4. ORGANIZATIONAL ASPECTS OF WARNING SYSTEMS

This section focuses on the detection and emergency management components of warning systems. These two components both typically involve organizations, relationships between organizations, and the behavior of individuals in those organizations. It is also possible for people who are not organizational members to participate in these two components of a warning system. Nonmember participation in these warning system components was presented in Sect. 2. Public response, the third component of warning systems, is addressed in Sect. 5.

In the first part of this section, the warning dilemmas and uncertainties facing technicians, scientists and emergency managers are reviewed and discussed. This discussion of organizational warning problems is followed by a section summarizing the factors that help to mitigate these dilemmas and enhance warning system effectiveness. This discussion of solutions is followed by the chapter conclusion with a review of principles that are important for developing effective warning systems.

4.1 ORGANIZATIONAL DILEMMAS

4.1.1 Interpretation Dilemmas

Information about an impending hazardous event must work its way from event detection to prudent public warning decision. Along the way, this information is subject to the interpretations of those who process it and pass it along to others. These interpretations can facilitate the warning process if they are sound. They also can raise uncertainties in the system and give rise to subsequent bad decisions. Interpretation uncertainties concern the recognition of the event, the recognition that the event is hazardous, a definition of the magnitude of the hazard, a recognition of the warning system's role, a recognition of relevant information, and a recognition of authority. Such uncertainties can be reduced with systematic planning and decision methodologies (Lindell et al. 1985), but it is difficult to imagine a time when all uncertainties could be eliminated.

4.1.1.1 Recognition of Event

The ability to recognize the presence of an impending event is determined by the degree to which an indicator of the potential threat can be detected and the conclusion reached that a threat exists. For example, observation of a particular cloud formation may suggest rain to some, a tornado threat to a few, and merely a cloudy day to others. Both "trained" observers and members of the public vary in their ability to recognize a potential threat. The variable abilities of people to recognize threat has delayed some warnings, thereby reducing the time available for public response. For instance, in several recent dam failures, the company responsible for managing the reservoir failed to understand that the dams were unsafe. The inability to link runoff conditions with dam failure precluded early warnings. This was a problem to a limited extent in the Lawn Lake dam failure (Graham and Brown 1983) and was a major contributing factor in the Buffalo Creek dam disaster (Erikson 1976). A procedure in place that clearly specifies how to monitor for the presence of events can help reduce uncertainty in such circumstances.

4.1.1.2 Recognition of Hazard

Variation in the ability to define the level of threat, once the presence of an event has been recognized, is a second uncertainty that has constrained effective and timely hazard recognition. Once the physical properties of an impending event are recognized, uncertainties can exist in reference to event impacts. For example, an impending flood could affect a large part of town or only a small segment of it; a hurricane could produce hazardous winds for 30 miles inland or only for 3 miles; a terrorist threat may or may not actually result in an attack. The inability of managers to recognize the extent of public hazard associated with an impending event has been the cause of overestimating and underestimating the seriousness of impending emergencies. In some cases, this uncertainty has led to less effective and poorly timed warning decisions. Implicit in the recognition of hazard is the trade-off between false alerts, true positives, and warning lead time. As the sensitivity of a warning system increases, the number of correct definitions of hazards will also increase (Pate-Cornell 1983, 1986).

The warning and evacuation of 225,000 people in Mississauga, Canada, following a train derailment was effective only because the ensuing fire caused hazardous fumes to rise above nearby residents. Initially, warning decisions were hampered by officials' inability to determine the hazardous materials on the train. When the manifest was located, officials were uncertain as to whether or not it was accurate. If it had not been for the fire, nearby populations would have been exposed to escaping chlorine gas. As many as 14 separate evacuations were ordered during the incident as a consequence of new hazard information coming to light (Burton et al. 1981). Estimation of the hazard is often facilitated through prior knowledge and training.

4.1.1.3 Definition of Magnitude

Sometimes it is difficult to accurately forecast the magnitude of an impending hazard. For example, it is difficult to foretell the precise windspeed of hurricanes at landfall. Because of the inexactness of our ability to predict magnitude, uncertainty regarding the advisability of public warning often cannot readily be resolved.

There are magnitudes of events for which warning and evacuation is advisable and others for which they are not. Uncertainty can lead to wrong warning decisions. It can also delay warning and evacuations. The Rapid City flood is a case in point (Mileti and Beck 1975). Heavy rains and rising water levels in the creek were both detected. However, the magnitude of the flood event was not accurately foreseen; those estimating magnitude did not know that a natural dam in a canyon above the city had broken. The lack of this knowledge delayed the timely issuance of warnings, led to ambiguity concerning what protective actions to recommend, and resulted in significant losses. Magnitude estimation is typically more accurate if it is based on available technology and if knowledgeable personnel are working with the information.

