ORGANIZATIONAL INFORMATION SYSTEMS:
DETERMINANTS OF THEIR PERFORMANCE AND
BEHAVIOR*

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This paper is concerned with organizational information systems. Examples of such systems include intelligence systems, communications systems, management information systems, decision support systems, and administrative control systems. Systems such as these are critical to an organization's functioning; indeed to its survival.

The paper is intended to be of use to three types of professionals: those who study organizations; those who design information systems; and those who manage. This fact causes the paper to differ in a number of ways from earlier works dealing with organizational communications and related topics. For example, the paper draws on three different literatures: the psychological literature dealing with perception and cognition, the social-psychological literature dealing with the role of motivation in communications, and the organizational literature dealing with behavior in information systems. Further, the paper gives greater attention than do earlier works to logistical determinants of information system effectiveness, such as the workload of the unit processing the message or the priority assigned to a message, as contrasted with social-psychological determinants. Finally, the explicit introduction of judgment and argument by analogy when direct evidence is unavailable in third way in which the paper differs from earlier works.

The paper focuses in particular on the determinants of the performance and behavior of such systems as those mentioned above. It discusses in some detail the impact of these determinants on four processes that are of key importance in the operation of information systems. Two of these processes are used to increase system efficiency. One, message routing, causes any particular message to be distributed to relatively few organizational units, and thus greatly reduces the information processing load of the many units that might otherwise be involved in receiving or relaying the message. The other, message summarizing, plays a similar role. It has as its purpose reducing the size of the message while at the same time faithfully reproducing its meaning.

The remaining two processes follow from the fact that organizational units necessarily exercise some discretion in the way that they handle messages. Message delay is a consequence of the priority assignment given a message, and in many cases, enhances the effectiveness not only of the operating unit but of the organization as a whole. Message modification refers to the distortion of message meaning. Its source may be either the cognitive limitations or the motivations of the sender or receiver. Modifications may be conscious or unconscious, well-intentioned or malicious.

Each of these four processes is discussed in some detail. More specifically, the several determinants of the probability or extentiveness of each process's occurrence are identified. The literature related to the various process-determinant pairings is then reviewed, and is summarized in the form of propositions. Several areas where additional research is needed are noted and recommendations are made concerning the nature of such research should be. (ORGANIZATION DESIGN; INFORMATION SYSTEMS)

1. Introduction

This paper is concerned with the performance and behavior of organizational information systems, (e.g. intelligence systems, communication systems, management information systems, decision support systems, and administrative control systems).

In their traditional and noncomputer-aided forms, such systems are critical to organizational functioning external environments, the organizational units that "implementation-related in units, and they transmit the monitoring and scale performance and behavior that a number of orga information processing. Nadler, [76]; O'Reilly an of our knowledge concen organizational information.

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organizational functioning; they monitor and scan the organization's internal and external environments, they transmit the resulting observations and interpretations to organizational units that "decide" if actions are called for, they relay the decisions and implementation-related information from these deciding units to the implementing units, and they transmit the progress and results of these implementations as part of the monitoring and scanning activities mentioned earlier. Indeed, organizational performance and behavior are so closely linked to organizational information processing that a number of organizational scientists have advocated viewing organizations as information processing systems (cf., Simon, [70]; Galbraith, [31]; Tushman and Nadler, [76]; O'Reilly and Pondy, [58]). These thoughts suggest that a summarization of our knowledge concerning the determinants of the performance and behavior of organizational information systems would be useful, useful to those who design organizational information systems and useful to those who manage such systems.

Although the concept of information is clearly important to those whose profession is to design or manage information systems, we should note that the concept is also important to the theories and concepts employed by those management scientists whose profession it is to develop, test, and refine theories for predicting and understanding organizational performance and behavior. For example, a major thrust of contingency theory (Child, [17]; Lorsch, [46]) concerns the processing and distribution of environmentally-related information. Other aspects of this theory deal with environmental uncertainty, a variable frequently viewed as a lack of information about the organization's current or future environment. Similarly, expectancy theory (Vroom, [79]; Campbell and Pritchard, [14]) deals with variables (expectancies or probabilities and valences or utilities) that are thought to be affected by information about the outcome and payoffs associated with certain behaviors. Other variables that seem to be affected by the nature or availability of information and that are important components in theories of organizational performance or behavior are the distribution of power, the availability of organizational slack, and the nature and quality of decisions. These variables in turn have a considerable impact on other variables important to the fields of organization theory and organizational behavior, such as organizational conflict and organizational effectiveness.

In view of these many linkages, it is perhaps not surprising to find that the concept of information is important not only to the fields of organization theory and organizational behavior, but to that of organization design as well. Many would argue, in fact, that the treatment of information may be the key issue to be dealt with in the analysis or design of organizations (cf. Thayer, [73]; Wielen, [82]; Miller, [56]; Simon, [70]; Galbraith, [31]; Tushman and Nadler, [76]; O'Reilly and Pondy, [58]). It seems that this may be especially true when designing boundary spanning units (Tushman, [74]; Jemison, [40]).

Given all of this, it seems reasonable and important to examine and summarize the literature dealing with the performance and behavior of organizational information systems, and in this way enable management scientists to operate more confidently in the world of practice and to claim a fuller understanding of their field in the world of science. This paper reports the results of having attempted these efforts.

