therefore distinguish different levels of communication processes, from basic discussion to complex societal communication processes.

Our model consists of four layers of communication processes, each higher level process providing a context that embeds the lower-level processes. From high to low-level processes these are: collaboration, authoring, support, and interaction processes:

- **Collaboration processes** *give purpose* to the authoring activities, discussions, and documents.
- **Authoring processes** *produce* the structured document.
- **Support processes** focus on the *organization* of the discussions between the participants, ensuring that they contribute to the document creation and interpretation.
- **Discussion processes** are the actual interactions in which the argumentation between participants take place.

By embedding the basic discussion process in three top layers, a systematic context analysis can be performed.

Next, we briefly explain each layer in greater detail.

4.1.1 Collaboration processes

Discussion documents such as group reports are not written for their own sake, but play a role in goal-oriented collaborative activities, such as public discourse processes conducted in the mass media, joint research, political decision or policy making, or mediation between stakeholders in an environmental conflict. Thus, these processes ground and link the goals and activities that are to be served by the discussion.

The collaborative layer provides the ultimate context and rationale for the discussion processes, stimulates adherence to community norms, and increases commitment to the collaboration objectives. It is here that the overall "rules of engagement" in collaboration and argumentation are defined, derived, for instance, from a courtroom setting, parliamentary rules of order, etc. (Aakhus, 1999; Cannon, 1992). At the collaborative level, the online environment has to provide ways to cater to these broader goals. For example, given that the rules of order can be sufficiently and flexibly defined, partial automated mediation support may sometimes be provided (Prakken and Gordon, 1999).

It is crucial that at this level - and in the lower layers - core community values such as the need for neutrality and transparency are designed into the processes and supporting tools (De Moor and Weigand, 1996). There may be a need, for instance, for transparency of the goals to all stakeholders, and transparency of the way in which all contributions are presented or produced. The environment may have to provide tools to "break the ice" between participants, to allow the facilitator to have a good overview of what is happening in the group, and to occasionally invite external participants from outside of the group. Finally, the collaboration process may have to be divided in several more or less detailed stages, and deliverables may be necessary that help check progress against the goals (Antunes and Ho, 1999).

4.1.2 Authoring processes

Documents should help accomplish the objectives of the collaboration processes. The authoring processes include writing, reviewing, and editing. The final output of these processes is a structured document, although contributing authoring processes may focus on specific document parts like abstracts or issue positions. The form of this document can range from the traditional linear report formats to increasingly sophisticated network designs like the one Ted Nelson, who coined the term hypertext, has been developing in his Xanadu project[9]. Notification processes are important to indicate document evolution to the authoring participants.

Documents are not to be seen as isolated artifacts, but may contain live links to embedded discussions, consisting of support processes regulating interaction processes. There can be specific places for discussion of annotations and comments. These conversations may even continue after the final version (if there is one) of the document has been produced. Thus, the definition of the links between text and conversations needs careful attention, much more than has traditionally been the case (Taylor, 1993).

Furthermore, different authoring roles have to be specified (author, editor, reviewer, for example), as well as clear authorizations for these roles and procedures for role assignment.

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[9] http://www.xanadu.com/

4.1.3 Support processes

The interactions making up the actual discussion processes need to be organized in order to achieve sufficient participation, as well as to keep all members in the discussion focused and informed about the progress in the discussion. Support processes thus set the direct context for the interaction processes making up the discussion, initialize the discussion, focus it, and ensure that the results are made available to the authoring processes. These functions are thus to be used in the context of writing (part of) a document.

The support layer includes for instance discussant registration, moderation, and facilitation processes (see e.g. (Preece, 2000; Surman and Wershler-Henry, 2001) for many examples of support processes). Support functions can also include notification services for new messages, or digest versions. Also, a discussion moderator may have the option to summarize discussions, or even cut off discussions or conversations. In the support layer, there can also be rules to appoint discussion moderators. Furthermore, scheduling and file sharing may enhance the interaction between participants.

Note that the concept of facilitation is often used in different meanings. Sometimes, it means stakeholder facilitation so that they can find common ground and become productive. We consider this form of facilitation a collaboration process. Often, however, there is a much more restricted, technical interpretation of facilitation, such as the technical facilitator role in the well-known GroupSystems tool[10]. This facilitation role properly belongs in the support process layer.

4.1.4 Discussion processes

Basic interaction processes have not changed much over the history of the Internet. Email, online message boards, and chat rooms still support the majority of interactions. There is mostly only limited variety in the appearance of messages, and the organization is usually merely linear (based on the time sent) or hierarchical (based on threads of replies to specific messages).

