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Interactional perspective on environmental communication in construction projects

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RESEARCH PAPER

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Drawing on theories of social interaction, a critical discourse analysis approach is used to examine the resources and constraints on environmental-communication practices in four construction projects in Sweden. The assumption is that talk and action work together to construct, maintain and change organizational structure, social practices, and contractual arrangements. The empirical data were collected through in-depth interviews and field observations where photo documentation was extensively used. The study showed mismatches between information and action, both within the project and between the project and its stakeholders. The mismatches were not caused by a lack of information, but rather by inconsistencies between the communication cultures, the status of the communicator, and the tools used to mediate the information, e.g. the media, discourses and genres used. These discrepancies resulted in a lack of engagement in environmental work in the projects. If environmental and other performances in construction projects are to be improved, more effort needs to be exerted on understanding the dynamics of the social context, human interaction, and the mediating tools used to communicate. This paper suggests an approach that can enhance such an understanding.

Keywords: communication, construction projects, engagement, environmental information, mediators, social context, workplace effectiveness

S'appuyant sur les théories de l'interaction sociale, les auteurs procède à une analyse du discours critique pour examiner les ressources et les contraintes liées aux pratiques en matière d'environnement et de communication dans le cadre de quatre projets de construction en Suède. On suppose que la parole et l'action fonctionnent ensemble pour construire, entretenir et modifier la structure organisationnelle, les pratiques sociales et les dispositions contractuelles. Les données empiriques ont été recueillies au cours d'interviews approfondies et d'observations sur le terrain où la documentation photographique a été largement utilisée. L'étude a montrer des décalages entre l'information et l'action, à la fois dans le cadre de projets et entre projets et parties intéressées. Ces décalages ne sont pas dus à un manque d'information mais plutôt à des incohérences entre cultures de la communication, état du communicateur et les outils utilisés pour médiatiser les informations comme, par exemple, les média, les discours et les genres. Ces différences se sont traduites par un manque d'engagement dans les travaux environnementaux des projets. Si les performances environnementales et d'autres dans le cadre de projets de construction doivent être améliorées, il faut faire davantage d'efforts pour mieux comprendre la dynamique du contexte social, les interactions humaines et les outils de médiatisation utilisés pour communiquer. Cet article suggère une approche qui pourrait améliorer une telle compréhension.

Mots clés: communication, projets de construction, engagement, information sur l'environnement, médiateur, contexte social, efficacité du lieu de travail

Introduction

No one in the construction industry today would deny that effective communication is crucial for the successful performance of teams and projects (Emmitt and Gorse, 2003; Dainty *et al.*, 2006). The problem, however, is how communication is defined and handled in endeavours to improve performance. Most often, communication is seen as one, rather stable, element of organizational structure, processes and products (Church, 1996). For example, this mindset is conceptualized in many generic models of processes, where *communication* is represented as a randomly placed black box among a plethora of other activity black boxes. This representation seems to ignore that communication is a dynamic and complex mediated discursive practice that both constructs and is constructed by human actors, using semiotic and technical tools (Fairclough, 1992, 2003; Scollon, 1998).

To improve communication, therefore, would first and foremost require an understanding of the social practices in which the communication functions; and what media are used and how these support or hinder the purposes of the actors (Scollon, 1998). Moreover, the media used are imbued with historical, cultural, and situational uses from contexts in which these have previously been used, or for which they were designed (Wertsch, 1991; Wertsch *et al.*, 1995).

A lack of consideration of the social interrelationship between talk and action may well explain the failures of information and communication technology as the panacea for all communication illnesses (Dainty *et al.*, 2006). Indeed, it may also explain the simplified view on communication expressed by an environmental manager in one of the projects examined in this paper:

> We have me. I sort and disseminate [environmental] information on paper. Everyone throws it away [...] acquiring information is up to each individual. There is an infinite amount of information. I suggest what is realistic.
> (Environmental Manager)

This statement seems to take for granted that communicating is informing; that what is 'realistic' information is determined by one or a few people; that information in hard copy is 'thrown away'; and that it is the project members' responsibility to acquire the needed information. Furthermore, the statement carries an interesting tension: on the one hand, the manager takes on the role of agent; he sorts and disseminates what he deems to be 'realistic'. On the other hand, he disassociates himself from responsibility concerning the actions resulting from his 'communication'.

The fragmented nature and wide variety of stakeholders involved in construction projects put high demands on the mediators of the information and on the mediating tools used (Emmitt and Gorse, 2003). In the above example, neither of these factors seems to have been considered. Dainty *et al.* (2006, p. 5) argue that communication in construction is multifaceted and inherently complex, encompassing several dimensions on individual, group and organizational levels: not only does it involve the transfer of information, but also it bridges distances, is the basis of interaction between people, and conveys feelings, values and beliefs. Most importantly, Dainty *et al.* emphasize that effective communication takes place on the interpersonal level, when individuals, through discursive practices, work toward a common understanding of phenomena, actions and processes. However, most attempts to improve performance in the construction industry still seem to focus on improving processes and products rather than examining the constraints of organizational culture and social relationships on the outcome of communication (Emmitt and Gorse, 2003). For example, although poor communication has been recognized as a major obstacle for environmental improvements within the industry (Cole, 2005; Dammann and Elle, 2006), focus here has mainly been on developing assessment methods and tools capable of translating environmental meaning into quantifiable terms that are a priori assumed to be interpretable for practitioners.

