

MICROCOPY

CHART

12

Organizations As Information Processing Systems

Office of Naval Research
Technical Report Series

AD-A168 286

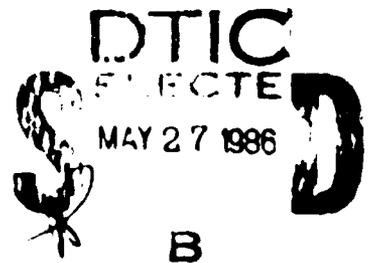
How Organizations Learn:
A Communication Framework

Richard Daft
George Huber

TR-ONR-DG-18 ✓

April 1986

Department of Management
Texas A&M University



DTIC FILE COPY

DISTRIBUTION STATEMENT A
Approved for public release
Distribution Unlimited

Richard Daft
and
Ricky Griffin
Principal Investigators

86 5 27 09 8

How Organizations Learn:
A Communication Framework

Richard Daft
George Huber

TR-ONR-DG-18 ✓

April 1986

DTIC
ELECTE
S MAY 27 1986 D
B

DISTRIBUTION STATEMENT A

Approved for public release
Distribution Unlimited

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER TR-ONR-DG-18	2. GOVT ACCESSION NO. AD A168286	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) How Organizations Learn: A Communication Framework	5. TYPE OF REPORT & PERIOD COVERED Technical Report	
	6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s) Richard Daft George Huber	8. CONTRACT OR GRANT NUMBER(s) N00014-83-C-0025	
9. PERFORMING ORGANIZATION NAME AND ADDRESS College of Business Administration Texas A&M University College Station, TX 77843	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS NR170-950	
11. CONTROLLING OFFICE NAME AND ADDRESS Organizational Effectiveness Research Programs Office of Naval Research Arlington, VA 22217	12. REPORT DATE April 1986	
	13. NUMBER OF PAGES	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report) Unclassified	
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
16. DISTRIBUTION STATEMENT (of this Report) Approval for public release: distribution unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) If organizational scientists could create and validate operational theories of how organizations learn, and if they could cause organizations to learn and effectuate these theories, then some of the wasted resources associated with organizational failures might be diminished. An early step is to assess where we stand in the development of operational theories of organizational learning. We make this assessment and propose a new model of organizational learning. Our goal is to define two perspectives on organizational learning and to con-		

DD FORM 1473
1 JAN 73

EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-014-6601

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Office of Naval Research
N00014-83-C-0025
NR 170-950

Organizations as Information Processing Systems

Richard L. Daft and Ricky W. Griffin
Co-Principal Investigators

Department of Management
College of Business Administration
Texas A&M University
College Station, TX 77843

- TR-ONR-DG-01 Joe Thomas and Ricky W. Griffin. The Social Information Processing Model of Task Design: A Review of the Literature. February 1983.
- TR-ONR-DG-02 Richard L. Daft and Robert H. Lengel. Information Richness: A New Approach to Managerial Behavior and Organization Design. May 1983.
- TR-ONR-DG-03 Ricky W. Griffin, Thomas S. Bateman, and James Skivington. Social Cues as Information Sources: Extensions and Refinements. September 1983.
- TR-ONR-DG-04 Richard L. Daft and Karl E. Weick. Toward a Model of Organizations as Interpretation Systems. September 1983.
- TR-ONR-DG-05 Thomas S. Bateman, Ricky W. Griffin, and David Rubenstein. Social Information Processing and Group-Induced Response Shifts. January 1984.
- TR-ONR-DG-06 Richard L. Daft and Norman B. Macintosh. The Nature and Use of Formal Control Systems for Management Control and Strategy Implementation. February 1984.
- TR-ONR-DG-07 Thomas Head, Ricky W. Griffin, and Thomas S. Bateman. Media Selection for the Delivery of Good and Bad News: A Laboratory Experiment. May 1984.
- TR-ONR-DG-08 Robert H. Lengel and Richard L. Daft. An Exploratory Analysis of the Relationship Between Media Richness and Managerial Information Processing. July 1984.
- TR-ONR-DG-09 Ricky Griffin, Thomas Bateman, Sandy Wayne, and Thomas Head. Objective and Social Factors as Determinants of Task Perceptions and Responses: An Integrative Framework and Empirical Investigation. November 1984.
- TR-ONR-DG-10 Richard Daft and Robert Lengel. A Proposed Integration Among Organizational Information Requirements, Media Richness and Structural Design. November 1984.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

trust and connect them, and thereby to facilitate movement from metaphor making to theory building.

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability	
Dist	
A-1	

SECURITY
UNCLASSIFIED
3

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

- TR-ONR-DG-11 Gary A. Giroux, Alan G. Mayper, and Richard L. Daft. Toward a Strategic Contingencies Model of Budget Related Influence in Municipal Government Organizations. November 1984.
- TR-ONR-DG-12 N. B. Macintosh and R. L. Daft. Technology, Personal Attributes and the Perceived Amount and Focus of Accounting and Information System Data. March 1984.
- TR-ONR-DG-13 N. B. Macintosh and R. L. Daft. Management Control Systems and Interdependencies: An Empirical Study. March 1985.
- TR-ONR-DG-14 Thomas C. Head, Valerie L. Yates, Ricky W. Griffin, and Thomas S. Bateman. The Priming Effect in Task Design Research. April 1985.
- TR-ONR-DG-15 Ricky W. Griffin, Kristen Dahlen Skivington and Gregory Moorhead. Symbolic and Interactional Perspectives on Leadership: An Integrative Framework. May 1985.
- TR-ONR-DG-16 Ricky W. Griffin and Thomas S. Bateman. Job Satisfaction and Organizational Commitment. May 1985.
- TR-ONR-DG-17 Ricky W. Griffin. Toward an Integrated Theory of Task Design. April 1986.
- TR-ONR-DG-18 Richard Daft and George Huber. How Organizations Learn: A Communication Framework. April 1986.

HOW ORGANIZATIONS LEARN:

A COMMUNICATION FRAMEWORK

1. Introduction

Next month, after 153 years of production, the last fire truck will roll off the quarter-mile-long assembly line at American LaFrance in Elmira, N.Y. American LaFrance once ruled its marketplace as well as any American company ever dominated a business. But the parking lot is mostly empty now, and it's hard to find a person in Elmira who clearly understands why the company is closing up shop. Executives directly in charge at LaFrance offer no explanation. Figgie International, the conglomerate that has owned it since 1966, cites LaFrance's dated truck designs, high overhead and a string of losses, culminating last year with a pretax loss of \$7.6 million on flagging sales of \$21.5 million (Merwan, 1985).

Why does a company like American LaFrance fail? How, in just a few years, could a preeminent franchise built on eight generations of craftsmen come to fall woefully behind the competition?

The answer is "Emergency One," only eleven years old, an upstart manufacturer of fire trucks that tried a new idea--make the bodies of fire trucks out of aluminum rather than steel. This revolutionary idea has made Emergency One the market leader because aluminum doesn't corrode and is cheaper in the long run for fire departments with tight budgets.

Emergency One also revolutionized the assembly process for fire trucks. American LaFrance spent a week handdrafting blueprints for each order. Emergency One does the same thing in a few hours with the aid of a computer. American LaFrance took six months to manufacture a basic fire truck; Emergency One takes one and one-half months.

Emergency One has been especially creative in establishing links with customers. It lent new fire trucks to the Boston Fire Department, and sales executives lived at the Boston fire house and went out on sixty fire calls.

The company also flew twenty fire chiefs to Florida to drive trucks home that were purchased by other departments in their locale.

For American LaFrance, tradition was blinding. American LaFrance grew out of touch with customers, with new technology, with industry changes. We hear of other companies that lost touch with the environment, suddenly found themselves in a crisis, and ultimately failed. Braniff Airlines, Penn Square Bank, Air Florida, Columbia Data Products, Osborne Computers and Facit Corporation (Starbuck, 1983) all shared a common fate with American LaFrance. They did not listen. They did not see. They did not react. These organizations failed to acquire accurate information about environmental events, or they did not interpret it correctly. They did not learn.

If organizational scientists could create and validate operational theories of how organizations learn, and if they could cause organizations to learn and effectuate these theories, then some of the wasted resources associated with organizational failures such as American LaFrance's might be diminished. An early step in enacting this scenario is to assess where we stand in the development of operational theories of organizational learning. In this chapter we make this assessment and propose a new model of organizational learning. Our goal is to define two perspectives on organizational learning and to contrast and connect them, and thereby to facilitate movement from metaphor making to theory building.

Organization Theory and Organizational Learning

It is rarely made explicit, but organizational learning has been a key assumption in organization theory since the 1950's. A large proportion of the literature on organizations concerns organizational adaptation to the environment. Early and oft-cited pieces are those by Burns and Stalker

(1961), Emery and Trist (1965), Lawrence and Lorsch (1967), Terreberry (1968). More recent are those by Miller and Friesen (1980) and Zammuto and Cameron (1985). Implicit in this idea that individual organizations adapt to their environment, are the ideas that organizations learn what their environment is and which organizational design features work best in their particular environment.

Another large proportion of the literature concerns the nature and extent of congruence among major organizational characteristics such as strategy, structure, and technology. Examples of research from this perspective are Perrow (1967), Miles and Snow (1978), and Hambrick (1982). While arguments and evidence can be marshalled to support the contention that the observed pairings of these characteristics are a consequence of natural selection (Hannan and Freeman, 1977), it is also true that arguments and evidence can be marshalled to support the contention that organizations learn which pairings facilitate goal achievement by copying, by experimentation, or by trial and error (Aldrich, McKelvey, Ulrich, 1984; Dutton and Freedman, 1985). Thus a manufacturer who moves to a "defender" strategy (Miles and Snow, 1978) learns that a formalized structure is congruent with the long-linked technology that makes the strategy viable.(1)

Perspectives on Organizational Learning

In their editorial introduction to the topic of organizational learning, Argyris and Schon noted that "the term, 'organizational learning', has been used in many different ways and figures in many sorts of research enterprises" (Argyris and Schon, 1983, p. 3). Not surprisingly, articles that have reviewed literature on organizational learning have attempted to cope first

with the task of interpreting the concept "organizational learning," and second with integrating the growing literature on the topic.

Shrivastava (1983) addressed these problems by integrating the extant literature on organizational learning into four approaches. These approaches represent distinct views on the complex topic of organizational learning. The four approaches proposed by Shrivastava are:

1. Adaptive learning. Organizations adapt to problems, opportunities, and changes in the environment by adjusting goals, decisions, and behaviors. Learning is incremental through the adjustment of goals, search, and decision making (c.f., Cyert and March, 1963; March and Olsen, 1976; Mintzberg, et al., 1976).
2. Assumption sharing. Organizational theories-in-use result from shared assumptions and values. Learning involves changes in these theories (c.f., Argyris and Schon, 1978; Mitroff and Emshoff, 1979; and Weick, 1979).
3. Development of knowledge. Learning is the process of acquiring knowledge of the relationship between organizational actions and environmental outcomes (c.f., Duncan and Weiss, 1978; and Dutton and Duncan, 1981).
4. Institutionalized experience. Learning curve effect through size and bureaucratic procedures. Learning is an accumulation of efficiencies through experience and tradition (c.f., Boston Consulting Group, 1968; Yelle, 1979).

Another recent approach examined the definition of learning. Fiol and Lyles (1985) argued that the literature on organizational learning dealt with

either cognitive changes or behavioral changes by the organization. Cognitive change pertains to new shared understanding and conceptual schemes by organization members. Behavioral development pertains to new responses, action, or structures. Based on these two types of change, Fiol and Lyles proposed a distinction between learning and adaptation. Learning is "the development of insights, knowledge, and associations between past actions, the effectiveness of those actions, and future action" (p. 811). Adaptation is "the ability to make incremental adjustments as a result of environmental changes, goal structure changes, or other changes."

The concept of learning thus is multidimensional and complex. We view the literature on organizational learning as reflecting two basic perspectives, which we will call the systems-structural perspective and the interpretive perspective. The systems-structural perspective on learning is drawn from the systems-structural view of organizations described by Astley and Van de Ven (1983). This is a rather mature organizational perspective at the organizational level of analysis that makes deterministic assumptions about organizational activities. This view in organization theory is also similar to what Burrell and Morgan (1979) referred to as the functional paradigm of organizational analysis. This perspective on organizational analysis can be seen in the rational, logical approaches to organization structures, and would include the institutionalized experience and development of knowledge approaches described by Shrivastava. In section 2, this perspective on organizational learning is described in detail.