The paper differs in three ways from earlier works dealing with organizational communications (cf. Guetzlow, [35]; Thayer [73]; Voos [78]; Ference, [28]; Carter, [16]; Redding [63]; Farace and McDonald, [27]; Porter and Roberts, [61]; and O'Reilly and Pondy, [58]). First, it draws upon three separate literatures—the psychological literature dealing with perception and cognition, the social-psychological litera-
ture dealing with the role of motivation in communications; and the organizational literature dealing with behavior in information systems.

Second, it gives somewhat greater attention than do earlier works to logistical determinants of information system effectiveness, such as the workload of the unit processing a message or the priority assigned to a message, as contrasted with social-psychological determinants. This feature does not, of course, limit the scope of the manuscript to the formal information systems of bureaucratic organizations, as messages transmitted within informal or ad hoc networks are also affected by the workload of the people involved and by the processing priorities that these people assign to the various items of information that they encounter. Obviously both logistical and social-psychological variables affect both formal and informal information systems. In view of this, it seemed important to highlight the importance of logistical variables, since the earlier works cited above had focused heavily on social-psychological variables.

The explicit introduction of judgment and argument by analogy when direct empirical evidence is unavailable is the third way in which the paper differs from earlier works, although the difference is more one of degree than of kind. The usefulness of drawing on reasoning by analogy when attempting to identify relationships among variables in organizational information systems is made clear in Miller's portrayal of the organization as a living system (Miller, [56]). In this classic work, Miller argues and demonstrates that the relationships among variables, that hold true at one level of organizational analysis generally also hold true at other levels. For example, the effects of stress on the information processing effectiveness, of an organizational unit are essentially the same whether the unit is a person, an ad hoc group, or an established organization (cf. Miller, [54],[55]; Meier, [52]; Driver and Streufert, [25]). As will be seen, the literature review leading to the present manuscript identified additional support for this position, and identified no evidence to the contrary. As a consequence, the summarizing statements put forth on the following pages are not qualified so as to pertain to only the levels of analysis (or organizational levels) for which empirical evidence is presently available. For example, in these statements the word "unit" is intended to be broadly defined, and subject to being interpreted as an individual, an ad hoc committee, or a formal work group, even a corporate division.

Thus the statements, which are labeled "propositions" are in general not conclusions based on empirical studies covering all possible levels of analysis. Rather they are statements that represent what it seems reasonable to believe, based on the aggregate evidence available. In a few instances, the literature pertaining to the topic was quite sparse. In these instances, I have stated and supported with argument what I believe the literature will say when it appears. So that the reader will not be misled, these few instances are clearly identified.2

By highlighting these facts, and by referencing under each proposition the supporting evidence, I hope to aid those researchers interested in filling the voids in our knowledge about the treatment of information in organizations. In addition, by explicating with these propositions what it seems reasonable to believe, based on the evidence at hand, I hope to be helpful to those management scientists who are being asked to analyze and "repair" malfunctioning information systems, and even to aid in the design of such systems.

Let us turn now to a discussion of four processes that affect the availability, form, and meaning of message performance and behavior will be used in this and refers to that which is in the information theoretical potential of which information is cut out of the ad hoc or assess, distribute, alter "organizational inform. to a broad scope of act analyzing a report, as includes activities that as those that take place.

2. Processes

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1If the reader would like to reserve the term "propositions" for relational statements that are well supported by the empirical literature, he or she may choose to regard the less well supported relational statements as "hypotheses," or "conjectures." For some readers the less well supported statements may be the more interesting, as they may identify the more likely opportunities for significant empirical contributions.

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and meaning of messages, and that consequently seem important to understanding the performance and behavior of organizational information systems. Three definitions will be used in this and later discussions. “Information” is used in the lay sense and refers to that which is received by the senses, such as words and numbers, rather than in the information theory sense where it would refer to the diagnosticity or uncertainty-reducing potential of these words or numbers. “Messages” refer to the vehicles with which information is communicated, e.g., letters, reports, or phone calls. The carrying out of the ad hoc or prescribed activities through which organizational members assess, distribute, alter or use organizationally relevant information is referred to as “organizational information processing.” The phrase, as used here, is intended to refer to a broad scope of activities. It includes, for example, intrapersonal activities, such as analyzing a report, as well as interpersonal activities such as conversing. It also includes activities that take place in informal networks, or on an ad hoc basis, as well as those that take place in formal networks or according to prescribed protocols.

2. Processes Integral to Organizational Information Systems

Organizations acquire and internally disseminate information in order to carry out the critical functions of decision making and control. In many cases, this effort requires the processing of a large number of information conveying messages. On the other hand, because a large number of messages may cause an overload on the cognitive and logistical capabilities of the individuals and work groups participating in the information system, organizations are forced to seek efficiencies in their processing of organizational messages.

Two processes that organizations use to increase the efficiency of their information systems are message routing and message summarizing. Message routing causes any particular message to be distributed to relatively few organizational units. This selective distribution greatly reduces the information processing load of the many potential receiving units having little or no use for the information and of the many intermediate units involved in summarizing or transmitting the message. Message summarizing plays a similar role. It has as its purpose reducing the size of the message, while at the same time, faithfully reproducing its meaning. For example, large sets of numbers are replaced by their average and multi-page reports are replaced by appropriately derived recommendations or conclusions. Summarization can greatly reduce the cognitive or logistical load on the units having to process the message.