This focus neglects communication trajectories involving the ways in which information is translated by given actors, who have their specific intentions, and then interpreted by project members (Gluch, 2005; Stenberg and Räisänen, 2006). The narrative of an environmental manager from another project described in this paper serves to illustrate this problem:

> I made them [site managers and foremen] all see Al Gore's film 'An Inconvenient Truth' and visit an eco-learning center. You would think that this would have interested and motivated them, and that they would have called me concerning any environmental matters that cropped up. I have not received a single call! They all went back to their work places and continued as usual, as if nothing had happened.

What happened in this failed communication? What were the obstacles between the intentions of the sender, his translation, and the ways in which the receivers apprehended the messages?

As Gorse and Emmitt (2003) have discussed, one reason for the mismatch between the intention of the manager and the non-enactment of the employees may be the inability of both parties to link the socio-emotional interaction elicited by the film to the

focused task-orientation in the workplace – the place and time were wrong. Moreover, as has been previously pointed out, environmental concerns are often subject to tensions between the long-term strategies of management as illustrated in the quote and the short-term, time-pressed tasks of the projects (Labuschagne and Brent, 2005). To enhance sustainability, there is a need for further research on the communication practices in construction projects and between projects and its stakeholders.

Using a social interaction lens to analyse the empirical data, this paper examines three issues:

- *situated practices*, wherein environmental information is disseminated

- the *roles and positioning of the human mediators* of environmental information

- how *technical and semiotic tools* are used to mediate the information

To enhance understanding, the theoretical concept *site of engagement* (Scollon, 1998, 2001) is introduced within construction management research and used as an explanatory metaphor.

Communication from a socio-cultural perspective

This study draws on socio-cultural, interactionist theories, such as mediated action theory (e.g. Wertsch, 1998), situated action (e.g. Lave and Wenger, 1991; Wenger, 1999), and mediated discourse (Scollon, 1998, 2001). The assumption is that talk and action are inherently interwoven and both construct and maintain organizational structure, social practices and contractual arrangements. It is in these interactions that information may be appropriated, i.e. engage and become part of a person's internalized stock of knowledge, and subsequently enacted upon. To facilitate appropriation of information and knowledge requires competent mediators and effective mediation tools. From an interactionist perspective, the situations, identities and mediating tools are culturally constructed and are the resources used to participate in a social community or practice (Lave and Wenger, 1991; Wertsch, 1998).

The implication of this perspective for a study of communication practices is that the unit of analysis cannot be reduced to only actors, social contexts or mediating tools. Rather, communication needs to be viewed as social practice, involving the interaction of interlocutors, contexts, semiotic systems, artefacts and technologies. In this interaction there often exist inherent tensions between these elements in particular contexts

of use (Wertsch, 1998; Orlikowski, 2000). For example, McDermott and O'Dell (2001) point out that the mediating tools for knowledge and information sharing need to be aligned with the business problems and the overall style of the organization. Fong and Chu (2006) conclude that sophisticated technology is not always a precondition for the appropriation of new knowledge. Thus, it is not only the mediating semiotic or technical tools that generate outcomes, but rather how these tools and other resources such as place and time are used to convey or appropriate a message (Scollon, 1998, 2001). Moreover, it is in these interactions that identities are constructed (Scollon, 1998, pp. 264–265).

Interaction takes place through socially recognized types of communicative action, genres, e.g. meetings, environmental inspections, error reports, which are habitually enacted by members of an organization to realize particular social purposes (e.g. Orlikowski and Yates, 1994; Räisänen, 1999). Genres not only serve as mediating tools to regulate and legitimate interaction, but also they become institutionalized templates by which employees' social actions may be normalized and controlled (Räisänen and Linde, 2004). Consequently, as well as problematically, management-imposed genres are often modified to suit different local contexts of use, which may give rise to conflicting communicative purposes and misunderstandings. Genres are manifested in concrete mediating tools such as texts, e.g. the message of a particular environmental memo, for example, or in other multimodal forms, meetings or technical graphs (Räisänen and Linde, 2004). Texts are events that manifest the causal effects of both the social action and the discursive practice and agency (Fairclough, 2001).

In order for a message (text) to be appropriated by a receiver, engagement has to take place, manifested through some form of enactment. Scollon (1998, 2001) refers to the real-time, unique social space in which engagement occurs as a site of engagement and defines it as a moment when a text leading to action is in actual use, not just passively present in the situation. A site of engagement as defined by Scollon (1998, p. 10) as:

> the window opened through the intersection of social practices in which participants may appropriate a message for mediated action.

