Task Variability and the Managerial Use of Information Channels

JAWAID A. GHANI

WESTERN MICHIGAN UNIVERSITY, KALAMAZOO, MICHIGAN

ABSTRACT

The relationship between task variability and the use of computer and other information channels was studied for a sample of 235 managers and professionals. Greater task variability was associated with greater importance of verbal and written channels in day-to-day work. The importance of traditional data processing applications decreased with increased task variability. There was no relationship between task variability and the importance of end-user computing applications. Organizational support for computing and accessibility of computer resources significantly increased the use of both traditional and end-user computing applications. These results are discussed in terms of the factors to be considered in the design of an organizational information support strategy.

INTRODUCTION

As post-industrial organizations face accumulating knowledge, turbulence, and complexity, information processing for supporting decision making and innovation is expected to take on added importance [16]. Research on the managerial use of computers and other communication technologies has steadily grown in the last decade. Yet much remains to be understood regarding the factors affecting the use of these technologies.

Computers represent one of several alternative information channels available in an organization. Since patterns of use of information channels are related by substitutability and complementarity [32], important insights may be gained by investigating the use of computers in the context of other information channels.

What factors determine the use of information channels in organizations? The factor most commonly referred to in MIS textbooks and in the various frameworks proposed for MIS (see for instance [11,19]) as determining user information needs is management activity. This consists of the strategic, tactical, and operational levels of activity first identified by Anthony [2]. Researchers conducting empirical studies on information channel and computer usage have typically operationalized management activity in terms of hierarchical level. Available empirical results, however, are mixed in their support of the relationship between channel usage and hierarchical level [18,21,23,30].

The Organizational Information Processing model and its recent extensions [6,7,8,13,35], provide a more theoretical basis for studying the factors influencing channel use. The model proposes that the reason organizations process information is to reduce uncertainty and to reduce equivocality.

Additionally, organizational performance is a function of the fit between information processing requirements and the capacity to process the required information.

Prior research has noted the importance of task uncertainty as a determinant of computer and information channel usage [4,5], yet few empirical studies have addressed this specific issue. Based on a study of 235 managers and professionals, this paper explores whether and how task uncertainty affects the use of computers and related information channels and draws conclusions for the management of organizational information resources.

THEORETICAL BACKGROUND

Information channels

An information channel is any medium by which a message may be transmitted from a source to a receiver [31]. In terms of organizational information processing, information channels include any mechanisms used to process information, i.e., to access, distribute, alter or use organizationally relevant information [15]. Communication media[1] such as face-to-face meetings, written correspondence, and electronic mail thus form a subset of the information channels available to an organization, wherein both the source and the receiver are humans. MIS reports and Decision Support Systems are also information channels wherein information is altered within the computer system and also transmitted between the computer system and humans.

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[1] Daft and Lengel [8] include MIS reports as a communications medium; Jones et al. [21] use the term information media to include all information channels available in an organization.

Why do organizations process information? The Organizational Information Processing model [35] suggests that the reason organizations process information is to reduce uncertainty. Media[2] richness theory [6,7,8] suggests that organizations also process information in order to reduce equivocality. While uncertainty refers to the absence of information, equivocality refers to the existence of multiple and conflicting interpretations about a situation. When equivocality is high, new data may actually cause more confusion and hence increase uncertainty.

How do organizations and individuals choose among information channels? Media richness theory [6] is based on the observation that different media vary in their "richness," i.e., their capacity to convey information in a fixed period of time. The factors contributing to media richness are (1) the use of feedback so that errors can be detected; (2) the ability to convey multiple cues; (3) the tailoring of messages to personal circumstances; and (4) language variety. Face-to-face communication is the richest medium, followed by written, addressed communication such as letters and memos. Formal, unaddressed documents such as MIS reports are considered lowest in richness. Rich media are preferred when the objective is equivocality reduction, i.e., when organization members need to deal with ambiguous messages and converge on a common interpretation. Less rich media are preferred when messages are unequivocal, i.e., when objective knowledge about well-defined events have to be conveyed.

How information technology can best be utilized to increase the information processing capacity of an organization is the concern of researchers in MIS. Early work on Decision Support Systems (DSS) emphasized the role of task uncertainty in the design of systems. Keen and Scott-Morton [22] suggested that semi-structured tasks were best supported by DSSs, while more structured tasks could be automated by traditional transaction processing systems. In practice however, most DSS applications have tended to address structured problems [40]. Nevertheless, as end-user computing continues to grow, and more powerful software becomes available, the impact of computers on less structured tasks such as those involving judgement, ambiguity, and creativity is expected to increase [12,40].

