

# Compensatory Adaptation to a Lean Medium: An Action Research Investigation of Electronic Communication in Process Improvement Groups

**Abstract**— Previous empirical findings from the computer-mediated communication research literature are consistent with media richness theory because they suggest that the use of electronic communication media is likely to have a negative impact on the success and outcome quality of process improvement groups. These findings lead to the expectation that electronic communication media will not be as appropriate as the face-to-face medium to support the type of complex and knowledge-rich communication that takes place in process improvement groups. This paper analyzes 12 process improvement groups interacting through an electronic communication medium and finds this expectation unfounded. In fact, the use of an electronic communication medium can actually have the opposite effect, that is, a “positive” effect, on process improvement group success and outcome quality. Two other theoretical models, namely the compensatory adaptation and social influence models, are used to explain these counterintuitive findings.

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**Index Terms**— Action research, collaborative technologies, compensatory adaptation model, electronic communication, knowledge sharing, media richness theory, New Zealand, process improvement, social influence model.

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**T**here has been increasing interest, particularly in the 1990s, in the use of electronic communication media to support work groups in organizations. A great deal of this interest has been fueled by the emergence of the Internet and, consequently, of organizational forms characterized by their low dependence on physical structures for employee interaction [1], [2]. There has been also increasing interest in process improvement, particularly since the rise of the business process re-engineering movement in the

early 1990s [3], [4]. However, only a few studies have addressed the impact of the use of electronic communication media on process improvement efforts.

Process improvement has been one of the pillars of widely practiced and researched (and at a certain stage revolutionary) management schools of thought [5], [6]. Illustrative examples are total quality management [7] and business process re-engineering [8], [9]. The term “process improvement” has been used to refer to improvements in quality

or productivity of processes in general, whether they are of radical or incremental nature or they target local or interdepartmental processes [6], [10].

A common characteristic of process improvement approaches is their group basis [11]–[14]. Process change proposals aimed at quality and efficiency improvements usually come from groups specifically formed to generate such proposals [7], [8], [15]. The groups that generate such proposals are generally referred to as “process improvement groups” [6], [9], [10].

Previous empirical findings suggest that the use of electronic communication media by process improvement groups may have a positive impact on group cost [10], [16]–[18], but it is likely to have a negative impact on group success. Previous findings from empirical research focusing on knowledge sharing among individuals engaged in collaborative tasks indicate that electronic communication media are not as appropriate as the face-to-face medium to support the type of complex and knowledge-ridden communication that usually takes place in process improvement groups [19]–[24].

Media richness theory [25] is particularly well aligned with the empirical findings summarized above, as it provides a rational explanation for them. A plausible prediction based on media richness theory is that for tasks as complex and “equivocal” as those performed by process improvement groups, the use of electronic communication media will lead to outcomes (i.e., process redesign recommendations) of lower quality and lower likelihood of success compared to recommendations produced by process improvement groups interacting primarily face-to-face.

This paper analyzes 12 process improvement groups

interacting through an electronic communication medium, and it finds that not only is this prediction incorrect but also that the use of an electronic communication medium can actually have the opposite effect—that is, a “positive” effect on the quality of the outcomes generated by process improvement groups as well as their success. Two other theoretical models from the computer-mediated communication research literature, namely Fulk et al.’s [26] social influence model and Kock’s [27] compensatory adaptation model, are combined to explain these counterintuitive findings.

**Organization of this Paper** The section “Research Background” reviews previous empirical studies that investigated the impact of electronic communication tools on group-based process improvement and related tasks, as well as Daft and Lengel’s [25] media richness theory, which is particularly well aligned with the empirical findings reviewed and provides a rational explanation for them. This section also develops expectations based on media richness theory regarding the impact of the use of electronic communication media on process improvement groups. To provide a balanced theoretical view, two other theoretical models that contradict media richness theory—Kock’s [6], [27] compensatory adaptation model and Fulk et al.’s [26] social influence model—are also introduced in this section. This empirical and theoretical discussion is then used as a basis for the development of four research questions, which guide the analysis of the data collected through the research study and address the constructs of process improvement group cost, knowledge sharing, outcome quality, and success.

The next section, titled “Research Method,” reviews the research method used, i.e., action research with details on the nature of the researcher’s involvement as well

as on the data sources used. This section also provides details on the process improvement groups studied, including their key stages, intermediate deliverables, and technology support. The description of the technology support provides details on the electronic communication tool used to enable “any time and any place” interaction among process improvement group members. The “Results” section then presents the results of the data analysis with a focus on the link between the use of the electronic communication medium and process improvement group cost, knowledge sharing, outcome quality, and success.

The “Discussion” section examines the results of the data analysis presented in the previous section, which point at a “positive” link between the use of the electronic communication medium and process improvement group success and contradict expectations based on Daft and Lengel’s [25] media richness theory. Kock’s [6], [27] compensatory adaptation model, and Fulk et al.’s [26] social influence model are used in this section to explain the data analysis results. Finally, the “Conclusion” section summarizes the paper and highlights the main findings of the data analysis, drawing implications for researchers and industry practitioners.

## RESEARCH BACKGROUND

### Previous Empirical Findings

Dennis et al. [16]–[18], [28] have conducted field investigations of the impact of electronic communication technologies on process improvement. Their studies were based on semicontrolled field experiments, and they dealt with a synchronous group support technology used by individuals in the same room, usually known by the term “group decision support system.” The studies investigated real-life process improvement situations, with researcher control

applied on group process structure (achieved by employing a specific group methodology and providing technology use facilitation). The studies suggested a decrease in the time groups took to reach process modeling and improvement decisions, and thus a decrease in process improvement group cost when the group decision support system was used. Another finding was a neutral impact on the quality of process modeling and improvement decisions. These are generally positive results. However, given that users were in the same room when they used the group decision support system (and that, therefore, some form of face-to-face interaction was taking place), it is difficult to draw conclusions regarding differences in the impact on group-related variables between the electronic communication medium created by the group decision support system and face-to-face interaction.

Kock and McQueen [10] also conducted a field investigation of the impact of electronic communication technologies on process improvement. Their study was markedly low in control (e.g., groups were formed voluntarily and decided whether they would use the electronic communication medium or not), dealt with nonsimulated process improvement situations, and also focused on the use of an asynchronous group support technology (email conferencing). The study suggested a decrease in the dollar costs associated with process improvement groups, a shortening of group life cycle, and a neutral impact on the quality of the process improvement recommendations generated by the groups. While moderately positive, these findings were based on a small sample of groups (only six groups were studied), all of which were from the same organization, which makes it difficult to generalize them to similar groups in different organizational settings.