This framework, for example, contributes to a deeper understanding of why the environmental manager's attempts failed to elicit environmental engagement from project members (see the second quote above): neither Al Gore's film nor the eco-learning centre were powerful enough sites to intersect with the project members' day-to-day practices. They were therefore not capable of appropriating the messages to enact

them in the workplace. In the following, the site of engagement concept is applied to the analysis of empirical findings from different construction projects.

Research methodology

This paper is based on a multiple case-study design (Yin, 2003) of the production phase in four civil engineering projects with six different contracts: two large inner-city tunnel projects, a road project and a railway project. Empirical data were collected between 2003 and 2007. Multiple sources of data – field observations, photo documentation, in-depth interviews and surveys of organizational documents – enabled a triangulation process which strengthened the reliability of the findings. A critical discourse-analytic approach (Fairclough, 2003) was applied to the interpretation of the data. In order to mitigate researcher bias, a reflexive stance (Alvesson and Sköldberg, 2000) was maintained throughout the research and writing process, consisting of an ongoing query of the researchers' positioning and assumptions.

The data were collected through open conversations with the projects' environmental managers to obtain an understanding of the context-specific circumstances pertaining to corporate and project-specific environmental policies, demands and management systems. Several field visits were made to each site, which enabled observation of situated social interaction. The field visits were photo-documented and generated extensive fieldnotes. Furthermore, over 500 organizational documents from the projects, the company intranets and management-control systems were reviewed.

In addition, in-depth interviews (of one to three hours) with 28 actors involved in the production and dissemination of environmental information were carried out. These semi-structured interviews were recorded and transcribed in full. The analysis of the interview transcripts focused on the ways in which the different actors construed their social world in their narratives. Keywords, phrases and concepts were extracted, compared and contrasted, and then triangulated with the findings from similar analyses of the documents, the visual material and the fieldnotes. Representative extracts were then selected to construct the narratives represented in the quotes in Tables 2–5.

The case settings – context and project practice

The basis for this study was four large ongoing civil-engineering construction projects – Cases A–D (Table 1) – consisting of six different contracts, two different clients and three contractors. The contracts varied in form and size, ranging from €7 million to €120 million, with contractor project organizations of 30–270 employees. All the construction projects were initiated and driven by national public authorities in Sweden.

Environmental pursuits in the construction projects

The projects were highly complex and politically vulnerable, involving many project-specific environmental problems. Before construction, Cases A and B had been assessed by the (Swedish) Environmental Court regarding environmental impact and water pollution, respectively. These projects were also described by the client as being environmentally cutting-edge projects, which was reflected in stricter contractual environmental demands and through the prominent exposure of the projects' missions: in Case A, 'The tunnel construction with the greatest possible environmental consideration' and Case B 'Everybody is responsible for the environment and we contribute to a long-term sustainable development'. Cases A and B also had project-specific Environmental Control Programmes, which further contributed to a strong emphasis on environmental considerations in these two projects compared with Cases C and D. Otherwise, the projects faced rather similar environmental challenges such as water pollution, groundwater issues, noise and contaminated soil.

The clients' governance of all the projects was tighter than usual, the projects being regulated not only by the Swedish Environmental Code, but also by client-specific environmental demands in contractual agreements and documents. The active project members had to attend a short mandatory introductory course on environmental and safety training before entering the sites. The purpose of this brief course was to highlight the items in the environmental control plan, e.g. issues that risked high penalty fines. Other environmental topics, e.g. waste management and contaminated soil, were relegated to a 'ragbag of environmental concerns' and not dealt with in the introductory course.

The priority of the construction projects, as stated by several interviewees, was to achieve the highest quality with the lowest input of financial resources within the given timeframe. This 'rule' seemed to strengthen the notion that there was no space for preventive or proactive environmental actions. Some of the interviewees considered such actions as being non-essential to achieving results within the stipulated financial and quality goals.

Another consequence of this tacit rule was that there was no time for networking beyond the boundaries of the project, which was perceived negatively by some interviewees who felt isolated and confined within the project. As a construction manager expressed it, 'The project is the project and, well, here we are; the project is very isolated.'

