

Research

Can communication medium limitations foster better group outcomes? An action research study

Ned Kock*

Department of Computer and Information Sciences, Temple University, 1805 N. Broad St, Computer Building (038-24), Philadelphia PA 19122, USA

Received 4 September 1997; accepted 30 June 1998

Abstract

Media richness theory has been an influential deterministic theory of communication media adoption and use since its development in the mid-1980s. However, there has been mounting evidence, particularly in the 1990s, that predictions based on the media richness theory do not always hold. For example, there has been evidence that a lean communication medium can be the choice of groups engaged in complex tasks, such as strategic decision making, even when richer media are available. The two main shortcomings of most studies aimed at testing the media richness theory have been: (a) an orientation toward controlled settings, which hampers the drawing of implications for the usually 'non-controlled' situations found in organizations in general; and (b) a focus on media *adoption* patterns, which has led to lack of evidence regarding group task outcomes. Here, we go some way towards filling this research gap by providing evidence that non-controlled groups can voluntarily adopt a communication medium that they perceive as *lean*. Moreover, we show that, due to a perception of the limitations imposed by the medium, group members can adapt their behavior in order to overcome such limitations, producing outcomes whose quality is perceived as higher by them than in richer media. We studied five process improvement groups in a New Zealand university. The groups, which redesigned typical university processes, voluntarily conducted most of their interactions through an e-mail conferencing system developed by the author. © 1998 Elsevier Science B.V. All rights reserved

Keywords: New Zealand; Action research; Intensive research; Process redesign; Process improvement; Group support systems; Media adoption theories

1. Introduction

The literature on the impact of group support technologies has grown steadily in the 1990s [7], reflecting their increasing use as tools to enable efficient communication in organizations [1, 26, 37, 38].

This literature, however, has been filled with mixed findings [30], where success in the introduction and use of group support systems (GSSs) has been as commonplace as failure [6, 8]. A number of theories and theoretical frameworks have been proposed which provide a basis for the understanding of these mixed findings. Examples of such theories are media richness theory [3, 11], adaptive structuration theory [32, 33], systems rationalism [23], genre-based communication

*Corresponding author. Tel.: +215-204-1912; fax: +215-204-5082; e-mail: kock@joda.cis.temple.edu

structuration [41, 31], the affective reward suppression model [34], and the social construction influence model [14, 24].

Among these theories, one has been particularly influential among designers and users of group support technologies – the media richness theory – to the extent that several other theories and theoretical frameworks have emerged from attempts to show, in several cases successfully, that the media richness theory cannot be used alone to explain certain group support technology adoption and use patterns. Studies based on the social construction influence model, in particular, have provided some compelling evidence that the media richness theory loses its predictive power as the compatibility between the shared mental models of the users of a GSS grows. The studies by Huang et al. [14] and Lee [24], for example, suggest that in groups where there is a previous history of interactions among their members, ‘lean’ media, such as e-mail, can be successfully used to reduce task equivocality (i.e. can be used for ‘rich’ communication) – a finding that is inconsistent with predictions based on the media richness theory.

Here, we attempt to show that the media richness theory does not hold in some specific group situations. We try to do this by analyzing five computer-supported process improvement groups – that is, groups whose main goal is to improve sets of interrelated organizational activities [19]. These five groups have, when given the choice of using a range of media with varying degrees of richness, spontaneously decided to use one of the leanest available to them – e-mail conferencing. Moreover, the final outcome of these groups – process redesign proposals – was qualitatively perceived by the group members as *better* than those likely to be generated with richer media (these perceptions were based on the respondents’ previous participation in face-to-face process improvement groups). These two research findings combined are contradictory to predictions based on the media richness theory.

However, our study takes a different path from most of the studies that aimed at disconfirming the media richness theory so far, by pointing to a new explanation for its findings – a form of constraint-induced adaptation. In addition, some elements of the adaptive behavior displayed by the groups in our study were remarkably similar; this may suggest a certain degree

of generality in these elements. Finally, the type of adaptive behavior described here cannot, to our knowledge, be explained by any single existing media adoption theory or theoretical framework.

2. Media richness theory

Our discussion of the media richness theory, as well as some of the findings of this research, is based on the concepts of information and knowledge and their interrelationship. Kock et al. [21, 22] present a detailed discussion of these concepts. For the purpose of our discussion, the following distinction between information and knowledge is drawn. While information is eminently descriptive, and can be seen as a collection of *facts* about the past, present, or future; knowledge is either predictive or associative, and can be seen as a collection of *rules* to process information [40]. Predictive knowledge can be used to generate information about the future, based on information about the past, present, or future – for example, if one is a heavy smoker, then one will die earlier than someone who does not smoke. Associative knowledge, on the other hand, allows for the generation of more information about the present, based on information about the past, present, or future – for example, if one is sneezing and is not fevery, then one probably has a cold.

