FROM ADVERSITY TO DIVERSITY:
APPLICATIONS OF COMMUNICATION TECHNOLOGY TO CRISIS MANAGEMENT

Ronald E. Rice

INTRODUCTION AND QUALIFICATIONS

This chapter speculates on how computer-based communication and information systems (CMCIS) may be used to not only increase but also manage communication diversity in the management of organizational crises. The chapter first summarizes a model of ways information and communication may be constrained when individuals, groups, and organizations respond to crises. Then the chapter describes general characteristics of communication media, and identifies ways different communication channels can increase or decrease constraints on communication processes. Working from these two theoretical foundations, the relevance of CMCIS to the problem of constrained responses in organizational crisis management is considered at three stages of organizational information processing—input (crisis prevention and identification), conversion (crisis response and management), and output (crisis

Advances in Telecommunications Management
Volume 3, pages 91-112.

ISBN: 1-55938-146-9

communication and learning). At each stage, CMCIS are considered both as channels of information and communication about crises, as well as the content of managerial and organizational activities in the crisis management process.

It is useful to identify some of the assumptions underlying the arguments in this chapter, and to make explicit some of the limitations of this discussion.

First, although information and communication are necessary in all three stages of crisis management, they are not necessarily sufficient. Clearly, personal and organizational values and norms, luck and faith, experience and skill, material and political resources, economic conditions, personal leadership, regional and national politics and policies, and a whole host of other factors play important roles.

Second, we focus on ways in which CMCIS may be used to handle, manage, exchange, retrieve, decide upon, evaluate, and create information. But such systems are far more than just technology and software; they are intrinsically embedded in social contexts (users, groups, organizations, cultures, economies). This context means that (1) there are clearly many other (possibly more appropriate and generally more accessible) sources of information and ways to communicate, (2) CMCIS may be used in damaging as well as helpful ways, and (3) the capabilities of CMCIS must be fitted to those contexts.

Third, while there is considerable empirical research on both crisis management, and on CMCIS, this discussion is primarily speculative. It uses a previously developed framework for analyzing computer-mediated communication systems (Rice, 1987): (1) to identify how different kinds of CMCIS applications may facilitate crisis management, (2) based upon a consideration of constraints inherent in both crises and CMCIS.

INFORMATION AND COMMUNICATION CHALLENGES OF CRISES

While there is a considerable body of literature on decision making and the use of information during crises, the "threat-rigidity" hypothesis developed by Staw, Sandelands, and Dutton (1981) provides the present framework for identifying some problems of information processing and communication in crises at the individual, group, and organizational levels of analysis.

Individuals undergoing psychological stress, anxiety, and physiological arousal tend to increase their reliance on internal hypotheses, pay greater attention to dominant cues, emit well-learned responses, and exhibit increased drive. These responses decrease individual performance if the dominant responses are inappropriate. Further, in situations of uncertainty, decision makers tend to increase their search for information (often for symbolic purposes, and often in self-fulfilling ways [Feldman and March, 1981]), well past the point at which their performance begins to decline—even though they

believe their performance continues to increase (Smith, 1988). Groups that attribute threats to external forces, or predict a reasonable likelihood of success of handling the threat, show increased cohesiveness, support for their leaders, and pressure for conformity, leading to restriction of information and constriction of control. However, groups that attribute threats to internal forces, or foresee failure, exhibit the opposite traits, leading to a greater search for new information, decentralization of decision making, and greater member autonomy. Organizations facing threats overload their information channels, rely on prior knowledge, and reduce communication complexity, all leading to restrictions in information processing. They also tend to centralize authority, and place greater emphasis on formalization, leading to constriction of control. Finally, they also tend to increase their concern for efficiency, leading to a conservation of resources.

Essentially, Staw, Sandelands, and Dutton (1981) conclude that at each level, there are two main responses to threat: (1) a restriction of information processing (by narrowing the field of attention, simplifying information codes, and reducing the number of channels used), and (2) a constriction of control (by centralizing decision making, reverting to more hierarchical- and power-based sources of influence). While these two responses may be appropriate when the threat is predictable, well-understood, or frequent, it decreases the organization's chances of survival in many crisis situations. The consequence is that during a crisis, just when an organization's environment changes rapidly, organizations tend to revert to well-learned responses and reduce the number of alternative solutions or strategies, developed in the context of a stable environment that no longer exists.

This emphasis on control, programmed responses, and formal channels has a variety of consequences. Limiting the search for alternative solutions or discrepant information, as well as relying only on formal communication channels, works against one of the fundamental principles of successful systems: equifinality, or the ability to arrive at a goal state through a variety of paths. Moreover, understanding and interpreting information during crises is especially difficult because the rigidity response attempts to filter out uncertainty by ignoring information or reinterpreting it to fit expectations and prior categories, even though the usual contexts that make this filtering effective are removed or replaced.

The extent of searching for information in a planning or decision-making context is based upon a wide variety of influences, but some of the most commonly identified include (1) accessibility (of the content, source, and the medium), (2) the importance of the decision, (3) the irreversibility of the decision, (4), the accountability of the decision maker, and (5) the equivocality or interpretability of the information (Hurtman, White, and Crino, 1986). One paradox, then, is that when decision makers are faced with multiple alternatives or information overload (as in crisis situations), they find ways to simplify their

evaluation of information, but when the decision is important, irreversible, or involves high accountability, they tend to avoid simplifications in their search for, and evaluation of, information. A basic challenge in crisis situations, then, is to avoid satisficing and making suboptimal, inflexible or programmed decisions, while also avoiding overload and decontextualized masses of information. That is, the challenge is to develop diverse sources, kinds, and interpretations of information, in the midst of adverse conditions.

CONSTRAINTS AND COMMUNICATION MEDIA

We have seen that, according to the "threat-rigidity hypothesis," constraints on information processing, communication and control increase during crises. Thus, CMCIS may usefully be analyzed by the extent to which they can reduce or improve some of these constraints. Because CMCIS combine the capabilities of both the computer (storage and processing of information) and telecommunications networks (exchange of information), they differ from both interpersonal communication channels (face-to-face, telephone) and mass media (video or radio broadcast, books, newspapers, magazines). Rice (1987, p. 68) compares these media on a variety of characteristics. We summarize those most important to the subsequent discussions.