4.1.1.4 Self-Definition of Role

Uncertainty in the performance of warning-related work has affected both those who initiate communication and those who receive it. People uncertain about their communication role in a warning system do not always perform it. Uncertainty on the part of those who play key parts in the chain of communication can slow activation of the system because key players who are uncertain of their role often do not convey risk in a

timely manner. For example, the mining company responsible for creating the slagheap reservoir on Buffalo Creek did not define its role as that of emergency responder or communicator. As a result, when the dam failed, no timely alert was given to public officials who could have issued a public warning (Erikson 1976). People are more likely to understand their role in a warning system if plans exist and training occurs.

4.1.1.5 Sorting of Relevant Information

Sorting relevant from nonrelevant information is needed when there is either too much or bad information facing the decision maker. It is then necessary to determine which pieces of information should be used to make a decision and which should be ignored. For example, a local sheriff who must decide whether to activate an evacuation alarm system in the vicinity of a hazardous chemical spill might be given recommendations from different organizations, as well as meteorological data, projected dose rates, and so on, until the sheriff is overwhelmed by the amount of information. In such cases, the decision maker may exclude some information and make a decision on the basis of partial information. Another possibility is to ignore the information and make the decision on the basis of some exogenous factor. This uncertainty in how information is sorted can reflect itself in the quality of the warning decision. For example, when Mount St. Helens became active, emergency response organizations were given raw data on seismicity and plume activity. In the course of trying to understand and use these data, they tended to neglect some responsibilities, such as providing warnings to the public (Sorensen 1981). Warning system plans that anticipate such problems and which provide for the communication of only important understandable information help to solve this problem.

4.1.1.6 Definition of Authority

In a warning system, authority may be defined as the way in which the various actors in the system perceive the responsibility and power of other actors to make decisions. The relative disposition of authority can create uncertainties in several ways. First, disputes can occur if more than one person or agency assumes a leadership role. Second, information may not reach the right decision makers if authority roles are perceived incorrectly. Third, decisions could be delayed or overlooked if no one takes charge because that level of authority is perceived as someone else's responsibility. This was a problem among agencies and private corporations preceding the large eruption at Mount St. Helens (Sorensen 1981). Disagreement over evacuation authority arose between the U.S. Forest Service and a lumber company. The Forest Service wanted to evacuate lands that were being harvested. The conflict led to a series of revisions in warning policies with compromises on both sides. Fortunately, the eruption occurred on a Sunday, when no logging was taking place. Plans that define authority before warning events occur can do much to reduce this problem.

4.1.2 Communication Dilemmas

Public advisement and warnings are usually the results of long chains of communications between different people in different organizations. Consequently, a key to understanding the warning decision-making process is to view it as a series of communications between both people and organizations. This process of communication has produced uncertainties in past emergencies, constraining warnings and protective

action by the public. These uncertainties fall into four categories: (1) whom to notify, (2) ability to describe a hazard, (3) physical ability to communicate, and (4) conflicting information.

4.1.2.1 Whom to Notify

Uncertainty about who should receive hazard information has constrained the communication process in some past warning situations and delayed public response. Sound hazard recognition and an accurate determination of threat cannot be useful unless that information is communicated. Dissemination of threat information to communities at risk can be constrained if the persons possessing hazard information do not know what local agencies—and which people within them—to notify. For example, at Mount St. Helens, warnings concerning ashfall levels and their consequences to eastern Washington were not given. This failure has been attributed to the lack of predisaster interactions between state and local emergency organizations and to a lack of knowledge about whom to contact when the volcano erupted (Saarinen and Sells 1985). Warning plans should specify the appropriate notification sequence.

4.1.2.2 Ability to Describe Hazard

Those engaged in providing hazard information to others have created uncertainties because of the way threat descriptions were worded. Nonscientists, for example, rarely share a common understanding of probabilities with scientists, much less with one another. Vagueness in the specification of risk areas can lead to increased uncertainties for those confused over whom to warn. Technical descriptions of the physical processes associated with a hazard may mean little to those interested in only simple definitions. The inability of some scientists and technicians to describe hazards in clear and simple ways has created uncertainties for those who must use that information to make decisions.

This inability also has created uncertainties in the process of communication leading up to protective action advisement. For example, when there was an explosion at a chemical plant in Taft, Louisiana, the evacuation of the surrounding population was delayed by the failure to communicate accurate information about the explosion and its potential consequences (Quarantelli 1983). Company officials did not explain the accident in terms that local officials could readily use in making their decisions. Even when they issued a warning that recommended a 5-mile evacuation, local officials did not understand why it should be that distance. In the 1985 eruption of the Nevado del Ruiz volcano, a poor description of the hazard contributed to the loss of 24,000 lives. After the eruption, national television broadcast the message that there was no cause for alarm. Several hours later a devasting mud flow destroyed the town of Armero (Voight 1988). Training or the use prescripted messages might have helped to address this problem.