The interpretive perspective is the more recent and novel approach to organizational learning. This perspective is closely associated with what Burrell and Morgan (1979) called the interpretive paradigm of organizational analysis.(2) This paradigm in organization theory is concerned with the

deeper processes, conflicts, interpretations, and power relationships that underlie surface structure. The interpretive paradigm relates to the higher level learning described by Fiol and Lyles (1985), and the assumption sharing and adaptive learning perspective described by Shrivastava. In section 3 we will describe the interpretive perspective on organizational learning in detail and suggest steps necessary to move it from its present metaphoric status to an operational tool for organizational scientists.

The idea that survival and other measures of organizational effectiveness tend to be higher for organizations that create an alignment between their characteristics and their environments seems commonsensical. But the pressing question is, "How do organizations learn about their environments?" The systems-structural and interpretive perspectives provide divergent answers to this question.

2. Systems-Structural Perspective of Organizational Learning

Information is acquired by and distributed within organizations for several reasons.(3) It is used as a weapon in intra-organizational debate (Sabatier, 1978). It is a source of power (Spekman, 1979; Shukla, 1982). It serves as a justification for ideologically-based decisions (Sabatier, 1978). It serves as a symbol of adherence to norms (Feldman and March, 1981). It also contributes to organizational learning (Wilensky, 1967; Hedberg, 1982; Nonaka and Johansson, 1985).

Information Acquisition

The systems-structural perspective emphasizes the acquisition and distribution of information as a resource that is necessary for an organization to learn about its external and internal environments. The

literature dealing with information acquisition is separable into that in which the organization or department is the unit of analysis (the "macro" literature) and that in which the individual is the unit of analysis (the "micro" literature). To a great extent, the macro literature on information acquisition is dominated by the writings of researchers interested in environmental scanning for strategic management (c.f., Aguilar, 1967; Hambrick, 1982; Dutton and Freedman, 1985). With hardly any exceptions, this literature is descriptive, largely reporting state-of-the-art case studies or surveys (c.f., Pyke, 1970; Fahey, King, and Narayanan, 1981; Jemison, 1984). The learning implied is often of a low order--a readily interpretable fact is observed, such as the market availability of a Nobel prizewinner or a new computer disk drive, and communicated to those organization departments best positioned to use this information.

The micro literature focuses on boundary spanning personnel as sensors of the organization's environment. Research on how boundary spanners learn about the environment and how they help centrally located units to learn is almost entirely limited to two streams of research. One of these, the literature on gatekeepers in the research and development industry (Pelz and Andrews, 1966; Allen, 1970) is relatively mature; there are empirical studies that build upon earlier conceptualizations and empirical studies (Tushman, 1977; Gerstenfeld and Berger, 1980). A modest theory linking gatekeeper characteristics and behavior to organizational performance has evolved (Tushman, 1979; Tushman and Katz, 1980; Tushman and Scanlan, 1981). A second and slowly developing stream of research deals with the environmental monitoring behavior of upper-level managers. It is less mature, consisting largely of field studies of managerial activities (Keegan, 1974; Mintzberg, 1975; Kurke and Aldrich, 1983; Dollinger, 1984). Somewhat related to these two streams of research are the

empirical studies that examine the idea that organizational members, including boundary spanners, tend to search for information from readily accessible sources (O'Reilly, 1982). Theory-testing studies of boundary spanners as sensors of the environment are still rare (but see Leifer and Huber, 1977, and Schwab, Ungson, and Brown, 1985).

Information acquisition occurs in two forms, monitoring and probing. Organizations monitor their external and internal environments in order to identify problems and opportunities. Monitoring or scanning is often passive and routinized, as when sales people are required to report competitors' sales or car dealerships are required to report observed manufacturing defects. Probing occurs when organizational members or departments actively initiate focused inquiries into the environment when more information is desired. These deeper examinations of environments are responses to concerns about actual or suspected problems or opportunities. Some of the search for information observed in organizations is undertaken by individuals seeking to develop or maintain a better understanding of their environments. Example probing behaviors include surveys of customers, phone calls to key contacts, and attending conventions or industry trade shows.

While the information thus obtained may result in the eventual fulfillment of organizational goals, it is obtained for the collector himself, or herself, rather than for the direct use of other units. For example, many officials regularly scan certain data sources (such as The Wall Street Journal or Aviation Week) without any prior idea of exactly what type of information they are seeking or will find. They do this not because they are dissatisfied, but because past experience teaches them that new developments are constantly occurring that might affect their present level of satisfaction (Downs, 1966, p. 169).

Information Distribution

Organizations purposefully disseminate information to carry out the

functions of decision making and control or, in other words, to learn what to do and what needs to be done differently. 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 or logistical capabilities of the individuals and work groups involved, organizations are forced to seek efficiencies in their internal communication systems.

Two processes that organizations and their members use to increase the efficiency of their communication systems are message routing and message summarizing. Both are carried out both formally and informally. Message routing causes any particular communication or message to be distributed to relatively few organizational units. This selective distribution reduces the information processing load of the departments charged with summarizing or transmitting the message and of the many potential receiving departments having little or no use for the information. 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 "averages" or by "exceptions," and multi-page reports are replaced by appropriately derived recommendations or conclusions. Summarization can greatly reduce the cognitive or logistical load on the departments 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 organizational units responsible for routing and summarizing exercise some discretion in the way they handle messages. This 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 a delegated and discretionary act, it is often difficult to make objective judgments about the excessiveness of individual delays. Message modification refers to the distortion of message meaning. Its source may be either the cognitive limitations or the motivations of either the sender or receiver. Modifications 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.

For the most part, the empirical literature on these four processes has used individuals as the unit of analysis. (See, for example, the reviews by Porter and Roberts, 1976, and Huber, 1982.) The more macro literature dealing with the distribution of information has focused on the process of coordination or "integration" (c.f., Lawrence and Lorsch, 1967, 1969). An important component of this literature has a prescriptive orientation. Thus Simon (1973) argues that organizations should be designed such that their units require minimal information exchange with other units, and Galbraith sets forth numerous organization design guidelines for coordination and integration (Galbraith, 1977). To summarize, the systems-structural perspective of organizational learning focuses on reducing ignorance by providing data. Information is treated as if it is a tangible good that is transported in containers called messages. Data are acquired by boundary units or personnel who use the data and/or distribute it to appropriate departments. The local use of information, as reflected in the paradigm, is

as input to decision-making or controller-coordinator units. It is implicitly assumed that these units know how to use the information, that they merely need to obtain "the facts" in order to take action.

3. Interpretive Perspective of Organizational Learning

The interpretive approach focuses on the underlying purpose and meaning of messages. From the interpretive perspective, data mean nothing until they are used by organization participants. Information can be defined as data that have utility, reduce uncertainty, or changes one's understanding about the external world (Daft and Macintosh, 1981). Research using the interpretive perspective is concerned with symbols and their meanings, and how individuals create and interpret those symbols (Putnam, 1983; Ritzer, 1975). Specific issues of concern in this perspective are the cognitive interpretation of messages, the means through which shared interpretations are reached, and the media through which messages are transmitted.

The concept of the information equivocality is central to the interpretive perspective. When managers observe an external event, the information cue may be ambiguous and have several interpretations. Managers are unclear about what the event means or how to translate it into organizational action. New data may be confusing, and may even increase uncertainty. Weick proposed that organizations must be designed to reduce equivocality from the environment (Weick, 1979). Organizing requires the development of a common grammar for resolving ambiguity. When managers are confronted with an equivocal issue, they discuss the issue among themselves and gradually arrive at a common interpretation and frame of reference. Managers talk things over and enact a solution. Ambiguity precipitates discussion and the exchange of views rather than the collection of additional

data. Managers define or create an answer based on their definition of the event.

The notion of equivocality is intriguing because it contrasts with the concern for data and messages in the systems-structural perspective. The interpretive perspective argues that organizations do more than process large amounts of data. Environments can be confusing, impenetrable, and changing. Managers interpret an ill-defined environment and define a course of action for participants. This approach avoids the assumption that data are concrete and fully interpretable. Managers organize cues and messages into meaningful patterns by imposing interpretations (Weick, 1979; Smircich, 1983). Moreover, emphasis is on shared meaning. The problem for administrators is interpreting and knowing the world rather than controlling the organization. For an organization to learn, equivocality must be reduced to an acceptable level. Indeed, the essence of organizational learning is the reduction of equivocality, not data gathering. The interpretive perspective deemphasizes the rational aspects of communication attributed to the systems-structural view. With respect to the larger organization in which learning occurs, phenomena such as coalitions, power, and conflict influence learning from the interpretive perspective more than do the traditional organization concepts of technology, environment, and size (Zey-Ferrell, 1981).

4. Summary of Two Views

Key assumptions of the systems-structural and interpretives of organizational learning are summarized in Exhibit 1. Fully understanding organizational learning requires viewing the organization as a structure both for acquiring and distributing data and for interpreting and sharing meaning. The systems-structural perspective assumes a system for handling messages,

while the interpretive perspective assumes a system for giving meaning to data. Learning from the systems-structural view is a consequence of the number, direction, and physical characteristics of messages. The external environment is objective, and can be understood through data acquisition. In the interpretive perspective, learning occurs through information content and the sense making behavior of participants. Interactions among human beings are more important than frequent messages. The environment is equivocal and is interpreted through the enactment and shared definition of the membership. Organizations learn through joint discussion and interpretation of events, and through gradual changes in the assumptions, symbols, and values of participants. Moreover, in the systems-structural view, new cognitive understanding typically precedes information acquisition, so that acquired data lead to action. In the interpretive view, trials and errors, or actions and outcomes, are important means of learning. Thus, new organizational actions often precede understanding. Managers learn by doing.

Exhibit 1 about here

Both views of learning are important. Both perspectives in Exhibit 1 are legitimate ways to study and understand organizational learning. Indeed, either view may be accurate depending on the contingencies facing an organization. These views represent two information paths that organizations must travel if they are to learn. The systems-structural perspective focuses on information acquisition and distribution. The interpretive perspective focuses on information interpretation and sharing. The point we make in this paper is that organizations undertake both types of activity. The approaches are not mutually exclusive. Organizations have an objective structural

framework through which tangible data and messages are transmitted and stored. They also have human participants who engage in day-to-day interpretive processes that make sense of events and reduce equivocality. In the next section we begin to integrate these two perspectives and show how organizational learning includes both the handling of data and the reduction of equivocality.

5. Information Load and Learning

In order to learn, organizations must solve two problems. One problem deals with the need to acquire and distribute information about their external and internal environments (Huber and Daft, 1986). Fulfilling this need, and determining whether the amount of information is sufficient, excessive, or optimal, is a logistics problem and is reflected in the systems-structural perspective. The second problem concerns the need to reduce equivocality, to develop a shared interpretation of messages that have been received through the logistical system. The interpretation and sharing processes reflect the interpretive perspective. Solving the logistics and equivocality problems results in organizational learning. But solving the logistics and equivocality reduction problems creates an information load on the organization.

Information load is defined as the volume of information inputs required for an organization to perform its tasks (Farace, Monge, and Russell, 1977). Information load is reflected in the amount of organizational resources allocated to information processing. An organization experiencing an uncertain, complex and variable environment will allocate many resources to scan and interpret the environment. An organization experiencing a high

information load will typically be coping with both the logistics and interpretive problems.

The relationship among the information logistics problem, the equivocality reduction problem, and the concepts of information load and learning are illustrated in Exhibit 2. The equivocality of information, and the extent to which equivocality must be decreased in order for the organization to take action is illustrated on the vertical axis of Exhibit 2. This is the interpretive problem for organizations. The horizontal axis in Exhibit 2 reflects the amount of information that must be acquired and distributed, which is the logistical problem. The diagonal in Exhibit 2 is information load, and as load increases, learning demands on the organization also increase.