The media richness theory can be defined in terms of the relationship between knowledge and information. Both are stored by individuals as mental structures [35], and are typically shared in organizational teams that carry out business processes [2, 36]. The building of shared organizational knowledge typically occurs through communication between members of the same process team, and less often between members of different process teams – we say ‘typically’ because some types of knowledge, generically referred to as tacit knowledge, cannot be verbally communicated [36]. The process by which individuals form and share knowledge and information in organizations has been dubbed *perspective making* and *perspective taking*, respectively [2].

Media richness theory claims that different communication media can be classified as lean or rich, according to their ability to convey knowledge and information. Knowledge must be communicated in

order to reduce task *equivocality*, whereas information must be communicated in order to reduce task *uncertainty*. The classification scheme proposed by the media richness theory places face-to-face as the richest communication medium, and e-mail as a relatively lean medium [10, 24]. Media richness theory claims that lean media are not appropriate for knowledge communication (i.e. equivocality reduction), and that the adoption of media and the outcomes of its use will usually reflect this fact [4, 25].

2.1. Media adoption versus task equivocality and uncertainty

Media richness theory posits that there are two main reasons why organizational communication takes place – to reduce *uncertainty*, and to reduce *equivocality* [3, 11, 39]. Uncertainty is seen as the lack of information in carrying out a given task, and therefore as being reduced by access to information relevant to the task. The uncertainty associated with the task of deciding which structural shape to use when building a bridge, for example, can be reduced by gathering information about the properties of several structural models of bridges and the results of their use in previous similar projects.

Equivocality is seen as the lack of shared knowledge about a given task, which prevents uncertainty from being reduced through the gathering of extra information about the task. An equivocal task carried out by engineers, for example, would be to decide whether to propose the building of a bridge, in a particular city, without knowing the negative or positive social and political implications of the project. The complexity of this situation requires the engineers to make decisions whose outcomes cannot be predicted, irrespective of the amount of information available. That is, equivocality can be seen as a measure of the inability to reduce uncertainty [3, 39], or a measure of the absence of knowledge about a given task.

According to the media richness theory, communication media vary in their capacity to reduce equivocality, or support knowledge communication. Richer media are required, and lean media are seen as inappropriate, for reducing equivocality [4]. The following list is proposed by Daft and Lengel ([3] p. 560) as a classification of communication media in

order of decreasing richness: (1) face-to-face, (2) telephone, (3) personal documents, such as letters and memos, (4) impersonal written documents, and (5) numeric documents. This implies, as Lee [24] and Fulk et al. [10] suggest, that electronic written communication, such as that supported by e-mail and asynchronous conferencing systems [27], would be less appropriate than face-to-face communication to reduce equivocality.

Media richness theory has been used as a basis to predict that when given the opportunity to choose between the face-to-face and a leaner medium, users involved in tasks where equivocality is high would rationally opt for the face-to-face medium [25]. Since one of the main sources of equivocality in organizations is seen as interdepartmental relations [39], one would then naturally expect that process improvement groups spanning different departments would prefer face-to-face over e-mail conferencing for their group discussions. Here we provide some evidence that is counter to this prediction. We also try to explain why this prediction does not hold, but differently from previous studies whose focus is on showing that e-mail can support rich communication [24, 28], and we attempt to do this by showing that: (a) the e-mail medium can indeed be seen by users as inherently lean, and as imposing constraints on their ability to communicate as a group; and (2) this perception can lead users to adapt their behavior to overcome this leanness, leading to group outcomes that are perceived as better than those expected to be achieved on richer media.

3. Organizational context

We studied five process improvement groups over a period of 7 months at the University of Waikato. Forty-eight staff and faculty from 15 different departments participated as members in the groups. All groups comprised members from at least four different departments, and redesigned cross-departmental processes (see Table 1). At the time this study was conducted, the University of Waikato had approximately 1,300 employees – 550 faculty and 750 administrative staff – all based in the same campus. It had an enrollment of approximately 11,000 students and yearly revenues of 119 million New Zealand dollars (US\$ 84 million).

Table 1
Main group features

Group	Number of members	Departments involved	Generic description of the main process targeted by the group
G1	8	5	Providing academic advice to students
G2	11	5	Providing computer support to students
G3	7	5	Handling student assignments
G4	13	8	Providing support to graduate students
G5	11	4	Orienting new international students

The University of Waikato was one of seven government-funded universities in New Zealand which were collectively facing difficulties due to a recent cut in government funding. As a result, a number of initiatives were started, initially at the presidential level and later moving to college and departmental levels, to increase the effectiveness and efficiency of core (i.e. teaching and research) and support (i.e. aiding teaching and research) university processes. In order to benefit from this improvement-oriented 'organizational mindset,' we suggested an approach to be used by process improvement groups to a few college deans and research division directors, and offered our services as group facilitator. The approach combined a group methodology, called MetaProi, and an e-mail conferencing tool.