CMCIS in general have moderate or low constraints on the ability to identify the sender, the need to know the specific receiver, the need to know a specific address, the ability to overcome a receiver's selectivity (attention, interest), temporal and geographic proximity, accessibility (though this point is highly context-specific), ability to store and retrieve content, and ability to reprocess the content (index, edit, structure). On the other hand, text-based CMCIS are more constrained in their ability to convey many of the visual or audio communication modes of other media (closeness, movement, intonation, social and nonverbal cues). CMCIS are more interactive than mass media, and rival interpersonal communication in some aspects of interactivity, especially when they can overcome temporal and geographical constraints inherent in interpersonal communication. Finally, CMCIS overcome a variety of network constraints inherent in other media, such as enabling all parties to communicate simultaneously with each other while reducing the potential for distortion and gatekeeping.

The following sections discuss specific ways in which the characteristics of CMCIS can be taken advantage of to increase diversity in communication and information processing during adversity in three information processing stages of crisis management—input (crisis prevention and identification), conversion (crisis response and management), and output (crisis communication and learning). Further, continuing the framework developed by Rice (1987) for evaluating media characteristics, we comment on the use of CMCIS as both

Table 1. Characteristics and Processes of Interpersonal, Mass, and Computer-Mediated Communication Media

		Medium						
		Interpersonal		Mass Media		Computer Media		
Characteristics	*Process*	*Face-to-Face*	*Telephone*	*Broadcast*	*Text*	*Electronic Mail*	*Numeric*	*Voice Mail*
Constraints on users								
Able to identify sender	Routing	+	0	0	0	0	0	0
Have to know receiver	Routing	+	+	−	+	0	0	0
Have to know address	Routing	+	+	−	+	0	0	0
Able to overcome receiver's selectivity	Modifying	+	0	−	−	−	−	0
Need to be temporally proximate	Delaying	+	+	+	−	−	−	0
Need to be geographically proximate	Routing	+	−	−	0	−	−	−
Access to sending system	Routing	−	+	−	−	0	+	−
Able to store content	Delaying	−	−	−	0	+	−	0
Able to retrieve content	Summarizing	−	−	−	0	+	+	+
Able to reprocess content	Modifying/summarizing	−	−	−	−	+	+	0
Bandwidth								
Proxemic-distance	Modifying/summarizing	+	−	−	−	−	−	−
Kinesic-gestures	Modifying/summarizing	+	−	+	−	−	−	−
Paralinguistic-tone	Modifying/summarizing	+	+	+	0	0	−	+
Linguistic-meaning	Modifying/summarizing	+	+	+	+	+	−	+
Data-denotation	Modifying/summarizing	0	−	0	+	+	+	−
Ability to convey social presence	Modifying	+	+	0	0	−	−	+
Speed of input	Delaying	+	+	+	0	−	−	+
Interactivity								
Quickness of response	Delaying	+	+	−	−	+	0	+
Ability to terminate	Delaying	−	0	+	+	+	+	+
Mutual discourse	Modifying/delaying	+	+	−	−	0	−	0
Network factors								
Information flow	Routing	One to few		One to many		Many to many		Few to many
Distortion	Modifying	+	+	0	−	−	−	−
Effect of role	Modifying/summarizing	+	+	0	0	−	−	0

Notes: The symbols + (high) and − (low) are approximate and relative scale endpoints. That is, when a communication channel has the lowest relative amount, or none, of the characteristic, it receives a "−" value. "0" indicates where characteristics are especially contextual or adaptable. Also, characteristics such as access assume the system exists; for example, electronic mail systems in general are highly inaccessible worldwide, but once a user has an account, access to sending messages is much less constrained than, say, having an article printed in a newspaper.

Source: Rice (1987, p. 69).

a channel or medium for informing and communicating during these stages of crises, as well as on CMCIS as the object of information and communication during the crisis stages.

INPUT: CRISIS IDENTIFICATION AND PREVENTION

CMCIS as Content: Modeling Crises

There is, of course, a variety of systems and programs specifically designed to plan for and simulate general crisis situations, or to provide computer-based management tools for handling crises. Within the framework of this chapter, these programs and systems may be considered formal mechanisms to maintain flexible information and decision making (by forcing users to consider potential factors and possible crises), and to reduce communication constraints (by providing a channel for outside experts, and, in some cases, representatives from other organizational levels).

Legasto (1984) reports on a crisis decision modeling program which has modules for generating simulated crises as well as for evaluating organizational responses and consequences. Traditional control systems may be reconceptualized as crisis identification systems and redesigned to become sensitive to patterns or combinations of changes (Ehrlemark, 1984). Programs that simulate corporations as systems can be used to clarify issues and possible relationships in crisis situations (Hall and Menzies, 1983). Some crisis programs simulate discontinuous, cyclical, expanding, declining, and stable markets to test a corporation's ability to analyze, reason, and compare alternate responses. Decision support systems and expert systems can be used to identify resources, political contexts, and changing assumptions that affect strategic choices, by means of providing scenarios and modules that represent adversaries or contrary assumptions (Kronenberg and Howard, 1986/1987). Libraries have used an "Emergency Information System" which provides a guided tour through emergency planning and response (Morentz, 1987). This program merges emergency management data bases with maps and floor plans, analyzes and plans crisis management procedures, provides online data bases for free-text searching of crisis topics and individuals' expertise, and involves both internal information (plumbing and spatial information) as well as external information (emergency roads, airplane flight paths, book-freezing equipment).

A related approach is to reinvent systems developed for operational concerns into systems that facilitate the management of crises. One example is a geographic-based decision support system designed to help selection of delivery truck routes. The microcomputer-based system provides visual and textual

presentation of routes and accounts, and can produce reports and maps for drivers. The graphics modules have also been used to prepare for managing delivery and resource crises due to weather and construction emergencies (Belardo, Duchessi, and Seagle, 1985). Another is the use of a decision system designed to help individuals evaluate and compare job or career options. However, it can also be used by managers to plan for and respond to crises in situations of organizational restructuring, mergers, and human resource planning (Wooler, 1982).