Members of process improvement groups often need to share their individual knowledge about the process under consideration with other members so that their target processes can be effectively improved [9], [29], [30]. Therefore, a review of previous empirical findings about the impact of electronic communication tools on knowledge sharing was also conducted to inform our research. The review suggested that early investigations in noncontrolled settings have led to either negative or inconclusive findings. For example, Orlikowski's [21], [22] study of an implementation of an asynchronous computer conferencing system (Lotus Notes) at a large consulting firm concludes that organizational culture and reward systems prevented knowledge sharing among consultants, in spite of the availability of technological support. Another example of study pointing to similar results is Ackerman's [19] investigation of usage patterns and perceptions of an organizational memory system (Answer Garden) by software engineers. The study yielded a mix of positive and negative results regarding knowledge sharing involving experts and users, where the former had been a source of expertise to the latter.

More recent research paints an even more negative picture regarding the impact of electronic communication tools on knowledge sharing. Riggs et al.'s [23] study, for example, suggested that electronic communication technologies lacked enough sophistication to effectively support the sharing of organizational knowledge, referring to features that are still missing in electronic communication tools today. In the same line, Neilson's [20] noncontrolled longitudinal study of Lotus Notes' users in a public organization concluded that electronic communication tools do not prevent the departure of knowledgeable employees from having a negative impact on organizational knowledge

retention. The same study suggests that, without adequate group processes, technology itself is unlikely to have any conclusive impact on knowledge sharing. This is a theme that has recently been revisited by Tan et al. [24], in the context of virtual teams communicating electronically. Their study builds on the assumption that electronic communication does not, *per se*, facilitate building of shared understanding among team members, and proposes and tests, with positive results, a group process (whose main element is a dialogue technique) to facilitate building of shared understanding in virtual teams.

In summary, previous empirical findings suggest that the use of electronic communication media may have a positive impact on process improvement group cost, but use is likely to have a negative impact on the success of process improvement groups. The findings suggest that electronic communication media may not be as appropriate as the face-to-face medium to support the type of complex and knowledge-ridden communication that takes place in process improvement groups.

A number of theories have been used to explain the effects of electronic communication technologies in organizational settings, such as media richness theory [25], the social influence model [26], adaptive structuration theory [31], [32], systems rationalism [33], genre-based communication structuration [34], [35], the affective reward suppression model [36], and the compensatory adaptation model [6], [27]. Among these theories, three are particularly relevant to this research study. The first is Daft and Lengel's [25] media richness theory because it is particularly well aligned with the empirical findings above. The other two are Kock's [6], [27] compensatory adaptation model and Fulk et al.'s [26] social

influence model because they provide theoretical arguments that contradict the empirical findings above.

### Media Richness Theory

According to media richness theory, different communication media can be classified as "lean" or "rich," depending on their ability to support communication in equivocal tasks. The classification is based on the ability of communication media to support language variety, personal focus, immediate feedback, and nonverbal cues. That is, a communication medium that allows for synchronous communication aided by the use of nonverbal cues (e.g., gestures, tone of voice) should be seen, according to the theory, as "richer" than a communication medium whose communication is asynchronous and devoid of nonverbal cues. The classification scheme proposed by media richness theory places face-to-face as the richest communication medium and email as a relatively lean medium [25], [26], [37]. Media richness theory hypothesizes that lean media are not appropriate for knowledge sharing (or "equivocality" reduction, using the theory's terminology) and claims that the selection of media and the outcomes of its use will always reflect this hypothesis [38], [39]. While several studies convincingly questioned media richness theory's ability to predict the outcomes of collaborative tasks [27], [37], [40], [41], several tests of the theory have suggested that its basic tenets are generally true [42], [43], particularly the similarity between the perceived relative richness of a communication medium by users and the medium's actual position on the media richness scale proposed by the theory. Also, media richness theory has been successfully used in its original form as a basis for the understanding of empirical findings of research on contemporary communication

issues in organizations and society as a whole [44]–[46].

Media richness theory leads to some expectations regarding the use of electronic communication media by process improvement groups. The first expectation is that group members interacting via an electronic communication medium will not be able to effectively share their individual knowledge about the process they are trying to improve, which will drive their groups into sterile and shallow discussions and, over time, lack of member interest and participation. The second expectation is that most process improvement groups will fail to generate useful process improvement recommendations, which will lead to lack of acceptance of the recommendations by management, negative perceptions from group members about the success of their own groups, and negative organizational consequences from the implementation of suggested process changes (if and when they are actually implemented).

### The Social Influence and Compensatory Adaptation Models

Media richness theory has been questioned many times based on empirical research that yielded findings that were incompatible with the theory. However, few theoretical models have been proposed to explain findings that were incompatible with media richness theory. Among those theoretical models are Kock's [6], [27] compensatory adaptation model and Fulk et al.'s [26] social influence model.

The **compensatory adaptation model** emerged from Kock's [6], [27] studies of computer-mediated meetings conducted by small groups. One of the goals of these studies was to answer the paradoxical question: Can communication media limitations foster better group outcomes? The studies suggest that better outcomes are possible with the

use of "lean" media like email as group members adapt their behavior toward technology in a "compensatory" way. The compensatory adaptation model argues that, if group members are motivated enough to accomplish their goals regarding a group task, they will overcompensate for the obstacles posed by media of low richness (according to the media richness classification proposed by media richness theory). The groups will, in turn, generate better outcomes than similar face-to-face groups, regardless of the fact that most group members will still perceive the electronic communication medium as less adequate than the face-to-face medium. That is, the compensatory adaptation model is a theoretical model that both complements and refines (or corrects a problem with) media richness theory.

In contrast with media richness theory, which focuses on communication media traits (which are often defined by the features of a collaboration technology), **the social influence model** [26] argues that social influences can strongly shape individual behavior toward technology in ways that are relatively independent of technology features. Examples of social influences are technology use patterns observed in other individuals [47], as well as formal or informal social norms of accepted behavior followed by a group to which an individual belongs. A study by Markus [41] builds on the social influence model to show that social influences can shape individual behavior toward communication media in ways that are inconsistent with media richness theory predictions. The study focused on media choices made by managers at a large risk management services provider and suggested that social pressures can change the way email users behave toward the technology. More recent studies, such as El-Shinnawy and Markus's [40] that focuses on

users' choices between electronic mail and voice mail, provide similar evidence and conclude that a complex set of social factors governs organizational media use in ways that are often inconsistent with media richness theory.