Table 1 Case descriptions for Cases A–D

	Case A	Case B	Case C		Case D	
	Contract A	**Contract B**	**Contract C1**	**Contract C2**	**Contract D1**	**Contract D2**
Type of project	400 m inner-city motorway tunnel	6 km inner-city railway tunnel	8 km road and a 1.1 km road tunnel	Traffic interchange	Double-lined railway interchange	600 m railway viaduct
Contract (€)	80 million	120 million	70 million	12 million	7 million	8 million
Contract period	2001–06	2005–11	2004–08	2005–08	2005–07	2005–07
Client	SRA[1]	NRA[2]	SRA	SRA	NRA	NRA
Contractor	IntCon	NordicCon	NordicCon	IntCon	IntCon	EuroCon
Contract form	Design–build	Traditional	Design–build–operate	Design–build	Design–build	Design–build
Employees within the contractor	40 managers and foremen; 80 construction workers; varying amount of subcontractors	70 managers and foremen; 200 construction workers; varying amount of subcontractors	30 managers and foremen; 90 construction workers; 35 subcontractors	Nine managers and foremen; 25 construction workers; ten subcontractors	Ten managers and foremen; 16 construction workers; seven subcontractors	Five managers and foremen; 25 construction workers; ten subcontractors
Environmental management and contractual control documents	• Demands on environmental education • ISO14001 • PECP	• Demands on environmental education • Clients environmental policy • Certified in accordance with ISO14001 • PECP	• Demands on environmental education • EMS • GECP		• Demands on environmental education • EMS • GECP	
Environmental project personnel	Contractor: Q&E coordinator in project organization Client: E-coordinator for the total infrastructure project	Contractor: QEH&S coordinator in project organization Client: E-coordinator in project organization	Contractor: E-coordinator in project organization	Contractor: QEH&S coordinator in project organization Client: E-coordinator in central organization	Contractor: QEH&S coordinator in project organization	Contractor: E-manager assigned to the project Client: E-coordinator in central organization
Environmental regulations	Environmental Code; water rights	Environmental Code; environmental court decision set as a foundation for environmental demands	Environmental Code		Environmental Code	
Main environmental challenges in the project	Groundwater; waste water; land masses; contaminated soil; noise and air pollution; vibration and settings	Groundwater; waste water; water pollution; noise and air pollution; chemicals	Water pollution; biodiversity	Water pollution	Land masses; contaminated soil; noise; culture–historical buildings	Land masses; contaminated soil; noise
Other	Prestigious project	Prestigious project; tested in the Environmental Court – unique in Swedish history	First in Sweden moving a meadow			
Years of study	2003–04	2006–07	2006–07	2006–07	2006–07	2006–07

Notes: 1. The Swedish Road Administration (SRA) is the national authority assigned the overall responsibility for the entire road transport system. Its task is to cooperate with others to develop an efficient road transport system in the direction stipulated by the Swedish Government and Parliament.

2. The National Rail Administration (NRA) is the authority responsible for rail traffic in Sweden. It carries out developments in the rail sector and assists the Government and Parliament on issues that concern the entire rail transport system.

EMS, environmental management system; GECP, general environmental control programme; PECP, project-specific environmental control programme; Q&E, quality and environmental; QEH&S, quality, environmental, health and safety.

Characteristics of the construction project organizations

The organizations of the four projects were similar (Figure 1). Regardless of contractual form, the client had a project team that consisted of an 'in-house' head project manager who carried the final responsibility for the project, one or several assistant project managers, building inspectors, and a supporting staff with personnel who coordinated aspects such as personnel, economy, quality, environment, and health and safety issues. Most often the clients' environmental officials (EC_{CLIENT}) coordinated environmental aspects and provided environmental expertise for multiple projects and/or contracts simultaneously. Many of the members of the client project organizations were external consultants, which the interviewed contractors saw as the cause of delays and communicative mismatches.

The contractor organizations also had similar structures (Figure 1). Depending on the contract size, the environmental coordinators (EC_{CON}) were either located on the project site or at regional divisions (Table 1). The environmental coordinators' tasks thus varied from providing environmental expertise to a single project to handling multiple tasks, e.g. quality, environmental, and health and safety issues in concurrent projects. All three contractors – IntCon, EuroCon and NordicCon – organized their environmental work in accordance with a corporate environmental management system (EMS) and were ISO14001 certified.

Roles and positioning of environmental mediators

There were three main categories of human mediators of environmental information in the construction projects: client representatives, construction managers, and the contractor's environmental coordinator.

Clients and their proxies

The main role of the clients' project managers was controlling rather than operative. Through their formal contacts with the projects, aimed at checks and information exchange, they had low visibility.

The EC_{CLIENT}s had little or no visibility on-site nor did they wield direct influence on environmental practices and decisions in the projects. Their roles seemed to consist solely of administrative tasks ministered from within the client organization. Client power and visibility were instead wielded by proxy, i.e. through building inspectors, who were the main translators of information between clients and contractors (see quote (1) in Table 2). These inspectors were consultants with no formal environmental responsibilities or training, yet they possessed the mandate to enforce action. Their power and visibility were strengthened by the fact that their attendance on-site was associated with assessment and control.