As more and more organizations become dependent on information and computer systems, there is a growing need to plan for crises related to the integrity and reliability of those systems themselves, yet a surprisingly small percentage of firms have plans for managing crises caused by or involving their own systems (Johnson, 1986; Mandell, 1986). Computer system crises may arise from fraud, embezzlement, sabotage, power failures, floods, system conversions, and so on. External storage sites, system emulation, and rerun and error recovery procedures are necessary to handle crises when they occur. Information from and about audit trails, encryption, physical security, logs of late project delivery dates, budget overruns, loss reporting, downtime, employer turnover, and user dissatisfaction all can be used to help prevent computer system crises (Bornhofen and Somerson, 1988; Gellman, 1986; Newkirk, 1981; Nolan, 1979; Scoma, 1981).

CMCIS as Channel: Reinvention and Learning

Half of the organizations responding to one survey still do not use crisis management systems, even though 89 percent of the same organizations felt a crisis was inevitable, and even though the survival rate of organizations that have crisis information systems or plans is 2.5 times higher than for those that do not (Housel, El Sawy, and Donovan, 1986). There are likely many reasons for this contradictory situation, but here we consider ways to use CMCIS to overcome constraints on becoming informed about the existence of potential crises, and to plan for and prevent possible crises.

With only some difficulty, a crisis can been seen as a rapidly adopted new practice or tool that changes with use and has extremely negative impacts. While this conceptualization in some ways trivializes crises, it allows us to apply a concept from the field of innovation known as reinvention—the adaptation of an innovation after it has been adopted (Rice and Rogers, 1980). Our fourfold typology of reinvention consists of (1) whether reinvention is chosen intentionally or not, and (2) whether the source of information about the reinvention is direct or not (Johnson and Rice, 1987): planned (directly seeking information as part of a conscious process of reinventing an adopted innovation), vicarious (seeking ways to learn from other's mistakes), reactive (solving problems generated unintentionally by adopting an innovation), and

secondary (solving consequences of someone else's reinvention). Organizations should attempt to foster intentional (planned and vicarious) reinvention, to learn how to forestall or manage possible crises. The worst scenarios, and likely the most constriction of information and control, occur when seeking information and making decisions about crises is unintentional (reactive or secondary).

One vicarious approach to preventing crises is to use online data bases to search for scientific and technical information on management of past crises, such as the reviews of the Penn Central Bankruptcy, the oil embargo of 1973-1974, the emergency blackout of New York City in 1970, and the Apollo 13 incident by Gellman Research Associates (1977). For another example, Hayes and Hazelwood (1976) described the characteristics of 289 crises since 1946, and analyzed 70 kinds of crisis management problems in a detailed study of 41 of those crises.

Shell Corporation intentionally invests in the vicarious learning process, using "what-if" scenarios, computer models, and sessions with consultants to raise managers' awareness of trends and inconsistencies, which may be used to detect or prevent crises (de Geus, 1988). Some companies have developed trend analysis programs to help them scan and analyze crisis management publications in order to anticipate future trends. Specified individuals write abstracts of articles on trends or discontinuities in specific subject areas, the abstracts are analyzed by a diverse committee (including a futurist consultant), and significant themes are chosen as the basis of trend analysis report and special projects, and discussed in an annual conference (Weiner, 1976).

Another planned or vicarious approach is to determine prospectively what sources and kinds of information may be needed in a crisis, and make that information accessible, retrievable, and usable. For example, chemical plants use information systems to store information on meteorological, topographical, and chemical materials that can be used to predict the dispersion of toxic clouds; the U.S. Coast Guard organizations weather and tidal information to be able to plot drifting patterns of ships and predict arrival times of rescue teams; the federal Nuclear Regulatory Commission also requires such information management tools (*Business Week,* 1982). Exxon Research and Engineering has supported an Information Management Program since 1971, providing information to maintain procedures, awareness about potential problems and events that have occurred in other plants, and materials to use during crisis situations. The original documents are custom-indexed for the petroleum industry, and used to generate current awareness alerts, keyword-in-context indices on computer-output-microfiche, and entered into an online data base for use by Exxon affiliates worldwide (Soled, Veverka, Krieg, Barrett, and Allan, 1987).

Another example of vicarious reinvention is the use of computer conferencing and computer bulletin board systems as ways to link

administrative staff in one state who are experiencing a crisis (such as a toxic waste spill, or a threatening referendum) with similar staff in another state who might have information on similar past experiences (Hiltz and Turoff, 1978). This solution is not only cheaper and more targeted than the typical sole reliance on attending conferences, belonging to professional associations, or scanning government regulatory documents, but also facilitates short-term ad hoc interagency coordination and allows a variety of experiences to accumulate in retrievable and communicable form.

CONVERSION: CRISIS RESPONSE AND MANAGEMENT

CMCIS as Channel: Coordination and Structure

A crisis by its very nature challenges the capabilities of in-place communication systems (including regular face-to-face staff meetings) whose natural constraints may ordinarily be acceptable. However, when multiple actors in dispersed locations must have immediate access to each other, as during a crisis, they must overcome these traditional communication constraints. Cellular telephones have been used to coordinate a team repairing a computer system damaged by water during an earthquake (Housel and El Sawy, 1990), because they did not require telephone lines that had been broken. Voice mail systems allow for multiple interactions, delegation, and maintenance of the original call, overcoming constraints of error-prone and time-delayed written messages, while providing an audit trail of obligations and information (Rice and Shook, 1989). Some electronic messaging systems such as the Coordinator allow or require participants to make their assumptions about a message or a sequence of interactions explicit (Richman, 1987). That is, knowing that a message is a formal request for information with a specific deadline for response is likely to reduce overload and uncertainty in a crisis situation. The Coordinator program also allows users to store and track specific strands of ongoing online conversations, so they may avoid ambiguity as to how rapidly-developing situations are related to past information or expectations. Traditional media do not easily provide these kinds of support, which may be particularly helpful in crisis situations.

Another problem in coordination and communication during crises is overcoming constraints due to organizational structure. Routine conditions bring together people who share similar tasks, and help to develop social ties, but they also develop fixed structures and boundaries that restrict information flow and increase control in crisis situations. Krackhardt and Stern (1988) theorize that social ties are critical to successful management of crises, because such ties involve higher trust between participants. With higher trust comes

a greater ability to manage the increased stress, uncertainty, and threat of change inherent in crises. Cross-subunit cooperation and communication across subunits may decline in crises, both because there is less likelihood of strong social ties across subunits and thus greater conflict, and because those cross-subunit social ties that do exist are more difficult to maintain. Krackhardt and Stern (1988) found evidence that organizations with stronger intersubunit social ties were more effective during times of (a simulated) crisis.