Many discussion tools only allow for the support of discussion threads consisting of posts and nested replies, like web-based newsgroups. More sophisticated tools also allow for issues to be defined and arguments to be constructed. These are all examples of *discussion processes.* However, although they are at the heart of the communication process model, we have argued that these processes should not exist in a vacuum. Thus, environments like D3E are promising, as they can be used to construct tools that classify and couple discussion processes to clearly defined document structures and other social context elements.

4.2 The Communication Process Structure

Each communication process, whether it is a discussion process or one of its embedding context processes, has a structure comprised of certain process entities. First, there are the *process elements* (the elements the process itself is made of). Second, there

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[10] http://www.ventana.com

are the processes constructed out of these elements. These we subdivide into *actions* (which constitute the actual communication process) and *change processes* (meta-processes in which the communication process can be adapted).

4.2.1   Process Elements

There are, at least, three types of process elements that play a role in the communication process actions and change processes: goals, roles and objects.

Communication process *goals* define what the outputs of these processes should be focused on. The higher-level processes more closely reflect the societal purpose of the discourse. For example, a collaboration goal may be to reach a certain degree of resolution of an environment conflict. A (low-level) discussion process goal, on the other hand, might be to reach a conclusion in a diverging discussion thread.

A second type of structural element is the different kinds of discussion *roles* that participants play. At the basic discussion level, participants simply are issue definers, argument defenders or attackers, and so on. However, at higher levels, people can be facilitators or mediators. Even more specific, domain-dependent roles also exist, from the editors, authors, and reviewers in electronic journals, to the case managers, experts, referees and judges of the law-inspired "Science Court" (Aakhus, 1999).

Third, we distinguish the *objects* that are the inputs and outputs of the discussion processes. At the basic discussion process level, objects include arguments pro and con. At the higher context levels, however, these elements could consist of process logs, various document elements (sections, meta-information), the outlets in which these documents are published, etc.

4.2.2   Actions

Actions describe the dynamics of the communication processes. They define the workflows of the community and are composed of configurations of process elements. In actions,   more complex objects are generated as outputs from simpler objects by the participants playing process roles. For example, in a discussion process, the action of replying can consist of a discussant producing a reply to a post. In an edit action, a section editor could create a final report section out of a draft section.

4.2.3   Change processes

Change processes describe how the evolution of the socio-technical system takes place. Given that the complex context of most discussion processes continuously evolves, a static communication process structure will not suffice. To ensure that communication processes and their supporting functionality co-evolve adequately, the processes in which they are changed need to be explicitly defined. For instance, in the GRASS case, the mailing list members decided that they wanted to go beyond merely discussing the pros and cons of forestry policies and start authoring group reports

together. This triggered a cascade of change processes to their socio-technical system, including their communication processes.

Action and change norms

An important process element for both the actions and change processes are the *norms* that apply. These norms describe the acceptable behavior in the community by defining the authorizations of the participants in the process roles that they play. Norms prescribe what actions and change processes participants may, must, or may not be involved in. All communities have such norms, some explicitly laid down in charters and by-laws, others only implicitly defined, but no less strong in impact (Preece, 2000; Surman and Wershler-Henry, 2001). Having clear and relevant communicative norms is essential for argumentation to become effective (Aakhus, 1999).

Examples of action norms are that an editor must discuss the submission with an author. An author, on the other hand, is not permitted to review her own paper. An example of a change norm would be that only the editor is allowed to redefine the discussion process in which articles are reviewed.

As the structural dimension merely orders the elements of the communication processes introduced in the context dimension, we do not give a more detailed treatment here. Instead, in Table 1, we give examples of context and structural elements in the different cells of the social context model. This is not an exhaustive list, but should be considered a good illustration of how the model can be used to organize the complexity of discussion processes in their context.

	Process Elements *Actor roles, objects*	**Actions** *Actions (production, intervention processes)*	**Change Processes** *Definition of socio-technical system (structure and actions)*
Collaboration processes *(Why is* the discussion taking place?)	- Collaborative roles (facilitator, judge, expert, keynote speaker) - Stakeholder profiles - Policy reports - Conflict resolution priorities	- Facilitation - Mediation - Conflict resolution - Debating - Political inquiry	- Define goals of collaboration - Define rules of engagement - Set social norms for roles
Authoring processes: *(What* is produced in the discussion?)	- Authoring roles (editor, author, reviewer) - Document structure elements (section, position, case, argument)	- Editing - Authoring - Reviewing - Publishing - Notification	- Change authoring roles - Change authoring norms - Change authorizations - Adapt document structure
Support processes *(How* is the discussion *organized?)*	- Support roles (moderator, technical facilitator) - Discussant profiles - Message digests - Discussion summaries - Archives	- Inviting - Reminding - Registration - Agenda-setting - Moderation	- Set communication policy - Agree upon discussion planning - Change notification parameters
Discussion processes *(How* is the discussion *conducted?)*	- Interaction roles (discussant, attacker, defender) - Discussion elements (posts, replies, item labels) - Discussion objectives	- Raising issues - Replying - Creating a position - Playing devil's advocate - Position taking	- Assign attackers, defenders of position - Define discussion rules