Cell 1 represents a situation where the environmental events that influence the organization are equivocal and poorly understood. These events may be infrequent, but when they arise, as in a crisis, managers may not know how to respond. Learning is achieved through equivocality reduction. Managers may talk to enact a common perception, and they rely on intuition and judgment to interpret events. Learning is a process of making sense of the environment, and includes discussion, guesses, hunches, and trial and error. A clear map of the environment is not available. Decision making is incremental as the organization copes with equivocality. The amount of organizational learning in Cell 1 is expected to be moderate.

Exhibit 2 about here

Cell 2 represents an organization experiencing a high information load. The amount of information is high and the level of equivocality is also high.

Events are poorly understood, and there are a large number of events to be dealt with and interpreted. Special surveys and probes into the environment may be combined with extensive discussion and judgment to reach decisions. Organizations in this situation are characterized by rapidly changing environments, as would occur in an emerging industry, or during rapid technological development. The amount of organizational learning in Cell 2 would be very high.

Cell 3 reflects a low information load because both information amount and equivocality are low. The need for organizational learning is minimal, and organizational responses are normally from memory, as stored in precedents, scripts, and procedures. Organizations in Cell 3 would be perceived as traditional bureaucracies where the goal of learning is to attain efficiencies through experience and the repeated performance of a stable task. Learning is low.

Cell 4 is defined as moderate-high information load because the volume of data processed about the environment is large. This situation is typified by a large knowledge base and many external events. The organization needs to adopt mechanisms to process and integrate a large volume of data. This could include the adoption of new specialists, positions, and departments or the use of new communication technologies to help in monitoring many environmental sectors simultaneously. Learning in Cell 4 is typified by planning, data collection, and data transmission. Organizational learning is moderate to high.

6. Information Media and Organization Learning Capacity

How can organizations process information sufficient to meet the moderate to high loads required of many environments? How can managers receive

information displays, be involved in trial and error, and in other ways interpret the environment? The answer is capacity, capacity to increase the volume of data processed by the organization, and capacity to reduce equivocality. One approach to increase capacity for data volume is to add resources to information processing activities. Additional people could be hired or departments created, communications could be routed or summarized in new ways, or new technologies could be adopted to increase information flow.

A more difficult problem is how to increase the capacity to reduce equivocality. Here the emphasis is on clarifying and defining reality, on managers reaching a consensus about the environment and organizational actions. Increasing the logistical capacity to process data will not necessarily increase the organization's ability to understand an equivocal environment. If an organization is designed to learn, an important aspect is the implementation of appropriate communication channels and connections, through which data and messages are processed. Channels influence the organization's ability to transmit data as well as participants' ability to interpret messages. We propose that the concept of media richness, which is related to the channel or medium used for conveying information, influences capacity for organizational learning. Media have the ability to increase data processing or help managers interpret ambiguous events depending on the information load and learning requirements.

Media Richness

Organizations process information through many channels, and recent research indicates that these channels are not equal in their capacity for facilitating understanding. The need for organizations to have a high information capacity is reflected in the observation that managers spend a

very large proportion of their time communicating (Mintzberg, 1973). But managers do not use all channels equally. A number of studies have observed that managers prefer face-to-face communications (Mintzberg, 1973; Daft and Lengel, 1986; Rice and Bair, 1984). Managers seem attracted to informal channels such as personal meetings and the telephone, and they tend to ignore formal reports and computer based information (Fischer, 1979; Martin, 1983).

The question is, why do managers prefer face-to-face communication? Does the face-to-face medium offer special advantages for organizational learning? Daft and Lengel (1984, 1986) proposed that media selection is closely linked to the amount of learning in organizations. A medium is how information is carried from sender to receiver, and may include telephone, computer printouts, memos, or face-to-face discussions. Daft and Lengel (1984), based on the work of Bodensteiner (1970), characterized media as high or low in richness based on the capacity to convey information. Recall that information is defined as that which can change a person's understanding or mental representation. Media richness is defined as the medium's capacity to change mental representations within a specific time interval (Lengel, 1983; Daft and Lengel, 1984). A medium is considered rich if it provides big insight to managers in a short time. A rich communication transaction results in a major change in mental representation. Media low in richness tend to require a longer time to convey the same understanding, and tend to convey information that is less insightful or helpful for understanding the environment.

Media typically used in organizations can be organized into a hierarchy, based upon the capacity for conveying meaning among organizational members. Exhibit 3 illustrates a media hierarchy with five levels of richness. The capacity of each medium is based on a blend of four characteristics: (1) the use of feedback so that errors can be corrected; (2) the ability to convey

multiple cues; (3) the tailoring of messages to personal circumstances; and (4) language variety.

Face-to-face is considered the richest medium because it allows immediate feedback so that understanding can be checked and interpretations corrected. This medium also allows the simultaneous communication of multiple cues, including body language, facial expression, and tone of voice, which convey information beyond the spoken message (Meherabian, 1971). Face-to-face communication uses high variety, natural language and messages tailored personally to the receiver (Pondy and Mitroff, 1979; Daft and Wiginton, 1979).

Exhibit 3 about here

The telephone medium is somewhat less rich than face-to-face because visual cues are not available. Feedback is fast, but individuals rely only on language content and audio cues to reach understanding. The telephone medium is personal and utilizes natural language.

Written communications are considered lower in richness than oral communications. Written documents, personally addressed, such as letters and memos, are characterized by slow feedback. Only written data are conveyed, so visual cues are limited to those on paper. Addressed documents can be tailored to the individual recipient.

Formal, unaddressed documents are lowest in richness because they apply to everyone in the same way. Examples are fliers, bulletins, written rules, and MIS reports that are impersonal and are not amenable to feedback, although they do use natural language. Visual cues are limited to those in the standard format.

What does the media richness continuum mean for organizational learning?

The answer is that media vary in their capacity to help organizations reduce equivocality. Managerial work is highly fragmented, and managers work under time pressure (Mintzberg, 1973). Time is a scarce resource, and so is information. Information transactions processed through a rich medium allow rapid feedback so that managers can quickly converge on a common interpretation. Richer media allow multiple cues, including body language and facial expression. When managers experience equivocality, rather than search for an objective answer, they resolve it by enacting or defining a course of action. Equivocality reduction takes place through the exchange of opinions, perceptions, and judgments of relevant managers. Managers may bring different frames of reference to the discussion, so disagreements need to be surfaced and resolved. Rich media enable managers to construct a joint cognitive map, and to resolve equivocality through discussion and rapid feedback that would be impossible if communication channels consisted only of letters, electronic mail, or written or numeric documents.

On the other hand, media of lower richness are preferable when messages are unequivocal. For the logistics problem of acquiring and distributing data, especially when the communications are one way, impersonal, and to the point, written and electronic media are efficient. Rules, regulations, memos, and reports convey objective knowledge about well-defined events. Using rich media to convey routine information would be inefficient and could result in overcomplication and needless ambiguity.

The point for organizational learning is that rich media facilitate interpretive learning. When learning is characterized by the logistical processing of objective data, media of lower richness are appropriate. Organizations can learn by tailoring the medium to the nature of messages to be transmitted. Conversely, the wrong medium for a message can restrict

learning. Written media and standard reports would oversimplify messy problems because these media do not transmit the subtleties associated with unpredictable, personal, subjective aspects of organizations and environments. Conversely, face-to-face discussions would contain surplus and perhaps erroneous meaning for objective, well-understood communications, and would be inefficient.

A number of studies are consistent with the argument that as uncertainty or equivocality increases, rich media are the preferred mode of information processing in organizations. Van de Ven, Delbecq, and Koenig (1976) studied coordination under high task uncertainty, which is a high learning situation. Managers preferred face-to-face modes of coordination. Kreps (1980) reported that discussion and feedback cycles increased among faculty senate members when issues were equivocal, and Holland, Stead, and Leibrock (1976) found that face-to-face channels of communication were preferred to written channels when perceived uncertainty was high. Meissner (1969) and Randolph (1978) found that when communications were objective and certain, sources of information such as objects, signs, and written documents were used in departments, while personal communications were used as tasks increased in uncertainty. Bodensteiner (1970) reported a sharp increase in the frequency of face-to-face and telephone media when organizations experienced stress and uncertainty from the occurrence of unanticipated difficulties and problems.

Additional findings were reported by Weinshall (1979), who found that managers selected face-to-face more frequently for the difficult transactions associated with negotiating and advice giving, while telephone and written channels were selected for routine communications such as giving orders or receiving standard information. Rice and Williams (1984) showed that electronic mail, a medium of low richness, was preferred for exchanges of well

defined information, but was not used for bargaining or resolving conflict. Jones and McLeod (1984) found that managers preferred face-to-face media for communicating about difficult aspects of the managers' job. Finally, Kiesler, Siegel, and McGuire (1984) found that when computers were used to mediate communications between people, the ability to solve complex problems was low compared to face-to-face discussions.

All in all, the evidence supports the idea that media vary in their capacity to convey understanding and reduce uncertainty. The use of media is a key element in the amount and type of learning accomplished by an organization. Rich media facilitate rapid feedback and the use of multiple cues so that ambiguity can be brought into resolution and diverse frames of reference can be integrated. Face-to-face communication is a powerful means of resolving equivocality and changing mental representations, which is one important aspect of organizational learning. On the other hand media of low richness are efficient for processing large amounts of objective data, which is the second important aspect of organizational learning. Organizational choices among media will influence what and how the organization learns.

Consequences of Media Usage

The point made above is that media are related to the capacity of an organization to learn. Now we want to go a step further, and propose that the use of media influence the information displays made available to organization participants, and in turn influence decisions based on that information. If we think of managers and other employees as mini nerve centers of organizational learning, what view of the environment is provided to them through media, and what type of decisions will be made? Organizations can consciously emphasize media, and in so doing change the organization's

information base, decisions, and learning. Exhibit 4 summarizes our proposed relationships between media and the way in which individuals perceive and act on organizational information from those media.

Information displays. The upper part of Exhibit 4 proposes how media may influence perceptions of organizational events (Argyris, 1979). By encouraging or limiting cues, a medium filters information and thereby provides a world view different from other media. For example, the use of a medium such as face-to-face discussion is expected to induce individuals to perceive the phenomena as close to them, to think concretely and intuitively, and to be aware of specific events and conditions within the organization and the environment. Rich media are personal, convey emotional cues, and enhance social presence. Rich media also induce individuals to see the equivocal, ill-defined aspects of events, to develop personal networks, and to take personal responsibility for data acquisition and accuracy.

Media of lower richness, by contrast, are expected to induce individuals to perceive events and conditions as distant and remote, and to think abstractly and rationally about those events. When individuals receive numbers and written reports, they are more likely to conceptualize the organization and environment in terms of stable activities, overall trends, and measurable, well-defined characteristics. Individuals relying on written media are more likely to be isolated, to be uninvolved in personal networks, and to accept data as legitimate and authoritative and outside their personal responsibility.

Exhibit 4 about here

Information displays are similar to what Argyris (1979) described as

local versus distant management information systems. Media of low richness tend to carry information about "distant" events, and to describe the organization as a whole. Distant information is universal, objective, and applicable to everyone in the organization. Local information is unique, subjective, and applicable to the circumstances of specific departments and groups.

Decision making. The middle portion of Exhibit 4 describes how information is expected to translate into decision making. Information from media of low richness is expected to induce individuals to think in terms of results and performance, to see major exceptions in performance, to infer causality from data that lack specifics, and to use statistical judgment in making decisions. Media of high richness is expected to influence decisions in terms of the underlying events and processes that cause organizational performance, to detect errors before there are exceptions, to infer causality from a situation's specific circumstances, and to use clinical judgment in making decisions.

We generally expect organizations that rely on media of low richness to use statistical judgment based on calculation and rational procedures. Statistical judgment relies on the frequency and pattern of events. In contrast, clinical judgment relies on close personal knowledge of underlying cause-effect processes and on the way specific events influence one another, which is associated with the use of rich media.