Messages vary considerably in relevance, length, accuracy, timeliness, and other attributes. As a consequence of this fact and the need to control their work load, the units responsible for routing and summarizing necessarily exercise some discretion in the way they handle messages. Such discretion allows two other information-processing phenomena to occur in parallel with summarizing and routing. These are message delay and message modification.

There is no value judgment or negativism implied in the use of the phrase message delay. Since the priority assignment given a message is a principal determinant of the time it will be delayed, and since making such assignments is necessarily (at least in part) a delegated and discretionary act, it would often be difficult to make objective judgments about the excessiveness of individual delays. This, combined with the fact that the sources of most delays are the same regardless of whether delays are categorized as excessive or routine, suggests that we not distinguish between these two categories.

Message modification refers to the distortion of message meaning. Its source may be either the cognitive limitations or the motivations of the sender or receiver. Modifica-

3 The word “unit” is to be interpreted broadly, and may refer, for example, to an individual, an ad hoc committee, a formal work group, or even a corporate division.
tions may be conscious or unconscious, well-intended or malicious. They range from the well-intended correction of minor errors to the extreme modification of substituting one message for another. Message modification differs from message summarization in that it distorts a message’s meaning, whereas summarization does not. Although these processes are often thought of as occurring in the context of a formal organization they occur in informal organizations as well, as anyone’s analysis of the “message board” in their own household will show.

Let us turn now to examining the variables that determine the availability of information in organizations. We begin with the process of routing, the process that determines the organizational location of information.

3. Routing

The real accomplishment of modern science and technology comes in taking ordinary men, informing them narrowly, and deeply and then, through appropriate organization, arranging to have their knowledge combined with that of others, specialized but equally ordinary men. This dispenses with the need for genius."

This quote from Galbraith’s The New Industrial State [30, pp. 60–61] highlights a principal rationale for specialization and consequent departmentalization of many organizations. A particularly important consequence of such specialization and departmentalization is that all organizationally relevant information does not have to be routed to all organizational units. Information routing, the process that principally accounts for certain messages being sent to some units and not to others, is a logical mechanism for reducing the organizational resources devoted to information processing. This, and the fact that wisely selecting the destinations of messages allows organizational units to achieve proprietary as well as organizational goals, probably accounts for the fact that routing is so pervasive that we seldom notice its presence.

Although the term “routings” is not frequently used in the organizational literature: it does capture better than do terms like, “communicating” and “transmitting” the concepts of direction, route, and destination that are integral to much of this literature, and so we use it in those propositions where these concepts play a role.

The literature identifies six variables that seem to affect the routing and transmission of organizational information: (1) costs of communicating; (2) workload of the message-sending unit; (3) message relevance; (4) repercussions from communicating “bad news;” (5) relative power and status of the sender and receiver; and (6) frequency of previous communications. Although a particular author may have used terms different from those of the previous sentence, in all cases the variables referred to were equivalent to or subordinate to one of these six.

It is important to note that it is the perceived, psychological values of these variables to which we refer, both here and in later sections as well. There are two reasons for the use of perceived values. One, important to researchers, is that the objective values are often unmeasurable, e.g., how would one measure “relevance” or “power,” whereas these variables are almost always scalable. The other, important to managers, is that the perceived values can often be manipulated when the objective values cannot be, whereas the opposite is less often the case. Thus it would seem to be most useful to know the relationships between the system performance variables and the perceived values of the performance determining variables. Indeed it may be that the perceived values, in some cases, are the performance-determining variables.

The following paragraphs summarize what the literature says about message routing.

PROPOSITION R. 1. The probability that a message will be routed to a unit is inversely related to the perceived costs of communicating with that unit.

In order to conserve space we shall not reproduce the discussion of a more frequently with which we could expect directed toward (a) pen, (c) persons in the same a more macro basis, and that “In general the farther the units are (or the more channels between them) and “the less” [28, p. 31]. In subsequent e Bacharach and Aiken determinants of the fre

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In order to conserve their resources, we expect organizational units to communicate more frequently with units easily contacted than with other units. This certainly would be so if we could extrapolate the social-psychological findings that messages will be directed toward (a) persons in close proximity, (b) persons in the same socioeconomic status (Collins and Guetzkow, [19, p. 187]), On a more macro basis, and focusing on the concept of physical accessibility, Miller states that “In general the farther components of a system are from one another and the longer the channels between them are, the less is the rate of information flow among them” and “the less ... encoding a channel requires, the more it is used” (Miller, [56, p. 3]). In subsequent empirical studies, Brenner and Sigband [11], Conrath [20], and Bacharach and Aiken [7] found that either physical or structural accessibility was a determinant of the frequency with which subordinates communicated with superiors.

The difficulty in communication may be interpersonal as well as physical or structural, as observed by Brenner and Sigband [11], Goldhar, Bragaw, and Schwartz [33] and as noted by Jam [39], “If the subordinates perceive the communication from the supervisor as generally positive, they would be encouraged to exchange a great deal of information about task related matters ...”

Anticipating these findings, March and Simon argued that “the greater the communication efficiency of the channel, the greater the communication channel usage” [49, p. 167]. Ference [28] offered similar propositions that focus on avoidance of time losses as a variable that determines routing. Studies concerning the choice of a communication medium or information source are also supportive of this proposition (cf., Johnston and Gibbons, [41]).

**Proposition R.2.** The probability that a message will be transmitted from a unit is inversely related to the workload of the unit.