4. Group process and structure

MetaProi, which stands for meta-process for process improvement, comprises a meta-process (i.e. a process to guide process improvement) around which a structured set of activities, guidelines, and graphical tools were developed to help the work of process improvement groups. This methodology draws on our previous work in process improvement projects [17] and on general normative literature in the field (e.g. [5, 13]). MetaProi has been summarized in a manual [16], which was given to group members as a guide. We do not believe that the use of MetaProi has had any significant bias on the findings of this study from an organizational perspective, not only because MetaProi reflects most of the current process improvement practice in organizations, but also because the variations observed in the dependent variables of this study seem to be unrelated to any of MetaProi's main guidelines.

The e-mail conferencing tool supported group discussions through electronic list servers built on Novell Groupwise (TM by Novell Corporation). Electronic mailboxes were created to replicate messages from group members to the other members of their groups. Message replication was programmed through *mailbox rules*, a feature of Novell Groupwise. The group distribution lists created were similar to Internet e-mail distribution lists (e.g. ISWorld e-mail list). The system allowed group members to exchange one-on-one electronic messages within and outside the group, as well as post messages and replies to the whole group. Spreadsheets, flow charts, presentations, and graphs could be attached (as files) to electronic messages, and read by recipients. Attachments could be read by clicking on icons representing the attached files on the computer screen.

Process improvement groups were typically formed by a self-appointed group leader who was approached by us or who independently sought our help as a group facilitator. Initially, we briefed the prospective leader on our proposed group approach and group support technology. The prospective leader then proceeded to choose a general problem (associated with a process) to be tackled by his or her group, and invite from six to twelve people to become members of the group, telling each of them of his or her intention to lead the group and use our facilitation. We consistently recommended the use of MetaProi in our initial contacts, due to the apparent general lack of structured group methodologies for organizational improvement found in these contacts, but left the use of the e-mail conferencing tool at the group leader and member's discretion. We presented some of the evidence from the study by Kock and McQueen [19], which pointed to both positive and negative effects, as a basis to guide the leader's initial decision to use the e-mail conferencing tool or face-to-face. This decision was also based on

consultation with group members about their preferences of communication media.

Once there was agreement on the medium to use to begin group discussion, the leader proposed an organizational process to be redesigned to the group. The group then collectively agreed on a process to be redesigned (which could be different from the process proposed by the leader), and modeled and analyzed (i.e. presented and discussed information about) the process. Process modeling and analysis were accomplished partially with our aid, which was limited to helping the group leader to model and analyze the process, in face-to-face and one-on-one e-mail interactions. The group then proposed and agreed on a number of changes to the process. These were, in most cases, later implemented under the supervision of the group leader.

5. Research method

The research method used was of the action research genre [9, 12, 15]. Three main features must be emphasized: (a) it was low in control; (b) it relied on previous research findings as a basis for comparison; and (c) it relied on the perceptions by group members about face-to-face process improvement discussions in which they had been recently engaged.

5.1. Low control

We did not ask group members to follow specific procedures, or to use the e-mail conferencing system provided. We rather proposed MetaProi and the system as tools that could be used, and let the group members decide whether they would use these, none, or any other group process and support tools available. All groups decided to use MetaProi. This happened, in our view, due to the lack of any other available structured group methodology for process improvement. As most group members had been involved in less structured (typically face-to-face) process improvement groups before, they saw value in using MetaProi as a guide. As for the e-mail conferencing tool, different degrees of use were observed in different groups, as discussed later in this paper. Although posing some methodological difficulties, this lack of control allowed us to draw important conclusions about non-induced group behavior patterns.

5.2. Reliance on previous research

Lack of control over the groups prevented us from using face-to-face control groups. This led us to use quantitative data from a previous study of face-to-face business group meetings [29]. Since the groups studied by McQueen [29] were not concerned only with process *improvement*, but also business decision making and other issues, we restricted ourselves to quantitative measures that appeared to be highly correlated with our perception of those measures in the face-to-face process improvement groups that we facilitated prior to this research [17, 18, 19, 20], and whose normalized variance was very small when those groups and the five groups in this study were treated as a single large sample. As a result, three measures and respective results in that study were used – mean contribution speed, mean response time, and mean contribution lengths in groups.

5.3. Reliance on members' perceptions

We asked group members in interviews to compare their perceptions of e-mail conferencing with face-to-face discussions. As we did not have face-to-face control groups, we concluded that higher mean reliability in answers to interview questions would probably be obtained with members who had recently participated in purely face-to-face process improvement groups. Even though we did not select group members ourselves, it was possible to ensure that over 90% of the group members had been involved in one or more non-computer-supported process improvement groups prior to their participation in the group studied here. This was because the University of Waikato had been recently engaged in non-computer-supported process improvement initiatives.