An example of how information influences decisions is Mehl's box in psychology (Wiggins, 1973). The outside of the box contains several lights and buttons, and pushing the buttons will cause the lights to go on in different combinations. Statistical judgment would involve collecting data about which lights come on in correlation with which buttons are pressed. By

using frequency counts and statistical logic the odds of any light coming on can be estimated. However, a skilled mechanic who has experience repairing similar boxes would not need to make statistical judgments. He would adopt a clinical approach based upon information about internal mechanisms. He would look inside the box to construct a theory about the internal arrangement of gears, wires, and electricity to understand which light will come on when each button is pressed. Similarly, a clinical psychologist dismantles mental processes to understand individual behavior, while a research psychologist may rely on correlations between questionnaire responses and behavior. The objective data acquired through formal, written media is expected to lead to different decision processes than will subjective cues acquired through rich, personal sources.

Culture and values. The final aspect of media selection proposed in Exhibit 4 pertains to media impact on internal culture and human values. Media can be warm versus cool with respect to the ability to convey emotions. Written media and its substitutes are considered "cool" because they are impersonal, and communicate facts and figures. Formal reports and official memos are rational and business like. These media are preferable when the organization seeks values of logic and efficiency (Rice, 1984). The criterion of rationality dominates organizational culture when media of low richness are emphasized.

Face-to-face media, the telephone, and substitutes such as picture phones and teleconferencing, are "warm" media. These media are able to deal with human relations, personal opinions and emotions. Senders and receivers have a social presence (Rice, 1984). Group norms, trust, and affection can be communicated through rich media. Personal differences and emotional conflicts can be surfaced and resolved. Personal influence and persuasion can be used.

Warm media enable individuals to negotiate and resolve issues of power, status, and conflict, while cool media emphasize impersonal facts and stable events. Thus we propose that the frequent use of a medium can influence whether the organization's culture is perceived as warm, caring, and emphasizing personal values, or whether the cultural values are cool, calculative, and performance oriented.

7. Designing Systems for Organizational Learning

Now we want to bring together several ideas presented in this chapter to propose specific design characteristics that enable organizations to learn. In order to learn, organizations have to solve both the logistics and interpretive problems. They must both process data and be able to interpret equivocal cues. Organizations thus need to design two systems--a logistical system to handle the processing of data, and an interpretive system to enable the appropriate perception and understanding of data. Organizations can be designed with characteristics to increase the capacity of either system.

Designing the Logistical System

How do organizations acquire and handle a large volume of data when needed for learning? Examination of the literature suggests three methods, which we call organization structure, communication strategy, and technology.

Organization structure. Perhaps the single most important way to increase the volume of information is to add organizational positions or departments designed to process data and messages (Huber, 1984a). As Lawrence and Dyer (1983) noted in their study of environmental complexity, the addition of boundary roles and departments were needed to monitor and interpret

environmental complexity. Boundary spanning individuals and departments act as sensory units to monitor relevant environmental sectors and events.

Structural changes can also be used to process data among departments within organizations. Many organizations have created specialized departments, called information centers or support centers, to help managers identify and obtain needed information (Zmud, 1984). This structural change increases the division of labor and enables personnel to specialize in acquiring and disseminating information vital to organizational learning. New departments can both span the boundary to the external environment and facilitate internal communication and coordination.

Communication strategy. Communication strategy is the organization's approach for acquiring and handling data. There are several parts to an organization's information processing strategy. First, an organization can aggressively search for external information, or it can passively monitor the environment. To the extent that more data are needed, an aggressive posture can be adopted (Aguilar, 1967; Daft and Weick, 1984). Organizations can build special communication links to other organizations, or send agents into the field (Wilensky, 1967). Organizations can formalize and routinize certain types of information, such as periodic surveys of the external environment or periodic internal reports on performance. The organization can explicitly send communication probes into environmental sectors as part of routine communication activities.

A second information strategy is to set priorities to pinpoint critical information that can be summarized or "chunked" into meaningful units (Farace, et al., 1977; Huber, 1982). Chunking information prevents managers from being subjected to an endless stream of facts. The information is broken into meaningful units that apply to specific questions. A third strategy is to

choose whether the organization wants to centralize or decentralize the responsibility for information. Decentralization means that major departments are responsible for their own information acquisition and dissemination, which prevents information overload on the central processing department. Decentralization also makes departments responsible for selecting data relevant to their needs.

Technology. The technology for processing information has undergone a revolution in recent years. The new computing and communication technologies have been called the "new media" (Rice, 1983). Such electrically-based communication technologies provide an enormous opportunity to enhance the volume of data that can be processed through organizational channels (Huber, 1984a). The new media include teleconferencing, electronic mail, voice mail, picture phones, and other forms of organizational wiring. They provide for both storage and transmission of huge volumes of data that would otherwise be stored or transmitted through the written word. Some of the new media, such as teleconferencing and picture phones, are designed to supplement face-to-face communication. The new technology is important because it provides multiple and permanent high speed channels for connecting the organization to the environment and for connecting departments together. New media can instantly direct and route messages around the world. The computer can provide a direct link to customers and suppliers, as in the case of American Hospital Supply, Westinghouse and Xerox (Porter and Millar, 1985). Electronic media also provide superb internal coordination, such as when franchises, branches, or overseas offices are hooked directly to the central office for daily exchanges of operating data. Finally, electronic media facilitate the use of more efficient organizational structures (Huber and McDaniel, 1986).

Designing the Interpretive System

Equivocality reduction demands a different approach from that outlined above because new data often do not resolve ambiguous issues. Equivocality reduction typically requires media high in richness, which involve personal communication. Designing the interpretive system is based on organization structure, communication strategy, and technology, but specific elements are quite different from the design of the logistical system.

Organization structure. The structure to facilitate equivocality reduction should place organizational members in direct contact with relevant external sectors to obtain rich information. This would mean structural disaggregation that locates people close to customers, close to suppliers, or close to other elements in the field. People can be assigned to the field for personal observation and reporting back to the organization (Wilensky, 1967). Moreover, disaggregation encourages opportunistic contacts and nonroutine information. Managers are encouraged to be in personal touch with environmental sectors they believe important, and to use trial and error to obtain feedback from the environment.

With respect to internal information processing, equivocality reduction makes extensive use of group meetings and organizational integrators. Group meetings may be in the form of task forces, project teams, or committees (Galbraith, 1973; Lawrence and Lorsch, 1967). These structural mechanisms enable participants to exchange opinions, perceptions, and judgments. Managers are able to establish a common frame of reference and to enact meaning about environmental events (Daft and Lengel, 1986). Integrators play a similar role by personally carrying information back and forth between relevant departments. Integrators act as liaison personnel who coordinate

across departments through face-to-face and telephone discussions to overcome disagreement and thereby reduce equivocality.

Communication strategy. To interpret equivocal events and cues, communication strategies should encourage face-to-face contacts and nonroutine information. Personal communications enable individuals to receive information displays that are close to the phenomenon of interest, and to interpret the ambiguous and ill-defined nature of events. Discussions among managers can then be used to reduce equivocality. Group meetings enable managers to enact a shared definition of events. The organization's strategy can encourage members in contact with the environment to bring interpretations and opinions back into the organization for discussion.

Another strategy is to encourage few rules for processing data but encouraging rapid cycles among managers. Assembly rules are procedures or guides that organizations use to process data into a collective interpretation (Weick, 1979). When data are clear, rules can be used to handle the processing of routine information to a joint interpretation. Fewer rules should be used for ambiguous information because there is uncertainty as to what the information means, and managers may have to seek out and discuss information in nonroutine ways. Although rules are fewer for equivocal issues, the number of information cycles and exchanges among managers will be greater. Managers should be encouraged to meet face-to-face on a frequent basis so the data can be cycled among members before an interpretation is reached and action taken.

Technology. Even though they are not as rich a communication media as are face-to-face discussions, electronically-based communication technologies can be adopted to reduce equivocality to the extent that they possess qualities of richness. Picture phones and teleconferencing enable managers to

see one another, to use multiple cues, and to receive rapid feedback. While these new media do not have the social presence of face-to-face communications (Rice, 1984) and do not as effectively convey subtle emotional, social and power relationships, they do convey richer information than written messages. In addition, some technological devices, such as electronic mail, are richer than written communications because they facilitate frequent messages and encourage rapid information cycles among managers. Finally, Group Decision Support Systems enhance the exchange of information in face-to-face meetings and thereby facilitate the discussions that lead to the development of shared understanding (Kull, 1982; Huber, 1984b). The new media are valuable for equivocality reduction to the extent that they increase feedback and encourage a jointly constructed interpretation among individuals.

8. Toward a Model of Organizational Learning Modes

Now we bring together several ideas to answer the question raised earlier in this chapter, "How do organizations learn?" So far we have (1) defined and compared the systems-structural versus interpretive perspectives on organizational communication; (2) explained how these perspectives define the logistics and interpretive problems for organizations; (3) proposed that learning is a function of the information load facing an organization; (4) introduced the notion that media have different capacities for conveying messages and reducing equivocality; (5) proposed that media can influence information displays, decision making, and values within organizations; and (6) proposed specific design characteristics to resolve the logistics and interpretive problems within organizations.

Given the importance of both the logistics and interpretive systems, we hypothesize that organizations may use one of four learning modes illustrated

in Exhibit 5. These modes represent a gestalt of organization characteristics that define a style or approach to learning based on information load. The gestalt represents congruence among structure, technology, load, media, information displays, and communication structure. The four learning modes include traditional bureaucracy, extended bureaucracy, self-designing organization, and experimenting organization. Each of these modes represents a style of learning appropriate to the logistic and interpretive requirements from the environment.

Exhibit 5 about here

Traditional bureaucracy. The traditional bureaucracy is the appropriate learning mode when both equivocality and logistics requirements are low. New or ambiguous problems do not arise with sufficient frequency to require frequent face-to-face discussions or new data about the environment. The organizational assumption is that learning is based on institutionalized experience. The organization expects to continue the same behavior that worked in the past, only more efficiently. Data relevant to efficient behavior are stored in the bureaucratic records, rules, and in the organization's past experience.

The information load required for the traditional bureaucracy to perform adequately is low compared to organizations in other environments. The information media are both low technology and low touch. "Low technology" means that written media can handle the necessary volume of data. "Low touch" means that face-to-face and personal communications are not needed to reduce equivocality. The information displays made available to administrators within the bureaucracy are characterized as impersonal, remote, objective, and

promote the use of statistical judgment and rational procedures. The communication strategy and structure require relatively few departments with environmental scanning responsibilities, centralized record keeping, few committees and other coordination devices. The organization would have little use for the new computing and communication technology.

Extended bureaucracy. The extended bureaucracy also exists in an environment characterized by a low need for equivocality reduction, but the logistics problem of processing data and messages is much greater than for the traditional bureaucracy. The external environment may be very complex, and hence the bureaucracy must extend itself into the environment to acquire necessary data. The basic learning assumption is that the systems-structural approach is an appropriate mode for learning. The premise for learning from an administrative perspective is the development of an internal knowledge base (Shrivastava, 1983). The organization is expected to acquire data that answers relevant questions, and to plan future actions. The criteria for learning are action-outcome relationships (Duncan and Weiss, 1979).

The information load confronting the extended bureaucracy is medium-high. Appropriate information media are high technology but low touch. New communication technology can help process volumes of data, but managers do not need personal discussions because reduced equivocality is low. The dominant information issue is to acquire large amounts of data about a complex but definable environment. Electronic technology combined with surveys and other systematic data collection are appropriate for an extended bureaucracy. Technology is also used to bring the data into useful summaries for management. The information displays to managers about the organization and its environment will tend to be impersonal, report overall trends, be results oriented, and induce statistical judgment and rational procedures. The

organization's structure would have many boundary spanning individuals and departments, and perhaps special departments designed to obtain useful data.

Self-designing organizations. The self-designing organization is considered opposite the extended bureaucracy. The self-designing organization has to cope with perpetual equivocality, and there is little hard data. This organization exists in an ambiguous and shifting environment, so interpretive systems are more relevant than logistical systems. Facts and figures that describe the environment are not available. The basic assumption within the organization reflects the interpretive approach to learning. Management must enact a definition of environmental events, and they engage in trial and error to figure out the environment. In this type of organization, action may precede understanding. Learning will involve frequent changes in basic assumptions about organizational purpose, mission, and products (Argyris and Schon, 1978).