It is reasonable to expect that the transmission behavior of organizational units would be affected by their workload. Meier, for example, found that overloaded units “destroy lowest priorities” when carrying out their functions [52, p. 535]. Research supporting this hypothesis for individuals and small groups is reported by Miller [54] and Driver and Streufert [25], respectively.

The empirical studies relevant to this proposition have found support for it only under high load conditions where the unit seemed to be near or beyond its information processing capacity suggesting that the phrase “work overload” might be more appropriate than “workload.” We call attention to this issue of word choice in order to highlight the fact that the nonuniform arrival of demands for message transmissions will cause occasional work overloads, and thus temporarily lower the probability of transmission within time periods where the average workload observed would not be beyond the unit’s capacity.

Proposition R.2 highlights the usefulness of providing for multiple message sources, especially multiple sources whose workload magnitudes are somewhat independent of one another.

**Proposition R.3.** The probability that a message will be routed to a unit is positively related to the perceived relevance of its contents for that unit.

The literature on management by objectives, on personnel evaluation, and on contractual grievance procedures suggests that organizations tend to reward activity that achieves organizational goals and to punish activity that does not. It follows that, message-sending units, in order to achieve organizational rewards and avoid organizational penalties, would use the relevance of a message for some other unit as a criterion in determining whether to route the message to that unit. Certainly it seems that if relevance criteria were formalized with standing orders directing certain types of
messages to certain units, it is more likely that the message would be sent to the designated units than to undesignated units. In addition, our everyday encounters with overworked colleagues suggest that the receiving units themselves tend to provide penalties in the form of complaints to units that send irrelevant messages. An early study by Davis [23] offers strong support to this proposition, and a later study by Sutton and Porter [72] offers weak support.

Relevance, is, of course, influenced by tasks, assignments and responsibilities. Tushman found that, for high performing units, the greater the task interdependence, the greater was the frequency of communication (Tushman [75]). We should note, however, that while relevance influences routing, this influence is not entirely dictated by formal considerations, as shown by Festinger, Schachter, and Back [29] and by Wickesburg [81], who found that individuals seek information ‘‘wherever in the organization information, advice counsel, and expertise may be found . . . .’’ Formal organization boundaries and levels yield to the demand of the task and situation’’ (Wickesberg, [81, p. 257]).

PROPOSITION R.4. The probability that a message will be routed to a unit is inversely related to the decrease in its goal attainment that the sending unit believes will occur as a result of the routing.

As a result of his survey research in three industrial organizations, Read concluded that ‘‘Individuals in power hierarchies tend to screen out information passed upward, and to withhold or refrain from communicating information that is potentially threatening to the communicator’’ (Read, [62]).

Direct support for this proposition comes from three lines of empirical research. One is the social-psychological research dealing with the suppression of ‘‘bad news’’ in interpersonal communications (cf., Rosen and Tesser, [65]; Rosen, Johnson, Johnson, and Tesser, [66]). A second is the field research dealing with the suppression of information that reflects adversely on the organizational performance of the unit controlling the information (cf., Carter, [18]; Ullman and Huber, [77]; and McCleary, [SOD]. The third is the research on bargaining (cf., Cummings and Hamett, [21]) and organization power (cf., Pfeffer, [60]) indicating that information is a critical resource to joint decision situations and that withholding information from one’s competitors is often useful in attaining one’s goals in a competitive environment.

As we will see when we discuss message modification, a good deal of research indicates that individuals distort those messages that might adversely affect their goal attainment (cf. the laboratory studies of Cohen, [18]; and O’Reilly and Roberts, [59], and the field studies of Mellinger, [53]; Gore, [34]; Read, [62]; Athanassiades, [6]; Kaufman, [42]; Roberts and O’Reilly, [64]; and O’Reilly, [57]). Since message suppression (nonrouting) is an extreme form of distortion, it may be argued that this body of literature also supports the present proposition.

PROPOSITION R.5. The probability that a message will be routed to a unit is positively related to the perceived power and status of the unit (except for the situation described under Proposition R.4).

This proposition follows from the findings that (1) persons of low status and power tend to direct messages to persons with more status and power, and (2) persons of high status and power tend to communicate more with their peers than with persons of lower status and power (Bamlund and Harland, [8]; Collins and Guetzkow, [19, p. 187]; Allen and Cohen, [3]). The proposition might also be inferred from the finding that persons in high organizational positions, positions which often have more power and status, are better informed (Davis, [23]; Zajonc and Wolfe, [83]; Sutton and Porter, [72]), although other variables such as seniority or perceptiveness may also play a role in this finding.

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PROPOSITION R.6. The proposition related to the frequency with recent past.

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Let us turn now to a availability of information:

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some nonsupportive evidence is the conclusion of Davis [23], in his study of communications within an industrial management group, that “the predominant communication flow was downward or horizontal.” It seems, however, that this finding might be a consequence of (1) higher organizational levels issuing directives that were in reality initiated by lower level staff groups or (2) the fact that in organizations with routinized technologies many upward “messages” are uncounted by observers, e.g., scheduled quality control reports or the absence of “out-of-stock” reports which is, via management by exception, a message in itself.

Proposition R.6. The probability that a message will be routed to a unit is positively related to the frequency with which similar messages have been routed to the unit in the recent past.

This proposition follows from the Propositions R.1, R.3, and R.5, since it is unlikely that the sender’s perceptions of cost, relevance, and status will change significantly in a short term interval. It also follows from the argument of March and Simon that

Channel usage tends to be self-reinforcing in informal communication, much of it social in character, develops side-by-side with task-oriented formal communication, and those of the channel for either kind of communication tends to reinforce its use for the other (March and Simon, [49, pp.167-168]).