4.1.2.3 Physical Ability to Communicate

Loss of technical capacity to communicate has been a source of uncertainty in many prior warning situations. Some reasons include the nonmatch of radio frequencies, the lack of dedicated phone lines when regular lines are overloaded, and the lack of back-up communications systems when planned or routine systems fail. A good example of a physical communication failure is provided by the 1977 Johnstown flood. The loss of the phone system hampered efforts of the Corps of Engineers' weather observer to transmit

rainfall data to flood forecasters and, consequently, efforts of NWS to alert local officials (NWS 1978). Technical hardware to provide for communication between different entities in a warning system should be resilient when damaged and redundant to provide for backup communication mechanisms.

4.1.2.4 Conflicting Information

Conflicting data or recommendations can lead to different conclusions about whether to issue a warning. The decision maker must then decide which information is valid. For example, if a local official in charge of warning receives information from one source that a dam has overtopped and from another that it is sound, a decision on whether to warn people to evacuate may be delayed. A bad decision may result if erroneous information is acted upon.

This type of situation was encountered in 1983 with Hurricane Alicia. Local officials relied on official forecast information from both NHC and the Galveston National Weather Service Office. The local weather service was warning officials that the hurricane could take a northerly turn and hit Galveston. The NHC was concentrating on warning of a more southerly landfall. Galveston officials played down the potential of Galveston's being affected, and it was too late to evacuate when the storm turned (Savage et al. 1984). This problem can never disappear entirely; however, efforts to minimize the chances of it occurring can be undertaken. Pre-event plans can formalize who makes such judgments and to whom they are communicated to avoid conflicting reports. The quality of those judgments are, however, limited by technology and those organizations and people involved.

4.1.3 Perceptual Dilemmas

Uncertainties also exist in the warning process because of decision makers' perceptions regarding the negative impacts of making wrong decisions. Some of these perceived impacts have no basis in reality and are instead part of a general myth structure about public emergency response. Others are potentially real. Six categories of negative impacts, identified from past events, include public consequences, personal consequences, unnecessary costs, liability, evacuation feasibility, and outside expectations. Having plans that classify events into categories that are followed by predesignated actions can do much to relieve the impact of perceptual factors.

4.1.3.1 Adverse Consequences

Warning decisions can be influenced by a decision maker's perception of the adverse consequences of action. For example, in an evacuation typical concerns may be that people will panic, be hurt or killed, or that homes will be looted while residents are away. While such events may occur in some isolated and unusual circumstances, such beliefs are largely unfounded given previous experiences. Despite evidence to the contrary, however, the belief still persists that such problems are typical rather than rare events. In addition, decision makers may believe that a false warning will hinder future warning needs (the "cry wolf" syndrome). There is little evidence that this is the case.

For example, in Hurricane Carla, the state government decided against issuing a warning for a general evacuation for fear of panic and unnecessary movement. Instead, it let local governments make decisions (Moore et al. 1963). In Hurricane Alicia, several

local governments, having ordered evacuations that proved unnecessary for Hurricane Allen, decided not to issue an evacuation warning for fear of being wrong again (Savage et al. 1984).

4.1.3.2 Personal Consequences

Uncertainty has led to apprehensiveness in notifying other organizations and the public about an impending threat. Often this results in downplaying the potential threat when it is communicated. Decision makers have feared that transmitting risk information for a threat that might not materialize could lead to personal consequences such as loss of reputation or image or loss of votes in a future election. For example, in a 1965 tsunami threat situation in Crescent City, California, local officials feared public sanctions if they called for another evacuation and no tsunami occurred (Anderson 1970).

4.1.3.3 Costs of Protective Actions

Decision makers also can be influenced by their perceptions of the dollar costs or losses that may stem from warning, particularly when the warning is precautionary. Costs may include transportation and sheltering of the public, as well as costs for emergency personnel. Losses can include revenues lost from employment or sales, damages incurred from injury during evacuation, or losses from the shutdown of productive sectors in an economy. A city that has exhausted its emergency funds and cannot easily pay for police overtime may be reluctant to issue a warning. Perceived economic costs played a significant role in determining evacuation zones at Mount St. Helens. Evacuation boundaries were shifted to divide the cost of manning roadblocks between two counties and to allow access to economic enterprises in the area (Sorensen 1981).