Task Variability

From the above discussion we can conclude that the use of information channels in influenced by task uncertainty and by information equivocality. In this paper we have chosen to focus on the effect of task uncertainty while controlling for the effect of information equivocality. The next question arises: how do we measure uncertainty. Researchers have operationalized the level of uncertainty in a job in terms of the number of unexpected events which occur in the job, i.e., task variability[3].

Task variability is defined as the frequency of unexpected and novel events that occur in a work process [28]. High variability means that individuals cannot typically predict problems in advance and many tasks are unique. In such situations much of the activity cannot be preplanned and there is a greater need to process large amounts of information during task execution. Several studies [9,29,33,34,36] have found task variability to be positively related to the amount of information processed within work units. This leads us to the first hypothesis:

Hypothesis 1: Task variability will be positively related to the overall importance of information channels in day-to-day work.

We are also concerned with what effect task variability has on the importance of specific channels. Media richness theory suggests that richer channels such as face-to-face meetings are more appropriate when dealing with equivocal information, while less rich media are appropriate when dealing with unequivocal information. However, if one controls for information equivocality than one expects that the importance of a specific channel is related to the extent that the channel can be used to acquire, distribute, or otherwise process information which is relevant to the task. As task variability increases, the number of unexpected situations increase. Where do individuals obtain information about unexpected situations? A number of studies support the idea that as uncertainty increases individuals make greater use of verbal channels of communication, and to a lesser extent, written channels. Van de Ven, Delbecq, and Koenig [37] found that when tasks are non-routine, managers prefer face-to-face modes of communication. Meissner [24] and Randolph [29] found that personal communications were used more frequently in high uncertainty tasks. This leads to the next two hypotheses:

Hypothesis 2: Task variability will be positively related to the importance of verbal information channels in day-to-day work.

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[2] Daft and Huber [6] use the term Media Richness rather than the original term Information Richness. As used in this paper the term Channel Richness may be a more appropriate term.

[3] We suggest that the term task variability more accurately fits the definition given by Perrow [28], rather than the generally accepted term task variety. A job involving a large number of predictable tasks may offer great variety by little variability. It is the variability of tasks, not the variety of tasks, that is of interest here.

Hypothesis 3: Task variability will be positively related to the importance of written information channels in day-to-day work.

Cheney and colleagues [4] argue that it is more difficult to develop software to support ad hoc, one-time tasks, than for routine tasks. As tasks become less routine, it becomes less worthwhile for users to formulate procedures and to utilize computers in the task. Daft and Lengel [7,8] describe Management Information Systems as providing data about stable, recurring, predictable evens, and hence place MIS near the bottom of their media richness spectrum. For this same reason Mintzberg [25] was critical of traditional MISs as a source of information for upper-level management. Thus we expect that:

Hypothesis 4: Task variability will be negatively related to the importance of computers in day-to-day work.

Accessibility and Computer Use

The addition of the direct use of computers to our list of information channels adds an additional complication: the accessibility of the channel. All organizations are not equal in their support of computer use. Note that while the accessibility of a channel is an important factor in any channel use [1,5,27], it becomes particularly important in the case of computer use. Swanson [32] found information quality and accessibility to be related to the frequency of use of ten different MIS reports. Gogan [14] found accessibility to be a key factor influencing the use of personal computers by auditors. This leads us to our final hypothesis:

Hypothesis 5: Accessibility of computers will be positively related to the importance of computers in day-to-day work.

Controlled Variables

The focus of this study is on the effects of task variability on channel use. Since previous research suggests that information equivocality and channel accessibility also affect channel use, hypotheses 1-4 should be tested after controlling for these two variables.

METHOD

Sample

The sample consisted of 1200 randomly selected business managers and professionals from lists maintained by the alumni office of a mid-Western Business School. A self-administered questionnaire was sent to the sample, and 260 (22 percent) individuals responded. Respondents not holding full-time managerial or professional jobs in an organization were omitted from the analysis. The final data set contained 235 responses.

The sample was predominantly male (76 percent). The average age was 37 (std. dev. 6.6). Job descriptions indicated 41 percent to be professionals, 30 percent managers, 19 percent senior executives, and 10 percent supervisors. On average, respondents had held the jobs they described in the survey for 4.9 (sd=4.7) years, and had been with their present organization for 7.4 (sd=6) years. The sample represented individuals in a diverse set of industries, including manufacturing (34 percent), service (28 percent), financial (14 percent), retail (13 percent), and public organizations (11 percent).