The information load confronting the self-designing organization is low-moderate. A large volume of data is not processed, although participants spend time figuring out data that are available. Media will be low tech and high touch. High technology is of little use because facts and figures communicated through these media have little value. Managers would be in touch with each other on a regular basis. Frequent meetings to figure out a course of action are needed. The information displays made available to managers by rich media are of a personal nature, pertain to underlying cause-effect relationships, and induce clinical judgment and human values in decision making. The communication structure of the organization encourages the development of personal networks, ad hoc meetings, and disaggregation of the organization so that members can be in personal contact with relevant sectors of the environment.

Experimenting organizations. The experimenting organization is in the most demanding learning situation because the interpretive and logistical problems must both be managed. The organization must simultaneously define the environment and gather hard data about the environment. The underlying learning assumptions represent multiple criteria, including both interpretive and systems-structural approaches to learning, both centralized planning and enactment. The learning premise within the organization would be adaptive learning (Cyert and March, 1963; March and Olson, 1976), and incremental, trial and error decision processes (Lindblom, 1979; Mintzberg, et al., 1976). The experimenting mode of learning is appropriate for a large, complex organization undergoing transformation or confronting unexpected environmental changes. Rational processes may be attempted, and if unworkable, the organization would use more personal, enactive learning techniques.

The information load in the experimenting organization is very high because a large volume of data is needed about definable elements of the external environment, and meetings and discussions are required to interpret ambiguous stimuli. Media would be both high technology and high touch. High technology would enable the organization to scan a complex environment and assimilate data about many events. High touch would enable the organization to use personal interpretations and discussions of events. The information displays available to managers include both personal and impersonal views, and describe both overall trends and cause-effect relationships. The media could facilitate either clinical or statistical judgment depending on the data and the events. The communication structure should include many boundary spanning people and departments, an aggressive approach to data acquisition such as surveys, and disaggregation of structure so that members are involved in direct contact with environmental events. The personal networks of

managers and the technology network are both important. The experimenting organization devotes a large amount of time and resources to information processing, and is expected to experiment with matrix structures, computer networking, and other devices for assuring information for external scanning and internal coordination.

9. Conclusions and Research Implications

We began this chapter with the story of American LaFrance, the fire truck manufacturer that once ruled its marketplace and now is going out of business. The reason American LaFrance failed is that a major competitor, Emergency One, manufactures fire trucks from aluminum, uses computer design techniques, and has aggressively marketed its product to fire departments. American LaFrance failed because it was not equipped to learn about and respond to changes in the external environment. American LaFrance is acting like a "traditional bureaucracy," but it should have been designed as an "extended bureaucracy." American LaFrance did not use marketing surveys, or send people into the field to find out what customers wanted, find out about new technologies, or to discover the actions of competitors. American LaFrance acquired no data on aluminum bodies, on computer designs, or on new assembly techniques. American LaFrance was perfectly designed to continue making fire trucks in the same old way, with incremental efficiencies, but had no knowledge base for larger changes. American LaFrance failed because it was not designed to learn, yet it existed in an environment that required learning and adaptation to survive.

Organizational learning has been implicit in the organizational literature for many years. Previous research and theorizing can be categorized into either the systems-structural perspective or the interpretive perspective on learning. These two perspectives are reflected in the need for

both data logistics and interpretation within organizations. We proposed that media could be used to facilitate either type of learning, and recommended specific design characteristics. The four learning modes--traditional bureaucracy, extended bureaucracy, self-designing organizations, and experimenting organizations--reflect an integration of ideas and research findings from the literature. A great deal of additional work in the area of organizational learning is called for, and specific implications for research are as follows.

1. Perhaps the most urgent need for additional research is to develop organization design guidelines for the interpretive perspective. The field of organizational design already knows a great deal about using the systems-structural perspective for the acquisition and distribution of information (Huber, 1984). For example, techniques, strategies, and technologies to increase the flow of information and reduce its cost are already adopted in organizations. A bigger problem is to develop explicit recommendations for designing organizations with effective interpretive systems, soft and ill-defined as they currently are. At this point we can make common sense suggestions, such as provide managers with the opportunity for face-to-face discussion, have a lounge where people can talk informally, perhaps create a softball team with members from several departments, and scold managers for remaining in the office rather than visiting organizations in the environment. Organizations may be able to consciously design the use of task forces, group decision support systems, and perhaps even matrix structures to encourage the interpretation of equivocal events in a way that produces a logical course of action (Huber, 1984b; Daft and Lengel, 1986).

2. Systematic research into the topic of organization learning is not likely to progress far without initial effort to develop measures that

operationalize basic learning concepts. Many aspects of organizational learning are elusive and ill-defined. Concepts often pertain to understanding as it takes place within the minds of managers, which is hard to identify and measure. Initial research could focus on defining and operationalizing relevant dimensions of the environment, logistics system components, interpretive systems components, media, the nature of messages, characteristics of new communication technologies, information load, and when learning occurs. These are difficult concepts, and their measurement is a full menu for organizational researchers.

3. Yet a third area of potential research is the impact of interpretive and logistic systems on the organization. This research would correspond to the ideas in Exhibit 4 about the information displays, decision processes and internal values induced by the organization's communication system. An organization that emphasizes logistic systems such as written and electronic media could be studied to learn whether managers perceive the world differently than managers in organizations that emphasize interpretation through personal discussion. The impact of media on manager perceptions, mental representations, decision making, and individual versus shared perceptions represent a new and intriguing avenue for understanding the impact of information designs for decision making and learning.

4. At a more micro level, research is needed that focuses more precisely upon individual messages, the media through which they are communicated, and the context of the communication. Initial findings suggest that the matching of messages to media and situation constitutes effective information processing (Lengel, 1983). Yet the surface has only been scratched in this research. Even more important is the need to define the multiple dimensions of messages, media, and situations. How do media differ with respect to

feedback, speed, accuracy, social presence, focus, and so on? What characteristics of messages, such as equivocality, length, complexity, reliability, are relevant to organizational learning? How does the communication situation, including the relationship between sender and receiver, differences in frames of reference, and physical distance affect the learning process? The research questions pertaining to possible combinations of messages, media, and situations seem almost limitless.

5. Yet another needed line of research would involve field studies of the learning relationships proposed in this chapter and elsewhere in the literature. This type of research would compare organizations to see whether the clusters of elements proposed in the model of learning modes hang together in the grouping suggested here, or in any other groupings. Other questions include: How do environmental characteristics correlate with perceived learning requirements within organizations? How do environment characteristics correlate with internal systems for logistics and interpretation? Is an organization's ability to learn correlated with performance? This type of research will enhance our understanding of learning at the organizational level of analysis.

The major conclusion from this paper is the need for organizations to be aware of external events, to acquire and distribute messages about these events, and to try to make sense of things when events are equivocal. In order to learn, organizations have to solve both the logistics and interpretive problems. They must both process data and be able to interpret equivocal cues. Organizations thus need to design two systems--a logistical system to handle the processing of data, and an interpretive system to enable the appropriate perception and understanding of data. Organizations may learn spontaneously and intuitively, but we propose that learning systems can be

deliberately designed to enhance learning and adaptation. The model of organizational learning modes calls attention to different ways of learning that managers and researchers may not have thought about before. Each mode has a learning strength, but is suited to a specific situation. If an organization has been designed in one mode, as was the case at American LaFrance, then it may need to assess whether another mode may be better. The value of any comparative model is that it provides alternatives and new perspectives. The ideas proposed in this paper suggest a viewpoint and model--perhaps a starting point--from which to build toward more complete understanding of how organizations learn.

Exhibit 1. Two Perspectives on Organizational Learning.

<u>Systems-Structural Perspective</u>		<u>Interpretive Perspective</u>
1. Organization is a system for transmitting data.	vs.	1. Organization is a system for giving meaning to data.
2. Amount, frequency, direction, physical characteristics of messages.	vs.	2. Purpose, meaning of symbols, sensemaking of participants.
3. The environment is objective and can be learned through data acquisition.	vs.	3. The environment is equivocal and is learned through shared definition and enactment.
4. Organizations learn by acquiring data, rational analysis and new behavior is then directed by top decision makers.	vs.	4. Organizations learn by discussion and shared interpretation of events, changing assumptions, and trial and error.
5. Understanding leads to action.	vs.	5. Action leads to understanding.

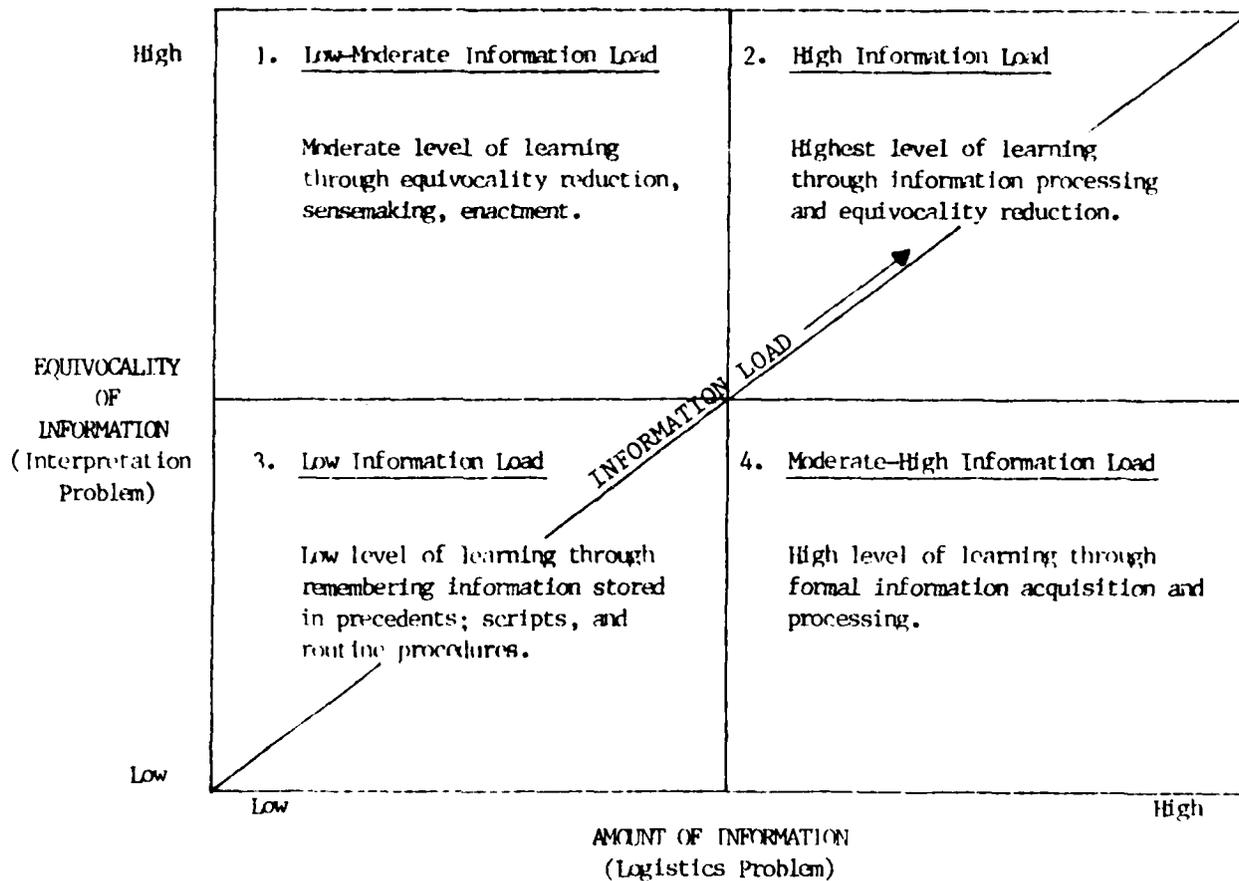


Exhibit 2. Characteristics of Information Load on organizations.

		Media Characteristics			
Medium	Media Richness Capacity	Feedback	Chans/Channels	Intimacy	Language
Face-to-Face	High	Immediate	Multiple	Personal (visual, audio)	Natural
Telephone		Fast	Audio	Personal	Natural
Written, Addressed (letter, memo)		Slow	Limited Visual	Personal	Natural/Numeric
Written, Unaddressed	Low	Very Slow	Limited Visual	Impersonal	Natural/Numeric

Exhibit 3. Media Capacity and Communication Characteristics.