**Research Questions** The discussion above leads to some doubt regarding electronic communication media effects on process improvement groups that have particular theoretical and practical relevance. These effects are related to group cost, knowledge sharing among group members, group outcome quality, and group success (these constructs are defined below). Four main research questions are developed below and used to guide this research study in connection with these effects.

*Research Question 1:* What effect does the use of an electronic communication medium have on process improvement group cost?

Process improvement group cost, or the overall cost of running a process improvement group, is defined as the dollar amount associated with the formation and completion of the group. Group cost is a function of a number of items, including the cost of the group members' time for an organization, the transportation and accommodation expenses incurred by group members, the cost of disruption caused by group activities on the group members' regular activities, and the overhead costs associated with running the group (e.g., clerical costs, telecommunication costs).

*Research Question 2:* What effect does the use of an electronic communication medium have on knowledge sharing in a process improvement group?

Knowledge sharing in a process improvement group is defined as the communication of knowledge possessed by one or a few members of the group to the

other members. The knowledge shared may relate to a number of issues, including the members' organization's formal and informal structure, organizational culture, and day-to-day activities.

*Research Question 3:* What effect does the use of an electronic communication medium have on the quality of the outcome generated by a process improvement group?

A process improvement group's main outcome is a redesigned version of the process that they targeted for improvement. The quality of this outcome is necessarily a subjective attribute, which defines how close the redesigned process is from a contextually "optimal" process design.

*Research Question 4:* What effect does the use of an electronic communication medium have on the overall success of a process improvement group?

For the purposes of this study, process improvement groups are seen as either successful or unsuccessful. Following criteria proposed in the process improvement literature [5], [8], [9], a process improvement group is seen as successful if the recommended process changes are implemented fully or partially and lead to positive observable results.

## RESEARCH METHOD

**Action Research** There is a body of literature on the use of action research in organizational studies in general, as well as in the more specific context of information systems research [48]–[53], [54]. Peters and Robinson [55], as well as Elden and Chisholm [56] provide general, discipline-independent reviews of action research. Lau [57] presents a review of action research within the field of information systems. This literature is not reviewed here. Rather, a concise definition of

action research is borrowed from Kock: "A general term to refer to research methodologies and projects where the researcher(s) tries to directly improve the participant organization(s) and, at the same time, to generate scientific knowledge" [58, p. 66].

One of the reasons for the emergence of action research and its consequent use in the information systems field is the recognition that an organization can be more deeply understood if the researcher is part of the organization being studied, which can be achieved by the researcher facilitating improvement-oriented change in the organization. This involvement is also believed to foster cooperation between researcher and those who are being studied, information exchange, and commitment toward both research quality and organizational development. This situation was illustrated by Eric Trist [59] in his account of one of the earliest studies with the characteristics of action research, conducted in Austria by Paul Lazarsfeld and Marie Jahoda, a project on long-term unemployment in a textile village outside Vienna whose workers have become unemployed overnight. The researchers had found that in order to get access to people and relevant research information they had to clearly show that they were doing something in the villagers' interest. In doing so they eventually changed those people's own view about the very system that was believed to have caused them to be unemployed, improved their relationship with management, and eventually led workers and management through a process of cooperative solution of mutual problems.

The origins of this research approach rest on sociopsychological studies of social and work life issues [55]. Action research is often uniquely identified by its dual goal of both improving the organization participating in the

research project, usually referred to as client organization, and at the same time generating knowledge [56], [57]. Although typically applying very little, if any, control on the environment being studied, the action researcher is expected to apply intervention on this environment [60].

In this study, the researcher tried to improve the participant organizations primarily by providing technology support for process improvement groups. It was believed that electronic communication support would create new opportunities for the improvement of organizational processes by allowing group members to interact from "any place and at any time."

#### Process Improvement Groups

*Participants:* The criteria for selecting client organizations for the research included commitment to process improvement (demonstrated by the existence of at least one formal organization-wide process improvement program) and initial absence of electronic communication support for process improvement activities. As interviews were expected to be one of the main sources of research

evidence, the organization selection criteria were aimed at increasing internal validity. The selection criteria ensured that process improvement group participants had a basis for comparison grounded on past participation in face-to-face process improvement groups on which to form their perceptions regarding electronic communication media effects.

This study made use of structured and unstructured interviews, participant observation, and compilations of electronic postings collected in the context of an action research study involving 12 process improvement groups in two organizations: Waikato University (Waikato), a large and comprehensive university in New Zealand; and MAF Quality Management (MQM), a branch of the Ministry of Agriculture and Fisheries of New Zealand. At the time of the research, Waikato had 550 faculty and 750 staff, all based in the same campus in Hamilton, New Zealand. Waikato's yearly revenues were approximately US\$ 83.3 million. MQM employed approximately 2500 people at a number of offices throughout New Zealand. These offices typically housed 5 to 200 people each, depending on the geographical area covered by them (e.g., a small

town and its vicinities, or a large metropolitan area) and services supplied. Most services could be categorized as inspection audits, based on government regulations and industry standards, and related training and consulting services aimed at helping audited organizations comply with regulations and standards. MQM's yearly revenues were approximately US\$ 105 million.

Table I provides an overview of the process improvement groups. The process improvement groups conducted at Waikato and MQM are listed in Table I as W1-W6 (Waikato) and M1-M6 (MQM), respectively, along with some of their main features. The columns in Table I show, from left to right: the name of the group, the number of group members, the duration of the group in days, the number of different departments (e.g., marketing, finance, computer support, international students office) represented in the group, and a brief description of the main process targeted by the group.

Since this was a noncontrolled study, group members were not asked to avoid the use of media other than the electronic communication medium. In spite of that, group members voluntarily

TABLE I  
SUMMARY INFORMATION FOR THE  
PROCESS IMPROVEMENT GROUPS

Group	No. of Members	Duration (days)	No. of Depts.	Process Description
W1	7	33	2	Teaching a university course
W2	8	41	5	Providing academic advice
W3	11	32	5	Providing computer support
W4	7	45	5	Handling student assignments
W5	13	33	8	Supporting graduate students
W6	11	54	4	Orienting international students
M1	5	26	1	Providing software support
M2	5	25	1	Editing an internal newsletter
M3	7	14	1	Reporting on an outbreak
M4	11	29	4	Providing quality consulting
M5	15	28	6	Providing hardware support
M6	14	10	3	Coordinating staff training

decided to conduct the vast majority of group interactions electronically. Interviews revealed that a relatively small number of one-on-one interactions between group members through other media (telephone and face-to-face interactions) took place. However, these seemed to have little impact on group discussions since most process-related information, whether possessed by one individual or a pair of individuals, had to be shared by all of the group members so a group could proceed with its work. Additionally, most groups were "zero-history" groups, that is, their members had not been part of the same group before, even though in most groups at least half of the members had some form of prior work-related interaction with other group members.