Implications for the use of CMCIS include the development and maintenance of social ties through electronic interest groups (bulletin boards, distribution lists, and topic-oriented computer conferences). These relationships would not only tie together subunits on dimensions other than that of shared tasks, but would also be less constrained by cross-unit boundaries during times of crisis. While the traditional response to such suggestions is that CMCIS could not support personal or social relationships well, research, in fact, shows that not only do some CMCIS support considerable socioemotional content, but also that electronic support of social relations can help organizational members become familiar with an organization's culture and members more quickly (see reviews in Rice, 1987). Danowski and Edison-Swift (1985) found, for instance, that the density of messages sent over an electronic messaging system during an organizational crisis increased, and that the content of the messages reflected growing concern for the crisis topic (budget slashes).

Beyond developing and maintaining social groups, CMCIS could also help maintain group structures developed for crisis management. Cummings and Shapiro (1976) showed that ad-hoc groups were generally less effective than permanent organizations or groups in managing crises. However, since crises are by definition infrequent and temporary, it is generally infeasible to maintain a standing crisis management group. Because of the ability to connect individuals in different departments, locations, and schedules, CMCIS could be used to establish permanent but not full-time, managed but flexible—that is, "virtual"—communication and decision-making structures to handle crises. Linkages among coordinating roles (independent of specific individuals, if necessary), menus of decision-making procedures, distribution lists for internal and external communications, and so on, may be resident (and adaptable) on a system for use in a crisis. In that way, groups responding to a crisis will not necessarily have to develop completely ad-hoc structures and relationships, or reconstruct resource and contact data bases from scratch, particularly at a time when information overload is a significant threat.

CMCIS as Channel: Communication and Group Decision Making

Crisis management is inherently group- and organization-oriented. That is, decisions involve diverse actors, information must be shared and interpreted

by groups, and activities must be coordinated within and across multiple unit and organizational boundaries. Yet, only recently have group-oriented CMCIS been available, such as bulletin boards and computer conferencing (Hiltz and Turoff, 1978), group decision support systems (GDSS) (DeSanctis and Gallupe, 1987), electronic blackboards (Stefik, Foster, Bobrow, Kahn, Lanning, and Suchman, 1987), and groupware systems (Ellis, Gibbs, and Rein, 1989).

Like electronic mail, group-oriented communication systems allow multiple users to communicate across geographical and temporal constraints. Because computer conferencing systems share rather than send files (as in electronic messaging systems), the communication can be explicitly oriented and structured according to the needs of groups brought together to manage crises. Studies show that because typical nonverbal and symbolic codes such as status, physical location in a room, dress, speech abilities, and so on, are removed from this communication context, individuals are more likely to participate in discussions and decision making, make higher-quality decisions, maintain more creative or opposing opinions, and choose leaders on the basis of expertise rather than on frequency of communication (Rice and Associates, 1984). Users can also enter comments as quickly or frequently as desired—or can wait to make a measured response. Because of the stored record, the transcripts can be searched for specific comments or associations of phrases, and edited for immediate minutes or reporting.

EMISARI, an early computer conferencing system (Hiltz and Turoff, 1978), and RIMS (Resource Interruption Monitoring System) (Macon, McKendree, and Wynn, 1975) have been used in crisis situations by the Office of Emergency Preparedness, the Government Services Administration, and other federal agencies since the early 1970s, starting with managing the wage-price freeze crisis of 1971. RIMS was an early interactive MIS, providing online numerical data base and full-text reports, conferencing, and computational and reporting functions.

In the context of crisis management, computer conferencing overcomes some constraints, and could facilitate greater diversity of information in decision-making groups, compared to face-to-face communication. McKendree (1978) and Price (1975) conclude that computer conferencing may be most appropriate for a complex problem requiring input from many people; where the communication process must be structured to insure understanding; where an accurate record of the communication process is necessary; where more individuals are needed than can meaningfully interact face-to-face; when disagreements may be great enough that face-to-face communication would be excessively confrontational; when geographical or temporal constraints are significant; and when specific group processes are needed.

In their prescriptions for planning and decision-making situations, Hurtman, White, and Crino (1986) suggest a variety of well-known information-

processing strategies that match the (1) requirements of interactions among environmental volatility (more predictable or less predictable), (2) need for organizational adaptation (unstable or stable), and (3) level of planning (strategic, or the nature of the business; operational, or the organization's competitiveness; and tactical, or the ability to accomplish organizational objectives). We may extend their analysis to the crisis management situation, pointing out how CMCIS may support these strategies.

In the most extreme situation, where the environment is volatile, and the organization's ability to adapt to the demands is unstable, the authors suggest the following information-processing strategies for the three planning levels:

1. *Strategic: Morphology and Social Judgment Analysis.* Here, it is necessary to conduct an extended search for alternatives. Many environmental factors must be scanned and synthesized into a complex model of possibilities. Numerical and full-text online data bases could be used to search for, download, and analyze relevant information, or to search for prior research reports on similar problems. Or, the different judgment processes used by those affected by the decision should be explored for their assumptions and evaluation criteria, in order to arrive at a consensus of the directions the organization might take or prepare for. Part of Xerox PARC's electronic blackboard system (Stefik, Foster, Bobrow, Kahn, and Lanning, 1987) is called the Argnoter, which contains an evaluation module designed to make users explicitly consider the assumptions behind various arguments, display proposals in the context of different belief sets, select and rank different beliefs, and reduce disagreement stemming from miscommunication. It uses shared workspaces, graphic portrayals, and decision analysis and assumption-linking software.
2. *Operational: Scenarios.* Here, in order to avoid overload, known environmental conditions, causal factors, and likely relationships and consequences are used to describe a set of plausible future conditions as the basis for preventative action. Shared computer conferencing workspaces could be used to allow a subset of individuals to develop these scenarios. Such systems could reduce the constraints of time and geography, allow internal and external experts from around the country to contribute, and allow electronic observers (perhaps topic-specific outside experts) to respond when they can but not edit the files, without having to wait together in a meeting until a tentative set of scenarios is developed. Another approach would be to distribute, via diskettes or a local area network, a set of scenarios for use with ForComment, a software program that allows multiple parties to provide comments on specific passages, which the authors may later read and incorporate in that section (Raskin, 1987).
3. *Tactical: Linear Compensatory Modeling.* Conducting information processing at the tactical level reduces some of the potential information overload, so that the various alternatives and attributes can be compared to arrive at an overall assessment as the basis for a decision. Here, ongoing

information in internal organizational data bases could be retrieved by local workunits and compared to their interpretation of the resources and problems. This internal information could be compared to related, but unknown, data through the use of intelligent information retrieval systems that send "intelligent agents" through electronic networks to find relevant materials (Malone, Grant, Trubak, Brobst, and Cohen, 1987).