MEASUREMENT

Task Variability

The instrument developed by Withey and his colleagues [39] was adapted and used in this study to measure task variability. The scale included four questions such as, "I do the same job in the same way most of the time" and "Most of my major tasks are different from day-to-day" (reverse coded). Each item was ranked on a seven-point scale from "No, I strongly disagree" to "Yes, I strongly agree." The internal reliability as measured by Cronbach's coefficient Alpha was 0.80. This is well above the 0.50 suggested by Nunnally [26] for acceptable scale reliability.

Information Equivocality

The instrument developed by Daft and Macintosh [9] and further refined by Balaguera [3] was used to measure information equivocality. The scale included four questions such as, "The information I use can be interpreted in several ways and can lead to different, but acceptable solutions" and "The problems I face usually have more than one acceptable solution." Each item was ranked similarly to the items for task variability. The internal reliability was 0.83. There was a moderate correlation between equivocality and variability (r=0.27) as predicted by theory and found by other researchers [9].

Information Channel Use

The information channels considered in this study were adapted from studies by Jones and McLeod [20,21]. These included verbal channels (telephone, scheduled face-to-face meetings, unscheduled meetings such as observation tours

and business meals), written channels (memos and letters, periodicals and non-computer reports), and computers (routine MIS reports, direct use of applications developed by data processing, direct use of applications developed by an end user). Respondents were asked to rate the importance of each channel (eight items) for carrying out their normal, day-to-day work on a scale of 1-to-7 (not important to extremely important). Note that we measured the importance of the channel rather than the amount of channel use. It is possible that the volume of information being conveyed through a channel is very high (as in the case of computer printouts or unsolicited mail), yet the importance of the channel may be very low. Jones and McLeod [20] contrasted these two measures, concluding that channel quality rather than quantity was the more meaningful measure.

In order to ascertain the dimensionality underlying these eight items, a principal component analysis with varimax rotation was computer. Three dimensions emerged: verbal, written, and computer applications. The items comprising each of the three dimensions were averaged to form indices. The internal reliability for the verbal importance index (three times) was 0.68, for written (two items) was 0.56), and for computers (three items) was 0.65.

Computer Accessibility

Computer accessibility was measured by the following three items: "The computer tools I need are not easily accessible to me" (reverse coded), "This organization provides help to individuals who want to learn and use computer tools (PCs, terminals, etc.)," and "I feel encouraged to use computer tools at work." The internal reliability was 0.77.

Organizational and demographic variables

Many other variables were also included in the study to check for spurious results. These included organizational variables such as industry, number of employees, position in organization, number of direct subordinates, number of years in present position and in present organization, and number of years since using computers. Demographic variables included age, gender, and education.

FINDINGS

Table 1 shows the means and standard deviations for the key variables considered in this study. Table 2 shows the partial correlations between task variability and channel use, controlling for information equivocality and for computer accessibility. Note that the table presents the results for the main channels and also the specific channels as measured by individual items in the survey instrument. Figure 1 shows a plot of channel importance against task variability.

Table 1
Descriptive statistics for variables studied
(n = 235)

	Mean	Standard Deviation
Task Variability	5.11	1.21
Information Equivocality	5.11	1.18
Computer Accessibility	5.26	1.52
CHANNEL IMPORTANCE		
Verbal Channel	5.43	1.21
Written Channel	4.71	1.29
Computer (DP + EUC)	4.60	1.53
DP Applications	4.51	1.69
EUC Applications	4.79	1.98

Task variability was found to be significantly correlated with overall channel importance as suggested by hypotheses 1. This is consistent with the Organizational Information Processing model and several empirical studies [9,33,34]. The data also indicates a positive relationship between task variability and both verbal and written channels of information. This supports hypotheses 2 and 3, and studies have found that as uncertainty increases, individuals make greater use of rich media (see for instance [37]).

