Access to, Usage of, and Outcomes from an Electronic Messaging System

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This study examines relationships among perceived accessibility to an electronic messaging system (EMS), computer-monitored and reported usage of the system by approximately 100 employees of one division of an aerospace firm, user's job type, perceived appropriateness of the EMS, and reported outcomes such as changes in effectiveness and use of paper-based media. Greater accessibility resulted in more usage and reported increases in effectiveness. Physical distance to a terminal affects the associations of other aspects of accessibility with usage and has a greater influence on these associations earlier in one's adoption process. Differences in job type showed statistically significant associations with usage, independent of the influence of accessibility. Computer-monitored and reported usage measures were only moderately correlated and were differentially associated with the access measures and with the two outcomes. The article ends by discussing implications for implementation and evaluation of computer-based communication systems, theories of media characteristics and information value, and methodological issues in using computer-monitored usage data.

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Additional Key Words and Phrases: Accessibility, communication augmentation, computer-monitored data, media substitutability

1. INTRODUCTION

The combination of the capabilities of computers and telecommunications networks provides the electronic messaging system (EMS) with the potential to remove a variety of constraints inherent in traditional organizational communication channels and to improve certain aspects of office work [21, 38].

For example, users do not have to be on the system simultaneously to send or receive messages, thereby removing temporal constraints inherent in face-to-face

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or telephone communication. Users may respond as quickly as they wish to clarify points or request further information, reducing constraints of interpersonal interruptions and time lags inherent in paper-based communications or a series of meetings. Messages can be retrieved wherever the user has access to a terminal, which removes geographic constraints inherent in face-to-face communication and the delays inherent in point-to-point communication such as letters and memos. Users may apply computer commands to help structure their communication, such as by preestablished distribution lists or collaborative writing, which eliminates the dyadic constraints of some traditional communication interactions. Users can contact other users by using keywords for interest areas or distribution lists, without needing to know the other participants in advance. They may also have access to multiple applications and technologies through one system, thereby avoiding formatting and transformational constraints inherent in using several traditional media.

To take advantage of such potential, of course, users must have access to an EMS. Further, other contextual factors influence the adoption and use of EMS. A better understanding of the forms and consequences of these factors on the use and outcomes associated with an EMS is necessary if organizations are to take advantage of new information systems and to cope with the increasing complexity of their environments [10, 23, 26].

This claim is not as obvious as it seems. When the computer administrators in one organization saw that usage of an EMS was correlated with benefits, they wanted to "put a box on every desk" without regard to a wide variety of other variables that completely affected this correlation [41]. Another organization charged directly for usage of a new EMS in spite of the fact that all other media (memos, express mail, telephone calls, and facsimile) were supported as administrative overhead and then wondered why people did not quickly adopt the system [29]. A third organization adopted an intelligent telephone system to provide nearly 100 sophisticated features at the touch of a finger, but the employees used only an average of 3 because the features were perceived as difficult to use and not appropriate for some types of jobs [27]. This study considers some of the factors that can impede—or enhance—the relationship between usage of EMS and potential benefits associated with that usage.

2. CONCEPTUAL FOUNDATION AND HYPOTHESES

2.1 Accessibility

For doctors, scientists, engineers, forest service personnel, county welfare agency workers, and potential adopters of innovation, perceived accessibility to information has been a stronger determinant of information use than the perceived quality of the desired information [1, 3, 9, 16, 19, 32, 45, 46].

One theoretical rationale for this apparent greater interest in the accessibility of information than the quality or value of information is due to the nature of information itself. Because the value of retrieved information is often difficult to determine, both before and after retrieval, users cannot easily guarantee that the results of a search for information or the use of the channel will be cost beneficial [18]. Trading greater accessibility for lower information value may be a rational

strategy for reducing this uncertainty, especially in the early stages of adoption when uncertainty is greatest.

Other factors may also influence the trade-off between access costs and information value such as trustworthiness of sources in conditions of ambiguity [32], psychological costs and information-sharing norms in organizations [13], professional motivations for seeking information [1, 8], and the authoritativeness of, alternatives to, or ability to reduce the uncertainty of, a specific channel [53].

The influence of accessibility on the use and evaluation of a computer-mediated communication system such as EMS has received increasing attention [20, 21, 25, 31, 34, 41, 52]. Culnan [10, 11] suggested four dimensions to the concept of system accessibility: (a) terminal accessibility, (b) information accessibility, (c) system reliability, and (d) ease of learning the control language. This study focuses on the first dimension of accessibility.

With respect to accessibility, an EMS differs from general information systems in at least one important way: One of the values of using an EMS is the ability to communicate with other people. The extent to which a potential user feels that important or geographically dispersed contacts will also be using the system influences a user's level of adoption [20, 25, 28, 43, 45, 50]. When important or frequent communication partners also use an EMS, the system is more valuable both for the individual user and for the organization as a whole, leading to greater adoption and usage earlier in the diffusion process [28, 44].

Thus, where terminals are located, the difficulty in gaining access to the system, how many important contacts also use the system, and the stage of adoption of the system, should influence the use of and outcomes associated with an EMS.

Research Question 1: How are components of EMS terminal accessibility related?

Hypothesis 1a: Accessibility to an EMS is positively associated with usage of the system.

Hypothesis 1b: Accessibility is a greater influence on usage of the system than the level of needed contacts also using an EMS.

Hypothesis 1c: Accessibility is a greater influence on levels of usage earlier in a user's process of adopting an EMS.

Hypothesis 1d: The value (number of others who are accessible through the system) of an EMS is greater for earlier adopters.

Our hypotheses are detailed in the Figure 1 model.