In a less extreme condition, with a volatile environment but an organization that is relatively able to respond, the following strategies may be appropriate:

1. *Strategic: Morphology, Lateral Thinking and Delphi Analysis.* The organization should extend the search for information and develop innovations that may help prevent crises. Lateral thinking involves procedures such as conceptual block-busting, right-brain thinking, and brainstorming, to break out of traditional patterns. Potentially relevant organizational reports or online bibliographic data bases could be searched to find what other concepts or terms are associated with specific terms of concern (Badgett, 1987). Hypertext seems ideally suitable for such electronic browsing and dynamic associations of concepts and information (Conklin, 1987). Hypertext involves dynamic searching and filing of (potentially multimedia) data objects by means of nonhierarchical directed links. Thus, the current user, and thus the nature of the information applied to a crisis management problem, is not necessarily constrained by the categorization schemes of prior users or the database developer.

Delphi analysis is the iterative, anonymous surveying of a panel of experts until a consensus emerges on, say, the likelihoods of certain problems in the short and long term. The earliest computer conferencing systems were in fact developed to support Delphi analysis, because they dramatically cut down the turnaround time within survey iterations, guarantee anonymity, and can even be used for automatic data collation and analysis Delphi method (Johansen, Vallee, and Spangler, 1979; Linstone and Turoff, 1975).

2. *Operational: Scenarios, and Nominal Group Techniques.* Nominal groups list possible problems, solutions, and resources in an environment structured to encourage suggestions and limit criticism in an effort to increase the diversity of possible solutions. Group ratings are used to not only make decisions about likely solutions but also to incorporate scenarios and the group decisions into policies and actions. Computer conferencing could support nominal group discussions because its capability for maintaining anonymity would divorce substantive suggestions from the constraining influences of social, hierarchical, and nonverbal factors. Also just noted, participants in this form of group decision making are more able to maintain their opinions, should they disagree, in the face of group pressures to conform. While the potential for the associated lower consensus may be detrimental to formulating actions

based upon consensus in a crisis situation, for our purposes this resistance to group pressure and to subsequent "groupthink" may represent a particular benefit, by resisting restrictions in information flow and content. It should also be noted that some of these studies also found that the greater consensus in face-to-face groups is often superficial, a result of expected perceptions about the group, and not based upon individual decision preferences, and that consensus was not necessarily correlated with correctness of the decision.

The Argnoter component of Xerox PARC's electronic blackboard system may be more appropriate because of its ability to portray and link suggestions visually, while its proposal module facilitates explicit but anonymous statements of proposals.

An extension of both conferencing systems and GDSS would be a network of flexible, locally-managed GDSS that provide both computing and communication support, within and across decision-making groups (Rathwell and Burns, 1985). Such systems could be particularly effective in improving users' understanding of perspectives, assumptions, and priorities inherent in other groups with which they must coordinate activities.

3. *Tactical: Similar Prescriptions for the More Volatile Situation.*

OUTPUT: CRISIS COMMUNICATION AND LEARNING

CMCIS as Channel: Communicating About Crisis

Internal communication about decision processes and crisis-related information is important as part of a process to convert reactive and secondary reinvention into planned and vicarious reinvention. Some engineering projects use systems that allow "gripes," "advice," and "try it" comments in computer conferences to generate ongoing awareness of changes in systems and alternate solutions (Rathwell and Burns, 1985). These insights will not aid future crisis management unless they are communicated and integrated into ongoing procedures; this process is typically constrained by management policies, not by communication systems (Johnson and Rice, 1987). CMCIS may be used to communicate information about disasters and crises to the external environment, with varying results. For example, a communication satellite leased by a private French company was the first to provide pictures of the Chernobyl disaster to news services; the stock market responded rapidly to the Challenger explosion by dropping the value of the rocket manufacturer's stock by 20 percent in a one-hour period (Rogers, 1988).

One of the crucial communication bottlenecks in crises is providing information to the external environment, about the status of the crisis, the accuracy of rumors, the condition of personnel, the need for resources, and

so on. Reporters covering natural disasters have identified access to external communication links, and access to internal information sources and media tours, as the two most critical requirements (Sood, Stockdale, and Rogers, 1987). Research on mass media coverage of disasters also finds that the early reporting often sets the agenda for later stories; for organizations, then, it is clearly important to provide both access to communication systems as well as accurate, timely information to avoid unreasonable focus on misleading or damaging stories later.

As Housel, El Sawy, and Donovan (1986) suggest, the source of this access should be centralized, to avoid providing conflicting information. Information overload may be reduced by using systems that reduce constraints on how many people can access information. Thus, providing public bulletin boards, voice mail, and audiotex systems with options for hearing answers to different sets of questions (Finnigan and Meade, 1986), or broadcasting electronic messages to public information services would help in this situation by providing press releases, hot line numbers, and status updates. Housel and El Sawy (1990) describe how Johnson & Johnson, in response to the Tylenol poisoning crisis, used AT&T's broadcast telephone service (Dial-it 900) to send messages to 9,000 sites at once, and provided inbound WATS (800) numbers that redirected the calls to information centers in the caller's region. Johnson & Johnson also sent press interviews and updates to 60 satellite video downlinks. Other options for external communication include video news releases to electronic news gathering services and broadcasting networks, and "instant press releases" entered into online public relations data bases (Druck, Fiur, and Bates, 1986).