*Group Stages:* A process improvement group typically has a short lifetime (from a few days to no more than a few months) during which its members define, analyze, and search for alternatives to improve one or a few organizational processes [3], [61], [62]. The literature suggests that process improvement groups usually conduct their activities along three main conceptual stages, namely, definition, analysis, and redesign [3], [6], [9]. In the definition stage, the process improvement group selects a process for redesign. In the analysis stage, the group studies the process in detail. Finally, in the redesign stage, the group proposes redesign modifications [3], [6], [8]–[10], [28], [63]–[65]. These stages are followed by the implementation of the changes. The groups described here were no exception. The activities conducted by these groups within each of these three stages are summarized below.

#### *Definition Stage:*

- **Identify problems.** In this activity, a self-appointed

group leader identified problems associated with a process. Based on this, the self-appointed leader invited the other members that would make up the process improvement group.

- **Identify processes.** In this activity, the process improvement group identified a small list of processes that were causing the problems identified in the "identify problems" activity.
- **Select a process for redesign.** In this activity, the process improvement group selected one of the processes identified in the "identify processes" as the target of the process improvement attempt.

#### *Analysis Stage:*

- **Model the process.** In this activity, the process improvement group created a graphical representation of the process selected in the previous stage to be targeted for redesign. The most common type of representations used here were variations of the standard flowchart [65], nonstandard diagrams, and sketches.
- **Summarize performance information.** In this activity, the process improvement group summarized performance information about the target process, such as cycle time, execution cost, and frequencies of customer complaints.
- **Highlight opportunities for improvement.** In this activity, the process improvement group highlighted improvement opportunities based on the model generated in the "model the process" activity as well as the information summarized in the "summarize performance information" activity.

#### *Redesign Stage:*

- **Search for suitable changes.** In this activity, the process improvement group proposed, discussed, and agreed upon actual process changes based on the improvement opportunities highlighted in the "highlight opportunities for improvement" activity conducted in the previous stage.
- **Incorporate changes into the process.** In this activity, the process improvement group incorporated the changes agreed upon in the "search for suitable changes" activity into the process. A new, redesigned process emerged from this activity.
- **Evaluate redesign feasibility.** This was the last conceptual activity conducted by each process improvement group, where the group discussed how the new process would be implemented. This involved discussions about the reallocation and relocation of resources, changes in the management structure, and information technology tools to enable the new business process. The process improvement group members discussed the feasibility of the process changes proposed and, if necessary, modified them so they matched the reality of their organization.

Fig. 1 provides a graphical representation of the stages and activities outlined above. Arrows indicate the outputs and inputs of the activities. The "evaluate redesign feasibility" activity marks the completion of the process improvement group, whose process redesign recommendations are then put into practice. This is the real test of the quality of the outcomes (process redesign recommendations) produced by the process improvement group. A successful process improvement group would be

followed by implementation of process redesign proposals, which in turn would lead to positive organizational results (e.g., observable reduction in process cycle time, increase in revenues).

Most of the process improvement groups studied followed the general structure outlined above. Some were discontinued before completion (this is discussed later in the paper), which means that they did not go through all the activities shown in Fig. 1.

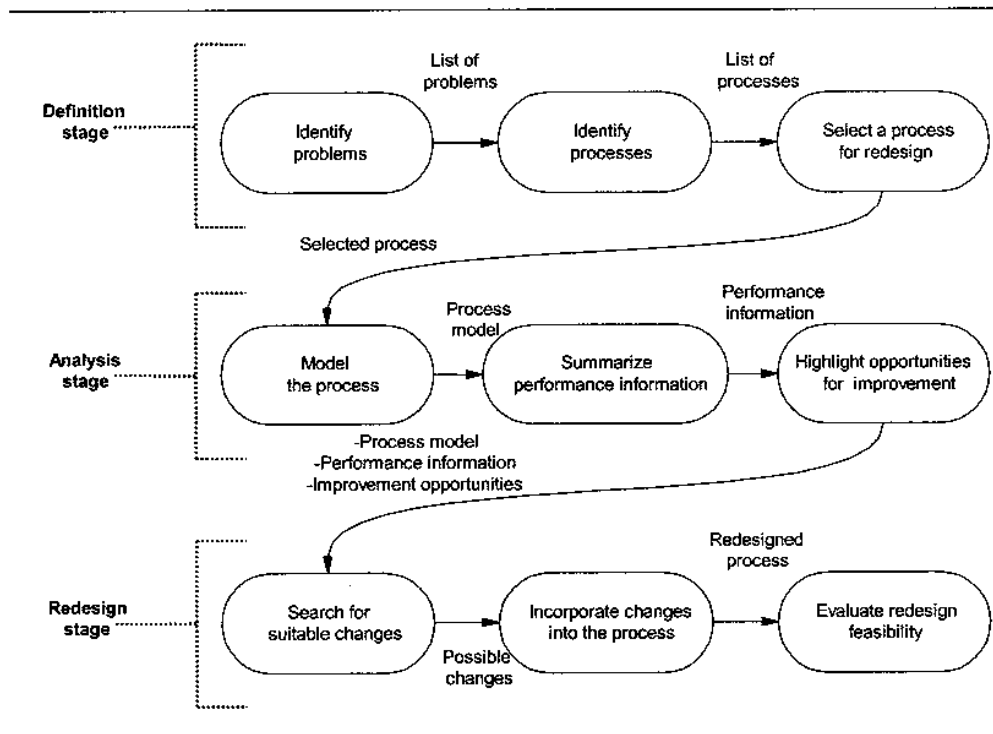
*Technology:* Electronic list servers developed using Novell Groupwise (Novell Corp.) enabled electronic communication among process improvement group members. Electronic mailboxes were created to allow group members to post and read electronic messages (with or without file attachments) among themselves. Spreadsheets, flow charts, presentations, and graphs could be attached as files to electronic messages and easily read by recipients who all had the same applications used to generate

attachment files installed on their desktop computers.

