# AN EMPIRICAL STUDY ON THE COMMUNICATION QUALITY OF MAJOR COLLABORATION TECHNOLOGIES

**Dr. Roman M. Wong, Barry University, email: rwong@mail.barry.edu**
**Dr. Cretson L. Dalmadge, Winston-Salem State University**

## ABSTRACT

*Managers are responsible to plan and acquire information and communication technologies to support proper functioning of work groups and coordination of business processes. In the current study, we revisit the concept of communication quality and its underlying dimensions, and provide a modified view to the concept. Based on our revised concept of communication quality, we examined the technical properties of a sample of twenty-one major collaboration technologies that have been identified in prior study, and ranked them along the three communication quality dimensions. The a priori logical ranking was then validated through a survey administered on a group of forty-seven experienced practitioners. The validation result has confirmed all three logical ranking of the collaboration technologies. The ranking provides business managers with a taxonomy and validated examples for classifying and selecting appropriate collaboration technologies that optimally support process management.*

**Key Words:** Collaboration technologies, communication quality, media richness, interactiveness, specificity

## INTRODUCTION

Communication technology plays a critical role in organizational management in the Internet era. Geographically dispersed business processes are coordinated using information and communication technologies. The transmission of multimedia information is enabled by advancement in information and communication technologies. Researchers such as Pauleen (Pauleen 2001) and Kumar (Kumar 2001) identify the necessity of adopting effective information and communication technology for supply chain management. Research in other areas such as customer relation management (CRM) and enterprise resource planning (ERP) is also showing the importance of collaboration technologies for effective process management. The fact is, irrespective of the specific mission of the organization or business unit, information and communication technologies are emerging as a necessary factor for business success. This need for effective information and communication technologies in process management leads to the question: "How do we proceed in choosing technologies to support our business processes?" Wong and Dalmadge (Wong and Dalmadge 2004)suggest that process characteristics, such as its processing nature and how it is set up and organized to work with other processes, have a strong implication on the communication quality that needs to be in place to support the optimal operation of that process. On the other hand, the technical properties of an information and communication technology determine the quality of communication it can support. Therefore, it is managers' responsibility to make sure the collaboration technologies are properly matched with the needs of the business processes.

In the current study, we revisit the concept of communication quality and its underlying dimensions, and provide a modified view to the concept. Based on our revised concept of communication quality, we examined the technical properties of a sample of twenty-one major collaborative technologies and ranked them along the three dimensions underlying the concept of communication quality. These twenty-one collaboration technologies have been identified by Wong and Dalmadge (Wong and Dalmadge 2004) as technologies commonly installed in organizations for the support of their processes management. The logical ranking was then validated through a survey administered on a group of forty-seven experienced, professionally qualified practitioners. The validation result has confirmed all three logical ranking of the collaboration technologies. The ranking provides business managers with a taxonomy and validated examples for classifying and selecting appropriate collaboration technologies that optimally support process management.
The objective of this paper is to first present our discussion of the revised concept of communication quality, and the classificatory taxonomy for collaboration technologies together with the basis for their classification. We then provide a summary of the survey we have done in validating the logical classification.

## MEDIA QUALITY IN COMMUNICATION

Prior studies in media richness have pointed out the importance of cue multiplicity and feedback immediacy to decision quality [e.g. (Daft and Lengel 1986), (Kahai and Cooper 2003)]. Daft and Lengel (Daft and Lengel 1986) and Steinfield and Fulk (Steinfield 1986) have taken media richness as a linear construct starting with a very lean medium, written data, and progressing to the richer media such as telephone and face-to-face. Wong and Dalmadge (Wong and Dalmadge 2004) suggest that the information quality of a given collaboration method needs to be studied as a multi-dimensional construct rather than a single-dimensioned construct of richness. Three dimensions underlying the construct of communication quality are identified in their study: (a) The richness of the communication medium, (b) degree of interactiveness supported by the communication medium, and (c) the ability to support high level of precision in data representation. In the current study, we, however, argue that the dimension of precision is a quality embedded in specificity rather than as a stand-alone dimension underlying communication quality. Such deviation is explained more fully in the following paragraphs.