Source: Adapted from Richard L. Daft and Robert H. Lengel, "Information Richness: A New Approach to Managerial Behavior and Organization Design," in Barry Staw and L. L. Cummings (eds.), Research in Organizational Behavior, Greenwich, CT: JAI Press, 1984, pp. 191-233.

Exhibit 4. Consequences of Communication Media for Information Displays and Organizational Decision Processes.

Media of Low Richness Induce Administrators

1. To perceive phenomena as distant and remote.
2. To conceptualize stable events and overall trends.
3. To think abstractly and rationally.
4. To see unequivocal, well-defined aspects of phenomena.
5. Not to be involved in personal networks.
6. To accept data as legitimate and authoritative.

Rich Media Induce Administrators

Information Display:

1. To perceive phenomena as close and visible.
2. To conceptualize changing processes and specific conditions.
3. To think concretely and intuitively.
4. To see equivocal, ill-defined aspects of phenomena.
5. To develop personal networks.
6. To take personal responsibility for data accuracy and validity.

Decision Making:

1. To think in terms of results and performance.
2. To see errors that are exceptional.
3. To infer causality from overall trend data that lacks specifics about causal processes.
4. To use statistical judgment in making decisions.

1. To think in terms of the events and processes that cause performance.
2. To see errors before they are exceptional.
3. To infer causality from information about situation specific cause and effects.
4. To use clinical judgment in making decisions.

Internal Culture:

1. To convey facts, hard data, measurements, and rational expectations.
2. To experience impartiality and removal from the human side of organizational events.

1. To convey feelings, emotions, values, stories and myths.
2. To experience closeness and bonding to people involved in organizational events.

<p>High</p> <p><u>Self-Designing Organization</u></p> <p>Learning Emphasis: Assumption Sharing. Interpretive approach, exact definitions, trial and error.</p> <p>Information Load: Low-moderate.</p> <p>Media: Low tech, high touch.</p> <p>Displays: Personal, concrete, cause-effect, clinical judgment.</p> <p>Communication Structure: Decentralization, disaggregation, personal networks, group meetings.</p>	<p><u>Experimenting Organization</u></p> <p>Learning Emphasis: Adaptive Learning. Multiple criteria, interpretation and systems-structural, planning and enactment.</p> <p>Information Load: High.</p> <p>Media: High tech, high touch.</p> <p>Displays: Personal and impersonal, concrete and abstract, clinical and statistical judgment.</p> <p>Communication Structure: Personal networks, decentralization, boundary departments, surveys.</p>
<p>Low</p> <p><u>Traditional Bureaucracy</u></p> <p>Learning Emphasis: Institutionalized Experience. Repeat behaviors more efficiently. Relevant data stored in bureaucratic records and organizational experience.</p> <p>Information Load: Low.</p> <p>Media: Low tech, low touch.</p> <p>Displays: Impersonal, abstract, statistical judgment.</p> <p>Communication Structure: Few boundary departments, centralized, routine data systems.</p>	<p><u>Extended Bureaucracy</u></p> <p>Learning Emphasis: Development of Knowledge Model. Systems-structural approach. Acquire and distribute data.</p> <p>Information Load: Moderate-high.</p> <p>Media: High tech, low touch.</p> <p>Displays: Impersonal, overall trends, results oriented, statistical judgment.</p> <p>Communication Structure: Many boundary departments, surveys, chunk data, satellites.</p>

EQUIVOCALITY OF INFORMATION (Interpretation)

High

Low

AMOUNT OF INFORMATION (Logistics)

Exhibit 5. Model of Organizational Learning Modes.

Footnotes

(1) Although the literature focusing on adaptation and the literature focusing on congruence among internal organizational characteristics have different emphases, they are becoming less distinguishable (Van de Ven and Drazin). This is because (1) the "pairings" of the congruence literature are among the design features of the adaptation literature, and (2) the efficacy of a particular pairing for an organization often depends on the organization's environment. Together they constitute the basis for the contingency theory component of organization theory.

(2) Putnam (1983) and Smircich (1983) summarize and contrast the functional and interpretive paradigms of organizational analysis.

(3) Information theorists distinguish between data and information in the following way--data contain information to the extent that they reduce uncertainty. However, data can also increase uncertainty--can alert you to the presence of conditions you felt certain did not exist. This fact, and the fact that most readers do not make a distinction between data and information, causes us to use the terms interchangeably to mean symbols whose content is understood.

References

- Aguilar, F. J., Scanning the Business Environment, MacMillan, New York, 1967.
- Aldrich, H., McKelvey, B. and Ulrich, D., "Design Strategy from the Population Perspective," Journal of Management, Vol. 10 (1984), pp. 67-86.
- Allen, T. J., "Communication Networks in R&D Labs," R&D Management, 1970, pp. 14-21.
- Argyris, C., "From Inner Contradictions in Management Information Systems," in Lucas, H. C. Jr., Land, F. F., Lincoln, T. J., and Supper, K. (eds.), The Information Systems Environment, New York: North-Holland, 1979.
- Argyris, C. and Schon, D. A., Organizational Learning: A Theory of Action Perspective, Reading, MA: Addison-Wesley, 1978.
- Argyris, C. and Schon, D. A., "Editorial," Journal of Management Studies, Special Issue on Organizational Learning, Vol. 20, No. 1 (January 1983), p. 3.
- Astley, W. G. and Van de Ven, A., "Central Perspectives and Debates in Organization Theory," Administrative Science Quarterly, Vol. 28, No. 2 (June 1983), pp. 245-273.
- Bodensteiner, W. D., Information Channel Utilization under Varying Research and Development Project Conditions: An Aspect of Inter-Organizational Communication Channel Usages, Unpublished doctoral dissertation, The University of Texas, Austin, 1970.
- Boston Consulting Group, Perspectives on Experience, Boston: Boston Consulting Group, Inc., 1968.
- Burns, T. and G. M. Stalker, The Management of Innovations, London: Tavistock, 1961.
- Burrell, G. and Morgan, G., Sociological Paradigms and Organizational Analysis, London: Heinemann, 1979.
- Cyert, R. M. and J. G. March, A Behavioral Theory of the Firm, Englewood Cliffs, NJ: Prentice-Hall, 1963.
- Daft, R. L. and Lengel, R. H., "Information Richness: A New Approach to Managerial Information Processing and Organizational Design," in Staw, B. and Cummings, L. L. (eds.), Research in Organizational Behavior, Greenwich, CT: JAI Press, 1984, pp. 191-233.
- Daft, R. L. and Lengel, R. H., "Organizational Information Requirements, Media Richness and Structural Design," Management Science, Vol. 32 (May 1986), in press.
- Daft, R. L. and Macintosh, N. B., "A Tentative Exploration into the Amount and Equivocality of Information Processing in Organizational Work Units," Administrative Science Quarterly, Vol. 26 (1981), pp. 207-224.

- Daft, R. L. and Weick, K. E., "Toward a Model of Organizations as Interpretation Systems," Academy of Management Review, Vol. 9, No. 2 (April 1984), pp. 284-295.
- Daft, R. L. and Wiginton, J. C., "Language and Organization," Academy of Management Review, Vol. 4, No. 2 (1979), pp. 179-191.
- Dollinger, M. J., "Environmental Boundary Spanning and Information Processing Effects on Organizational Performance," Academy of Management Journal, Vol. 24, No. 2 (June 1984), pp. 351-368.
- Downs, A., Inside Bureaucracy, Little Brown, Boston, 1966.
- Duncan, R. B., "Characteristics of Organizational Environments and Perceived Environmental Uncertainty," Administrative Science Quarterly, Vol. 17 (1972), pp. 313-327.
- Duncan, R. B., "Modifications in Decision Structure in Adapting to the Environment: Some Implications for Organizational Learning," Decision Sciences, Vol. 5, No. 4 (July 1974), pp. 122-142.
- Duncan, R. B., "Multiple Decision-Making Structures in Adapting to Environmental Uncertainty: The Impact on Organizational Effectiveness," Human Relations, Vol. 26 (1973), pp. 273-291.
- Duncan, R. B. and Weiss, A., "Organizational Learning: Implications for Organizational Design," in Staw, B. (ed.), Research in Organizational Behavior, Greenwich, CT: JAI Press, 1979.
- Dutton, J. and Duncan, R. B., "The Process and Threats to Sense Making and Their Relationship to Organizational Learning," Working paper, Kellogg Graduate School of Management, Northwestern University, 1981.
- Dutton, J. M. and Freedman, R. D., "External Environment and Internal Strategies: Calculating, Experimenting, and Imitating in Organizations," in R. Lamb and P. Shrivastava (eds.), Advances in Strategic Management, Vol. 3, Linden: JAI Press, Inc., 1985, pp. 39-68.
- Emery, F. E. and E. L. Trist, "The Casual Texture of Organizational Environments," Human Relations, Vol. 18 (1965), pp. 21-32.
- Fahey, L., King, W. R. and Narayanan, V. K., "Environmental Scanning and Forecasting in Strategic Planning--The State of the Art," Long Range Planning, Vol. 14, No. 1 (1981), pp. 32-39.
- Farace, R. B., Monge, P. R. and Russell, H. M., Communicating and Organizing. Reading, MA: Addison-Wesley, 1977.
- Feldman, M. and March, J., "Information in Organizations as Signal and Symbol," Administrative Science Quarterly, Vol. 26, No. 2 (June 1981), pp. 171-186.

Fiol, C. M. and Lyles, M. A., "Organizational Learning," Academy of Management Review, Vol. 10, No. 4 (1985), pp. 803-813.

Fischer, W. A., "The Acquisition of Technical Information by R&D Managers for Problem Solving in Nonroutine Contingency Situations," IEEE Transactions on Engineering Management, Vol. EN-26, No. 1 (1979), pp. 8-13.

Galbraith, J. R., Strategies of Organization Design, Reading, MA: Addison-Wesley, 1973.

Galbraith, J. R., Organization Design, Reading, MA: Addison-Wesley, 1977.

Gerstenfeld, A. and Berger, P., "An Analysis of Utilization Differences for Scientific and Technical Information," Management Science, Vol. 26, No. 2 (1980), pp. 165-179.

Hambrick, D. C., "Environmental Scanning and Organizational Strategy," Strategic Management Journal, Vol. 3, No. 2 (April-June 1982), pp. 159-174.

Hannen, M. and Freeman, J., "The Population Ecology of Organizations," American Journal of Sociology, 82 (1977), pp. 929-964.

Hedberg, B. L. T., "How Organizations Learn and Unlearn," in Nystrom, P. C., and Starbuck, W. H. (eds.), Handbook of Organizational Design, New York: Oxford University Press, 1982, pp. 3-27.

Holland, W. E., Stead, B. A. and Leibrock, R. C., "Information Channel/Source Selection as a Correlate of Technical Uncertainty in a Research and Development Organization," IEEE Transactions on Engineering Management, Vol. 23 (1976), pp. 163-167.

Huber, G. P., "Issues in the Design of Group Decision Support Systems," Management Information Systems Quarterly, Vol. 8, No. 3 (September 1984b), pp. 195-204.

Huber, G. P., "Organizational Information Systems: Determinants of Their Performance and Behavior," Management Science, Vol. 28, No. 2 (February 1982), pp. 135-155.

Huber, G. P., "The Nature and Design of Post-Industrial Organizations," Management Science, Vol. 30, No. 8 (August 1984a), pp. 928-951.

Huber, G. P. and Daft, R. L., "Information Environments," in L. Putnam, L. Porter, K. Roberts, and F. Jablin, Handbook of Organizational Communication (Beverly Hills, CA: Sage, 1987), in press.

Huber, G. P. and McDaniel, R., "Exploiting Information Technology to Design More Effective Organizations," in Jarke, M. (ed.), Managers, Micros, and Mainframes, New York: John Wiley and Sons, 1986.

Huber, G., O'Connell, M. and Cummings, L., "Perceived Environmental Uncertainty: Effect of Information and Structure," Academy of Management Journal, Vol. 18, No. 4 (December 1975), pp. 725-740.

Jemison, D. B., "The Importance of Boundary Spanning Roles in Strategic Decision Making," Journal of Management Studies, Vol. 21, No. 2 (April 1984), pp. 131-152.