2.2 Media Characteristics and Perceived Appropriateness of EMS

Studies of *social presence* and *information richness* have suggested that media differ in their appropriateness and utility for different tasks [12, 35, 36, 41, 47]. *Social presence* is loosely defined as the extent to which a medium can transmit the nonverbal cues, physical proximity, and psychological context of an unmediated interpersonal communication. *Information richness* is loosely defined as the ability of a medium to allow learning from, and interpretation of, the message. Media such as business memos or EMS have lower social presence and infor-

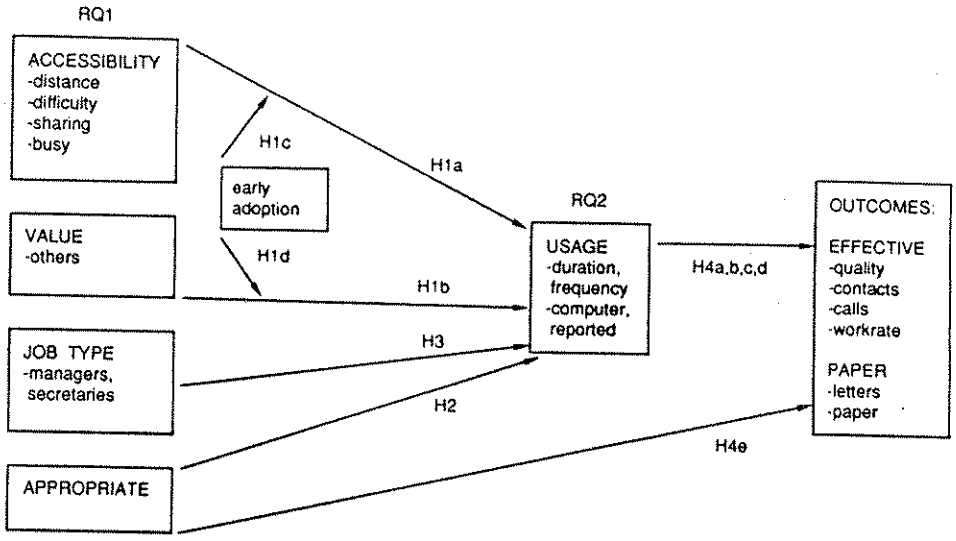

Fig. 1. Overall model and hypotheses.

mation richness than face-to-face interactions or telephones, so they are less appropriate for tasks requiring interpersonal or intuitive communication. Owing to some of the capabilities resulting from the convergence of computing and telecommunications, however, EMS are hypothesized to be appropriate for other kinds of tasks, such as exchanging information, asking questions, exchanging opinions, staying in touch, and generating ideas.

Hypothesis 2: Perceived appropriateness of EMS for a range of communication activities will be positively associated with use of an EMS.

2.3 Job Type

Individuals in different jobs are likely to use an EMS in different ways and in different amounts. Some organizational tasks require predictable, routine information to reduce uncertainty, while other tasks require difficult-to-analyze information or negotiated interpretation among participants to reduce equivocality [12]. Over 20 studies have shown that managers tend to spend around 75 percent of their time communicating, and most of that in face-to-face interaction, while clerical workers tend to spend 30–40 percent of the time communicating, and most of that handling printed communications [43]. Thus, because managers spend much of their time in face-to-face communication about equivocal tasks that cannot be easily resolved through text-based information, an EMS may not provide sufficiently diverse cues and content for those potential users, as suggested above. For clerical workers such as secretaries, who have somewhat more certain tasks such as exchanging factual information, an EMS is more likely to provide sufficient support for their communication needs. Further, managers delegate more routine and less decision-oriented work to secretaries, which would contribute to the greater likelihood of their use of an EMS.

Hypothesis 3: People in lower organizational jobs (e.g., secretaries) are more likely to use an EMS than people in higher organizational jobs (e.g., managers).

2.4 Usage

An important concept in the study of information systems in general is usage. We focus on two dimensions, the form and the source, of usage measures here (these are discussed in greater detail in [55]). The form of usage data may include, among other types of usage, duration (or the total amount of time spent on a system), and frequency (or the number of accesses or entries to a system). With respect to computer systems, these forms of usage are typically called connect time and log-ons, respectively. The source of usage data may include computer-monitored data or self-reported data. There is considerable evidence that data on the same activity collected from self-reports and observed or monitored behavior, in general, are not highly correlated [5, 7] and that this holds for reported and computer-monitored computer usage [6, 14, 49]. Of particular significance is that usage data collected by the computer system are typically much more accurate and reliable than self-reported usage data, can be measured from a user's initial log-on, and can be collected for the full census of users [40]. As with self-report data, however, there are also questions of validity about computer-monitored usage data. For instance, log-ons may indicate intention to use the system but may be strongly influenced by whether one can just leave the account running or must log-out of the account and terminal after each use. Similarly, connect time alone does not indicate whether the monitoring system is being actively used or what packages and commands are being used. Analyses that involve different forms of usage (duration or frequency) and different sources of usage (computer-monitored or self-reports) may come to somewhat different conclusions from those using behavioral measures of system use. In general, none of these measures of usage is the "best", and they are all typically open to interpretation. Therefore, it seems wise to use and compare multiple measures of usage.

Research Question 2: How are different forms and sources of usage measures interrelated?

2.5 Outcomes

2.5.1 *Media Substitution.* Research has generally found that the implementation of computer-mediated communication systems reduces somewhat the use of media (memos, phone calls, letters) or interpersonal exchanges (meetings, trips, office visits) that have similar demands for social presence or information richness but are more constrained by time, location, or the transience of the message (for reviews see [35, 36, 38]), thus providing opportunities for increased performance [43].

Hypothesis 4a: Usage of an EMS is positively associated with reported decreases in the use of paper-based communication channels.

2.5.2 *Communication Contacts.* Another potential outcome of using an EMS is an increase in the number, diversity, and direction of communication contacts,

including horizontal, vertical, and cross-organizational communication (for reviews see [35, 36, 38]). As Allen and Cohen [2] argued, sharing of information in R&D environments is a greater predictor of productivity than the sources of that information. Thus, using an EMS could lead to an increased stock of ideas and exposure to research activities through increased communication contacts [20]. Use of an EMS could facilitate interorganizational communication through the development of communities of interest and by assisting the exchange of information across locations, time, and hierarchies [21, 25, 54]. Finally, by making a large number of others accessible through the system, use of an EMS may increase the number of "weak ties" to infrequent or previously unknown others through whom users can find out about new information [17, 37]. The lowered social presence or information richness of an EMS may, in fact, encourage task-related communication which otherwise may have been discouraged by more formal or imposing face-to-face or telephone conversations.