**Data Analysis** Structured interviews were conducted with process improvement group members and addressed perceived differences between face-to-face and electronic process improvement groups they had participated in. To avoid perception bias, structured interview answers were probed deeply for rationale, personal motivations, and other factors that could bias perceptions, as well as triangulated with data from unstructured interviews, participant observation, and compilations of electronic postings. Sixty-two structured and over 100 unstructured interviews were conducted. The structured interviews, the core source of evidence in this study, were taped and later transcribed. They employed an "in-depth interviewing" method proposed by Sommer and Sommer [66], lasted from 45 minutes to 2.5 hours each, and were based on open-ended questions.

The open-ended questions used in structured interviews (listed in part in the Appendix) were developed based on the group support systems and computer-mediated communication literature, partially reviewed earlier in this paper. They were worded in a neutral way so as not to induce any specific answer. Each question was accompanied by the follow-up question "Why?" and other related questions to clarify the interviewees' motivations for their answers, allow for the screening and elimination of ambiguous answers, and generate perception-related qualitative data that could be used for content analysis. The frequency distributions of interview answers were tested for statistical significance using the Chi-Square technique. The Chi-Square tests excluded ambiguous and "I don't know" answers (both placed in the "I don't know" category when frequency distributions were calculated), which added robustness to the results. The frequency distributions of answers in interviews were similar for

Fig. 1. The typical stages of a process improvement group.





Walkato and MQM (Cronbach Alpha = 0.72).

In spite of the researcher's direct involvement with the organizations in this study, the researcher did not contribute or directly influence the contribution of research data. Specifically, the researcher's intervention was restricted to technology support and veered away from directly influencing the content of the discussions conducted by process improvement groups. Written permission to use these research data for analysis was sought and obtained from the management of each organization, as well as from each individual contributor.

**RESULTS**

The data analysis supports the positive expectation that the use of electronic communication media will have a positive impact on group cost by indicating a drastic decrease in group cost. However, even though not all groups were successful (the success rate was 67%; more details are provided below), the data analysis does not support any of the negative expectations outlined above. On the contrary, it suggests that, when compared with the use of the face-to-face medium, the use of the electronic

communication medium by the process improvement groups led to a) more knowledge sharing, b) higher group outcome quality, c) higher group success. What follows is a detailed discussion of these observed effects.

**Research Question 1: Group Cost** As can be seen in Fig. 2, 88.7% of the participants felt that the use of the electronic communication medium decreased group cost. The perception trend toward a decrease in group cost was very skewed and statistically significant (Chi-Square > 100, P < 0.01).

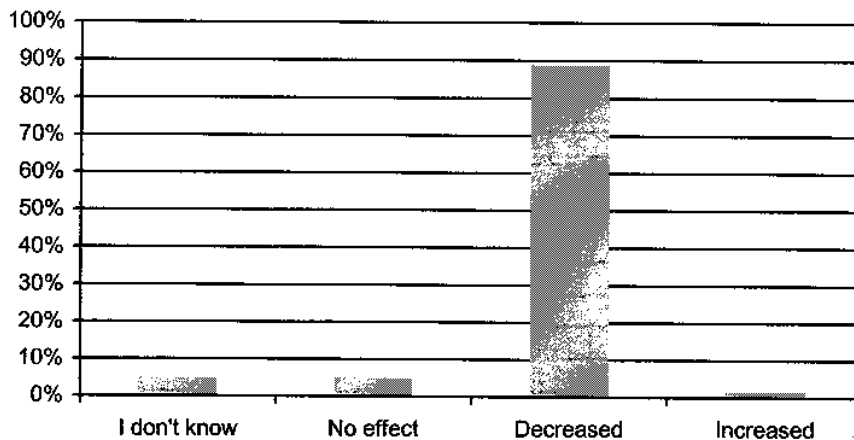
Most of the respondents described the reduction in cost as being "drastic." In their view, cost reduction had been caused by a virtual elimination of travel and accommodation costs, reduction in the total amount of time required from them to participate in group discussions, and reduction in the costs associated with disruption of normal activities usually caused by face-to-face meetings.

No evidence emerged from participant observation regarding the opposite effect, that is, that the use of the electronic communication medium increased the cost of running process improvement groups. Only one

process improvement group member perceived such an increase in a structured interview. That member had spent a significant amount of time contributing electronic postings to a group that eventually failed to produce process change recommendations (see subsection "Group Success Is Increased" below for a more detailed discussion on group success and failure), and this explained his perception by noting that a face-to-face discussion would have led to better outcomes and his time would not have been completely wasted. He blamed the failure on communication problems associated with the electronic medium, which he saw as too "dry" for process improvement discussions. No spontaneous remarks in structured or unstructured interviews by process improvement group members pointed to increased group cost in connection with the use of the electronic communication medium. Negative remarks are important sources of evidence in action research given the emergence-focused nature of this research approach [67].

**Research Question 2: Knowledge Sharing Among Group Members** As can be seen in Fig. 3,

Fig. 2. Frequency distribution of answers regarding the impact of the use of the electronic communication medium on group cost.



Chi-Square > 100, P < .01. Chi-square parameters: N = 62, df = 2. "I don't know" answers were disregarded in the Chi-Square analysis.

51.6% of the participants perceived knowledge sharing among process improvement group members as having been increased by the use of the electronic communication medium. The perception trend toward an increase in knowledge sharing among group members was statistically significant (Chi-Square = 10.61,  $P < 0.01$ ).

Group members independently provided two main reasons to explain why the use of the electronic communication medium had increased knowledge sharing. The first main reason was a higher departmental heterogeneity than in similar face-to-face process improvement initiatives, enabled by the electronic communication tool's asynchronous and distributed interaction support. Having more people from different departments broadened the scope of knowledge brought into the discussion by the participants, which led to a perception of increased knowledge sharing. The second main reason was better quality of individual contributions made through the electronic communication medium in comparison with similar contributions in face-to-face situations.

As mentioned before, interviews were in-depth. Therefore, the reasons above were not selected

by respondents from a set of predefined alternatives, but emerged from the content analysis of interview transcripts through "axial" and "selective" coding, two text coding techniques proposed by Strauss and Corbin [68]. The quotes below from interviews are illustrative of the explanations provided by group members. Job title, organization, and reason provided for perception are provided below the quotes.