Let us turn now to a discussion of delay, another of the processes affecting the availability of information.

4. Delaying

The time that elapses between when a message is received and when, in perhaps a summarized or modified form, it is passed on to the next link in the communication chain we will call “delay.” The delay time has three components: (1) the time necessary to process the message, (2) the time lost while the processing unit tends to other tasks, and (3) the time lapse while the processed message is held in storage, waiting perhaps for its relevance to increase or for another message to arrive for inclusion as a combination of messages to be transmitted simultaneously. The second of these components is a function of, among other things, the relative priority that the sender assigns to processing the particular message. The sender’s prioritization may, of course, be influenced by organizational directives. The third component is basically a matter of timing.

The next several paragraphs highlight three variables that seem to affect message delay: (1) timeliness of the message, (2) work overload of the sending unit, and (3) number of links in the communication chain. Because the empirical support for the associated propositions is relatively weak, the reader should exercise some judgment in assessing their usefulness in fulfilling his or her needs.

Proposition D.1. The probability or duration of message delay will be inverse related to the perceived timeliness of the message for the receiving unit.

Our everyday observations and some research (cf., Ullman and Huber, [77]; Gerstenfeld and Berger, [32]) suggest that message processing units tend to delay sending messages in situations where premature delivery would reduce the message’s impact, such as when the message receiver is overloaded or has a mental set against receiving the message.

Assuming that organizations tend to reward good performance, it follows that sending units would tend to delay most of those messages that were not timely and to delay least those messages where delay would be costly to the receiving unit. Another way of putting the argument is that use of organizational sanctions would cause sending units to use timeliness as a criterion for assigning priorities to the processing of messages.
Proposition D.2. The probability or duration of message delay will be positively related to the workload of the sending unit.

In laboratory settings, Miller [54,55] has observed that delay in processing of information is one way in which individuals deal with information overload, and he argues that the delay would also be used by organizational units when faced with overload. Additional evidence is the case study of work overload in libraries by Meier [52]. In a more clinical vein, as a result of his interviews with administrators in bureaucratic organizations, Downs concluded that “The most common bureau response to communications overloads is slowing down the speed of handling messages without changing communications network situations or transmission rules” [24, p. 270].

Proposition D.3. The probability or duration of message delay is positively related to the number of sequential links in the communication chain connecting the receiver to the message source.

This proposition relies on the reasoning, supported by Allport and Postman [4], Higham [36], and Miller [56], that the greater the number of sequential links in a communication chain, the greater would be the overall effect of a phenomenon that took place at each link.

Let us move on now to examining the variables that determine changes in the form and meaning of organizational messages. We begin by looking at those that affect message modification, as it is this process, rather, than message summarization, at which the greater amount of empirical research has been directed.

5. Modification

Altogether, eight propositions are presented that relate message modification to other variables. We begin with a few propositions concerning the motivational bases for modification, then turn to those dealing with perceptual and cognitive bases, and conclude with a proposition identifying an organizational determinant of message modification.

In some cases a proposition could have been decomposed into subpropositions that would focus on a particular form of modification or form of the associated determining variable. I have chosen to avoid extensive divisions of this nature and hope that I have thereby decreased the chance that either I or the reader would miss the forest for the trees. The references identified with the propositions contain the more specific propositions or findings from which these propositions were constructed.

Proposition M.1. The probability or extent of message modification is positively related to the increase in its goal attainment that the sending unit believes will result from introducing the modification.

As a result of his extensive interviews with administrators, Downs concluded that “Each official tends to distort the information he passes upward in the hierarchy, exaggerating this data favorable to himself and minimizing those data unfavorable to himself” (Downs, [24, p. 266]). His conclusion is strongly supported by the laboratory studies of Cohen [18] and O’Reilly and Roberts [59] and the field studies of Mellinger [53], Gore [34], Read [62], Athanassiades [6], Kaufman [42], Roberts and O’Reilly [64], and O’Reilly [57]. The independent variables in these studies were the receiver’s status and influence over the message sender’s goal achievement, the sender’s trust in the receiver, and the sender’s attitudes towards his own upward mobility. The dependent variables were quite varied, and included revising the message format (the mildest form of modification) and eliminating the message or substituting an incorrect message.

Further evidence in the study of bureaucratic organizations, Miller [54] observed that delay in processing of information is one way in which individuals deal with information overload, and he argues that the delay would also be used by organizational units when faced with overload. Additional evidence is the case study of work overload in libraries by Meier [52]. In a more clinical vein, as a result of his interviews with administrators in bureaucratic organizations, Downs concluded that “The most common bureau response to communications overloads is slowing down the speed of handling messages without changing communications network situations or transmission rules” [24, p. 270].
Further evidence in support of the proposition follows from the findings that managers attempt to create slack in their budgets by understating revenues and overstating costs (Lowe and Shaw, [47]; Schiff and Lewin, [67], [68]) and that when senders do not trust the motives of the receivers, they tend to modify the messages more than otherwise (cf., Mellinger, [53]; Loomis, [48]; Read, [62]; Zand, [84]; O’Reilly and Roberts, [59]; Roberts and O’Reilly, [64]. Related findings are that modification is influenced by the sender’s perception of the receiver’s influence over the receiver (Watson and Bromberg, [80]); Alkire, Collum, Kaswan, and Love, [2] and the sender’s mobility aspirations (Read, [62]; Lawler, Porter, and Tenenbaum, [44]; Athanassiades, [6]). O’Reilly [57] provides a particularly articulate discussion of the variables of trust, influence, and mobility.