Three main data sources were used: unstructured interviews, transcripts of electronic postings from group members, and structured interviews. Thirty unstructured interviews were conducted. They lasted from 1 to 3 hours each, and addressed perceptions of the respondents about their own or their colleagues' participation in process improvement groups (some of the respondents were not or had not been group members). Most of the interviews addressed perceived effects of the e-mail conferencing system on group members and on groups as a whole. Responses in

unstructured interviews were initially summarized through interview notes on paper, which were later merged with participant observation notes into a 'field notes' file. Another source of research data, transcripts of electronic messages from group members, were indexed by group and date. Additionally, 46 structured interviews were conducted. These interviews lasted from 45 minutes to 2 1/2 hours each, were based on open-ended questions (i.e. not restricted to a set of pre-defined answers), and were audio-taped and later transcribed. Most of these interviews were transcribed by the author to ensure uniformity.

6. Adaptation of the groups through stages

Groups consisted of 7–13 members, and lasted, on average, 41 days. Each group selected, analyzed and conceptually redesigned one or a few organizational processes. This section describes the evolution of the groups through four main stages.

6.1. Stage 1: Choice of medium

The vast majority of the members of all five groups chose the electronic medium for most of their *group interactions* – that is, interactions in which the communication mode was many-to-many, within the group. Phone and face-to-face media were used predominantly for one-on-one communication, within and outside the group. In interviews conducted within 2 weeks from the group completion, members were asked about the amount of time spent interacting via each medium. Their responses were checked against their individual contribution patterns, to ensure accuracy (e.g. one person who had contributed 600 words in postings to the discussion, but who stated she had spent only 10 minutes interacting with other members through the EC medium was asked to review her estimate). An aggregate analysis of the responses to this question indicates that the electronic medium was used by members, on average, 76% of their group discussion time (see Table 2).

These figures suggest that the electronic medium was consistently favored by the groups as their main medium for communication, in spite of being a 'leaner' medium than the phone and face-to-face media. When asked to explain their choice of medium, the overwhelming majority of the interviewees assigned a

Table 2

Proportions of time spent by members interacting through different media

Group	Electronic medium (%)	Phone and face-to-face (%)
G1	81	19
G2	96	4
G3	77	23
G4	52	48
G5	75	25
Group mean	76.2	23.8

reduction in disruptiveness, typically linked with the possibility of interacting with the group at the most convenient time for them, as the main reason for the choice of the electronic medium.

6.2. Stage 2: Perception of medium limitations

After the initial choice, however, several group members pointed out that they thought that the new medium could increase 'ambiguity' in the discussion. These opinions were provided in a non-induced way during unstructured and structured interviews – that is, they were not answers to questions in which respondents were specifically asked about the relationship between type of media and likely discussion ambiguity. The two following quotes from interviewees illustrate this:

People read different things on e-mail. [Member's name – removed], for example, was misunderstood as volunteering to do something, when in fact she had made just a supportive comment.

I sometimes feel that things are left hanging because with e-mail people can understand different things out of the same message. At the end of the day I think you should have a face-to-face meeting not to leave things hanging.

The main reasons given by members for the higher likely ambiguity in an electronic group discussion, in comparison with a face-to-face group discussion, were the lack of immediate feedback and the filtering of verbal cues inherent in the electronic medium. These reasons are highly consistent with predictions of likely media perceptions by users based on the media richness theory [3].

6.3. Stage 3: Adaptation to the leaner medium

At this point we could observe an interesting pattern in all five groups. On the one hand, group members had apparently chosen the electronic medium for most of the group interactions. On the other hand, a number of members perceived the electronic medium as likely to foster ambiguity in the discussion. Plausible predictions based on the media richness theory for future scenarios involving these groups would be the perception by group members of an actual increase in discussion ambiguity, and either a move to richer media (such as face-to-face) or the demise of the groups, both as a consequence of the higher perceived ambiguity.

None of these scenarios became reality. On the contrary, not only did the groups continue using the electronic medium for most of the group interactions, but most respondents spontaneously also reported a perceived increase in member contribution quality. A quote from one of these members illustrates this perception :

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 e-mailed 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.