Hypothesis 4b: Usage of an EMS is positively associated with reported increases in the number of communication contacts.

2.5.3. *Effectiveness.* Because of some of the characteristics of an EMS summarized earlier, use of an EMS has the potential to reduce delays in information exchange, improve maintenance of records and information received, increase coordination of geographically dispersed groups, and improve users' abilities to process large amounts of information [24, 43]. One aspect of such outcomes is improved efficiency: an increased rate of information processing. Another aspect is improved effectiveness: an increased quality of work. Considering the difficulties in evaluating the cost-benefit ratio of information, as noted above, opportunities for value-added effectiveness are seen by some as the primary justification for implementing new information systems [30, 33, 51].

Hypothesis 4c: Usage of an EMS is positively associated with reported increases in the quality of one's work.

Hypothesis 4d: Usage of an EMS is positively associated with reported increases in the rate at which users handle information.

Although perceived appropriateness is likely to influence the extent to which an individual will use an EMS (Hypothesis 2), it may have the less obvious effect of affecting how users evaluate the benefits of the EMS, regardless of their level of usage. That is because, as discussed earlier, since the value of information is often ambiguous or contextual, an EMS is likely to be evaluated on the basis of attitudes about the system as well as on the basis of usage of the system [25].

Hypothesis 4e. Perceived appropriateness of an EMS is positively associated with reported outcomes associated with the use of the EMS.

3. DATA AND METHOD

3.1 System and Subjects

The system used is PROFS (Professional Office System), running on an IBM mainframe. Users accessed PROFS by means of remote terminals (here either

IBM 3270 terminals or IBM PCs with emulation boards). PROFS was used primarily for electronic messaging at this stage of implementation in this organization. The mainframe provided support for engineering computations, graphics design, and divisional budgeting, while PC software and clerical staff provided document, financial, and administrative support. The sample for this study consisted of 148 people employed in one division of a Fortune 500 aerospace organization. This sample was a census of all 73 PROFS account holders who had received training on a new system and a random sample of 75 account holders who had not received training.[1]

3.2 Procedure

A questionnaire was administered after users had been on the system for an average of 8 months (243 days). All of those who received training, and all but 12 of those who did not, responded, resulting in a 93 percent response rate.[2] Mainframe software continuously collected measures of computer usage. (We later discuss problems inherent in analyzing computer-monitored measures of mainframe use as measures of PROFS EMS use).[3]

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[1] Training as implemented in this company did not have a significant effect on reported outcomes. Part of this lack of effect was due to the fact that those users who did not receive training had a small but significantly greater amount of prior computer experience. Respondents had moderate or frequent prior experience, but experience was not significantly correlated with any other variable.

[2] Unfortunately, because of administrative problems, not all questionnaires included the last page with the access questions. Values for the entire sample are reported when appropriate.

[3] The question immediately arises, and is discussed elsewhere, as to what portion of the computer-measured mainframe usage may be attributable to the electronic messaging component of PROFS. In a study similar to this article [48], a stratified random sample of 160 experienced PROFS users in a R&D division of a major corporation reported this ranking of PROFS usage: opening mail, 2–3 times a day; receiving a note, 1–2 times a day; sending a note, almost daily; receiving a real-time message, several times a week; printing a hard copy of a document, several times a week; replying to a note, about twice a week; searching for a document, about once a week; sending a real-time message, about once a week; forwarding a note, almost weekly; printing a hard copy of a note, almost weekly; create or modify a document, less than weekly; and so forth. Using the calendar function, scheduling meeting rooms, and the like, were used a few times a month or less. These results suggest that within PROFS, the primary use may be to support electronic messaging.

A more general study at the organization, conducted immediately after the present study of 150 randomly selected users of either PCs or terminals, found that: (1) most workers used PCs instead of terminals (69 percent of managers reported using PCs only versus 18 percent of managers using terminals; among clericals, usage was 95 and 5 percent, respectively; among engineers, 53 and 31 percent, respectively), (2) clericals were more likely to use the PC word processing software more, and engineers were less likely to use either PROFS or the PC spreadsheet software ($p < .05$), but (3) engineers were twice as likely as the other job categories to use a shared terminal in an open area. The managers and clericals in this sample ranked their use of the following from most to least: PC word processing, PC spreadsheet, connecting to the mainframe, PROFS, downloading, PC database, and PC chart programs, with considerably lower estimated number of usage hours by engineers for the first three applications. This second study indicates that (1) the majority of workers primarily used PCs rather than terminals, (2) they used PC software for a substantial portion of their office information tasks, and (3) engineers were much less likely to do either of these. Thus, we have a feeling that for managers and clericals in the present organization, although PROFS was clearly not used exclusively for electronic messaging, neither was it used primarily for word processing, and users were able to distinguish PROFS usage from other mainframe usage. However, engineers' computer-monitored usage is clearly inflated by non-PROFS mainframe usage.

Table I. Descriptive Statistics

Variable	Mean	Standard deviation	Range	Standard error	Number
Terminal Accessibility:					
Distance[a]	2.2	1.3	1/5		78
Difficulty of access[b]	2.0	1.3	1/5		75
Number of people sharing	1.7	1.9	0/11		65
Length of wait (mins)	10.8	26.4	0/99		67
Percentage of time terminal is being used by someone else	12.1	22.6	0/80		66
Value:					
Others on Email system[c]	2.6	1.0	1/5		70
Usage:					
Computer-monitored:					
Days since first log-on	243.0	50.2	4/292		133
Connect time per day (mins)[d]	72.9	116.0	0/462		133
Log-ons per day[d]	2.2	2.6	0/12		133
Reported:					
Number of minutes in average day spent using your account	38.2	70.3	0/480		113
Percentage of average day using PROFS	5.7	7.3	0/35		122
Appropriateness[e]	1.3	.64	1/2		77
Outcomes:[f]					
Contacts made	3.3	.63	1/5	.08[g]	94
Paper produced	2.7	.68	1/5	.08	95
Calls made	2.4	.65	1/3	.08	96
Letters sent	2.7	.69	1/5	.09	96
Rate of work	3.2	.71	1/5	.07	94
Quality of work	3.3	.71	1/5	.07	94