Additional support for the proposition follows from the small group literature. For example, Collins and Guetzkow’s review led them to conclude that “The content of communication from low to high power-status persons will depend on what the low status person has learned is most likely to obtain reinforcement” (Collins and Guetzkow, [19, p. 187]).

\textbf{Proposition M.2.} The probability or extent of message modification is positively related to the decrease in stress on the receiver that the sender expects will result from his or her modification.

Some research suggests that message modifications are made for the purpose of reducing the stress on the receiver. In his review of the early psychological research, Campbell notes that “through an anticipatory monitoring of his own intended output, he (the sender) makes an active effort to produce a coherent output, by suppressing remembered detail that does not now seem to fit and by confabulating detail where gaps are conspicuous” (Campbell, [13, p. 342]). Further, Rosen and Tesser [65] found, even after controlling for any possible prior or subsequent interaction between the sender and receiver and for the possibility of any punitive action being taken by the receiver against the sender, that senders still attempted to modify their messages so as to not distress the receiver. As a result of his reading of the literature, Ference stated that “Information, once evaluated and integrated, will tend to fit the transmitter’s perceptions of the recipient’s needs” (Ference, [28, p. B-851).

\textbf{Proposition M.3.} The probability or extent of message modification is positively related to the discretion allowed in choosing the message format.

It seems that the tendency to modify messages would be less if the senders had less discretion in choosing the format of their communications. I know of no specific empirical study relating to this proposition, but note that Downs concluded from his extensive interviews with the administrators that “One way for officials to avoid distortion is to use messages that cannot be altered in meaning during transmission (except through outright falsification). Such messages usually involve both predesignated definitions and coding or easily quantifiable information” (Downs, [24, p. 126]), i.e., they are of fixed format. It is interesting to note that predesignated definitions and codings, the use of checklists and forms, and most other mechanisms for reducing discretion in the selection of message format would tend to reduce modifications in those instances where the modifications were perceptually or cognitively based as well as in those where they were motivationally based.

We turn now to the perceptual and cognitive bases of message modification. While they and the motivational bases of message modification are interactive—what we perceive is affected by what we are and what we are is affected by what we perceive—it is useful for both administrative and research purposes to make distinctions between them wherever possible. Propositions M.4 and M.5 identify modifications...
tions introduced by the message receiver. Propositions M.6 and M.7 return again to modifications introduced by the sender.

**Proposition M.4.** The probability or extent of message modification is positively related to the difference between actual message content and its expected or desired content.

In his review article, Campbell [13] notes that both cognitive limitations and personal motivations cause transmitters to imperfectly modify messages during assimilation, stating that the “tendency to distort messages in the direction of identity with previous inputs is probably the most pervasive of the systematic biases” (p. 346), and “that . . . the human transmitter is prone to bias away from input in the direction of the transmitter’s own attitudes” (p. 350). As a result of his interview study, Downs concluded that “Officials’ perceptions will operate so as to partially screen out data adverse to their own interests, and magnify those favorable to their interest” [24, p. 272]. These conclusions suggest that information inputs are transformed in the direction of the receiver’s prior information, expectations, or wishes. McLeod (51, p. 218) reviewed a number of studies suggesting that the transformation is less if the sender expects to receive further information on the subject.

**Proposition M.5.** The probability or extent of message modification is positively related to the perceived ambiguity of the data on which the message is based.

Bruner summarized the early work relating to this proposition in his review article “On Perceptual Readiness” as follows: “Presented with a complex stimulus, the subject perceives in it what is ‘ready’ to perceive; the more complex or ambiguous the stimulus, the more perception will be determined by what is already ‘in’ the subject and the less by what is in the stimulus” (Bruner, [12]). Porter and Roberts, in their review of findings related to this idea, stated that “These results would indicate that the more, tangible and objective the subject matter . . . the more likely it is that subordinates and their superiors will feel that they are communicating accurately, whereas when the messages involve more subjective opinions and feelings there is greater doubt about accuracy” (Porter and Roberts, 61).

**Proposition M.6.** The probability or extent of message modification is positively related to the extent of the sender’s work overload.

It seems reasonable to believe that, if the sender is either cognitively or logistically overloaded, message modifications would be greater. His early literature review led Campbell to conclude that “Whenever human beings operate at near maximum capacity, selective information loss—undesired reduction of message complexity—is apt to be involved . . . ” (Campbell, [13, p. 3363]). Miller [54, 55] has given considerable attention to information overload and found that a wide variety of modifications, e.g., filtering, approximation, and omission, and other devices, are used to deal with it. Of some interest was his observation that “At slow rates of transmission subjects used few adjustment processes. At medium rates they attempted them all. At higher rates filtering was preferred, but as the maximum channel capacity was reached, both subjects used chiefly omissions” (Miller, [55, p. 94]). Additional support is given to this proposition by the empirical study of Lanzetta and Roby [43], the case study by Meier [52], and the review by Driver and Streufert [25].

**Proposition M.7.** The probability or extent of message modification is inversely related to the cost that the sender expects to incur as a result of making the modification.