Videotex, bulletin boards, audiotex, and other CMCIS may have some advantage over traditional newsletters or mailings because they can be updated in real-time, avoiding having to respond to inquiries about conditions that have changed or been solved. In some crisis situations, constraints in traditional media such as the live press conference or the telephone hot line against retrieval of the message may be an advantage, in the sense that earlier comments may be retractable. Thus crisis information provided by online systems and electronic distribution lists may be more updatable but may also create a false sense of accountability and permanence.

CMCIS as Content: Reinvention and Learning

While the bulk of this discussion has considered how CMCIS developed for routine use in organizations may be applied to crisis management, systems that have been developed explicitly for crisis management may also be conceptualized and used as a means for routine and strategic operations. This is another example of reinvention—here, crisis management systems are reinvented as more general and strategic organizational CMCIS. Further, they are easier to justify when they are also used for ongoing operational purposes

(Housel and El Sawy, 1990; Morentz, 1987). Housel and El Sawy, (1990) argue, using a variety of examples, that if the triggers, impacts, and scope of crises generic to a particular industry can be identified, then the systems used to prevent, manage, and communicate about those crises can also be leveraged to improve an organization's competitive advantage. The library crisis management system summarized earlier (Morentz, 1987) may also be used for designing exhibits and relocating collections, and to allow users to explore different aspects of the library (as, matching book subjects with areas in the library, a sort of electronic browsing). A hypertext program would be an ideal, inexpensive form of such a combined crisis/operational system, because of its visual, free-form, multimedia capabilities.

CMCIS as Content: Systems as Sources of Crises

Because the intent of this chapter is to suggest some ways in which CMCIS may facilitate the prevention of, management of, and communication about, organizational crises, it has ignored many of the potential problems with such technologies. This section notes just a few.

In spite of the comments just mentioned about ways to structure CMCIS systems to avoid overload, CMCIS may well increase rather than decrease information processing demands. The information components may be used to search for and retrieve large amounts of information that have, to some extent, been decontextualized, thus increasing uncertainty, ambiguity, and need for additional processing. The communication components may increase the number of contacts that must be maintained, and may be used to "generate coherent messages that greatly exceed one's comprehension" (Smith, 1988, p. 14). Indeed, Rice (1982) has shown that while some users of a nationwide computer conferencing system managed to maintain their positions as information transmitters and carriers, the tendency was to be unable to process enough communications, and remain isolated in a group of others focused on similar tasks.

Hiltz and Turoff (1985) have, however, suggested ways (both technical and organizational) in which CMCIS can be used to structure human communications to avoid communication overload. They note that information overload tends to be more likely after initial use of such systems, but before users became experienced enough to use the structuring and processing capabilities of the computer. Further, they note, in accord with the earlier comments on intentional reinvention, that what may be considered "electronic junk mail" may be a great source of new information, so designs should not automatically prevent all but explicitly relevant messages from accepted senders from being sent or received. For example, a messaging network set up by IBM for employees to discuss new systems requirements, and so on became famous as "gripenet," a place for employees to complain

about current procedures and suggest solutions. Possible techniques to manage overload include the automatic categorization of message headers by topics or senders, the use of distribution lists to disseminate requests for information or solutions, limits on the length of messages, messages that simply refer to a longer document (stored on the system) that may be read by a related command, automatic topic-oriented distribution lists, communicating about specific topics inside a conference structure, dedicated conference or system moderators, anonymous "pen names," tickler files, extra costs for some kinds of sent messages, and so on.

Related to the issue of overload is the extent to which organizational tendencies to constrict control in situations of threat or control take the form of centralized control to CMCIS. That is, while such systems may increase the information processing capabilities of those in control, they may also exacerbate the problem of increased formalization and diversity of viewpoints because of limitations on who can use them during crises.

The very nature of crises increases the need to process equivocal, uncertain, ambiguous, and nonroutine information. Yet, according to theories of the extent to which a medium can convey these kinds of information (Daft and Lengel, 1984; Short, Williams, and Christie, 1976), text-based CMCIS may be quite inappropriate for these tasks. They may increase the constriction on understanding, but not allow equivocal or contextual understandings, even while increasing the apparent information processing capabilities of the organization and its users.

The continuing development, diffusion, and use of CMCIS are also manifestations of the increasingly complex and technocratic nature of modern organizations and societies. This very complexity gives rise to what Perrow (1984) calls "normal accidents." That is, there is now a class of problems, disasters, accidents, crises, and risks that are inherent to, and a direct result of, the systems themselves. Examples include crashes between ships in the middle of vast bodies of water, accidents in nuclear plants designed with layer upon layer of procedural and technological safety, and heightened national vulnerability from development of high-technology defense systems. The significance of "normal accidents" lies in the fact that although they are assigned extremely low levels of probability and, therefore, theoretically represent low levels of risk, they are a normal consequence of systems that rely on processes, technology, and assumptions that no group of individuals can understand, much less predict. That is, some systems—perhaps some CMCIS—developed as the response to certain crises, now may be the cause of other crises. One of the potential outputs of CMCIS is reactive reinventions—other crises.

Perhaps a major portion of the complexity of technological systems that creates these "normal accidents" stems from political, economic, bureaucratic, and cultural forces. For example, while weather satellites detected and predicted the 100-mile/hour hurricane that hit Andra Pradesh in November

1977 for a week, the forewarned ministries and agencies could not coordinate their activities, they were not sure how to interpret the information, and the all-India radio system was reluctant to broadcast the dire threats, and, hence, the villagers received no warning. From 25,000 to 50,000 were killed, and three million were made homeless. The technology succeeded, but the social system failed (Rogers, 1988).

Finally, information technologies may be contributing to larger, more global crises (Schiller, 1984). Unemployment, deskilling, injuries and illness, alienation, and social stratification—both within and across nations—may be consequences of the increased organizational reliance on information technologies. Information and information technologies may be seen as a solution to many economic problems, but they also tend to concentrate power in the hands of system developers, owners, and users, because these people are a highly select and small portion of most societies. Even less obvious is that information itself may be used to persuade resisters against these conditions, in the form of the massive advertising distributed internationally for consumer goods. These forces have, for instance, created a growing crisis in the public sector—more and more formerly public institutions are having to charge for their services, or collaborate with industry to survive. Further, the principle of "free flow of information" supported by U.S. free-market economics has created extensive crises of national sovereignty and debt, through dependence on information flows (such as television and film product, or new agencies) and information technologies (such as transmission networks and satellite systems). The ability to manage information and finances globally through CMCIS is, in turn, creating crises for U.S. organizations because international competitors can quickly manage labor forces and materials in the least expensive locations.