[a] Scale for distance from terminal was 1 = at your desk; 2 = in your office; 3 = close to your office; 4 = on the same floor; 5 = farther away than your floor.
[b] Scale for general ease of physical access to terminal was 1 = very easy; 2 = easy; 3 = neutral; 4 = difficult; 5 = very difficult.
[c] Scale for communication value, "Do the people you need to communicate with also have access to PROFS?" was 1 = always; 2 = usually; 3 = sometimes; 4 = seldom; 5 = never.
[d] Median.
[e] Appropriateness scale was mean of 11 questions that asked whether PROFS was appropriate (1 = yes, 2 = no) for the following activities: exchanging information, negotiating, getting to know someone, asking questions, keeping in touch, generating ideas, resolving disagreements, exchanging opinions, making decisions, exchanging confidential information, exchanging time-sensitive information. Cronbach's alpha, a measure of scale reliability, was .73.
[f] Scale for outcome variables based on the question, "What do you think the effects of using PROFS are on the following?" was 1 = significantly reduced; 2 = somewhat reduced; 3 = no change; 4 = somewhat increased; 5 = significantly increased.
[g] Using the standard error, one-tailed confidence intervals around the mean of 3.0 (no change) show significant changes for all outcomes.

3.3 Data and Measurement

Table I describes the variables, and the text summarizes results of principal components analyses of the accessibility, usage, and outcome variables.

Accessibility. The questionnaire included five measures of perceived (in)accessibility to the system's terminals, representing Culnan's category of

physical accessibility to a terminal: (1) physical distance to a terminal, (2) percent of time the terminal was being used by others, (3) the number of people sharing the terminal, (4) the general "difficulty of access," and (5) the number of minutes one usually had to wait to get a terminal. As Culnan [10] suggested, these items represent a single dimension of physical access, all with loadings higher than .77, explaining 69 percent of the common variance. However, analyses will primarily use physical distance, the least subjective of the items, and "difficulty of access," the most general attitudinal measure, to identify more specific relationships. On average the terminal was in or near the respondent's office ($M = 2.2$), and general accessibility was rated "easy" ($M = 2.0$).

Value. The questionnaire asked respondents the extent to which people they needed to communicate with also used the EMS, one measure of its value. The mean response to this five-point scale ($M = 2.6$) was between "usually" and "sometimes."

Appropriateness. Perceived social presence or information richness of the EMS was measured by the mean of 11 items asking whether an EMS was appropriate for specific communication tasks (see note (e) in Table I). Respondents felt that PROFS was appropriate for about 70 percent of the activities listed.

Job Type. Of those who indicated their job type, 14 were managers, 6, administrators, 19, engineers, 21, secretaries, 9, business staff, and 9, other.

Usage. Computer-monitored data included the date and connect time of each user's computer session. Computations using the first log-on date, and an assumption of five business days a week, resulted in three basic measures of usage: (1) stage of adoption, or days since first logging onto the system, (2) frequency of usage, or the average number of computer log-ons per business day, and (3) duration of usage or the average minutes of computer connect time per business day. As with most behavioral communication data, the raw data were skewed; therefore, the values for the number of computer log-ons and connect time per business day were transformed to a normal distribution (using SAS's PROC RANK with the Blom formula). Questionnaire measures included respondents' reported percent of total time, and the number of reported minutes, spent using the EMS in an average working day.

All four measures of usage loaded on a single dimension of usage, with loadings higher than .74 representing 61 percent of the variance. However, because reported and computer-monitored usage differed considerably and are differentially correlated with other variables, as discussed below, the analyses will primarily use computer log-ons and the reported minutes per day separately instead of a single usage factor score.

Outcomes. The questionnaire asked about the extent to which six activities, each measured by five-point items, changed when using the EMS: making telephone calls, making organizational contacts, sending letters, producing paper, quality of work, and the rate of work performed. Prior studies on communication outcomes were the source for these items [42, 50]. Two underlying dimensions were represented by these outcomes: "effectiveness" (increases in quality and rate of work and contacts and decreases in calls, with loadings from .64 to .90, representing 43 percent of the common variance and "paper" communication (increases in the use of letters and paper, with loadings greater than .73,

representing 27 percent of the common variance). Two factor score variables were derived, using the regression method.[4]

4. RESULTS

4.1 Usage of the EMS

Users were connected to the PROFS mainframe an average of 73 minutes per day and logged on approximately twice a day, and they reported spending about 38 minutes and 6 percent of the day using the EMS.

The two computer-monitored measures of use were highly correlated ($r = .86$, $p < .001$); the two reported measures were slightly less highly correlated ($r = .62$, $p < .001$); and the computer-monitored measures were moderately correlated, $r = .4$ with reported minutes, and $r = .5$ with reported percent of day ($p < .001$) (see Table II). Computer-monitored measures appear more internally reliable, while reported minutes per day either reflects a moderately different aspect of usage or is less reliable. These results concerning Research Question 2 indicate that, although the four usage measures statistically represent a unidimensional underlying factor of usage, reported and computer-monitored measures portray considerably different levels of usage and share only about 20 percent of their variance. (As we discuss later, we cannot expect perfect correspondence between the two sources of usage data because they are not measuring the same thing.)

Although differences among job types are not significant for computer-connect time, computer log-ons, and reported minutes (Table III), secretaries were the greatest users (109 nonnormalized connect minutes, 2.4 nonnormalized log-ons, 53 reported minutes), while all the other job types had lower levels (an average of 60 minutes, 2.2 log-ons, 28 minutes, respectively). Hypothesis 3 called for a direct comparison of usage between secretaries and managers. For both normalized log-ons and reported percent of the day spent using the EMS, secretaries had significantly higher values than did managers (.52 compared to .03, $p < .05$; 10.43 compared to 2.48, $p > .01$). These results provide support for Hypothesis 3.