Construction managers

As in most construction projects, there was a strict chain of command, which meant that all action points had to pass through the construction managers before implementation. On-site, the construction manager made the day-to-day decisions and had high visibility. In the interviews (see quotes (2) and (3) in Table 2), the influence of the construction managers on the status and level of environmental work in the projects was considered paramount, while that of the environmental coordinators was considered marginal.
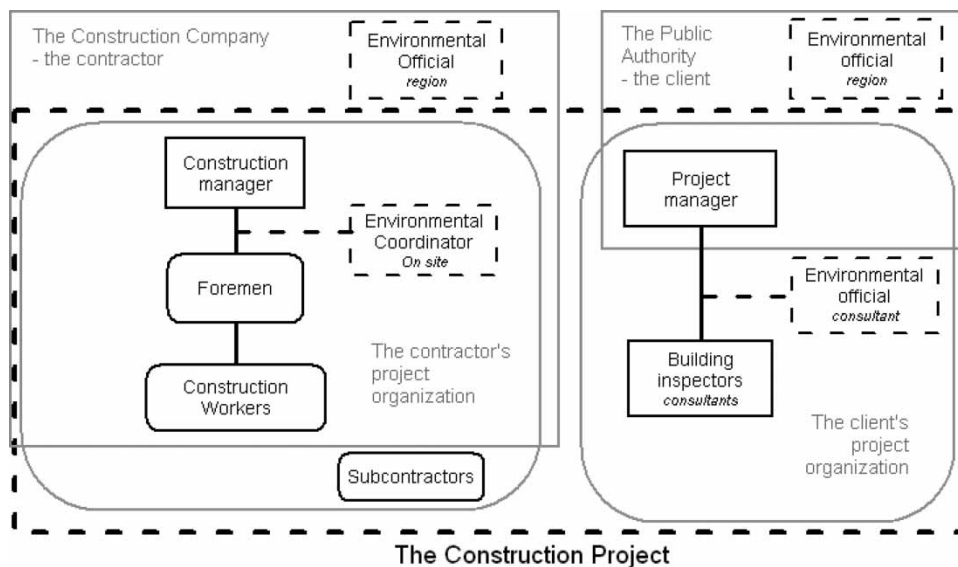

Figure 1 Schematic diagram of the project organizations with a focus on the actors involved in the environmental discourse

Table 2 Key mediators

Actors	Quotes from case studies
Client and its proxies	(1) '99 times out of 100, communication goes through us [building inspectors]' (Building inspector)
Construction Manager	(2) 'Sooner or later most issues land on or pass my desk and my ears . . .' (Construction manager)
	(3) 'In order to drive through certain aspects it is important that the construction manager shows interest in environmental issues. Some measures cost and also affect production. And then someone with a commanding presence has to tell when' (Environmental coordinator)
Contractor's Environmental coordinator (EC$_{CON}$)	(4) 'One disadvantage with this job is that you sometimes are regarded as a nag and as difficult because you make demands. You say: "You cannot use this product." "Yes I know but only for this time, we are in a hurry, we have a deadline to meet" and, well, sometimes you have to turn a blind eye to it, but at least you try to make them think ahead so that it is not regarded as 'oops do we have to do that as well' (EC$_{CON}$)

Contractors' environmental coordinators

Due to their rather high visibility on-site and their access to many sources of environmental information in the relevant contexts: the project, the regional organization, and the environmental staff organization, the EC$_{CON}$s acted as filters of the environmental information to and from the project. However, the different organizational structures, cultures and social processes in these contexts generated a lack of coherence concerning the status and definition of environmental actions, which was reflected in the ECs' behaviours. Rather than being environmental anchors, they often perceived themselves, and were perceived by project members, as 'nags' (see quote (4) in Table 2), which caused friction and undermined the authority of the EC$_{CON}$s. As a building inspector succinctly put it: 'It's not the most fun job. There is too much lecturing and that is not so popular.' Furthermore, communication between EC$_{CON}$s and EC$_{CLIENT}$s was limited since most of the information was mediated through the client's building inspector. Due to the ECs' fuzzy role, these often found themselves forced to compromise their environmental ideology for the projects' production-focused agendas.

Mediating genres and technologies

In all four cases, the same genres and technologies were used to mediate environmental performance:

- Environmental Control Programme>

- project plan including corporate environmental policies and routines

- various types of report genres

- corporate intranet with EMS and environmental databases

- e-mail

- internet

- project meetings

- informal talk and story telling

Mediating texts
Environmental Control Programme
The clients' environmental demands were stipulated in a regulatory genre disseminated in hard copy, an Environmental Control Programme (ECP), specifying the contractual demands on environmental performance and on information routines between client and contractor. Two sub-genres were identified: a general (GECP) and a project-specific (PECP) programme. These sub-genres established restrictions on the levels of environmental impacts on water, land, vegetation, and air, on levels of noise and vibration and the handling of chemicals and waste as well as the requisite documentation routines. Although ECPs were regulatory genres, they did allow for a certain degree of flexibility and change to accommodate unforeseen events. As such, they were perceived as dynamic 'living' texts.

The interviewees (see quotes (1) and (2) in Table 3) regarded the ECPs as the most authoritative project directives since they were highly visible, accessible, and governed behaviour and decisions in the projects. Of the two sub-genres, the information in the PECP seemed easier for project members to appropriate and engage with because it was context specific and tailored to a project's specific activities.