### Richness

In the traditional media research, richness measures the number of channels available for the simultaneous transmission of data in communication, notwithstanding the varying degree of feedback supported by the media and difference in the measure of personalness of each media (Daft and Lengel 1986). In another word, the measurement of simultaneity of transmission is the measure for multiplicity of cues. It therefore can be used as a measure for the depth or intensity of the data represented in these channels. This rather technical definition implies that richness is the measure of the level of data abstraction and transformation done in obtaining a representation of the observed phenomenon or object. The level of richness of a collaboration method is also a function of the number of alternative data representation forms that can be accommodated. For example, the monthly sales summary can be presented in tabulated form as well as in the form of a line chart with appropriate scales and legends. The line chart, while preserving the same level of data abstraction as the tabulated data using legends, provides another form of data representation. The required level of media richness is a function of the multiplicity of information stimuli, temporal criterion of processing such stimuli, and the depth/intensity of the stimuli. Face to face, video conferencing, streaming video, computer conferencing and online/steaming presentations are all examples of very rich communication channels. All of them support visual information – allowing users to process gestures and body language along with voice and alpha numeric data.

**Interactiveness**

Interactiveness is a measure of the timeliness and degree of association (i.e. one-way, two-way, multiple-way) that a given collaboration method allows for synchronizing data transmission in multi-way communication. Research on teamwork shows that collaboration technologies play an important role in bridging the gap between group members that are separated by space and/or time (Malone 1994). Higher degree of interactiveness serves to bridge this gap allowing dispersed team members to work more efficiently and effectively. Richer information such as video and audio streaming on multimedia featuring a temporal dimension also demands a high level of interactiveness (Purao and Han 2000). The interactiveness dimension of communication quality is defined in terms of two underlying magnitudes: (a) how timely the feedback can reach its targeted recipient, and (b) whether multiple-direction feedback is allowed (if so, whether it is unary or binary or ternary). Timeliness is an essential factor in information quality (Kriebel 1979; Ives 1983; Wang 1996), which determines the effectiveness of process management. In addition to timeliness, the degree of association is another magnitude of interactiveness. A multi-way conversation, for example, allows a higher level of interactiveness since it enables information to flow in multiple directions simultaneously, hence, requires shorted time for the parties involved in the communication to get informed.

**Specificity**

Specificity is different from accuracy and precision. The specificity dimension in a collaboration method refers to the capability of allowing the appropriate data representation forms to go through in the communication process. The use of a suitable data representational form is important for capturing the correct aspect and level of abstraction, so that the most critical attributes of the original object, including constraints associated with possible courses of action and time sequence of events (12), can be reserved or replicated. Note that most data representation forms have the function of suppressing data richness (e.g. data aggregation in traditional accounting systems). Accuracy is a necessary element of information quality (11). As such all processes demands accuracy built into the information content. Precision, on the other hand, refers to how close a measurement taken is to the measurement in reality. For example, a linear measurement in integer is not as precise as in one with decimal places. However, more precision in an inappropriate representation form does not correct the problem created by missing a measurement of a critical attribute, or by over sampling the attributes of the real object. Therefore, although zooming-in may increase the precision of a video shot, it does not necessarily remedy the fact that it lacks the specificity that a technical blueprint allows for correct design.

**Table 1 Summary of Research and Operational Definitions for Richness, Interactiveness, and Specificity.**

| Quality Dimension | Research Definition | Operational Definition |
|---|---|---|
| Richness | Cue multiplicity and level of suppression/transformation, availability of alternative media | • Level of abstraction<br>• Number of media forms |
| Interactiveness | The timeliness of the feedback in reaching its targeted recipient | • Timeliness<br>• Degree of association (one-way vs. multi-way) |
| Specificity | The capability of accommodating alternative forms of representation in data transmission to allow appropriate aspect and level of abstraction, so that the most critical attributes of the original object can be reserved or replicated | • Number of forms<br>• Availability of static attributes<br>• Availability of temporal attributes |

Table 1 summarizes the research and operational definitions of the three dimensions that underlie the construct of communication quality. Based on the operational definitions, the twenty-one collaboration technologies were classified along the three dimensions. Due to limitation of space, the more detailed classifications are reported under separate cover. For more details on the classification part, please send you request to the first author. Table 2 summarized the categorization of the collaboration methods based on the logical numeric ranking.