Jones, J. W. and McLeod, R. Jr., "The Structure of Executive Information Systems: An Exploratory Analysis," Unpublished Working Paper, Texas A&M University, 1984.

Keegan, W. J., "Multinational Scanning: A Study of Information Sources Utilized by Headquarters Executives in Multinational Companies," Administrative Science Quarterly, Vol. 19, No. 3 (September 1974), pp. 411-421.

Keisler, S., Siegel, J. and McGuire, T. W., "Social Psychological Aspects of Computer-Mediated Communication," American Psychologist, Vol. 39, No. 10 (October 1984), pp. 1123-1134.

Kreps, G. L., "A Field Experimental Test and Reevaluation of Weick's Model of Organizing," in Nimmo D. (ed.), Communication Yearbook 4 (1980), pp. 389-398.

Kull, D., "Group Decisions: Can a Computer Help?," Computer Decisions, Vol. 14, No. 5 (May 1982), pp. 70-82, 160.

Kurke, L. B. and Aldrich, H. B., "Mintzberg was Right!: A Replication and Extension of the Nature of Managerial Work," Management Science, Vol. 29 (August 1983), pp. 975-984.

Lawrence, P. R. and Dyer, D., Renewing American Industry, New York: The Free Press, 1983.

Lawrence, P. R. and Lorsch, J. W., "Differentiation and Integration in Complex Organizations," Administrative Science Quarterly, Vol. 12 (1967), pp. 1-47.

Lawrence, P. R. and Lorsch, J. W., Organization and Environment, (Homewood, IL: Richard D. Irwin, 1969).

Leblebici, H. and Salancik, G. R., "Stability in Interorganizational Exchanges: Rulemaking Processes of the Chicago Board of Trade," Administrative Science Quarterly, Vol. 27 (1982), pp. 227-242.

Leifer, R. and Huber, G. P., "Relations Among Perceived Environmental Uncertainty, Organization Structure, and Boundary-Spanning Behavior," Administrative Science Quarterly, Vol. 22, No. 2 (June 1977), pp. 235-247.

Longel, R. H., Managerial Information Processing and Communication-Media Source Selection Behavior, Unpublished doctoral dissertation, Texas A&M University, College Station, 1983.

Lindblom, C. E., "Still Muddling Not Yet Through," Public Administration Review, Vol. 39, (1979), pp. 517-526.

March, J. G. and Olsen, J. P., Ambiguity and Choice in Organizations, Bergen, Norway: Universitetsforlaget, 1976.

- Martin, E. W., "Information Needs of Top MIS Managers," MIS Quarterly (September 1983), pp. 1-11.
- Meherabian, A., Silent Messages, Belmont, CA: Wadsworth, 1971.
- Meissner, M., Technology and Order, San Francisco: Chandler, 1969.
- Merwan, J., "The Limits of Tradition," Forbes, May 20, 1985, pp. 112-115.
- Miles, R. E. and C. C. Snow, Organizational Strategy, Structure, and Process, New York: McGraw-Hill, 1978.
- Miller, D. and Friesen, P., "Archetypes of Organizational Transition," Administrative Science Quarterly, Vol. 25, No. 2 (June 1980), pp. 268-299.
- Miller, J. G., "Living Systems: The Organization," Behavioral Science, Vol. 17, No. 1 (1972).
- Mintzberg, H., The Nature of Managerial Work, New York: Harper & Row, 1973.
- Mintzberg, H. "The Manager's Job: Folklore and Fact," Harvard Business Review, Vol. 53 (July/August 1975), pp. 49-61.
- Mintzberg, H., Raisinhan, D. and Theoret, A., "The Structure of 'Unstructured' Decision Processes," Administrative Science Quarterly, Vol. 21 (1976), pp. 246-275.
- Mitroff, I. I. and Emshoff, J. R., "On Strategic Assumption-Making: A Dialectical Approach to Policy and Planning," Academy of Management Review, Vol. 4, No. 1 (1979), pp. 1-12.
- Nonaka, I. and Johansson, J. K., "Organizational Learning in Japanese Companies," in R. Lamb and P. Shrivastava (eds.), Advances in Strategic Management, Vol. 3, Linden: JAI Press, Inc., 1985, pp. 277-298.
- O'Reilly, C., "Variations in Use of Decision Makers' Use of Information Sources: The Impact of Quality Versus Accessibility of Information," Academy of Management Journal, Vol. 25, No. 4 (December 1982), pp. 756-771.
- Pelz, D. and Andrews, F., Scientists in Organizations, New York: John Wiley & Sons, 1966.
- Perrow, Charles, "A Framework for the Comparative Analysis of Organizations," American Sociological Review, Vol. 32 (1967), pp. 194-208.
- Pondy, L. R. and Mitroff, I. I., "Beyond Open Systems Models of Organization," in Staw, B. M. (ed.), Research in Organizational Behavior, Vol. 1, Greenwich, CT: JAI Press, 1979.
- Porter, L. W. and Roberts, K. H., "Communication in Organizations," in M. D. Dunnette (Ed.), Handbook of Industrial and Organizational Psychology, Chicago, IL: Rand McNally, 1976.

- Porter, M. E. and Millar, V. E., "How Information Gives Competitive Advantage," Harvard Business Review, (July-August 1985), pp. 149-160.
- Putnam, L. L., "The Interpretive Perspective: An Alternative to Functionalism," in L. L. Putnam and M. E. Pecanowsky (eds.), Communication and Organizations: An Interpretive Approach, Beverly Hills: Sage Publications, 1983, pp. 31-54.
- Pyke, D. L., "A Practical Approach to Delphi," Futures, Vol. 2, No. 2 (June 1970), pp. 143-152.
- Randolph, W. A., "Organizational Technology and the Media and Purpose Dimensions of Organization Communications," Journal of Business Research, Vol. 6 (1978), pp. 237-259.
- Rice, R. E. and Associates, The New Media: Communication, Research, and Technology, Beverly Hills, CA: Sage Publications, 1984.
- Rice, R. E. and Bair, J. H., "New Organizational Media and Productivity," in Rice, R. E., and Associates, The New Media: Communication, Research, and Technology, Beverly Hills, CA: Sage Publications, 1984, pp. 185-216.
- Rice, R. E. and Williams, F., "Theories Old and New: The Study of New Media," in Rice, R. E., and Associates, The New Media: Communication, Research, and Technology, Beverly Hills, CA: Sage Publications, 1984, pp. 55-80.
- Ritzer, G., "Sociology: A Multiple Paradigm Science," The American Sociologist, Vol. 10 (1975), pp. 156-167.
- Sabatier, P., "The Acquisition and Utilization of Technical Information by Administrative Agencies," Administrative Science Quarterly, Vol. 23, No. 3 (September 1978), pp. 396-417.
- Schwab, R. C., Ungson, G. R. and Brown, W. B., "Redefining the Boundary Spanning-Environment Relationship," Journal of Management, Vol. 11, No. 1 (Spring 1985), pp. 75-86.
- Shrivastava, P., "A Typology of Organizational Learning Systems," Journal of Management Studies, Special Issue on Organizational Learning, Vol. 20, No. 1 (January 1983), pp. 7-28.
- Shukla, R. K., "Influence of Power Bases in Organizational Decision Making: A Contingency Model," Decision Sciences, Vol. 13, No. 3 (July 1982), pp. 450-470.
- Simon, H. A., "Applying Information Technology to Organization Design," Public Administration Review (May/June 1973), pp. 268-278.
- Smircich, L., "Implications for Management Theory," in L. L. Putnam and M. E. Pecanowsky (eds.), Communication and Organizations: An Interpretive Approach, Beverly Hills: Sage Publications, 1983, pp. 221-242.
- Spekman, R. E., "Influence and Information: An Exploratory Investigation of

- the Boundary Role Person's Basis of Power," Academy of Management Journal, Vol. 22, No. 1 (March 1979), pp. 104-117.
- Starbuck, W. H., "Organizations as Action Generators," American Sociological Review, Vol. 48 (February 1983), pp. 91-102.
- Terreberry, S., "The Evolution of Organizational Environments," Administrative Science Quarterly, Vol. 12 (March 1968), pp. 590-613.
- Tushman, M. L., "Communications Across Organizational Boundaries: Special Boundary Roles in the Innovation Process," Administrative Science Quarterly, Vol. 22 (1977), pp. 587-605.
- Tushman, M. L., "Managing Communication Networks in R&D Laboratories," Sloan Management Review, Vol. 20 (Winter 1979), pp. 37-49.
- Tushman, M. L. and Katz, R., "External Communication and Project Performance: An Investigation into the Role of Gatekeepers," Management Science, Vol. 26, No. 11 (November 1980), pp. 1071-1085.
- Tushman, M. and Nadler, D. A., "An Information Processing Approach to Organizational Design," Academy of Management Review, Vol. 3, No. 3 (1978), pp. 613-624.
- Tushman, M. L. and Scanlon, T. J., "Boundary Spanning Individuals: Their Role in Information Transfer and Their Antecedents," Academy of Management Journal, Vol. 24, No. 2 (June 1981), pp. 289-305.
- Van de Ven, A., Delbecq, A. L. and Koenig, R., Jr., "Determinants of Coordination Modes Within Organizations," American Sociological Review, Vol. 41 (1976), pp. 322-338.
- Van de Ven, A. and Drazin, R., "The Concept of Fit in Contingency Theory," in L. Cummings and B. Staw (ed.), Research in Organizational Behavior, Vol. 7 (Greenwich, Conn.: JAI Press, 1985), pp. 333-365.
- Weick, K. E., The Social Psychology of Organizing, Reading, MA: Addison-Wesley, 1979.
- Weinshall, T. D., Managerial Communication: Concepts, Approaches, and Techniques, New York: Academic Press, 1979.
- Wiggins, Personality and Predictions, Reading, MA: Addison-Wesley, 1973.
- Wilensky, H., Organizational Intelligence: Knowledge and Policy in Government and Industry, New York: Basic Books, 1967.
- Yelle, L. E., "The Learning Curve: Historical Review and Comprehensive Survey," Decision Sciences, Vol. 10, No. 2 (1979), pp. 302-308.
- Zammuto, R. F., and Cameron, K. S., "Environmental Decline and Organizational Response," Research in Organizational Behavior, Vol. 7 (Greenwich, CT: JAI Press, 1985).

Zey-Ferrell, M., "Criticisms of the Dominant Perspective on Organizations," The Sociological Quarterly, Vol. 22 (Spring 1981), pp. 181-205.

Zmud, R. W., "Design Alternatives for Organizing Information Systems Activities," MIS Quarterly (June 1984), pp. 79-93.