However, there were complaints about the vagueness of some of the wording in the text, which gave rise to multiple interpretations. This was frustrating to many of the environmental officials, especially since the content concerned complex issues with possible juridical consequences. Expressions such as 'ought to be avoided' and 'to the utmost possible extent', which are inherent characteristic of legal discourse, added to the ambiguity. As quotes (3) and (4) in Table 3 show, the two parties were not always in agreement concerning the interpretation of these texts.

Table 3 Mediating texts

Mediating genres	Quotes from case studies
PECP and GECP	(1) 'I think the programme is very good. This is the first time I work according to such a comprehensive environmental document. An advantage is that all specifications are found in one document' (Construction manager)
	(2) '[with the PECP] we need not look up sections that and that, now it is simply "in the PECP", which makes it easier' (EC_{CLIENT})
	(3) 'We received complaints about how we handled the pumping of water, which resulted in an intensive discussion. They [the client] called the local environmental authority, which had set the rules in the first place. The authorities said "it's OK everything is in order". So, when we follow regulations we are told "But this was our intention; this is how we intended it." "But we cannot know what they intended, we can only do it as it is written"' (EC_{CON})
	(4) 'I realized that we [both parties] had read it in different ways. When I read it from the client's point of view it says one thing, and for the contractor it says something different. Then one thinks "yes it can be interpreted in that way" but one [still] uses it to enforce one's point of view because we in turn have to report to the authorities' (EC_{CLIENT})
Project plan	(5) 'When you start a project, corporate environmental policies are embedded in the project plan: "We are going to work like this in this project"' (Construction manager)
Reports	(6) 'It is very formal. All communication must be written and documented. . . . It is too formal, you should not need to write a letter about everything when you can pick up the phone and call or why not just visit, it is not far' (Construction manager)
	(7) 'I skim through the reports. They are rather repetitive. So, bla, bla, bla, I skim through them and there is nothing of interest and sometimes I get tired and I ask the EC_{CON}: 'Hey . . ., does one need to photo-document every day?' (Building inspector)

Note: PECP = project-specific environmental control programme; GECP = general environmental control programme.

Project plan

The project plan, written in the design phase, is the established control genre of a civil engineering project. The environmental sections of the plans in this study were the contractors' counterparts of the clients' ECPs, competing for visibility and authority in the projects. The texts iterated the clients' environmental demands, as stated in the call for tenders, as well as the construction companies' environmental norms and policies. As quote (5) in Table 3 shows, the project plans reflect the project goals concerning aspects such as time, costs, quality, and environmental concerns.

Contrary to the ECPs, the project plans were seen as inflexible texts with irreversible pre-set goals. Changes to the text were perceived as being negative, which contrasted with the flexible text of the ECPs. This contradiction often resulted in information mismatches at different levels of the project.

Reports

The clients in the case projects demanded a large repertoire of report genres such as weekly and quarterly environmental reports and critical-incident reports. According to the clients, there was a double purpose to these reports: they served a controlling function vis-à-vis the contractor and reified accountability practices for environmental management. In the projects, the report imperative was perceived as excessively bureaucratic.

A common report in several of the projects was the environmental status or deviation report consisting of a pre-printed form filled in by the EC_{CON}s at varying time intervals, depending on the clients' demands. A content analysis of the texts revealed that there was little added news in consecutive reports; most of the information seemed to be carried over through a cut-and-paste strategy. Few of the 75 reports analysed suggested or reported preventive measures. This seems to suggest that reports were produced 'on-the-hoof', as routine response to routine demands for short-term action. As quotes (6) and (7) in Table 3 illustrate, although the reports were obligatory genres, they did not seem to have high visibility. In fact, reports were seen as a necessary evil for a community that preferred talk as a problem-solving mediation tool. Reports therefore failed to generate engagement.

Information technology mediation
Corporate intranet with EMS and environmental databases

For computer-literate construction managers and EC_{CON}s the intranet with the environmental management system (EMS) and environmental databases was considered the most important mediating tool for communicating environmental information (see quotes (1) and (2) in Table 4). However, the comprehensiveness of the information technology system demanded computer skills and frequent use to enable rapid access to relevant information. In the time-pressed situations-of-use in the projects, the intranet was considered too cumbersome. Interviewees complained about the opaque logic of the architecture (see quote (3) in

Table 4 Information technology mediation

Mediating genres	Quotes from case studies
Intranet with EMS	(1) 'There is where everything is written with references and all' (Construction manager)
	(2) 'It happens that I receive questions and answer that it can be found on the intranet. Where?, they ask, why I have to help them. The fact is that not many are using and searching for environmental information on the intranet' (EC_{CON})
	(3) 'It is not easy but it works, sometimes the system is not completely logical' (Construction manager)
E-mail and internet	(4) 'One receives an e-mail that minutes have been posted on the digital project domain. "This news is absorbed and then one erases the e-mail and forgets all about it. People do not read the minutes. If one instead would receive a paper copy in ones hand one would have read it. Perhaps this way of working [digitally] has not settled yet"'(Construction manager)

Note: EMS = environmental management system.