4.2 Accessibility and Usage

4.2.1 *Direct Relationships.* Only some aspects of accessibility were correlated with EMS usage (see Table III). Physical distance was correlated between $r = -.2$ and $-.5$, and difficulty of access from $r = -.14$ to $-.4$, with the four separate usage measures. Correlations were as much as twice as strong for computer-monitored usage measures as for reported measures, and correlations for physical distance were about 50 percent greater than for general difficulty of access. That is, the strongest correlation ($r = -.5$, $p < .001$) was between the two least subjective sets of variables: closer physical distance and greater computer-monitored usage. These results provide specified support for Hypothesis 1a.

[4] There are, of course, many different kinds of (positive and negative) outcomes than those studied here, and many other appropriate research designs and methods than those used here. We encourage and, in other publications, conduct such research. However, these issues and methods are not the focus of this article.

Table II. Correlations Among Access, Use, and Outcomes

(a) Among all Access and Usage Variables

	Accessibility					Value	Usage: Reported		Usage: Computer
	Distance	Shared	Different	% Busy	Waiting	Other	Minutes	%	Log-ons
Access									
Sharing	.54**								
Different	.80**	.51**							
Percent Busy	.51**	.60**	.64**						
Waiting	.54**	.65**	.65**	.87**					
Value									
Others	.16	.05	.32	.04	.06				
Usage									
Reported:									
Minutes	−.23**	−.12	−.14	−.07	−.08	−.23			
Percent	−.34**	−.18	−.26	−10	−.09	−.04	.62**		
Computer:									
Log-ons	−.47**	−.12	−.30*	−.02	−.08	−.10	.37**	.49**	
Minutes	−.48**	−.22	−.38**	−.06	−.12	−.23	.38**	.47**	.86**

(b) Among Selected Access and Usage Variables, Appropriateness, and All Outcomes

	Usage: Computer Log-on	Usage: Reported %	Access: Distance	Access: Different	Appropriateness: Mean	Outcomes: Call	Letter	Paper	Control	Quality
Appropriateness										
Mean	.10	−.09	−.11	.10						
Outcomes										
Calls	−.35**	−.28*	.19	.13	−.22					
Letters	−.36**	−.11	.03	−.11	−.08	.32**				
Paper	−.28**	−.13	.10	−.03	−.16	.45**	.30**			
Contacts	.23	.26*	−.17	−.19	.18*	−.39**	−.07	−.34**		
Quality	.16	.27*	−.09	−.17	.00	−.65**	−.11	−.28**	.50**	
Work rate	.13	.01	.03	.01	.39**	−.49	−.22*	−.46**	.52**	.42**

* = $p < .01$; ** = $p < .005$ $n = 52$–122.

The three other accessibility variables (percent busy, number of others sharing, and number of minutes one has to wait) were not significantly correlated with any of the usage measures, perhaps because (1) although they have something to do with how busy the terminal is, they do not directly indicate how the respondent's use of the system is affected, and (2) it may be difficult to estimate or report such measures accurately.

4.2.2 *Interactions.* Is the apparent lack of influence of these other accessibility variables contingent upon the physical accessibility of the terminal? Table IV shows (not surprisingly) that locating the terminal on the desk removes any significant influence of general difficulty of access (the only other accessibility variable correlated with usage) on the two usage measures. When the terminal is

Table III. Differences by Job Type: Accessibility and Usage

Variable	Job Type				
	Secretary	Manager	Engineer	Business	Administrator
Distance to terminal*	1.20 (C**)	2.43 (B)	2.74 (B)	2.11 (BC)	3.83 (A)
Difficulty of access	1.37 (B)	2.08 (B)	2.11 (B)	1.56 (B)	4.50 (A)
Computer min/day (not normalized)	109.4 (A)	66.3 (A)	61.6 (A)	64.7 (A)	46.7 (A)
Computer log-ons/day (not normalized)	2.4 (A)	2.6 (A)	1.4 (A)	1.6 (A)	3.2 (A)
Reported min/day	53.0 (A)	21.1 (A)	12.0 (A)	55.2 (A)	39.2 (A)
Reported %/day	12.0 (A)	3.3 (B)	2.5 (B)	4.3 (B)	5.8 (B)
N	20	14	19	9	6

* Note the definition of physical distance in Table I: lower is closer.
** Users in job categories with different capital letters have significantly different means for the particular variable. Mean differences were calculated by the Duncan multiple range, at $p < .05$, using the Statistical Analysis System PROC GLM. See text for *t*-test results comparing secretaries and managers separately.

Table IV. Correlations of Accessibility and Usage by Levels of Physical Distance

Terminal Accessibility	Physical Distance To Terminal					
	On Desk		In Office		Nearby	
	Log-ons	%	Log-ons	%	Log-ons	%
Minutes waiting	−.22	−.19	.26	.08	−.58**	−.27
Difficulty of access	−.06	−.10	.55*	.17	−.16	−.21
Number of others sharing	.04	−.14	.10	.23	−.20	.26
% of time busy	.15	−.21	.37	.22	−.38	−.96
N	31 to 37		11		14 to 17	

Note: Correlations for categories of "on floor" [elsewhere in the building] and "farther away" are not reported because of the small number of cases.
* = $p < .1$; ** = $p < .05$.

located in the office but not on the desk, lower levels of other forms of accessibility are associated with more computer log-ons, though significantly so only for perceived difficulty of access. The change of direction in the relationship between accessibility and usage may mean that users must log on more frequently when they have to share a terminal, because they cannot just log-on once or twice a day and leave it running. This interpretation is supported by the fact that there are no significant correlations of perceived difficulty of access with reported percent of the day spent using the EMS. That is, the conceptual distinction between frequency and duration reveals different kinds of usage that are affected differently by various barriers to accessibility. One may use the terminal for just as great a total duration, but with greater frequency, when it is not as easily accessible, as long as the terminal is fairly close. It may also be that when terminals are placed in offices for shared access, high-frequency users are much more likely to perceive problems of accessibility. When the terminal is outside the office, however, the greater the average number of minutes one has to wait for a terminal, the less usage (though only the association with computer log-ons is statistically significant).