Computer consultant, MQM,  
*Increased departmental heterogeneity:*

*... [computer support] improved my learning ... I could email someone in the South Island ... You learn that way and you learn a lot ... You learn a lot from other people, but not in a [face-to-face] group.*

Adjunct Professor, Waikato,  
*Increased individual contribution quality:*

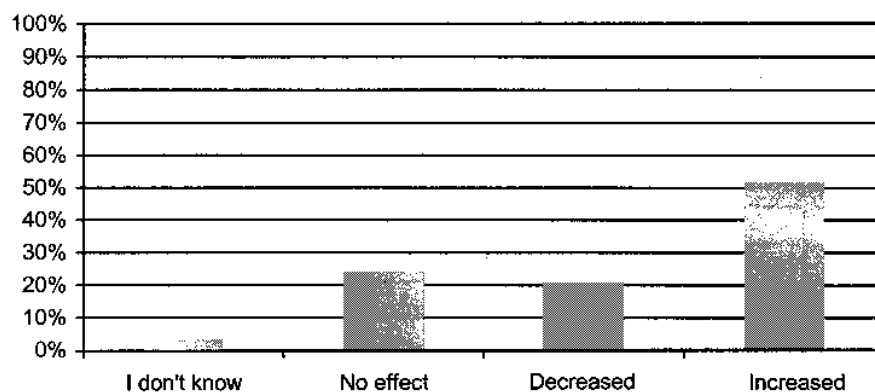
*When I write, my thinking process from formulating the ideas in my head to getting them down becomes more elaborate. I have to take much more time over that than I would if I was speaking. I think that, because one is forced to do that by writing the answer down, then the written answer you get is much more focused.*

*So I think that is an advantage. It requires more time from the participants, because they have to focus their writing, but, as a result, you get [better individual contributions].*

There was no clear evidence from participant observation and unstructured interviews of the opposite effect. As can be seen in Table I, most processes analyzed cut across different departments, which implies different types of knowledge being brought by different members into the group discussion. Given this, it is plausible to assume that, if knowledge sharing had been negatively affected by the use of the electronic communication medium, this would have been easily noticeable, as well as pointed out by participants in unstructured interviews.

Still, as can be seen in Fig. 3, 21% of the participants said in structured interviews that the use of the electronic communication medium had decreased knowledge sharing among group members. The chief explanation by these participants, who were mostly from groups that failed (see subsection "Group Success Is Increased" later), was that the electronic communication medium was not as "good," "rich," or "appropriate"

Fig. 3. Frequency distribution of answers regarding the impact of the use of the electronic communication medium on knowledge sharing among group members.



Chi-Square = 10.61,  $P < .01$ . Chi-square parameters:  $N = 62$ ,  $df = 2$ . "I don't know" answers were disregarded in the Chi-Square analysis.

as the face-to-face medium for the exchange of knowledge.

regarding individual contribution quality.

discussions, increasing the level of ambiguity in them.

**Research Question 3: Group Outcome Quality** Fig. 4 shows that group outcome quality, or the quality of the process redesigns generated by process improvement groups, was perceived by 43.5% of the participants as having been increased by the use of the electronic communication medium. The perception trend toward an increase in group outcome quality was statistically significant (Chi-Square = 5.84,  $P < 0.05$ ).

The two main reasons independently provided by group members to explain why the use of the electronic communication medium increased group outcome quality were the same as those provided to explain the perception that knowledge sharing had been increased in the previous section, but their order was inverted. The top reason was better quality of individual contributions and the runner-up was higher departmental heterogeneity than in similar face-to-face process improvement initiatives, both seen as enabled by the electronic communication tool used by the groups. The quote provided below is illustrative of the explanations provided by group members

Division Manager, Waikato, *Increased individual contribution quality:*

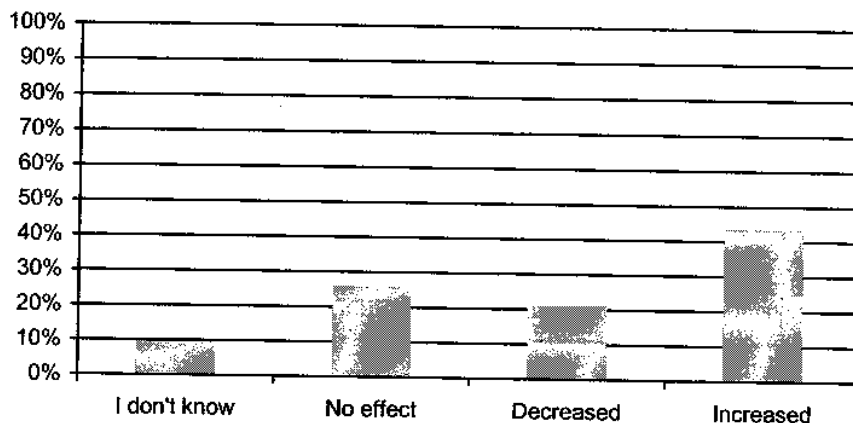
*You think more when you're writing something, so you produce a better quality contribution. Take for example what [member's name—removed] wrote, she wrote a lot and it seemed that she thought a lot about it before she emailed it to the group. She wasn't just babbling off the top of her head, she tended to think out what she was writing. I know I did it a lot, specially my first message. I really thought a lot to put it together.*

Nevertheless, 21% of the participants perceived a decrease in quality associated with the use of the electronic communication medium. Their explanation was similar to that provided by those who perceived a decrease in knowledge sharing among group members in the previous section. The main reason provided by them was that the electronic communication medium was not as "good," "rich," or "appropriate" as the face-to-face medium for process improvement group

Fig. 5 addresses perceptions regarding departmental heterogeneity in the process improvement groups, one of the key reasons provided to explain beneficial effects of the electronic communication medium provided in this and the previous section. Fig. 5 shows that 83.9% of the respondents perceived an increase in departmental heterogeneity due to the use of the electronic communication medium. The perception trend toward an increase in departmental heterogeneity was very skewed and statistically significant (Chi-Square > 100,  $P < 0.01$ ).

Group members provided one main (and virtually only) underlying reason to explain the perceived increase in departmental heterogeneity, which was the lower level of disruption to routine organizational activities afforded by the asynchronous and distributed mode of communication supported by the electronic communication tool. The fact that the electronic communication tool allowed group members to interact in a time-disconnected manner, with less disruption to their routine

Fig. 4. Frequency distribution of answers regarding the impact of the use of the electronic communication medium on group outcome quality.



Chi-Square = 5.84,  $P < .05$ . Chi-square parameters:  $N = 62$ ,  $df = 2$ . "I don't know" answers were disregarded in the Chi-Square analysis.

activities, made it possible for more members from different departments to participate in the process improvement group discussions.

#### Research Question 4: Group Success

The perceived quality of process redesign recommendations provides only indirect evidence of the likely degree of success of a process improvement group. It is plausible to assume that the higher the quality of the process redesign recommendations produced by a group, the higher will be the likelihood that those recommendations will lead to successful implementation. However, the degree of success of a process improvement group can only be fully evaluated based on the organizational impact of the actual implementation of the process redesign recommendations.