Table 1: The Social Context Model for Discussion Process Analysis

5   Applying the Social Context Model to Authoring Tool Analysis

In this section, we illustrate potential uses of the model. The model can be used to model *desired* and *actual* characteristics of discussion tools-in-context. We have used the social context model to compare the GRASS and freeText tool. The assumption is that for effective societal discourse, all cells of the model need to be addressed to some extent. What this extent is, depends on the characteristics of the particular authoring community, and requires future research. Space does not permit a full analysis of all elements and processes here. To illustrate, we only briefly examine some key differences in support for the communication *roles* provided by the two tools as experienced by their users.

5.1   Applying the Model to GRASS

Roles are collections of processes that can be conducted by a person in a particular capacity. Each communication process level has its own roles. GRASS focuses on defining communication roles on the authoring process level: roles such as report and section editors, authors, and readers. In the action view, much stress is on the social norms that define the privileges and prohibitions attached to these authoring roles. In the change process view, strict procedures have been defined on how actors can change the roles they play. For example, editorial roles can be played by any author interested in doing so by simply registering within a particular timeframe at the start of the report. Despite its strong focus on authoring roles, the roles at the other levels are less developed. Not much attention has yet been paid to collaborative roles (one possible link would be between *journalist* roles (collaborative level) that can be *readers* of the reports (authoring level). No support-level roles exist yet, while discussion interaction level roles only consist of issue, position and argument creators and repliers, without much attention for how to adopt or change these roles (Table 2).

	Elements	Action	Change
Collaboration			
Authoring			
Support			
Discussion			

Table 2: A Social Context Analysis of the GRASS Role Support

5.2   Applying the Model to freeText

FreeText focuses on roles for the collaboration, support, and interaction layers. Its original purpose was to streamline a review process for an existing document, with limited need for an elaborate document structure definition. The focus was therefore mainly on providing an easy way for group members to participate in the review process. Therefore, there is an important role for the facilitator.

A *facilitator* is a collaboration level role that keeps the social process of a document review going. No specific facilitation process functionality is provided yet (action view). On the other hand, FreeText is quite adaptable, resulting in quite an important role for change (configuration) in the tool, especially at the collaboration level. One freeText (change) norm says that one person may take different roles, for instance.

A *moderator* is a support process role, guiding discussion contributions. There is basic, but adequate support for commenting and discussing at the discussion interaction level, although more refined discussion functionality could be included in the future. An (action) norm says that a moderator may remove discussion flames. Also, it is easy for different people to take on these moderator roles.

Like in GRASS, some basic discussion support is available.

Again using our Social Context Model, we can mark the relatively strong points of the first version (Table 3):

	Elements	Action	Change
Collaboration			
Authoring			
Support			
Discussion			

Table 3: A Social Context Analysis of the freeText Role Support

In a second version of freeText, we blended in several features from GRASS, making it technically easier to vary the definition of document structures, and to have more freedom in specifying roles and authorization, thus strengthening its authoring layer. Discussions within the document are still limited. In our experience, the application of the context model and its comparison with GRASS has helped in identifying these issues.

This analysis is still only rudimentary. In future research, we intend to create more detailed reference models that can be used to define desired properties of tools in use, and to provide a checklist for the actual context in which they operate. Patterns could then be defined for very specific context features, and tools quickly compared on the basis of the degree to which they conform to these patterns, thus making effective tool selection and information system evolution much easier.

6   Conclusions

Much valuable work has been done on discussion process support, such as the issue nets creation and use in issue-based information systems (Conklin and Begemann, 1988). Other applications like the Digital Document Discourse Environment (D3E) provide support that is more directly tailored to the authoring of structured documents. However, we contend that if discussions are to lead to effective collaboration, a systematic analysis of the context of the discussion processes supported by such tools and environments is essential. In this paper, we have presented a social context model with which we analyzed two authoring tools, GRASS and freeText.

In future research, we intend to use our model to analyze more discussion tools in their context of use. We predict that many patterns in the various communication levels are similar, but that combining them in different ways can lead to substantially different pragmatic effects. The results of these analyses could be used to (1) devise typologies of environmental discussion processes and tools; (2) create tool environments in which a *set* of tools is used for particular purposes (for example, an environment consisting of a mailing list for free-style discussions, and an authoring tool such as GRASS for structuring discussion results); and (3) generate specifications for the development of new authoring tools. By analyzing contextualized discussion tool functionality in this way, more adequate support for complex sustainability authoring processes can be provided, catalyzing much needed global change.

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