Table 2
Partial Correlations with Task Variability
### (Controlling for equivocality and accessibility; n=235)

Information Channel (All) Importance	.18[b]
Verbal Media Importance	.35[c]
Telephone	.15[a]
Face-to-face meetings	.35[c]
Face-to-face (tours, meals, etc.)	.31[c]
Written Media Importance	.22[c]
Reports, periodicals	.18[b]
Memos, letters	.18[b]
DP Importance	-.19[c]
Importance of MIS reports	-.14[a]
Importance of using DP applications	-.17[b]
EUC Importance	-.06[ns]

[a] $p < .02$ [b] $p < .005$ [c] $p < .001$ [ns] not significant

The data supports hypothesis 4. As task variability increases, individuals find computers play a less important role in their day-to-day work. We had not hypothesized a relationship between task variability and the importance and use of different forms of computing. Data analysis revealed a negative correlation between task variability and the use of traditional data processing applications, but no relationship between variability and end-user computing (EUC). This result can be understood in terms of the distinct nature of EUC. Traditional methods of system development are less appropriate where information requirements are difficult to ascertain, where tasks to be supported are unstructured, ad hoc, and infrequent [10]. Thus, we expect traditional MIS and data processing applications to be negatively correlated with task variability. This is also consistent with observations made by Daft and his colleagues [7,8] that MIS reports constitute a "non-rich" medium. EUC on the other hand, is relatively more suited to handling unstructured, ad hoc, and infrequent problems. This may explain why EUC is used for both routine and nonroutine tasks.

Figure 1
Channel importance and task variability
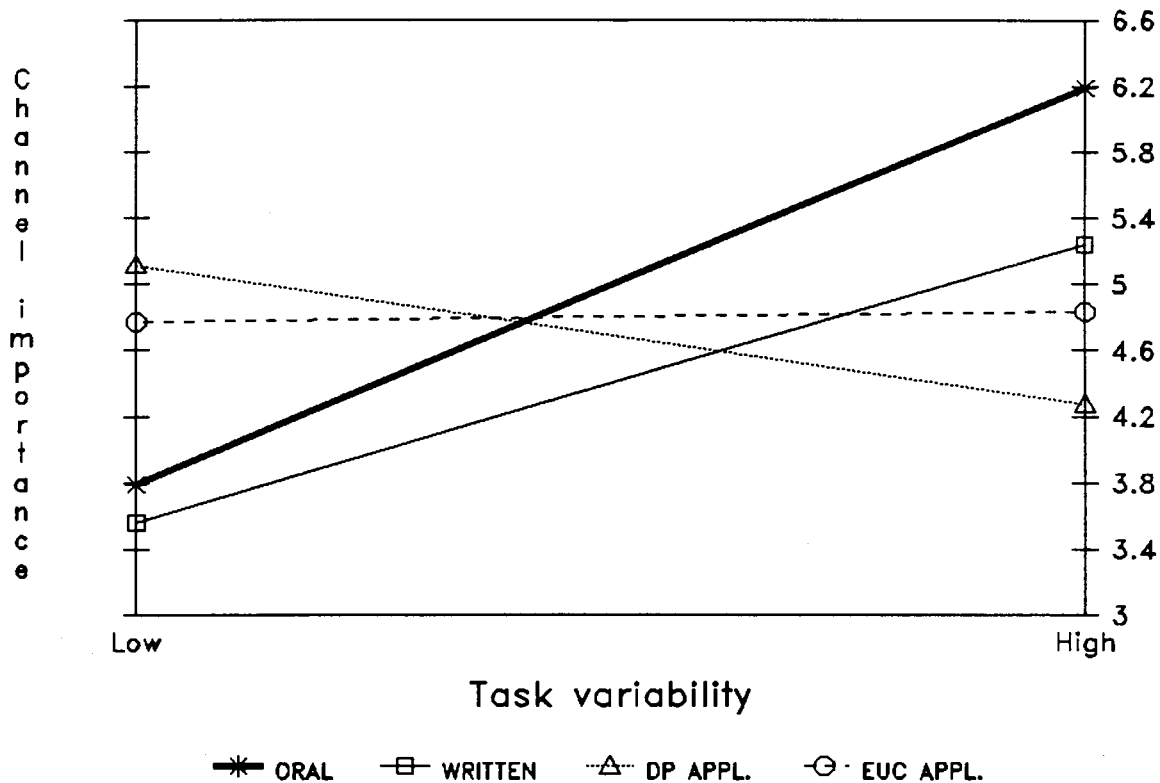
The final hypothesis was also supported by the data analysis. There was a significant correlation between computer accessibility and the use of computers ($r=0.44$, $p<.001$). Note that the relationship held for both traditional DP applications as well as EUC. This is consistent with results found by others [14] that organizational support and accessibility are key to the use and acceptance of computers.