The perceived increase in member contribution quality can be explained by an adaptation of the members to the leaner medium. Three main pieces of hard evidence suggest this adaptive behavior and some traits of its dynamics. Firstly, members seemed to have spent more time preparing their individual contributions, which is evidenced by an apparently large decrease in member contribution speed through the electronic medium, in comparison with face-to-face meetings. Table 3 shows that the mean contribution speed for the electronic medium was 6 words per minute, and 113 words per minute [29] in face-to-face meetings. The contribution speed in the electronic medium was calculated based on group members' estimates of time spent preparing and posting contributions and the actual word count of their postings,

Table 3
Mean contribution speed through different media

Source	Sample size ^a	Words per minute
Facilitator	5	6.93
Group leaders	12	5.29
Ordinary members	103	5.92
Mean (electronic medium)	6	
Mean (face-to-face medium) ^b	113	

^aElectronic postings.

^b[29].

and, in the case of the group leaders and the facilitator, measured directly by the facilitator. Estimates from the facilitator, group leaders and ordinary group members were calculated separately to allow for data triangulation. The low contribution speed through the electronic medium could not be explained only by the fact that 'typing is slower than speaking,' as average typists can type between 60–70 words per minute. A better preparation of the postings appears to be a more plausible explanation, as it matches the explanation of the interviewees.

Secondly, group members seemed to have taken much longer to provide their contributions to the group through the electronic medium. This partially suggests that members reflected more on their contributions, prior to posting them, than in typical face-to-face meetings. An aggregate analysis of the time delays for members to respond to postings from the group leaders (most of the postings from ordinary members were responses to group leaders' postings) provides some support to this assumption. Table 4 shows that the mean response time to contributions from the group leaders was 138 hours (between 5 and 6 days) through the electronic medium, and *no more than* 1 hour (estimated, based on the figures provided by McQueen [29]) through the face-to-face medium. The normalized variation around the overall mean (i.e. 138 hours) of the mean response times for each of the groups was relatively small (lower than 0.5 standard deviations), except for group G4 (slightly over 1 standard deviation). This suggests a high consistency across different groups.

Thirdly, group members seemed to have provided longer contributions through the electronic medium than in face-to-face meetings. An aggregate analysis of word counts per posting points towards this. Table 5

Table 4
Mean response times to leaders' contributions through different media

Group	Mean response time (hours)	Variation around mean (SDs)
G1	76	-0.48
G2	71	-0.52
G3	200	0.48
G4	277	1.09
G5	128	0.07
Mean (electronic medium) ^a	138	
Mean (face-to-face medium) ^b	1	

^aOverall mean.

^b[29].

Note: SD=standard deviations.

shows that the mean contribution length was 297 words through the electronic medium, and 18 words [29] through the face-to-face medium. The low normalized variation around the overall mean (i.e. 297 words) of the mean contribution lengths for each of the groups (less than 0.2 standard deviations) suggests a remarkable consistency of this adaptive pattern across groups.

If we assume that the number of words per posting correlates knowledge and information content, the above figures imply better thought out contributions in the groups studied, with more information and knowledge content each than oral contributions. We obtained a partial confirmation of this hypothesis by calculating the number of 'knowledge and information

Table 5
Mean contribution lengths through different media

Group	Mean contribution length (words)	Variation around mean (SDs)
G1	291	-0.02
G2	293	-0.02
G3	320	0.09
G4	317	0.08
G5	267	-0.12
Mean (electronic medium) ^a	297	
Mean (face-to-face medium) ^b	18	

^aOverall mean.

^b[29].

Note: SDs=standard deviations.

exchanges' of these contributions. However, since the operationalization of the concept of exchange of knowledge and information is a relatively complex issue, we refer the reader to [22] for more details. For the purposes of this study we believe it suffices to say that, according to our definition of information and knowledge, all electronic contributions were found to carry some information content. Additionally, approximately 32% of those contributions were found to carry some knowledge content. These were more than twice the proportions observed in routine communication exchanges in semi-randomly sampled process teams [22].

The above evidence suggests that the adoption of a leaner medium by the groups led members to adapt their group behavior in a way that led them to overcome the limitations posed by the leaner electronic medium. This adaptation apparently led group members to prepare longer and better thought out contributions than in face-to-face meetings.

6.4. Stage 4: Medium limitations are partially overcome

Given that several members perceived an increase in individual member contribution quality as a consequence of the adoption of the electronic medium, it seems plausible to expect that the quality of group outcomes would have been seen as increased. In fact, this was the trend of the perceptions gauged in interviews with group members. Nearly 48% of the interview respondents perceived an increase in quality, compared to the quality of similar face-to-face process improvements groups. However, 22% perceived a decrease (see Table 6).