CONCLUSION

This chapter has identified some of the typical reactions that individuals, groups, and organizations have to threats such as crises: restriction of information channels and content, and increased control and centralization. It has also shown that computer-mediated communication and information systems combine computers and networks to overcome some constraints (temporal, geographical, retrieval, distribution, and so on) inherent in traditional organizational communication channels (face-to-face, telephone, memos, meetings, and so on). Thus, CMCIS—both as channels for communication, and as the objects of management—may be used in the three general categories of crises—input (crisis prevention and identification), conversion (crisis response and management), and output (crisis communication and learning)—in order to reduce unwanted restriction of and constraints

upon the diversity of communication, information, and organizational perspectives necessary to make sense, and solve, organizational crises. The following paragraphs summarize a few of the implications of this analysis.

In the input stage, crisis modeling systems can be used to increase diversity by simulating crises and planning procedures, and online data bases can expand communication channels and information about potentially related crises. In-place control systems can be reinvented to decentralize prevention by monitoring operations, while computer conferences can use decentralized and extraorganizational expertise to plan for and prevent crises. In the conversion stage, electronic nominal group decision support systems and online Delphi surveys can increase the diversity of explanations and potential solutions, while hypertext systems can maintain flexible and visual representations of relations among potential causal chains. Voice mail can be used to coordinate, in decentralized ways, constantly moving task forces, and customizable online group communication structures can be used to reduce overload from pressure-driven centralized establishment of ad hoc groups.

In the output stage, a diversity of systems can be supported by reinventing systems, that were once solutions to crisis situations, into operational systems. Control of information accuracy and consistency can be centralized by developing response data bases, but control of access can be decentralized by providing audiotex and videotext systems for the public as well as the press. Planning should also attempt to understand how operational and crisis systems can generate secondary and reactive crises in other societies, organizations, and classes.

REFERENCES

Badgett, T. (1987), "Searching Through Files with Database Software." *PC Magazine* (October 27), pp. 175-190.

Belardo, S., P. Duchessi, and J. Seagle (1985), "Microcomputer Graphics in Support of Vehicle Fleet Routing." *Interfaces* 15(6), pp. 84-92.

Bornhofen, F. and I. Somerson (1988), "Loss Reporting: Your Pipeline to Results." *Security* 25(3), pp. 70-72.

Business Week (1982), "Help for People who Deal with Disaster." *Business Week* 2754 (Industrial Edition) (August 30), p. 59.

Conklin, J. (1987), "Hypertext: An Introduction and Survey." *Computer* (September), pp. 17-41.

Cummings, P. and H. Shapiro (1976), *Problems in the Use of Ad Hoc Structures in DOD Crisis Management and Implications for Change.* Report HSR-RR-76/1-NR. Contract N00014-76-C-0349. Mclean, VA: Human Sciences Research, Inc.

Daft, R.L. and R.H. Lengel (1984), "Information Richness: A New Approach to Managerial Behavior and Organization Design." *Research in Organizational Behavior* 6, pp. 191-233.

Danowski, J. and P. Edison-Swift (1985), "Crisis Effects on Intraorganizational Computer-Based Communication." *Communication Research* 12(2), pp. 251-270.

DeSanctis, G. and B. Gallupe (1987), "A Foundation for the Study of Group Decision Support Systems." *Management Science* 33, pp. 589-609.

Druck, K., M. Fiur, and D. Bates (eds.), (1986), *New Technology and Public Relations.* Foundation for Public Relations Research and Education, Inc.

Ehrlemark, U. (1984), "Design Your Own Management Information Systems." *Long Range Planning* 17(2), pp. 85-95.

Ellis, C., S. Gibbs, and G. Rein (1988), "The Groupware Project: An Overview." In J. Galegher, R. Kraut, and C. Egido (eds.), *Intellectual Technology: Social and Technological Foundations of Intellectual Work.* New York: Erlbaum.

Feldman, M. and J. March (1981), "Information in Organizations as Signal and Symbol." *Administrative Science Quarterly* 26, pp. 171-186.

Finnigan, P. and J. Meade (1986), "Audiotex: The Telephone as Data-Access Equipment." *Data Communications* (November), pp. 141-153.

Gellman, H. (1986), "Crisis Aversion ... Not Crisis Management." *CMA-The Management Accounting Magazine* 60 (May-June), p. 60.

Gellman Research Associates, Inc. (1977), *The Role of Scientific and Technical Information in Critical Period Management,* vols. I and II. Final Report. Contract NSF76-05499. Jenkintown, PA: Gellman Research Associates, Inc.

de Geus, A. (1988), "Planning as Learning." *Harvard Business Review* (March/April), pp. 70ff.

Hall, R. and W. Menzies (1983), "A Corporate System Model of a Sports Clubs: Using Simulation as an Aid to Policy Making in a Crisis." *Management Science* 29(1), pp. 52-64.

Hayes, J. and L. Hazelwood (1976), *Planning for Problems in Crisis Management.* Report CAC223. Contract N00014-76-C-0454. Arlington, VA: Policy Sciences Division, CACI Inc.-Federal.

Hiltz, S.R. and M. Turoff (1978), *The Network Nation.* Menlo Park, CA: Addison-Wesley.

Hiltz, S.R. and M. Turoff (1985), "Structuring Computer-Mediated Communication Systems to Avoid Communication Overload." *Communications of the ACM* 28(7), pp. 680-689.

Housel, T.J. and O.A. El Sawy (1990), "Leveraging Information Systems for Crisis Management: Silver Linings." Pp. 59-75 in T.J. Housel (ed.), *Advances in Telecommunications Management,* vol. 3. Greenwich, CT: JAI Press.

Housel, T., O. El Sawy, and P. Donovan (1986), "Information Systems for Crisis Management: Lessons from Southern California Edison." *MIS Quarterly* (December), pp. 389-400.