True to the action research tradition, this study did not rely on control groups [60]. We draw on the empirical literature on process improvement to establish a basis for comparison. Examples of process improvement have been and still are found in total quality management and business process re-engineering literature. Process redesign attempts are usually considered successful if the

recommended process changes are implemented fully or partially and lead to positive observable results [5], [8], [9]. Large multinational surveys of success rates of process improvement attempts based on total quality management principles suggest that those rates range from approximately 20 to 34% [69]. As for process improvement attempts employing business process re-engineering principles, the success rate found by Champy [70] based on a large survey of American and European companies was of approximately 30%. In addition, the rate of success of process improvement attempts based on total quality management and business process re-engineering principles has been consistently found to be around 30% or less.

In the analysis of the degree of success achieved by the process improvement groups conducted at Waikato and MQM, we applied the same generic criterion for success obtained from the literature and mentioned above. Process redesign attempts were considered successful if the recommended process changes were implemented fully or partially and led to positive observable results. This classification is summarized in Table II, where

groups W1-W6 were conducted at Waikato and M1-M6 were conducted at MQM (more details on these groups were provided earlier in Table I).

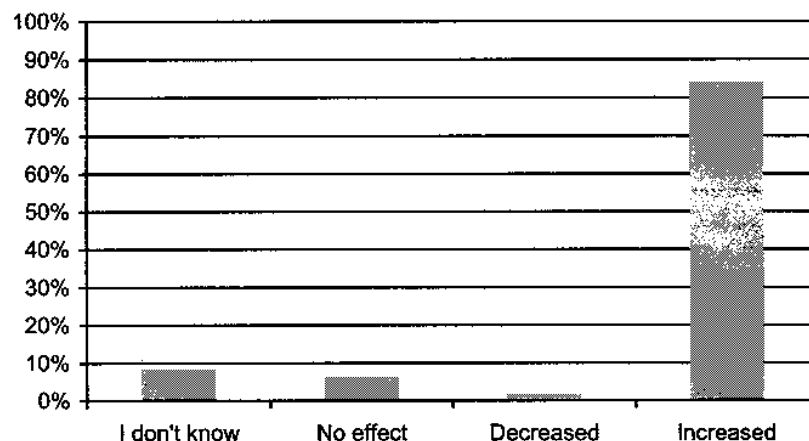
Table II suggests that four out of the six process improvement groups conducted at Waikato, as well as four out of the six process improvement groups conducted at MQM, were successful. That is, overall, eight out of 12 groups were successful, which yields a total success rate of 67%. The identical success rates in the two organizations suggest a certain degree of generality to this result.

The success rate of the process improvement groups studied, 67%, is over twice the success rate of process improvement attempts based on total quality management and business process re-engineering principles. The rate of success of the process improvement groups studied was significantly higher than the average suggested by the literature, in spite of the use of an electronic medium for communication.

## DISCUSSION

The results of the data analysis summarized above are aligned with one key finding from the

Fig. 5. Frequency distribution of answers regarding the impact of the use of the electronic communication medium on departmental heterogeneity.



Chi-Square > 100,  $P < .01$ . Chi-square parameters:  $N = 62$ ,  $df = 2$ . "I don't know" answers were disregarded in the Chi-Square analysis.

empirical literature: the use of electronic communication media will have a positive impact on group cost. However, the results contradict nearly all of the other expectations developed based on previous empirical findings and media richness theory. The results suggest that the use of the electronic communication medium had a positive impact on group success, which contradicts the expectation based on previous empirical research that the use of electronic communication media is likely to have a negative impact on group success. The results also suggest that knowledge

sharing among members of process improvement groups, as well as the process redesign recommendations generated by the groups, were increased by the use of the electronic communication medium, thus contradicting the expectation based on previous empirical research that the use of electronic communication media will not be as appropriate as the use of the face-to-face medium to support the type of complex and knowledge-ridden communication that takes place in process improvement groups.

The results of the data analysis also go against expectations based on media richness theory regarding group outcomes, but the results support the notion that electronic communication media are "leaner" than the face-to-face medium and are likely to pose obstacles to the effective discussion of process improvement issues. This support comes from the fact that all negative perceptions by group members regarding the electronic communication medium were explained based on the belief that the electronic medium was not as "good," "rich," or "appropriate" as the face-to-face medium for discussions as complex and knowledge-ridden as those conducted by process improvement groups.

So, how can we explain the findings that, when compared with the face-to-face medium, the electronic communication medium led, in the context of process improvement, to more knowledge sharing, higher group outcome quality, and higher group success? The answer to this question lies in Kock's [6], [27] compensatory adaptation model and Fulk et al.'s [26] social influence model, which both explain group outcomes that were incompatible with media richness theory.

We can draw on Kock's [6], [27] compensatory adaptation model to explain the data analysis results in this study by concluding that while

the electronic communication tool offered some advantages such as support for "any place and any time" interaction, it also posed obstacles due to its lack of richness. These obstacles induced compensatory adaptation behavior by group members, which in turn led them to suppress the obstacles and share more knowledge, produce better group outcomes, and be more successful than they would had the face-to-face medium been used. Further support for this conclusion comes from the fact that all negative perceptions by group members regarding the electronic communication medium were explained based on their underlying perception that the electronic medium was not as "rich" as the face-to-face medium.

Even though Kock's [6], [27] compensatory adaptation model provides a basis for understanding almost all of the data analysis results, it fails to identify the underlying **motivation** needed, according to the compensatory adaptation model itself, for the groups members to compensate for the obstacles posed by a lean medium. This gap can be filled with Fulk et al.'s [26] social influence model.

We can draw on Fulk et al.'s [26] social influence model to account for the underlying motivation that led the process improvement group members in this study to compensate for the obstacles posed by a "lean" communication medium. The underlying motivation comes, according to the social influence model, from social norms associated with group-based process improvement tasks, which led to social influences, such as perceived group mandate and expected individual behavior by other process improvement group members, that were conducive to compensatory adaptation. These social influences induced behavior toward technology that was obviously inconsistent with media richness theory

TABLE II  
DEGREE OF SUCCESS FOR EACH OF  
THE PROCESS IMPROVEMENT GROUPS

Group	Successful?
W1	Yes: Group agreed on process changes, from which all were implemented with positive results
W2	No: Group agreed on process changes, from which none was actually implemented
W3	No: No agreement on process changes was achieved
W4	Yes: Group agreed on process changes, from which all were implemented with positive results
W5	Yes: Group agreed on process changes, from which all were partially or fully implemented with positive results
W6	Yes: Group agreed on process changes, from which all were partially or fully implemented with positive results
M1	Yes: Group agreed on process changes, from which approximately two thirds were implemented with positive results
M2	Yes: Group agreed on process changes, from which all were implemented with positive results
M3	Yes: Group agreed on process changes, from which approximately one third were implemented with positive results
M4	No: No agreement on process changes was achieved
M5	Yes: Group agreed on process changes, from which approximately three quarters were implemented with positive results
M6	No: Unfocused discussion led the group to be discontinued without agreeing on any process changes

predictions but consistent with the compensatory adaptation model. The combination of the compensatory adaptation and social influence models with media richness theory fully explains the data analysis results and leads to the final paradoxical conclusion that the "leanness" of the electronic communication medium led to better group outcomes.