The main reason given by members for the increase in group outcome quality was an increase in member contribution quality; other reasons being a higher departmental heterogeneity enabled by the low disruptiveness inherent in the electronic medium, and the longer time to reflect on contributions before replying to them. In several responses, reasons were stated in a combined way, as illustrated in the following quote from a senior faculty:

[The reason for the increase in quality] is the opportunity to reflect on [the process change recommendations]. They would have been

Table 6
Effect of the electronic medium on redesign proposal quality

Answer	Frequency	Percentage
Increased	22	47.8
Had no effect	11	23.9
Decreased	10	21.7
Do not know	3	6.5
χ^2	16.08	
df	3	
<i>p</i>	0.001088	

Forty-six respondents. Question: Did the use of e-mail increase or reduce the quality of the process change recommendations generated by your group? Why?

produced incrementally one would think. Maybe somebody kicked them off, but just the longer elapsed time and the opportunity to refine them that would not have been available in a face to face situation... plus, they are written down, they are much more clearly articulated than if they are verbally [i.e. orally] expressed.

The main reason given by the respondents for the decrease in quality was the higher discussion ambiguity, also seen as inherent in the electronic medium. These explanations partially confirm the hypothesis that equivocality reduction is actually better accomplished in face-to-face than in electronic meetings, as

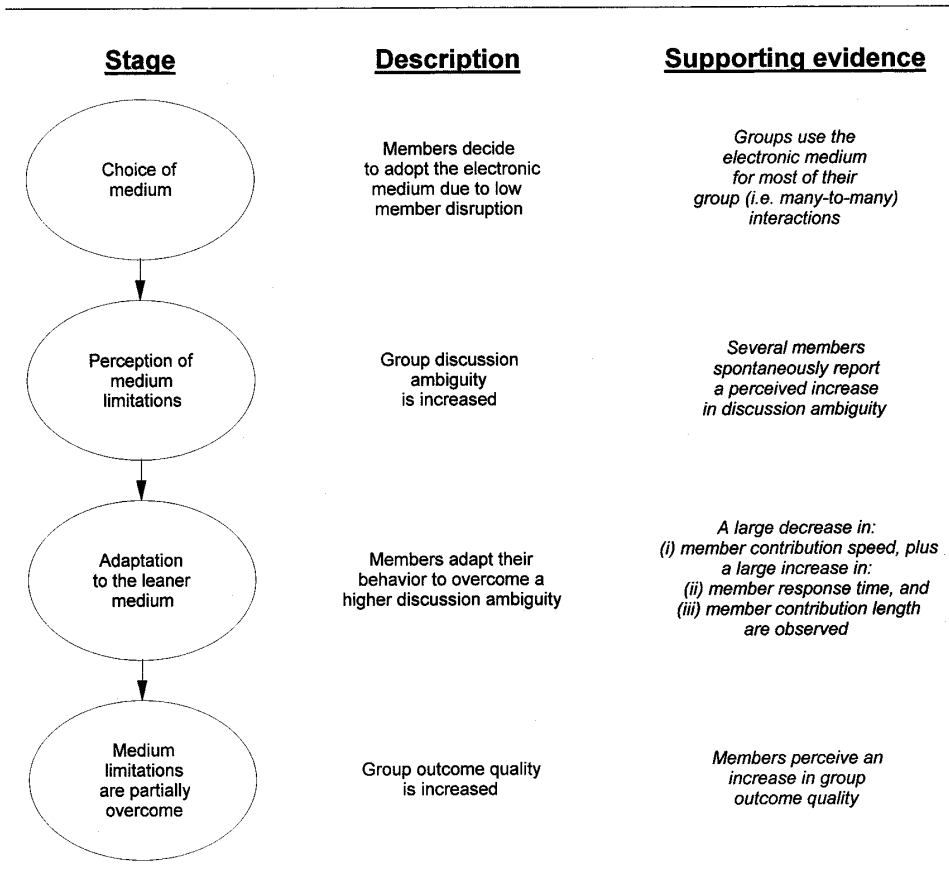


Fig. 1. Summary of the group stages.

the media richness theory claims. Our study, however, suggests that this medium limitation was perceived by group members, which triggered a reaction that led members to overcome this limitation by constructing and posting better written contributions. This is illustrated in Fig. 1.

7. Conclusion

We described in this paper a 7-month study of five process improvement groups in a New Zealand university. Those groups had from 7–13 members, and altogether involved 46 staff and faculty from 15 distinct university departments. The groups studied identified, analyzed, and conceptually redesigned one or a few processes. Redesign proposals were later implemented, resulting in process quality and productivity improvements.

The main goal of this paper was to show that groups can decide to adopt a lean communication medium for a relatively equivocal task, and that such medium adoption can foster outcomes that are perceived by the group members as better than those likely to result from the adoption of a richer medium. We argued that this can occur because group members adapt their communication behavior in order to overcome the communication constraints posed by the leaner medium, which is evidenced in our research in an effort by the members to reduce ambiguity in electronic contributions. We present research data to support these claims, based on the analysis of the five process improvement groups.