Note that several exploratory tests were also conducted in order to examine potential interactions, and to test for the effects of other demographic and organizational variables. Regression analysis revealed that task variability was indeed the most important variable for explaining the use of the verbal and written channels. For the computer channels, accessibility followed by task variability were the two most important variables. Interestingly, information equivocality was less related to the use of information channels than was task variability, and was significant in explaining only the use of verbal channels. It is also interesting to note that organizational level did not explain the use of information channels in contrast to what is commonly discussed in MIS texts and proposed in several MIS research frameworks (see for instance [11]).

DISCUSSION

What are the implications of these results for the information manager? As post-industrial organizations face increasingly turbulent and complex environments, supporting nonroutine and uncertain work becomes more important. This study indicates that the overall importance of information channels increases as work units face higher levels of uncertainty and work become nonroutine. If information systems are viewed as one of several alternative information channels available to the manager, then the information manager has the responsibility to identify and provide tools to support such nonroutine work. What kind of tools are appropriate to deal with uncertainty? This study did not report details about the nature of different computer tools, other than the finding that the importance of traditional DP applications decrease as uncertainty increases. Nevertheless, one can draw on research on task uncertainty and end-user computing to derive some recommendations. It is important to note that nonroutine work is not a monolith. There are differences in the level of information equivocality. Where equivocality is low, the decision maker may need to assemble masses of data from a variety of sources to determine if there is anything significant which can be understood from it. Tools such as executive information systems provide an effective means for accessing a large amount of current information about the status of the organization. On the other hand, where equivocality is high, the decision maker needs to brainstorm and develop a perspective on the issue from other sources. Electronic mail provides one possible channel for such brainstorming.

Thus, exactly what level of support and what specific computer tools are provided, should be based on individual and work unit task characteristics — rather than on a uniform company-wide policy. Information tools need to fit the task characteristics in order to be effective. IS managers should be cautious about transferring their experience with them when they switch departments or companies. What may have worked very well in a stable environment may not be appropriate in a more dynamic environment.

What are the implications of these results for researchers? The results support the notion that verbal and written media are "richer" than traditional MIS applications described in the original formulation of media richness theory [8]. An important result was that task variability is indeed a key determinant of information channel importance. Other organizational and demographic variables, including information equivocality and organizational level, played a much less significant role in explaining variations in channel importance. This finding contradicts the proposition of media richness theory which states that information equivocality, rather than task uncertainty, determines channel use. As Huber and Daft [17] point out, the information interpretation literature (dealing with

equivocality reduction) is woeful. Considerably more research must be undertaken in order to clarify the relationship between uncertainty, equivocality, and channel usage. Organizational support for computer use was found to be an important factor affecting the importance of computers in day-to-day work. Thus, any research dealing with the use of computers should take this variable into consideration.

There is also a need to take another look at how task characteristics are measured, and what is the most appropriate unit of analysis for measuring task characteristics. Most of the current measures were developed to measure task characteristics of work units rather than individuals. This was appropriate in a more certain environment, where work units were well defined and had relatively homogeneous tasks. These measures are less appropriate in organizations where electronic mail and group decision support systems change the very notion of a work unit. Indeed, researchers in EUC may find it more fruitful to focus on subtasks rather than the individual's overall task, as the unit of analysis. This should lead to more precise results regarding which tools are appropriate for different categories of subtasks. Research is also needed to identify (and to develop instruments to measure) the dimensions along which EUC tools differ. These dimensions than need to be related to the characteristics of the subtask being supported by the tool.

The results of this study are limited by several sampling and measurement issues. The sample for this study consisted of managers and professionals with business degrees, and was mostly limited to the mid-west region. Results may be different in a broader sample of managers. The instruments used for measuring the importance of information channels are not sufficiently validated.

Within these limitations, the study clearly shows that task characteristics should be an important consideration in providing information support to managers and professionals. Different organizations — and different work units within the same organization — face different levels of uncertainty. Their information processing requirements are different and it is important that the nature of support provided match these requirements.

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About the Author

Dr. Jawaid A. Ghani is an associate professor of Business Information Systems at Western Michigan University. He has degrees in Computer Engineering and in Management Science from MIT and in Decision Sciences from the University of Pennsylvania. Prior to joining WMU, he was on the faculty at the University of Petroleum and Minerals in Saudi Arabia and at the Sloan School of Management (MIT), and served as the Director of Gallup Research Institute (Pakistan). His current research interests are in the diffusion and in the organizational impacts of information technology.

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