**Table 2 Summary of Logical Ranking for Richness, Interactiveness, and Specificity.**

| Collaboration methods | Richness | Inter-activeness | Specificity |
|---|---|---|---|
| Fax | L | L | H |
| Written Document (wrtDoc) | L | L | H |
| File Transfer (FileTran) | H | H | H |
| Web Pages (html) | H | H | H |
| Shared Database (SharedDB) | L | H | H |
| email | L | H | L |
| Instant Message (instMsg) | L | H | L |
| White Board (whiteboard) | L | H | L |
| Electronic Meeting Systems (EMS) | H | H | H |
| Document Conferencing (docConf) | H | H | H |
| Shared Document (shareDoc) | H | L | H |
| Video Conferencing (videoConf) | H | H | L |
| Tele-Conferencing (teleConf) | H | H | L |
| Telephone (teleCall) | H | H | L |
| Face-to-Face (face2face) | H | H | L |
| Computer Conference (CompuConf) | H | H | H |
| Information Sharing (infoSharing) | H | L | H |
| Video Streaming (streamVideo) | H | L | L |
| Audio Streaming (streamAudio) | H | L | L |
| Presentation Streaming (streamPresentation) | H | L | H |
| Smart-room (smartRoom) | H | H | H |
| **Legend: H = 'High', L = 'Low'** | | | |

## VALIDATION

In their discussion of the selection of a studying method for decision support systems, Adelman and Donnell (13) suggest that researchers can based on their situation select from three major study approaches an appropriate one for evaluating the performance of a given decision support system. These three system evaluation approaches are (a) the use of subjective judgment from users with the help of a questionnaire, (b) observation by nonparticipating experts, and (c) objective measurement taken in empirical experimentation. These same researchers point out that notwithstanding the various advantages associated to the experimental approach, the other two approaches often are used more due to the relatively high data collection cost associated to an experimentation-based study. For a similar reason, we have used subjective judgment collected from experienced practitioners for our study.

Our analysis plan was to, relying on their familiarity with the technical properties of those technologies, survey experienced practitioners on how they would rank the same collaboration technologies using the three-dimensioned communication quality construct. We expect the a priori ranking we have done earlier based on logical analysis to be consistent with that done by the practitioners. The survey and its result are briefly discussed in the following paragraphs.

### The Survey

In a questionnaire survey we administered on the technical and engineering personnel of four major network and Internet solution companies, forty-seven technical/engineering practitioners responded to the survey. All of these respondents have attained at least a bachelor’s degree; 33% of them have at least one graduate degree. In addition to college education, 81% of the respondents have achieved one or more professional certification qualifications in the areas of database, networking, application development, and operating/server systems. In the survey, the subjects were asked to rank a list of major enterprise collaboration technologies by the three-dimensioned quality construct using a ten-point scale. The list consists of a sample of twenty-one collaboration technologies, identified in the Wong and Dalmadge study (3)to be commonly used in organizations for supporting their business processes.

### Data Analysis and Results

Our data analysis objective is to verify that the a priori ranking done before the survey was consistent with that performed by the practitioners. Therefore, the non-parametric Kendall's tau-b rank order was calculated to compare the ranking from each of the 47 respondents to the a priori ranking. This produces 47 comparisons for each of the three dimensions (i.e. richness, interactiveness, and specificity). The null hypothesis for the rank order testing is that the pattern of the rank order for the a priori ranking of the collaboration technologies is different from that generated by the practitioner subjects. Since the ranking of the collaboration technologies are not mutually exclusive among themselves, some of the collaboration technologies in the sample can share the same ranking as others. This coding created a number of ties in the data sets. The Kendall's tau-b statistics preclude the tied values in the numerator; therefore, it provides a more conservative test.

For the richness dimension, the statistical result for 34 of the 47 comparisons (72.34%) is significant at the 0.05 or lower level. For the interactiveness dimension, the statistical result for 45 of the 47 comparisons (95.74%) is significant at the 0.05 or lower level. For the specificity dimension, the statistical result for 37 of the 47 comparisons (78.72%) is significant at the 0.05 or lower level. In another word, the hypothesis that the pattern of the rank order for the a priori ranking of the collaboration technologies is different from that generated by the practitioner subjects can be rejected at the traditional level for most of the cases. In order to obtain a comparison of the rankings at the aggregate level, we calculated the average ranking (based on the 47 individual rankings) for each communication technology. We then performed the Kendall's tau-b comparison between the a priori ranking and the average practitioner ranking. The statistical result is significant at the 0.01 level. Therefore, the hypothesis that the pattern of the rank order for the a priori ranking of the collaboration technologies is different from that generated the aggregate of the practitioner subjects can also be rejected with very strong evidence.