Although contradictory to the expectations based on the media richness theory, the adaptive behavior displayed by the groups is remarkably consistent with that of groups in similar circumstances in different organizational settings. However, no single existing theoretical framework seems to provide a solid basis for predicting the adaptive behavior observed.

Acknowledgements

I would like to thank the staff of the University of Waikato, particularly the members of the five groups, for their time and collaboration. Thanks are also due to Robert Wellington and Andrea Jenkins, for their help in the facilitation of some of the groups and in the

interviewing of group members; and to Bob McQueen, for his valuable suggestions throughout this study and for generously providing research data obtained from his investigation of face-to-face business group meetings. An earlier version of this paper was presented at the 1998 Information Resources Management Association International Conference, and published in its proceedings.

References

- [1] M. Alavi, An assessment of electronic meeting systems in a corporate setting, *Information and Management* 25(4), 1993, pp. 175–182.
- [2] R.J. Boland, R.V. Tenkasi, Perspective making and perspective communities of knowing, *Organization Science* 6(4), 1995, pp. 350–372.
- [3] R.L. Daft, R.H. Lengel, Organizational information requirements, media richness and structural design, *Management Science* 32(5), 1986, pp. 554–571.
- [4] R.L. Daft, R.H. Lengel, L.K. Trevino, Message equivocality, media selection, and manager performance: Implications for information systems, *MIS Quarterly* 11(3), 1987, pp. 355–366.
- [5] Davenport, T.H., *Process Innovation*, Harvard Business Press, Boston, MA, 1993.
- [6] G. DeSanctis, M.S. Poole, G.W. Dickson, B.M. Jackson, Interpretive analysis of team use of group technologies, *Journal of Organizational Computing* 3(1), 1993, pp. 1–29.
- [7] A.R. Dennis, R.B. Gallepe, A history of group support systems empirical research: Lessons learned and future directions, in: L.M. Jessup, J.S. Valacich, (Eds.), *Group Support Systems: New Perspectives*, Macmillan, New York, 1993, pp. 59–77.
- [8] A.R. Dennis, B.J. Haley, R.J. Vanderberg, A meta-analysis of effectiveness, efficiency, and participant satisfaction in group support systems research, in: J.I. DeGross, S. Jarvenpaa, A. Srinivasan, (Eds.), *Proc. 17th Int. Conf. Information Systems*, The Association for Computing Machinery, New York, 1996, pp. 278–289.
- [9] M. Elden, R.F. Chisholm, Emerging varieties of action research, *Human Relations* 46(2), 1993, pp. 121–141.
- [10] J. Fulk, J. Schmitz, C.W. Steinfield, A social influence model of technology use, in: J. Fulk, C.W. Steinfield, (Eds.), *Organizations and Communication Technology*, Sage, Newbury Park, CA, 1990, 117–140.
- [11] J. Galbraith, *Designing Complex Organizations*, Addison-Wesley, Reading, MA, 1973.
- [12] B. Gustavsen, Action research and the generation of knowledge, *Human Relations* 46(11), 1993, pp. 1361–1365.
- [13] H.J. Harrington, *Business Process Improvement*, McGraw-Hill, New York, 1991.
- [14] W. Huang, K.K. Wei, R.T. Watson, L.H. Lim, R. Bostrom, Transforming a lean CMC medium into a rich one: An empirical investigation in small groups, J.I. DeGross, S.