## CONCLUSION

Our findings contradict expectations about group outcomes based on media richness theory and on the empirical literature on the impact of electronic communication media on groups engaged in complex and knowledge intensive tasks. Contrary to those expectations, our findings suggest that the use of electronic communication media can have a positive impact on group outcome quality and group success, as well as foster knowledge sharing among group members.

Two theoretical models fully explain our findings when combined with media richness theory: Kock's [6], [27] compensatory adaptation model and Fulk et al.'s [26] social influence model. Kock's [6], [27] compensatory adaptation model explains in part our findings by allowing us to conclude that while asynchronous electronic communication tools such as email may offer some advantages such as support for "any place and any time" interaction. Electronic media will also pose obstacles due to their lack of richness when compared with the face-to-face medium (an assumption that is consistent with part of the media richness theory). According to the compensatory adaptation model, these obstacles will induce compensatory adaptation behavior by group members, leading them to suppress the obstacles and share more knowledge, produce better group outcomes, and be more successful than they would

had the face-to-face medium been used. Fulk et al.'s [26] social influence model provides a missing theoretical element that complements the compensatory adaptation model—the underlying motivation for compensatory adaptation. According to the social influence model, the underlying motivation comes from social norms associated with group-based tasks, which in turn lead to secondary social influences, such as perceived group mandate and expected individual behavior by other group members, that drive compensatory adaptation.

While our findings support the richness scale proposed by media richness theory, they are not consistent with predictions based on media richness theory regarding group outcomes. The combination of the compensatory adaptation and social influence models with media richness theory leads us to a final paradoxical conclusion that the "leanness" of electronic communication media can lead to better group outcomes, or, in other words, that "less can be more." This is an interesting and counterintuitive finding that suggests the need for a rethinking of media richness theory. In particular, it seems necessary to amend media richness theory to avoid deterministic predictions regarding group outcomes based on where certain media fall in the media richness scale proposed by media richness theory. The amendment of media richness theory to make it compatible with the findings of this research study, and thus with Kock's [6], [27] compensatory adaptation model and Fulk et al.'s [26] social influence model, requires a degree of theoretical effort and elaboration that is beyond the scope of this paper and that is thus proposed as future research.

From a practitioners' perspective, our findings have two important and related implications. The first implication is that small groups conducting complex and

knowledge-intensive tasks such as process improvement can be conducted entirely electronically and still be successful. Given the emergence of the Internet and the consequent multiplication of organizational forms characterized by their low dependence on physical structures for employee interaction, such as the so-called "virtual organizations" [1], [2], this is not only good news for organizations but also provides the basis for a call for increasing use of electronic communication media to support all types of group tasks, ranging from routine group tasks, where the use of electronic communication media is already relatively common, and to more ad hoc (or project-based) ones, where the use of electronic communication media is still rare. The second implication, which is related to the first, is that the electronic communication tools used to support groups do not have to be much more sophisticated than simple email list servers as long as there are social (or perhaps financial) factors in place that motivate group members to compensate for the leanness inherent in the electronic communication media used. It seems, based on our study, that most instances of process improvement groups will, due to process improvement's own nature, incorporate social influences that will induce compensatory adaptation behavior toward electronic communication media.

Like any research study, this study presents some limitations that need to be acknowledged so the reader can qualify the findings. One potential limitation of this study is its heavy reliance on group members' perceptions, which could arguably have been contaminated by Rosenthal or Hawthorne effect biases [71]. For example, the participants could have been induced to voice "positive" perceptions to the researcher, given the fact that the researcher was providing a service to them. This

limitation was addressed through a) triangulation of research data, where the researcher looked for evidence that contradicted the participants' stated perceptions; b) the use by the researcher of Sommer and Sommer's [66] "in-depth interviewing" method, which was in part developed to eliminate the impact of biases on perception-related data; and c) the researcher presenting the electronic communication medium as an alternative medium that could be used by the process improvement groups but not explicitly showing any preference for that medium over other communication media. Another potential limitation of this study is that it does not clarify the nature of the underlying mechanisms that guide and define compensatory adaptation. For example, if communication media "leanness" is associated with obstacles, as suggested by our study, then compensatory adaptation may have a price, such as a higher degree of cognitive effort required from group members. Even though our findings suggest that this effect, if it exists, is not likely to lead to negative group outcomes, other unexpected consequences may emerge from future research. One possible negative consequence is avoidance by group members to participate in future electronic groups after their initial experience, as they will become increasingly aware of the extra effort required from them. This and other related issues should be addressed in future research.

## APPENDIX

This Appendix contains information about the structured interview questions in this study. Please note the following:

- Respondents reported having participated in face-to-face process improvement groups prior to answering the questions below.
- Waikato and MQM had recently conducted face-to-face organization-wide process improvement efforts by the time this study was began.
- The questions below are only part of a larger list of questions used in structured interviews. Minor rewording took place during interviews when respondents expressed difficulty understanding the meaning of the questions.

**Cost** There are several costs involved in running a process improvement group, such as those resulting from disruption of regular activities, and time spent in meetings. Did the use of the electronic communication medium decrease or increase the overall cost of running your process improvement group? Why?

**Knowledge Sharing** Sometimes individuals share knowledge as a result of the discussion that takes place in process improvement groups. Shared knowledge may relate their organization's formal and informal structure,

organizational culture, and day-to-day activities. Did the use of the electronic communication medium increase or decrease knowledge sharing in your group? Why?

**Quality** Did the use of the electronic communication medium decrease or increase the quality of the process improvement proposals generated by your group? Why?

**Departmental Heterogeneity** Sometimes it is difficult to gather people from different departments to work together in a process improvement group. Did the use of the electronic communication medium increase or decrease department heterogeneity, or the number of different departments represented, in your group? Why?

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