Table 4). Moreover, project members were critical of the system designers' assumptions of universal information technology literacy.

Thus, the motive for using the EMS on the intranet differed widely. While the environmental coordinators regarded the EMS as a repository of important strategic texts, for others its authority remained symbolic in that it represented the organization's espoused ideology rather than the local pragmatic day-to-day dealings on the project level. Moreover, the discourse of the EMS addresses management rather than construction-site employees. Therefore, although the EMS was a visible tool for the mediation of environmental information, it possessed less authority than did the clients' PECP. Also, the intranet and the EMS did not have a clear organizational identity related to a particular project's practices.

E-mail and the internet

E-mail was used in the projects to disseminate such genres as calls to meetings, minutes or reports. It was also a means of communication over project boundaries. E-mail was therefore an important mediating tool for environmental information management. However, several of the interviewees had an ambivalent relationship to e-mail. On the one hand, they acknowledged that it was a rapid and informal mediating tool, which, if used efficiently, could save time and effort. On the other hand, much due to the facility and speed, the tool was over-used, e.g. double postings, and incomplete, irrelevant or overload of information. Thus, as quote (4) in Table 4 illustrates, despite the visibility and potential influence of e-mail as a mediating technology, it remained dormant in the context of the projects. E-mail was mostly used as a transmission tool for written genres. As for the internet, it was hardly mentioned in connection with environmental information, which seemed to indicate that the incentive or desire to search for new information was low in the projects.

Face-to-face mediation
Project meetings
Formal meetings were regarded as one of the most important genres for the exchange of information in general. Common for most meetings at all levels was the formalized handling of environmental issues, mainly as checkpoints on the agenda. The environmental topics that were brought up for discussion tended to be the official ones specified in the ECP, and were mostly expressed by means of prescriptions and imperatives, e.g. 'shall', 'must', 'demand' and 'call attention to'.

Negative comments concerning the meetings were that they lacked discipline and/or purpose, which was the reason an EC_{CON} gave for not attending. The EC_{CON} felt he could disseminate information more effectively through other genres than the project meetings. Other EC_{CON}s also mentioned that they had ceased attending some meetings since the environmental issues on the agendas were seldom debated.

Despite the seemingly low information value of many meetings, they were regarded as an authoritative mediating genre due to the high level of participation of project members. This rendered meetings visible within the projects. As quote (1) in Table 5 indicates, the meetings seemed to function as checkpoints and manifestations of hierarchical authority.

Informal talk
Impromptu and informal talk was considered the most common and preferred interaction genre, even though they were aware of its transience. Written back-up to document decisions and elicit prompt action was needed (see quote (2) in Table 5).

An implicit notion prevailed that construction workers neither want to write nor read. One of the reasons for this non-writing culture is the site containment of the project and co-location of the members. In the impromptu conversations observed, environmental

Table 5 Face-to-face mediation

Mediating genres	Quotes from case studies
Meetings	(1) 'if there is something that we think is not functioning as its supposed to we bring it up for attention on the weekly meeting with the contractor. Then it at least becomes registered in the meeting protocols' (Building inspector)
Informal talk	(2) 'You can never know if they have perceived the information correctly until you see the result. It can go wrong even if you are very clear' (Foreman)
	(3) 'There are two ways to be informed in the coffee room, if someone done something good he talks about it himself and if someone done something foolish someone else talks about that' (Construction manager)

routines or issues were not brought up, but rather critical incidents, anecdotes, and jokes like how tomatoes were growing among the reinforcement bars or how pigeons were using metal wires to build their nests (see quote (3) in Table 5 for an illustrative example). There was a clear discrepancy between the weight ascribed to environmental challenges in written documents as compared with talk. In documents the environmental challenges tended to be worded in general terms, covering a wide range of broad issues, while the environmental issues on-site were concentrated to a few targeted issues, such as emergency measures in case of accidents.

Discussion and conclusions

In this study, the characteristics of the case projects corresponded to those of construction projects in general as identified by Loosemore and Uher (2003). The interviewees perceived the projects as labour-intensive, unique endeavours with defined goals constrained by strict time and cost frames. Coherence in the project group was partly created through professional and disciplinary homogeneity; the project members belonged to the same industry, thus sharing a common epistemology, which meant they possessed a basic common understanding and language.

Another important feature that strengthened coherence was the particular community of practice (Wenger, 1999) created by the project itself. The talk and interaction within these bounded communities were constructed and maintained by the local contingencies and management that prevailed. How environmental information is appropriated and acted upon by the users in construction projects largely depends on the urgency of the communication situation, the local context, the role and status as well as persuasive force of the human mediator, and the appropriateness of the mediating tools used (e.g. Bresnen *et al.*, 2003; Räisänen and Linde, 2004).

Although these organizations, as stated in their official documents, ranked environmental considerations high on their priority list, this commitment was not manifested in the project tasks. An explanation on the basis of this study was the lack of authority invested in the environmental officials, who seemed to play the roles of passive filters rather than active proponents of environmental thinking. They seemed unable to link the project members' emotional interaction to their task orientation. Not only did the environmental officials need to be visible in the project, but also their identities need to be backed up by operational authority. As is today, the role, despite its visibility in the project, seems to be mainly administrative.