Table V. Correlations and Mean Differences by Adoption Stage: Accessibility, Value, and Appropriateness

	Stage In Adoption Process: Quartiles Since First Log-on							
	1–214 Days		215–264 Days		265–270 Days		271–292 Days	
Variables	Log-ons	%	Log-ons	%	Log-ons	%	Log-ons	%
	Correlations with EMS Usage							
Distance	−.59**	−.29	−.30	−.44*	−.53*	−.28	−.19	−.26
Difficulty	−.64**	−.28	.07	−.29	−.56*	−.26	.21	−.17
Fewer contacts	−.09	−.01	.25	−.22	−.36	−.24	.13	−.24
Appropriateness	−.27	−.31	.21	−.33	.11	.03	.33	.14
	Means and Difference Tests							
Distance	1.79 (B)***		2.38 (AB)		2.67 (A)		1.71 (B)	
Difficulty	1.72 (AB)		2.13 (AB)		2.53 (A)		1.59 (B)	
Fewer contacts	2.50 (AB)		2.60 (AB)		3.12 (A)		2.24 (B)	
Appropriateness	1.50 (A)		1.43 (A)		1.42 (A)		1.38 (A)	
N	14–23		18–41		14–29		14–29	

* = $p < .05$; ** = $p < .01$

*** Users in adoption stages with different capital letters have significantly different means for the particular variable. Mean differences were calculated by the Duncan multiple range, at $p < .05$, using the Statistical Analysis System PROC GLM.

These results for Research Question 1 and Hypothesis 1a indicate that these four aspects of terminal accessibility are statistically unidimensional, but that the different aspects may be differentially reliable and valid, and that the influence of some aspects may be contingent on the levels of physical access to a terminal.

4.2.3 *Value and Usage of EMS.* The measure of the communication value of the system and the extent to which needed contacts were available on the EMS were not significantly correlated with levels of usage. That is, accessibility of the system is a more powerful influence than this (admittedly limited) aspect of the value of the EMS. This result provides support for Hypothesis 1b.

4.2.4 *Accessibility, Usage, and Adoption Stage.* Table V indicates a tendency for accessibility to be more strongly associated with usage for the most recent adopters than for those who have been using the system for longer periods of time. For the first (most recent) quartile and, curiously, the third quartile of days since first logging on to the system, correlations of physical distance and general difficulty of access with system log-ons were approximately $r = -.60$ and $r = -.55$ ($p < .005$), respectively, whereas the correlations for the second and fourth quartiles were not statistically significant. Clearer evidence of the greater influence of accessibility early in the adoption process would be a linear decline, from earlier to later adopters, in the strength of the association between access and usage, along with completely equivalent levels of accessibility and appropriateness.

Thus, we need to determine if accessibility was simply perceived as better by those users earlier in their adoption process. The bottom of Table V shows that although the average levels of accessibility for the fourth quartile (earliest

adopters) are statistically significantly better than for the third quartile, they are not statistically significantly better than the levels for the first and second quartiles. Further, we cannot attribute the differential influence of accessibility to the respondents' perceived appropriateness of the EMS; the bottom of Table V shows that this variable has similar values across all four stages of adoption. Thus, we have evidence of a decline in the association between accessibility and usage for later, compared to earlier, adopters but equal levels of accessibility and appropriateness. These results provide moderate support for Hypothesis 1c.

4.2.5 *Value, Usage, and Adoption Stage.* The correlations between the availability of needed contacts (value of the system) and levels of computer-monitored or reported usage (top of Table V) are not significant for any quartile of adopters, again providing support for Hypothesis 1b. However, the longest users report significantly greater availability of needed contacts ($M = 2.24$) and the highest correlation of this availability with usage ($r = -.24$). Hypothesis 1d is not supported, but there is a hint that stage of adoption may play a role in the relationship between use of an EMS and its value in making contacts available.

4.3 Accessibility, Contextual Factors, and Usage of EMS

We would like to disentangle the relative influence of these factors—accessibility, appropriateness, and job type—on computer log-ons and reported percentage of the day spent using the EMS. Accessibility varies by job type (see Table III). Secretaries report that terminals, generally located on their desk, are highly accessible to them. Managers, engineers, and business personnel report moderate levels of accessibility, with terminals typically shared or near the office. Administrative personnel report low levels of accessibility, with terminals typically located somewhere else on the office floor. Thus, it is not yet clear whether accessibility is independently associated with usage or simply reflects differential access to terminals for different job types.

Table VI provides the results of an analysis of covariance that tests for the influence of job type on increases in effectiveness and decreases in the use of paper media, while controlling for the influence of accessibility and appropriateness. First, the two usage measures were regressed on the two accessibility measures and the appropriateness scale. Then, an unbalanced design analysis of variance was used to detect significant differences in the residuals from this regression across job types.

The results show that neither the perceived overall difficulty of access of the terminal nor appropriateness of the EMS was independently associated in a statistically significant way with either type of usage in the multiple regressions. Computer log-ons were statistically significantly associated with closeness to the terminal and with job type (high residuals for administrators and managers, low for secretaries, business personnel, and engineers). Reported percent of the day spent using the EMS was statistically significantly associated only with job type (high residuals for secretaries and administrators, low for engineers, managers, and business personnel).