Hurtman, S., M. White, and M. Crino (1986), "Environmental Volatility, System Adaptation, Planning Requirements, and Information Processing Strategies: An Integrative Model." *Decision Sciences* 17(4), pp. 454-474.

Johansen, R., J. Vallee, and K. Spangler (1979), *Electronic Technical Alternative and Social Choices.* New York: Addison-Wesley.

Johnson, B. and R.E. Rice (1987), *Managing Organizational Innovation: The Evolution from Word Processing to Office Information Systems.* New York: Columbia University Press.

Johnson, G. (1986), "Planning for Disaster in a Computer Age; Few Firms Prepare for Contingencies, Despite Poor Survival Rate Among Those Struck." *Washington Post* 109 (June 15), G7.

Krackhardt, D. and R. Stern (1988), "Informal Networks and Organizational Crises: An Experimental Simulation." *Social Psychological Quarterly* 51(2), pp. 123-140.

Kronenberg, P. and M. Howard (1986/1987). "Crisis Management and Computer Support." *Bureaucrat* 15(4), pp. 49-54.

Legasto, A.A. (1984), "Modeling Under Crisis." *International Journal on Policy and Information* 8(2), pp. 111-120.

Linstone, H. and M. Turoff (eds.), (1975), *The Delphi Method.* Reading, MA: Addison-Wesley.

Macon, N., J. McKendree, and R. Wynn (1975), "Computer Conferencing in Emergencies: Some Reliability Considerations." Pp. 69-73 in *Proceedings of the Institute of Electrical & Electronics Engineers Computer Networks.* Gaithersburg, MD: National Bureau of Standards & Institute of Electrical & Electronics Engineers (Washington Sector).

McKendree, J. (1978), "Project and Crisis Management Applications of Computerized Conferencing." *Bulletin of The American Society for Information Science* 4(5), pp. 13-15.

Malone, T., K. Grant, F. Truback, S. Brobst, and M. Cohen (1987), "Intelligent Information Sharing Systems." *Communications of the ACM* 30(5), pp. 390-402.

Mandell, M. (1986), "Voices of Experience: Are You Ready for Disaster?" *Computer Decision* 18(19), pp. 64-75.

Morentz, J. (1987), "Computerizing Libraries for Emergency Planning." *Special Libraries* 78, pp. 100-105.

Newkirk, K. (1981), "Management Accounting Services: Securing the Small Business Computer." *Ohio CPA Journal* 40(4), pp. 175-177.

Nolan, R. (1979), "Managing the Crisis in Data Processing." *Harvard Business Review* 57(2), pp. 115-126.

Perrow, C. (1984), *Normal Accidents: Living with High-Risk Technologies.* New York: Basic Books.

Price, C. (1975), "Conferencing via Computers: Cost-Effective Communication for the Era of Forced Choice." Pp. 497-516 in H. Linstone and M. Turoff (eds.), *The Delphi Method.* Reading, MA: Addison-Wesley Co.

Raskin, R. (1987), "Editing by Committee." *PC Magazine* (March 31), pp. 277-285.

Rathwell, M. and A. Burns (1985), "Information Systems Support for Group Planning and Decision-Making Activities." *MIS Quarterly* 93, pp. 255-271.

Rice, R.E. (1982), "Communication Networking in Computer Conferencing Systems: A Longitudinal Study of Group Roles and System Structure." Pp. 925-944 in M. Burgeon (ed.), *Communication Yearbook,* vol. 6. Beverly Hills, CA: Sage.

Rice, R.E. (1987), "Information, Computer-Mediated Communication and Organizational Innovation." *Journal of Communication* 37(4), pp. 65-94.

Rice, R.E. and Associates (1984), *The New Media: Communication, Research and Technology.* Beverly Hills, CA: Sage.

Rice, R.E. and E.M. Rogers (1980), "Re-invention and Innovation: The Case of Dial-A-Ride." *Knowledge* 1(4), pp. 499-514.

Rice, R.E. and D. Shook (1989), "Voice Mail, Coordination and Communication." In J. Galegher, R. Kraut, and C. Egido (eds.), *Intellectual Technology: Social and Technological Foundations of Intellectual Work.* New York: Erlbaum.

Richman, L. (1987), "Software Catches the Team Spirit." *Fortune* (June 8), pp. 125-136.

Rogers, E.M. (1988), Personal communication, June 27 (also based on viewing news clips broadcast at the time of the hurricane).

Schiller, H. (1984), *Information and the Crisis Economy.* Norwood, NJ: Ablex..

Scoma, L. (1981), "How Secure is Your Computer from a Disaster?" *Office* 94(2), pp. 96-98.

Short, J., E. Williams, and B. Christie (1976). *The Social Psychology of Telecommunications.* London: John Wiley and Sons.

Smart, C., W. Thompson, and I. Vertinsky (1978), "Diagnosing Corporate Effectiveness and Susceptibility to Crises." *Journal of Business Administration* 9(2), pp. 57-96.

Smith, T. (1988), "Practical Theory and the Complexity Dimension of Information Overload." Paper presented to the International Communication Association, New Orleans, LA.

Soled, E., E. Veverka, J. Krieg, J. Barrett, and R. Allan (1987), "Information Technology Utilization in Emergency Management at Exxon Research and Engineering Company." *Special Libraries* 78, pp. 116-122.

Sood, R., G. Stockdale, and E.M. Rogers (1987), "How the News Media Operate in Natural Disasters." *Journal of Communications* 37(3), pp. 27-41.

Staw, B., L. Sandelands, and J. Dutton (1981), "Threat-Rigidity Effects in Organizational Behavior: A Multilevel Analysis." *Administrative Science Quarterly* 26, pp. 501-524.

Stefik, M., G. Foster, D. Bobrow, K. Kahn, S. Lanning, and L. Suchman (1987), "Beyond the Chalkboard: Computer Support for Collaboration and Problem Solving in Meetings." *Communications of the ACM* 30(1), pp. 32-47.

Weiner, E. (1976), "Future Scanning for Trade Groups and Companies." *Harvard Business Review* (September/October), p. 14ff.

Wooler, S. (1982), "A Decision Aid for Structuring and Evaluating Career Choice Options." *Journal of the Operational Research Society* 33(4), pp. 343-351.