If cognitive limitations were the cause of message modification, and if the anticipated cost to the sender of these modifications was high, then it seems likely that the sender would put forth a greater effort not to make errors and that the modification would be less. Empirical support related is the idea and if the anticipated cost of information channels (Downs, [24, p. 2691]). The one might expect (cf., Hs

**Proposition M.8.** The related to the number of receiver to the message so

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would be less. Empirical support for this belief is provided by Adams and Swanson [1]. Closely related is the idea that if motivations were the cause of message modification and if the anticipated cost of making them were high, then modification would be less. One contribution to anticipated cost would be the knowledge that the receiver could get the correct message from another source, and would hold the sender accountable for having made the modification. For example, Downs noted that “use of redundant information channels increases the probability of obtaining accurate information” (Downs, [24, p. 269]). The empirical support for this latter idea is more equivocal than one might expect (cf., Hsia, [37]; Anderson, [5]).

**PROPOSITION M.8.** The probability or extent of message modification is positively related to the number of sequential links in the communication chain connecting the receiver to the message source.

More links in a communication chain provide the opportunity for additional distortions to occur. That these additional distortions do occur was a central finding of the rumor transmission research by Bartlett [9], Allport and Postman [4] and Higham [36]. Other writers have also addressed the matter (cf., Downs, [24], p. 269]; and Miller, [51, p. 218]. In their discussion of organizational innovation, March and Simon stated that “Selective filtering takes place not only at the boundary of the organization, but at every stage in the transmission and elaboration of program proposals” (March and Simon, [49, p. 189]), and Downs concluded that “When information must be passed through many officials, each of whom condenses it somewhat before passing it on to the next, the final output will be very different in quality from the original input; that is, significant distortion will occur” (Downs, [24, p. 269]). Smart and Vertinsky [71] have addressed these same ideas in the context of decision making under crisis.

A dramatic example of what Downs was describing is the following:

* A reporter was present at a hamlet burned down by the U.S. Army's 1st Air Cavalry Division in 1967. Investigation showed that the order from the division headquarters to the brigade was: “On no occasion must hamlets be burned down.”

* The brigade radioed the battalion: “Do not burn down any hamlets unless you are absolutely convinced that the Viet Cong are in them.”

* The battalion radioed the infantry company at the scene: “If you think there are any Viet Cong in the hamlet, burn it down.”

* The company commander ordered his troops: “Bum down that hamlet.” (Millet, [56, p. 69]).

This phenomenon takes place in upward as well as downward communications. For example, Kaufman notes that “An official study of a mass killing of Vietnamese civilians by American troops disclosed that at each successive higher level in the military hierarchy the reported number of victims was reduced, so that the highest levels had no idea of the extent of ‘the tragedy despite two separate command channels for transmission of news about events in the field. A field commander subsequently declared that ‘every large combat unit has similar episodes ‘hidden somewhere’”’ (Kaufman, [42, p. 14]).

6. **Summarization**

Message summarization can perhaps best be illustrated with an example. If a military outpost monitors enemy truck traffic, it may report to some higher level command the number of trucks seen each day. The higher level command, receiving truck traffic counts from many such outputs and having to communicate a measure of truck traffic even further upward through the chain of command, may well report the average number of trucks per day observed by this outpost. The fit step has been taken in summarization—a frequency distribution has been reduced to a descriptive...
statistic, in this case the mean. The next higher echelon will receive many such traffic reports from its several subordinate units and may be required to conclude whether current truck traffic in its area is increasing or remaining constant. When it does this, the second step has been taken—a statistical inference has been drawn, a mean value has been encoded as a 1 or a 0, depending on whether the null hypothesis was rejected or accepted.

The echelon receiving this coded inference may receive such inferences about the increase in truck traffic from many subordinate units, and may pass upward the descriptive statement that “in two-thirds of the sectors polled, truck traffic has increased.” Here, data in the form of binary digits were combined into a descriptive statistic, a proportion. It may well be that proportions dealing with other variables such as rail traffic, construction of artillery sites, etc. would also be received by a still higher echelon and would be subjectively combined with the truck traffic proportion to facilitate the drawing of still another inference concerning whether or not the enemy is in the process of a major buildup of its forces in a particular region.

Depending on the number of echelons involved, we can envision the continuing repetition of the following cycle: (1) data are combined into a descriptive statistic, (2) the descriptive statistic is compared to some standard and a statistical inference is drawn, and (3) inferences are treated as data. It is not necessary that only one step in this cycle takes place at any particular node in the communication network, or that a summarization takes place at every node.

Of course summarization also occurs with qualitative information. For example, information obtained in an employment interview is subjectively aggregated and transformed into a descriptive rating, the rating is compared to some (perhaps implicit) standard, and a conclusion is drawn concerning the acceptability of the candidate.

As we noted earlier, message summarization is a process purposefully employed by organizations and tends to have as an outcome a faithful representation of the original meaning. These features are generally in contrast to those of message modification. Message summarization greatly reduces the cognitive and logistical loads on organizational units. In addition, in that the conclusions that follow from inference-drawing become guidelines and directives for organizational action, it aids considerably in planning and coordination (cf., the discussion of “uncertainty absorption” in March and Simon, [49, pp. 165-166]). For these reasons, message summarization is a pervasive organizational process. In spite of its pervasiveness, however, there is very little empirical literature that deals with the subject. The relative shortage exists in contrast with the abundance concerning message modification. Perhaps the disparity exists because findings of successful summarization, i.e., condensation without distortion, are less tantalizing than are findings of modification, e.g., alteration with distortion. Whatever the reason, there is very little literature on which to base propositions about message summarization.