Thus, although in this particular implementation there was an interaction between job type and accessibility, these two contextual factors are somewhat

Table VI. Covariance Regressions of Usage on Accessibility, Appropriateness, and Job Type, Then ANOVA of Job Type on Residuals

	Dependent Variables: Usage	
	Computer/Log-ons	Reported %/Day
Independent Covariates		
Distance to terminal	−.52*	−.39
Difficulty of access	.33	.08
Appropriateness	.19	.04
Overall *F*-ratio of covariates	3.69*	1.91
Adjusted *R*-square	.15	.05
Means of Covariate Residuals For Job Types		
Management	.21	−1.84
Business	−.13	−2.13
Engineering	−.35	−2.71
Administration	.88	5.05
Secretarial	−.12	5.71
Overall *F*-ratio of job type	2.45*	3.06*
Adjusted *R*-square	.17	.22

* = $p < .05$

Note: Values reported for independent covariates and independent variables are standardized beta coefficients. Values for independent job types are means of residuals controlling for the covariates.

independent influences on the computer-monitored measure of log-ons. One possible explanation for the influence of job type, suggested earlier, is that different job types require different types of communication, and an EMS is more suited to satisfying clerical tasks that require less social presence and information richness (such as exchanging information) than managerial tasks (such as reducing ambiguity through interpersonal negotiation). Further, secretaries may be using the computer to perform tasks delegated by their managers such as sending broadcast messages about meetings or procedures, following up earlier communications, and so forth. An additional explanation is that analytical tasks and professional norms of the engineers placed greater value on individual activities and mainframe computations; the EMS was not particularly relevant for either. Thus, Hypotheses 1b and 3 received support, Hypothesis 1a received strong bivariate but only specified multivariate support, and Hypothesis 2 was rejected.

4.4 Work and Communication Outcomes Associated with Using an EMS

4.4.1 *Descriptive and Bivariate Results.* Table I shows that overall, the respondents reported that use of the EMS slightly decreased the initiation of paper, letters, and phone calls ($M = 2.4$ to 2.7) and increased the level of communication contacts made, rate of work, and quality of work ($M = 3.2$ to 3.3). Although the mean values indicate no large changes, they are all significantly different from the "no change" value of 3.0 (see note g, Table I). These results provide support for Hypotheses 4a, b, c, and d.

Table VII. Regressions of Outcomes on Usage, Accessibility, and Appropriateness

Independent Variables	Dependent Variables: Outcomes	
	Effectiveness	Paper
Computer log-ons	.04	−.50**
Reported percent of day	.27*	.17
Distance to terminal	.55**	.20
Difficulty of access	−.47**	−.37
Appropriateness	.54**	−.08
F-ratio	5.48**	4.23**
Adjusted *R*-square	.31	.24

$N = 51$ for each analysis. * = $p < .05$; ** = $p < .01$.
Note: Values reported are standardized beta coefficients.

Table II shows that there is a statistically significant correlation of appropriateness with increased communication contacts ($r = .18$, $p < .01$) and work rate ($r = .39$, $p < .001$), providing support for Hypothesis 4e. Computer log-ons are more strongly associated with changes in use of paper-based media than is the reported percent of time spent using the EMS ($r = -.28$ to $-.36$ compared to $r = -.11$ to $-.28$), and the reverse was true for increases in contacts and quality of work ($r = .16$ and .23 compared to $r = .27$ and .26). However, neither measure of usage is associated with reported increases in work rate. These results provide support for Hypotheses 4a, b, and c, specified by the nature of usage, but reject Hypothesis 4d.

4.4.2 *Multivariate Results.* Table VII shows results of two regressions on the two outcome factor scales of "effectiveness" and "paper." Thirty-one percent of the variance in improved effectiveness was explained, with reported percent of the day spent using the EMS, physical proximity to one's terminal, difficulty of access to the terminal, and perceived appropriateness of the EMS for a range of communication tasks as statistically significant influences. Twenty-four percent of the variance in decreased use of paper-based media was explained, with computer log-ons as the only statistically significant influence.

5. DISCUSSION

5.1 The Outcomes of Using an EMS, as Measured Here, Are Moderate

From the perspective of a skeptic of office automation, the outcomes reported here do not of course include objective or financial measures of performance. Rather, they emphasize changes in communication activities that could potentially lead to improvements such as decreased shadow costs from less shuffling of paper and less telephone tag, reduced transformations of information from memos to calendars, and value-added organizational communication [33, 43]. The skeptic will also note that although these outcomes are significantly related to reported and computer-monitored usage, the amount of explained variance (24–31 percent) is moderate. These and similar results add to the growing literature that computer-mediated communication systems can lead to positive but not revolutionary outcomes and that a variety of factors moderate the relationships between usage and outcomes.

5.2 Access to a Terminal Significantly Affects Use of an EMS

The accessibility of an EMS terminal affects the usage of an EMS. Although the attitudinal measure of difficulty of ease of access to a terminal may be used effectively as a diagnostic measure in ongoing evaluations of contextual factors influencing the usage of an EMS, the physical proximity of the terminal will provide a more powerful indicator of the likely level of usage of an EMS. Simply, the terminal should be very close to the user, or, as the users made clear in their interviews, at least immediately visible to them. If users can at least see the terminal, they will use it when it becomes available. But if the distance is even moderate or if the terminal is not visible, they will not be as likely to spend the time and effort to take the chance that the terminal might be available to log-on to their account again, especially during the early stages of their adoption.[5] This is another example of the considerable effect of the uncertainty inherent in the value of information, and of the cost involved in learning a new system, in the face of real (even if small) costs involved in acquiring that information. The system, other users, and the messages exchanged may have great potential *value*, but getting up from one's desk has an immediate and real *cost*.

There are other perhaps not-so-obvious aspects of accessibility in this study. There may be a sort of a "threshold" of accessibility. Terminals apparently must be at least close to the user's office (the mean number of computer log-ons was statistically significantly different ($R^2 = .24$, $n = 77$, $p < .001$), between the set of categories of "on desk," "in office," or "near office," and the set of categories of "on the same floor" or "farther away than your floor." This distance threshold was especially salient because the respondents' offices tended to be temporary cubicles in close proximity during the period of a specific project. In more traditional, larger office areas, the threshold of accessibility may be exceeded for terminals located outside of one's office. Further, there is some limited evidence here that secondary components of physical terminal accessibility, such as a general attitude about the difficulty of access, or how long one has to wait to be able to use a terminal, become more salient influences on EMS usage when the terminal is not located on the desk.