## FUTURE RESEARCH

Wong and Dalmadge (3) has suggested the importance of matching a firm's IT infrastructure to the needs of its processes. In this study, we have done the first step in validating their theoretic model about matching business processes with appropriate collaboration technologies. Our validated list of collaboration technologies should facilitate researchers to proceed to validate the impact of the process-technology matching /mismatching on the organization's overall productivity. Such validation is important in providing further insights in IT infrastructure planning.

## CONCLUSION

Managers are responsible to plan and acquire information and communication technologies to support proper functioning of work groups and coordination of business processes. Since the technical properties of an information and communication technology determine the quality of communication it can support; therefore, it is managers' responsibility to make sure the collaboration technologies are properly matched with the needs of the various work groups and processes.

In the current study, we revisit the concept of communication quality and its underlying dimensions, and provide a modified view to the concept. We argue that precision is a requirement embedded in the dimension of specificity. Based on our revised concept of communication quality, we examined the technical properties of a sample of twenty-one major collaboration technologies that have been identified in prior study, and ranked them along the three communication quality dimensions. The a priori logical ranking was validated through a survey administered on a group of forty-seven experienced practitioners. The validation result has confirmed all three logical ranking of the collaboration technologies. The ranking provides business managers with a taxonomy and validated examples for classifying and selecting appropriate collaboration technologies that optimally support process management.

## REFERENCES


1. Pauleen, D.J.a.P.Y., *Relationship building and the use of ICT in boundary crossing virtual teams: a facilitator's perspective.* Journal of Information Technology, 2001. **16**: p. 221-236.
2. Kumar, K., *TECHNOLOGY FOR SUPPORTING SUPPLY CHAIN MANAGEMENT.* Communications of the ACM, 2001. **44**(6): p. p58 - 63.
3. Wong, R.M. and C.L. Dalmadge. *Media Choice for Complex and Knowledge-Intensive Processes*. in *The Thirty-Seventh Annual Hawaii International Conference on System Sciences*. 2004. Big Island, Hawaii: IEEE.
4. Daft, R. and R.H. Lengel, *Organizational Information Requirements, Media Richness and Structural Design.* Management Science, 1986. **vol. 32**(5).
5. Kahai, S.S. and R.B. Cooper, *Exploring the Core Concepts of Media Richness Theory: The Impact of Cue Multiplicity and Feedback Immediacy on Decision Quality*. Journal of Management Information Systems, 2003. **20**(1): p. 263-299.
6. Steinfield, C.W., and J. Fulk. *Task Demands and Managers use of Communication Media: an Information Processing View*. in *Academy of Management Conference*. 1986. Chicago.
7. Purao, S. and T.D. Han, *Distributing Multimedia Content to Balance Quality of Service and Cost.* Journal of Management Information Systems, 2000. **17**(1): p. 141-165.
8. Malone, T.W., and K. Crowston, *The Interdisciplinary Study of Coordination.* ACM Computing Surveys, 1994. **26**(1).
9. Kriebel, C.H., *Evaluating Quality of Information Systems*, in *Design and Implementation of Computer-Based Information Systems*, N.S.a.E.G. (eds), Editor. 1979: German-town, P.A.
10. Ives, B., M. H. Olson, and J. J. Baroudi, *The Measurement of User Satisfaction.* Communications of the ACM, 1983. **26**(10): p. 785-793.
11. Wang, R.Y., and Strong D. E., *Beyond Accuracy: What Data Quality Means to Consumers*. Journal of Management Information Systems, 1996. **12**(4): p. 5-34.
12. Tulving, E. and D.M. Thompson, *Encoding Specificity and Retrieval Processes in Episodic Memory*. Psychological Review, 1973. **80**(5): p. 352-373.
13. Adelman, L. and M.L. Donnell, *Evaluating Decision Support Systems: A General Framework and Case Study*, in *Microcomputer Decsion Support Systems: Design, Implementation, and Evaluation*, S.J. Andriole, Editor. 1986, QED Information Sciences, Inc.: Wellesley, MA.