I have chosen, nevertheless, to offer four propositions on the subject. I hope that their presentation will lead organizational scientists to undertake empirical studies of information summarization and that it will heighten the sensitivity of organization designers and analysts to this organizational process.

There are four variables that it seems reasonable to believe would affect the summarizing of information in organizations: (1) savings in transmission costs, (2) cost of summarizing the message, (3) workload of receiving unit, and (4) number of links in the communication chain. It is important to note that “costs” include the expenditure of any resource, including time, space, and intellectual effort.

**Proposition S.1.** The probability or extent of message summarization is positively related to the perceived savings in transmission costs obtained from summarizing the message.
receive many such reports to conclude whether enemy activities were a mean value has been rejected or 2. the greater the reduction in transmission cost that is possible, the greater the transmission costs are not important determinants of message summarization. Rather, only (1) where they are large and (2) where the sender is accountable for them, are transmission costs likely to be important determinants. In view of this, we highlight here the fact that the proposition deals with perceived savings.

PROPOSITION S.2. The probability or extent of message summarization is inversely related to the perceived cost of summarizing the message.

Working against the impact of Proposition S.1 are the facts that summarizing requires time and effort, and that the resultant costs could exceed the savings associated with transmitting a summarized message. This could lead to the transmission of unsummarized messages even when transmission costs are significant, as observed by Kaufman in his study of the communications from individual forest managers to the U.S. Forest Service (Kaufman, [42]). This idea is captured in Proposition S.2.

Because of the fact that summarization does take time and effort to carry out, one would expect an inverse relationship between the extent of message summarization and the cost of message summarization. If this inverse relationship exists, it would be difficult to validate both propositions, since S.1 posits a positive relationship between the dependent variables and the extent of summarization and S.2 posits an inverse relationship between the dependent variables and the cost of summarization. The difficulty of successfully validating these two propositions, even if both are in fact valid, may explain the lack of reported empirical studies dealing with the stated relationships.

PROPOSITION S.3. The probability or extent of message summarization is positively related to the perceived workload of the receiving unit.

A number of arguments suggest that the message will be summarized to a greater extent if it is known that the receiving unit is heavily loaded. One argument is that if the sending unit wants the message to have an impact, it will attempt to format the message in accordance with the desires of the receiving unit. This, combined with the thought that the greater the receiving unit’s workload, the more summarization would be desired, leads us to conclude that a relationship would exist between summarization by the sender and workload of the receiver. A final line of reasoning follows from the observation of Downs that “When the topmost level of communication intermediaries becomes overloaded for any reason, it can react ... by changing the transmission rules so that the lower levels in the network screen out more information before sending messages” (Downs, [24, p. 129]). Thus, an overloaded receiving unit might have some of its workload reduced with a directive that sending units condense their inputs to the receiver.

PROPOSITION S.4. The probability or extent of message summarization is positively related to the number of sequential links in the communication chain connecting the receiver to the message source.

It seems reasonable to believe that the greater the number of sequential links in a communication chain, the more intense would be the effect of a phenomenon that took place at each link. Evidence supporting this is suggested by the work of Bartlett [9], Allport and Postman [4], and Higham [36].
GEORGE HUBER

7. summary

This paper reviewed the literature concerning the determinants of the performance and behavior of organizational information processing systems. In most instances, these determinants and their impact were identified from an examination of the empirical literature, and thus most of the propositions are supported by this literature. The review did identify two areas, however, where there seems to be an especially acute need for further empirical research. One of these concerns message routing. The presently available literature related to message routing deals primarily with informal and not necessarily work-related messages. It may be that, in some instances, empirical studies of the more formalized information systems that deal primarily with work-related messages would lead to somewhat different propositions than those that followed from the presently available literature.

The second area in particular need of further empirical study concerns message summarization. The literature pertaining to this topic is extremely sparse. It seems that the results of studies dealing with message routing in formal settings and with message summarization would be quite useful to the designers and managers of information systems, since the availability, form, and meaning of messages are such important determinants of the quality of organizational decisions, and hence of the effectiveness and viability of the organization itself.

There is clearly much research to be done before management scientists can tell managers or information systems designers how to prevent or resolve any information system malfunction that might occur. I hope that highlighting this fact will accelerate the amount of research that will be brought to bear on the matter. In the meantime, however, management scientists are being called upon to address problems that have deadlines for solution. They cannot ask the clients to wait for future research results, but must work with the knowledge that is available today. By searching out and gathering together this knowledge, by summarizing what we know, or think we know, about the determinants of the performance and behavior of organizational information systems, I have attempted to take a first step in responding to this need.

Two matters seem to be worthy of special mention at this point. One is that the forthcoming inclusion of extremely sophisticated computing and communications technology, into our organizational information systems may affect the nature of the impact of the determinants identified in the review presented here. Or, it may generate additional determinants. Thus there will be a need for further research of a relatively basic nature.

The second matter concerns a more immediate need, the need for applied research to respond further to the needs of today's managers and systems designers. I believe we can expect to see, and should see, studies that include the following steps: (1) developing normative guidelines for the design and management of information systems, guidelines based on behavioral research such as that reviewed here, (2) testing, revising, and retesting the usefulness of these guidelines in the actual design and management of organizational information systems, and (3) reporting the results of these tests so that when the guidelines are valid, they may be adopted by others and so that when they are not, further and more targeted research can be initiated.

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