Most of the environmental information from the main contractor organizations was conveyed through managerial discourse by means of written documents and the intranet. Conversely, the projects, in accordance with findings from previous research (Fong and Chu, 2006; Styhre *et al.*, 2006), were overwhelmingly 'talking' cultures. As has been mentioned above, the discourse of the EMSs was governed by a management logic consisting of a rational, positivist linear process, while the daily acts of implementing environmental directives in the project were rife with uncertainty requiring rapid, *ad-hoc* decisions that relied on previous knowledge, experience and affect (also Bresnen *et al.*, 2003). The intranet-based EMS did not possess the potential to engage project members, nor were its resources exploited by the environmental actors. It therefore was an ineffective mediating tool for environmental information. The same negative finding applied for all the information technology-based mediating tools, which corroborates evidence from numerous studies on the constraints of information and communication technology in construction (Ng *et al.*, 2001; Dainty *et al.*, 2006).

When developing processes, methods and technical mediating tools, designers need to consider the resources and constraints of the implementation contexts as well as the potential local needs of the human mediators (Dainty *et al.*, 2006). More importantly, the actors need to understand how their choice of mediation tool, be it semiotic or technical, affects the interpretation of their message. A starting point could be to reflect over the meanings ascribed the term 'communication' in an

organization. The social-interaction framework introduced in this paper can help actors to understand the interdependencies of the resources available to them, as well as the constraints, thereby increasing their possibilities of exploiting them.

These resources and constraints became obvious for the environmental work in the projects. For example, the site inspectors, the PECP, and the project plan were able to create 'windows open to appropriation' and enactment (Scollon, 1998, p. 12). However, the project-specific definitions of environmental issues in the PECP only created sites of engagement at the local level of the projects, discouraging project members and environmental officials from seeking environmental information for preventive or long-term purposes elsewhere. Likewise, the project plan lacked the necessary flexibility to enable its adaptation to future environmental changes.

Bracketing the project organization in time and space is a mechanism that allows the project members to focus on the project task (Lundin and Söderholm, 1995). In the case projects, however, bracketing was one of the causes for the lack of interest in seeking 'new information'. When project members did seek information, their search was driven by need, e.g. when a particular critical situation or incident occurred. Nevertheless, they seldom sought information outside the sphere of their projects or companies. These findings show how actors and mediating tools contribute to the tendency discussed by Dubois and Gadde (2002) of projects becoming decoupled from the permanent organization.

The loose coupling of the case projects to the permanent organizations gave rise to structural contradictions in terms of both practice and communication. The projects' traditional hierarchical chain of command caused re-routings of information through additional translators, such as building inspectors and/or foremen. For example, environmental officials had to go via project managers, construction managers, building inspectors or foremen to initiate action, which not only accentuated their lack of authority, but also risked further distortions of the original message. Furthermore, a strong reliance on the clients' ranking of environmental priorities enforced the projects de-coupling. In the long run this could lead to bias and complacency in the face of new environmental challenges.

Aggravating the bias risks are, as many researchers have pointed out, the time constraints and costs governing the pace and focus of projects, resulting in a stressful work climate and limited time for reflection and learning (cf. Bresnen *et al.*, 2003; Styhre *et al.*, 2004). In the construction projects studied, the tensions between the ECs' personal environmental beliefs and the production-focused and time-pressed agenda of the projects supported this view. Balancing

between personal convictions and fulfilling project goals according to cost and time specifications put pressure on these officials who perceived themselves as isolated environmental islands in the project milieus. This situation was further complicated by the building inspectors acting as the proxies of the clients.

To improve the communication of environmental information, the environmental semiotic tools such as the discourse and genres have to be adapted to the communicative culture obtaining in the projects, rather than the other way around. The communication culture and choice of mediating tools need to be reflected upon by the actors before they manage information. Instead of risking resistance and/or misunderstandings by, for example, using dominantly formal written genres and technically complex systems, it might be more efficient to nurture the prevalent speech genres and adapt discourses and systems to more direct forms, e.g. audio-recorded reports and interactive agents to help members navigate through complex management systems.

This study has shown that there were a number of specifically appointed environmental mediators from the different organizational levels and numerous mediating tools available for inter- and intra-project communication. Yet, environmental communication most often did not result in engagement and enactment. A plausible explanation for this lack of engagement may be the fact that the project workers were not able to appropriate this information in their current work context; the messages did not carry meaning that they could relate to their primary interaction (Scollon, 1998), i.e. the interaction taking place for the moment in the project. The mediators were not able to generate a site of engagement where project members could enact the information together as a form of real-time social interaction (Scollon, 1998, p. 29). The perspective on communication in construction that a social-interaction perspective contributes is a better understanding of how mediated discourse is operationalized (or not) in actual communication.

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