- Jarvenpaa, A. Srinivasan, (Eds.), Proc. 17th Int. Conf. on Information Systems, The Association for Computing Machinery, New York, 1996, pp. 265-277.
- [15] S. Jonsson, Action research, in: H. Nissen, H.K. Klein, R. Hirschheim, (Eds.), Information Systems Research: Contemporary Approaches and Emergent Traditions, North-Holland, New York, 1991, pp. 371-396.
- [16] N.F. Kock, Jr., MetaPro: A Group Process for Business Process Improvement, Project Report GP-G-1995-R5, Department of Management Systems, University of Waikato, Hamilton, New Zealand, 1995, 25pp. (also available via Internet from <http://www.cis.temple.edu/~kock>).
- [17] N.F. Kock, Jr., Process Reengineering, PRO: A Practical Methodology, Editora Vozes, Sao Paulo, Brazil (in Portuguese), 1995a, 187pp.
- [18] N.F. Kock, Jr., J.L. Corner, Improving university processes through computer-mediated process redesign groups, Campus Wide Information Systems 14(1), 1997, pp. 13-23.
- [19] N.F. Kock, Jr., R.J. McQueen, Asynchronous groupware support effects on process improvement groups: An action research study, Proc. J.I. DeGross, S. Jarvenpaa, A. Srinivasan, (Eds.), 17th Int. Conf. on Information Systems, The Association for Computing Machinery, New York, 1996, pp. 339-355.
- [20] N.F. Kock, Jr., R.J. McQueen, Is re-engineering possible in the public sector? A Brazilian case study, Business Change and Re-engineering 3(3), (1996a) pp. 3-12.
- [21] N.F. Kock, Jr., R.J. McQueen, M. Baker, Learning and process improvement in knowledge organizations: A critical analysis of four contemporary myths, The Learning Organization 3(1), 1996, pp. 31-41.
- [22] N.F. Kock, Jr., R.J. McQueen, J.L. Corner, The nature of data, information and knowledge exchanges in business processes: Implications for process improvement and organizational learning, The Learning Organization 4(2), 1997, pp. 70-80.
- [23] M. Lea, Rationalist assumptions in cross-media comparisons of computer-mediated communication, Behaviour and Information Technology 10(2), 1991, pp. 153-172.
- [24] A.S. Lee, Electronic mail as a medium for rich communication: An empirical investigation using hermeneutic interpretation, MIS Quarterly, June, (1994), pp. 143-157.
- [25] R.H. Lengel, R.L. Daft, The selection of communication media as an executive skill, Academy of Management Executive 2(3), 1988, pp. 225-232.
- [26] J. Manzi, Working together, D. Coleman, (Ed.), Proc. Groupware '92 Conference, Morgan Kaufmann, San Mateo, CA, 1992, pp. 3-9.
- [27] M.L. Markus, Asynchronous technologies in small face-to-face groups, Information Technology and People 6(1), 1992, pp. 29-48.
- [28] M.L. Markus, Electronic mail as the medium of managerial choice, Organization Science 5(4), 1994, pp. 502-527.
- [29] R.J. McQueen, The effect of voice input on information exchange in computer supported asynchronous group communication, Ph.D thesis, Chapter 4, University of Waikato, Hamilton, New Zealand, 1991.
- [30] W.J. Orlikowski, Learning from notes: Organizational issues in groupware implementation, in: J. Turner, R. Kraut, (Eds.), Proc. CSCW '92 Conference, The Association for Computing Machinery, New York, 1992, pp. 362-369.
- [31] W.J. Orlikowski, J. Yates, Genre repertoire: The structuring of communicative practices in organizations, Administrative Science Quarterly 39(4), 1994, pp. 541-574.
- [32] M.S. Poole, G. DeSanctis, Understanding the use of group decision support systems: The theory of adaptive structuration, in: J. Fulk, C. Steinfield, (Eds.), Organizations and Communication Technology, Sage, Newbury Park, CA, 1990, pp. 173-193.
- [33] M.S. Poole, M.H. Jackson, Communication Theory and Group Support Systems, in: L.M. Jessup, J.S. Valacich, (Eds.), Group Support Systems: New Perspectives, Macmillan, New York, 1993, pp. 281-293.
- [34] B.A. Reinig, R.O. Briggs, M.M. Shepherd, J. Yen, J.F. Nunamaker, Jr., Affective reward and the adoption of group support systems: Productivity is not always enough, Journal of Management Information Systems 12(3), 1995, pp. 171-185.
- [35] F. Restle, Critique of pure memory, in: R.L. Solso, (Ed.), Theories in Cognitive Psychology: The Loyola Symposium, Erlbaum, Potomac, MD, 1974, pp. 203-217.
- [36] E.H. Schein, How can organizations learn faster? The challenge of entering the Green Room, Sloan Management Review, Winter, 1993, 85-92.
- [37] Stevenson, T., Groupware: Are we Ready?, PC Magazine, June 15, 1993 267-299.
- [38] Watson, R.T., R.P. Bostrom, A.R. Dennis., Fragmentation to integration, in: P. Lloyd, (Ed.), Groupware in the 21st Century, Praeger, Westport, CT, 1994, pp. 29-39.
- [39] K.E. Weick, The Social Psychology of Organizing, Addison-Wesley, Reading, MA, 1979.
- [40] K.E. Weick, M.G. Bougon, Organizations as Cognitive Maps: Charting Ways to Success and Failure, The Thinking Organization, H.P. Sims, Jr., Gioia, D.A. (Eds.), Jossey-Bass, San Francisco, CA, 1986, pp. 102-135.
- [41] J. Yates, W.J. Orlikowski, Genres of organizational communication: A structural approach to studying communication and media, Academy of Management Review 17(2), 1992, pp. 299-326.



Ned Kock is a professor of information systems at Temple University. He has been working as a systems analyst and organizational development consultant since 1987. He is the author of the book *Process Re-engineering, PRO: A Practical Methodology*, published in Brazil by Vozes. His articles have appeared in *Communications of the ACM*, *Journal of Organizational Computing and Electronic Commerce*, *Information Systems Journal*, and *Information Technology and People*. Kock serves on the editorial boards of the *Journal of Systems and Information Technology* and *Journal of Information Technology Cases and Applications*.