LIST 1
MANDATORY

Defense Technical Information Center (12 copies)
ATTN: DTIC DDA-2
Selection and Preliminary Cataloging Section
Cameron Station
Alexandria, VA 22314

Library of Congress
Science and Technology Division
Washington, D.C. 20540

Office of Naval Research (3 copies)
Code 4420E
800 N. Quincy Street
Arlington, VA 22217

Naval Research Laboratory (6 copies)
Code 2627
Washington, D.C. 20375

Office of Naval Research
Director, Technology Programs
Code 200
800 N. Quincy Street
Arlington, VA 22217

Psychologist
Office of Naval Research
Detachment, Pasadena
1030 East Green Street
Pasadena, CA 91106

LIST 2
OPNAV

Deputy Chief of Naval Operations
(Manpower, Personnel, and Training)
Head, Research, Development, and
Studies Branch (OP-01B7)
1812 Arlington Annex
Washington, DC 20350

Director
Civilian Personnel Division (OP-14)
Department of the Navy
1803 Arlington Annex
Washington, DC 20350

Deputy Chief of Naval Operations
(Manpower, Personnel, and Training)
Director, Human Resource Management Division
(OP-15)
Department of the Navy
Washington, DC 20350

Chief of Naval Operations
Head, Manpower, Personnel, Training
and Reserves Team (Op-964D)
The Pentagon, 4A478
Washington, DC 20350

Chief of Naval Operations
Assistant, Personnel Logistics
Planning (Op-987H)
The Pentagon, 5D772
Washington, DC 20350

LIST 3
NAVMAT & NPRDC

NAVMAT

Program Administrator for Manpower,
Personnel, and Training
MAT-0722
800 N. Quincy Street
Arlington, VA 22217

MANPOWER REPORTS ONLY

Naval Material Command
Management Training Center
NAVMAT 09M32
Jefferson Plaza, Bldg #2, Rm 150
1421 Jefferson Davis Highway
Arlington, VA 20360

Naval Material Command
Director, Productivity Management Office
MAT-00K
Crystal Plaza #5
Room 632
Washington, DC 20360

Naval Material Command
Deputy Chief of Naval Material, MAT-03
Crystal Plaza #5
Room 236
Washington, DC 20360

Naval Personnel R&D Center
Technical Director
Director, Manpower & Personnel
Laboratory, Code 06
Director, System Laboratory, Code 07
Director, Future Technology, Code 04
San Diego, CA 92152-6800

(4 copies)

Navy Personnel R&D Center
Washington Support Office
Ballston Tower #3, Room 171
Arlington, VA 22203-1923

E

LIST 4
MEDICAL

Naval Hospital
Psychology Department
San Diego, CA 92134

Commanding Officer
Naval Submarine Medical
Research Laboratory
Naval Submarine Base
New London, Box 900
Groton, CT 06349

Commanding Officer
Naval Aerospace Medical
Research Lab
Naval Air Station
Pensacola, FL 32508

Naval Medical R&D Command
Program Manager for Human
Performance (Code 404)
National Naval Medical Center
Bethesda, MD 20014

Wilkins Biomedical Library
Naval Health Research Center
P.O. Box 85122
San Diego, CA 92138-9174

LIST 5
NAVAL ACADEMY AND NAVAL POSTGRADUATE SCHOOL

Naval Postgraduate School (3 copies)
ATTN: Chairman, Dept. of
Administrative Science
Department of Administrative Sciences
Monterey, CA 93940

U.S. Naval Academy
ATTN: Chairman, Department
of Leadership and Law
Stop 7-B
Annapolis, MD 21402

Superintendent
ATTN: Director of Research
Naval Academy, U.S.
Annapolis, MD 21402

LIST 6
HRM

Commanding Officer
Organizational Effectiveness Center
Naval Training Center
San Diego, CA 92133-9000

Commanding Officer
Organizational Effectiveness Center
Naval Submarine Base New London
P.O. Box 81
Groton, CT 06349

Commanding Officer
Organizational Effectiveness Center
Naval Air Station
Mayport, FL 32228

Commanding Officer
Organizational Effectiveness Center
Pearl Harbor, HI 96860

Commanding Officer
Organizational Effectiveness Center
Naval Base (Bldg. NH-46)
Charleston, SC 29408

Commanding Officer
Leadership & Organizational Effectiveness
School
Naval Air Station Memphis
Millington, TN 38054-5099

Commanding Officer
Organizational Effectiveness Center
1300 Wilson Boulevard, rm 114A8
Arlington, VA 22209

Commanding Officer
Organizational Effectiveness Center
5621-23 Tidewater Drive
Norfolk, VA 23509

Commander
Organizational Effectiveness Center
5621 Tidewater Drive
Norfolk, VA 23509

Commanding Officer
Organizational Effectiveness Center
Naval Air Station Whidbey Island
Oak Harbor, WA 98278-9000

Commanding Officer
Organizational Effectiveness Center
Box 23
FPO New York 09510

Commanding Officer
Organizational Effectiveness Center
Box 60
FPO San Francisco 96651

Commanding Officer
Organizational Effectiveness System, Pacific
Pearl Harbor, HI 96860

Commanding Officer
Organizational Effectiveness System, Atlantic
5621 Tidewater Drive
Norfolk, VA 23509

Commanding Officer
U.S. Navy Organizational Effectiveness System, Europe
FPO New York 09510

Commanding Officer
U.S. Navy Organizational Effectiveness Center
Box 4
FPO Seattle 98762-2920

LIST 7
NAVY MISCELLANEOUS

Naval Military Personnel Command (2 copies)
HRM Department (NMPC-6)
Washington, DC 20350

Dr. Ann O'Keefe
Naval Military Personnel Command
(MNPC-6Q)
Washington, DC 20350

Commander
Naval Training Equipment Center
(Code 1 - Resource Center)
Orlando, FL 32813

Commanding Officer
ATTN: TIC, Bldg. 2068
Naval Training Equipment Center
Orlando, FL 32813

Chief of Naval Education & Training (N-22)
Naval Air Station
Pensacola, FL 32508

Chief of Naval Technical Training
ATTN: Code D17
NAS Memphis (75)
Millington, TN 38D54

Navy Recruiting Command
Director, Recruiting Advertising Dept.
Code 43
801 North Randolph Street
Arlington, VA 22203

Naval Weapons Center
Code 094
China Lake, CA 93555

LIST 8
USMC

Headquarters, U.S. Marine Corps
Code MPI-20
Washington, DC 20380

Headquarters, U.S. Marine Corps
ATTN: Scientific Adviser,
Code RD-1
Washington, DC 20380

Director
Education Center (E 032B)
MCDEC
Quantico, VA 22134-5050

Commanding Officer
Education Center (EO31)
MCDEC
Quantico, VA 22134

Marine Corps Command and
Staff College
Education Center
Quantico, VA 22134

LIST 9
OTHER FEDERAL GOVERNMENT

Defense Advanced Research
Projects Agency
Director, Cybernetics
Technology Office
1400 Wilson Blvd, Rm 625
Arlington, VA 22209

Professor Douglas E. Hunter
Defense Intelligence School
Washington, DC 20374-6111

Dr. Brian Usilaner
GAO
Washington, DC 20548

School Management Unit
National Institute of Education
1200 19th Street, N.W.
Mail Stop 17
Washington, DC 20208

National Institute of Mental Health
Division of Extramural Research Programs
5600 Fishers Lane
Rockville, MD 20852

Information Analyst
Center for Studies of Minority Group
Mental Health
Parklawn Building, Rm 11-94
5600 Fishers Lane
Rockville, MD 20857

Chief, Personnel Policy Analysis Branch
U.S. Coast Guard (G-P-1/2)
Washington, D.C. 20593

Social and Developmental Psychology
Program
National Science Foundation
Washington, D.C. 20550

Dr. Earl Potter
Department of Economics & Management
U.S. Coast Guard Academy
New London, CT 06320

Division of Industrial Science
& Technological Innovation
Productivity Improvement Research
National Science Foundation
Washington, D.C. 20550

Douglas B. Blackburn, Director
National Defense University
Mobilization Concepts Development
Center
Washington, D.C. 20319

Chairman, Dept. of Medical Psychology
School of Medicine
Uniformed Services University of
the Health Sciences
4301 Jones Bridge Road
Bethesda, MD 20814

LIST 10
ARMY

Headquarters, FORSCOM
ATTN: AFPR-HR Ltc. Sellards
Ft. McPherson, GA 30330

Army Research Institute
Field Unit - Ft. Leavenworth
P.O. Box 290
Leavenworth, TX 66048

Technical Director
Army Research Institute
5001 Eisenhower Avenue
Alexandria, VA 22333

(3 copies)

Head, Department of Behavior
Science and Leadership
U.S. Military Academy, New York 10996

LTC. Frederick J. Manning
Deputy Director
Division of Neuropsychiatry
Walter Reed Army Institute
Washington, DC 20307-5100

Army Military Personnel Command
Attn: DAPC-OE
200 Stovall Street
Alexandria, VA 22322

Army Research Institute
Attn: PERI-SF (Mr. Dennis Leedom)
5001 Eisenhower Avenue
Alexandria, VA 22333

Commandant
USA OECS
Attn: ATXW-RMA-S
Ford Ord, CA 93941-7300

LIST 11
AIR FORCE

Air University Library
LSE 76-443
Maxwell AFB, AL 36112

Head, Department of Behavioral
Science and Leadership
U.S. Air Force Academy, CO 80840

Major Robert Gregory
USAFA/DFBL
U.S.A.F. Academy
Colorado Springs, CO 80840-5941

A. R. Fregley
AFOSR/NL
Building 410
Bolling Air Force Base
Washington, DC 20332-6448

Technical Director
AFHRL/MO(T)
Brooks AFB
San Antonio, TX 78235

AFMPC/MPCYPR
Randolph AFB, TX 78150

LIST 12
MISCELLANEOUS

Australian Embassy
Office of the Air Attache (S3B)
1601 Massachusetts Avenue, N.W.
Washington, D.C. 20036

British Embassy
Scientific Information Office
Room 615
3100 Massachusetts Avenue NW
Washington, DC 20008

Canadian Defense Liaison Staff,
Washington
ATTN: CDRD
2450 Massachusetts Avenue, N.W.
Washington, DC 20008

Commandant, Royal Military
College of Canada
ATTN: Department of Military
Leadership and Management
Kingston, Ontario K7L 2W3

National Defense Headquarters
ATTN: DPSRSC
Ottawa, Ontario K1A 0K2

Sequential by Principal Investigator

LIST 13
CURRENT CONTRACTORS

Dr. Clayton P. Alderfer
Yale University
School of Organization and Management
New Haven, Connecticut 06520

Dr. Janet L. Barnes-Farrell
Department of Psychology
University of Hawaii
2430 Campus Road
Honolulu, HI 96822

Dr. Jomills Braddock
John Hopkins University
Center for the Social Organization
of Schools
3505 N. Charles Street
Baltimore, MD 21218

Dr. Sara Yogev
Northwestern University
Graduate School of Management
2001 Sheridan Road
Evanston, IL 60201

Dr. Terry Connolly
University of Arizona
Department of Psychology, Rm. 312
Tucson, AZ 85721

Dr. Richard Daft
Texas A&M University
Department of Management
College Station, TX 77843

Dr. Randy Dunham
University of Wisconsin
Graduate School of Business
Madison, WI 53706

List 13 (continued)

Dr. J. Richard Hackman
School of Organization
and Management
Box 1A, Yale University
New Haven, CT 06520

Dr. Wayne Holder
American Humane Association
P.O. Box 1266
Denver, CO 80201

Dr. Daniel Ilgen
Department of Psychology
Michigan State University
East Lansing, MI 48824

Dr. David Johnson
Professor, Educational Psychology
178 Pillsbury Drive, S.E.
University of Minnesota
Minneapolis, MN 55455

Dr. Dan Landis
The University of Mississippi
College of Liberal Arts
University, MS 38677

Dr. Frank J. Landy
The Pennsylvania State University
Department of Psychology
417 Bruce V. Moore Building
University Park, PA 16802

Dr. Bibb Latane
The University of North Carolina
at Chapel Hill
Manning Hall 026A
Chapel Hill, NC 27514

Dr. Cynthia D. Fisher
College of Business Administration
Texas A&M University
College Station, TX 77843

Dr. Thomas M. Ostrom
The Ohio State University
Department of Psychology
116E Stadium
404C West 17th Avenue
Columbus, OH 43210

Dr. William G. Ouchi
University of California,
Los Angeles
Graduate School of Management
Los Angeles, CA 90024

Dr. Robert Rice
State University of New York at Buffalo
Department of Psychology
Buffalo, NY 14226

Dr. Benjamin Schneider
Department of Psychology
University of Maryland
College Park, MD 20742

Dr. H. Wallace Sinaiko
Program Director, Manpower Research
and Advisory Services
Smithsonian Institution
801 N. Pitt Street, Suite 120
Alexandria, VA 22314

Dr. Eliot Smith
Psychology Department
Purdue University
West Lafayette, IN 47907

Dr. Barbara Saboda
Public Applied Systems Division
Westinghouse Electric Corporation
P.O. Box 866
Columbia, MD 21044

Dr. Harry C. Triandis
Department of Psychology
University of Illinois
Champaign, IL 61820

Dr. Anne S. Tsui
Duke University
The Fuqua School of Business
Durham, NC 27706

Dr. Andrew H. Van de Ven
University of Minnesota
Office of Research Administration
1919 University Avenue
St. Paul, MN 55104

Dr. Sabra Woolley
SRA Corporation
901 South Highland Street
Arlington, VA 22204

Dr. Eduardo Salas
Human Factors Division (Code 712)
Navy Training Systems Center
Orlando, FL 32813-7100

END

DATE

7-86