Thus an implementation strategy that increases the ratio of terminals to users simply by placing more terminals in common areas or in an information center—an apparently cost-effective approach for providing limited resources to a wide array of potential users in a pilot situation—may reduce the likelihood of users gaining experience with, or benefits from, the system. Such a decision would be particularly crucial during an experimental pilot or a demonstration period, since accessibility may have a greater effect on usage early in an individual's adoption process. Thus pilot implementations may be more successful when they involve a smaller number of users who have greater access to terminals and who need to communicate with each other.

The more integrated a computer-based information or communication system is, the more it provides the day-to-day, item-by-item functions that people need to accomplish their work. Even a small decrease in accessibility would be more

[5] In the related study of PC use introduced in Note 3, workers who used PCs in "open areas" (22 percent of the sample of 150) felt that PCs were "less helpful" (at statistically significant differences) than did workers who used or shared PCs at their workplace.

likely to interrupt and discourage use of such systems. This effect would be most obvious for the most explicit and common communication activities: use of written and telephone media and maintaining communication contacts. Additionally, as Swanson [53] suggests, this effect is also more likely for an EMS that is less authoritative (i.e., when usage is not officially mandated or supported), has more alternatives (i.e., when people are otherwise relatively close or easily accessible or many of one's needed contacts are not on the system), or cannot easily resolve uncertainty (as in more managerial tasks.) Indeed, the effects of accessibility may be much greater for EMS than, say, for a MIS or computer-operated production system, in which the information and its use is more authoritative, necessary, and certain, and in which critical mass may play less of a role in establishing the value of the system.

5.3 Accessibility and Appropriateness Affect Outcomes Independently of Usage

Individuals' evaluations of the EMS studied here seem related to perceptions about how well the system is able to satisfy certain communication requirements, in addition to the extent to which the respondent used the system. This result supports the importance of the concepts of social presence and information richness, as well as models of media choice that argue that outcomes are based upon contextual factors as well as upon levels of usage [12, 41, 44, 47].

The same general result holds for accessibility in the multivariate analyses. Close proximity to a terminal is associated with greater usage, and greater usage leads to reported increased effectiveness, but greater distance from a terminal is independently associated with reported increases in effectiveness. It may be that those who have to share or walk to use a terminal are more conscious of the benefits than those who have easier access. However, difficulty of terminal access is negatively associated with outcomes, as expected. The discrepancy between these two associations is perplexing.

5.4 Self-Report and System-Monitored Measures of EMS Usage Are Both Valuable

There are at least three conclusions to make about the usage measures in this study. The typical study of user behavior relies on self-reported measures of usage, which are to some extent biased attitudes toward, and mental reconstructions, of past behavior [7]. So the first conclusion is that computer-monitored measures of usage can be conceptually more valid measures of usage if they monitor specific functions, commands, and messaging patterns. Although the usual qualification of self-report data is partially based on the possibility that individual predispositions and attitudes would artificially raise the correlation between reported usage and reported outcomes, here computer-monitored measures of usage are even better predictors for some outcomes. That is, measurement error of recalled usage, and mental associations between attitudes and recalled usage measured by self-reports in the same time period, may decrease some relationships between usage and outcomes.

The second conclusion is that there are many conceptual and practical meanings of system usage. This study distinguished between duration and frequency as forms of usage. Because the distinction was confounded with the differences

between reported and computer-monitored sources of usage measures, we cannot draw any firm conclusions on their exact contributions. But an example of the usefulness of this distinction is the condition of low physical accessibility when users have to log-on to the terminal again every time they have to return after other users have had their turn. Clearly log-ons (frequency) and connect time (duration) represent different levels of interaction and involvement with an EMS. We note again, of course, that even computer-monitored log-ons and connect time do not tell much about how the system is really used, what functions are involved, and the extent to which a user is actively using the system. However, self-report measures cannot conclusively solve these problems at all. Clearly more detailed computer-monitored measures and richer questions and observations about EMS usage are both necessary.

The third conclusion is that even if both computer-monitored and reported usage measures were equally valid, they may still represent different aspects of usage. Here, self-report measures are significantly related to computer-monitored measures of system usage but only share about 16–20 percent of the variance. On average, monitored connect time to the mainframe (over an hour per day) is more than twice as much as reported usage of the electronic messaging component of PROFS (a half hour per day). Though these numbers differ, they may well accurately portray usage of different components of the computer system. Further, the two kinds of usage measures are not equally correlated with accessibility: In some cases the correlations are twice as strong for computer-monitored as for reported measures of usage. Finally, reported measures are not associated with as many, or the same, outcomes, and are not associated with the same outcomes as strongly: Computer-monitored usage measures are generally stronger influences, though reported usage is stronger for increases in contacts and quality of work. It seems that self-reported use of an EMS may be associated more with activities that complement current communication behaviors leading to an expanding range of contacts and improved value-added work, whereas computer-monitored use of an EMS may be associated more with perceived changes in substitution of an EMS for other communication media. Also, the effects of the threshold of accessibility and of the stage in an individual's adoption process seem to hold only for computer-monitored measures. However, until far more valid and reliable reported and computer-monitored measures are analyzed, these are only educated speculations.

According to these results, implementation strategies based on self-reported measures of system usage may thwart those users who use the system more and might considerably underestimate the demands on the system. Thus, future analyses should place greater effort on collecting computer-monitored usage data for merging with questionnaire data (see, e.g., [4, 14, 15, 22, 37, 39, 40, 42, 49, 55].

6. CONCLUSION

Accessibility is an important concept, for pragmatic and theoretical reasons, in the study of the acquisition of information and the use of computer-mediated communication systems such as an EMS. Users reported quite moderate, but

statistically significant, increases in communication contacts, quality and rate of information work, and decreases in paper media and telephone calls. Further, use of an EMS was statistically significantly associated with perceived improvements in organizational communication outcomes in ways predicted by prior theorizing on the nature of such systems and their appropriate match with different kinds of organizational communication activities and different job types. New evidence and questions have been offered about contingencies among aspects of access, differential costs and benefits during different stages in the adoption process, and conceptual and empirical aspects of self-report versus computer-monitored usage data. The EMS is not only an important addition to organizational communication processes and structures, but also provides fertile ground for testing theoretical questions about access, attitudes, usage, and outcomes.

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