4.1.3.4 Liability

How agencies, organizations, or the actors within them perceive liability also can influence warning decisions. Liability for public safety is frequently an issue for public agencies. The major concern is over responsibility for damages if a disaster occurs and actions are not taken to protect the public. In such cases, victims may claim both compensatory and punitive damages for a failure to warn (Davis 1986). In fact, a recent court case resulted in a jury awarding $16.2 million in punitive damages to 65 residents who were not warned of the hazards of a dioxin spill (Right to Know News 1987). This perception can cause officials to err on the side of caution. On the other hand, decision makers may perceive themselves as being liable for ordering an unneeded evacuation that leads to unnecessary costs and possible evacuation-associated damages. A recent earthquake prediction issued by California Institute of Technology scientists for the San Diego region did not lead to a warning from the state. One reason for silence was confusion about liability for issuing a public warning (Southern California Earthquake Preparedness Project 1985). Liability concerns can be reduced if pre-event legislation relieves warning system actors of it; this type of legislation exists in some states for some hazards.

4.1.3.5 Feasibility

Feasibility refers to the potential success of a warning in regard to successful public protection. Perceptions of the feasibility of specific public actions can be influenced by factors such as the severity of the hazard, geography, safety of evacuation routes, and the like. Misperceptions of feasibility could lead to poor decisions concerning a warning or influence the timing of warning decisions. For example, the fear of radioactive release during a fast-moving accident at a nuclear plant, in conjunction with poor weather, could lead to a warning advising evacuation even before plant conditions suggest than an evacuation is in order. In Hurricane Alicia, Galveston officials did not issue an evacuation warning because they felt there was insufficient time for all to leave before the storm hit (Savage et al. 1984).

4.1.3.6 Expectations

Warning decisions can be influenced by the expectations or demands of persons outside the warning system environment. A public official, for example, may perceive that a warning and evacuation is expected by the public. In addition, a decision maker may feel pressure from another level of government or from some other agency when deciding whether or not to issue a warning. At times such pressure may be counterproductive, causing the responsible official to overreact and follow the opposite course of action. During the Three Mile Island accident, the decision by Pennsylvania's governor to recommend a selective evacuation was partly a response to outside demands and pressures to demonstrate control and leadership (Dynes et al. 1980). During the approach of Hurricane Alicia, evacuation communication from the governor of Texas to the mayor of Galveston may have played a role in the early decision not to evacuate. In this case, the mayor may have reacted negatively against the state's position instead of making a decision independently of the state.

4.2 FINDINGS FROM RESEARCH ON WARNING ORGANIZATIONS

The effectiveness of detectors and emergency managers in performing their organizational duties in warning systems can be and has been constrained by dilemmas of interpretation (i.e., is the impending event hazardous, who should do what as part of the warning process, do those persons possess the authority to proceed, what information is important vs unimportant); by communication dilemmas (to whom should what be said, how can conflicting reports be resolved, is there the ability to contact others); and by dilemmas of perceptual constraint (will a warning have an adverse impacts, is there the potential for liability). Fortunately, these constraints can be managed.

Research over the last three or so decades has discovered several factors that affect organizational effectiveness in warning systems and in emergency response in general. It is the purpose of this part of this section to summarize those research findings. What has been learned is divided into four categories: (1) establishing organizational effectiveness when performing a warning role, (2) dealing effectively with other organizations during warning events, (3) integrating the warning system, and (4) maintaining flexibility during times of warnings. Appendix A provides a catalogue of research evidence to support the findings discussed in the remainder of this chapter.

4.2.1 Organizational Effectiveness

One focus of research has been to determine what factors inside an organization facilitate effective performance during emergencies. Each warning system organization could address these issues to avoid internal organizing dilemmas and increase the effectiveness of its warning role.

1. Identify all the warning tasks for which the organization is responsible. If an organization has multiple divisions, differentiating the role that each plays in a warning is recommended. This issue is particularly important in organizations where emergency work is not routine.
2. Specify clearly who has authority and responsibility for each task. The specification of the authority hierarchy within and among tasks can help prevent unnecessary disputes during an actual emergency. During an emergency, authority (in most organizations) shifts from that of routine operations. For example, the person who is routinely in charge of a scientific research organization may not be the person in charge of issuing volcano warnings when threat is detected.
3. If multiple tasks and authorities exist within the organization, it is helpful to identify the relationships between each. It is useful to establish the boundary between activities if they are closely related to each other. For example, if one group is responsible for preparing the content of a warning message and another for approving it, it would be desirable to understand the formats for each job to avoid duplication and conflict.
4. When time and resources can act as constraints, designate emergency priorities in the warning plan. The effectiveness of the organization can suffer if this is not addressed in plans.
5. Examine the similarities and differences between normal work tasks and emergency work functions. In general, the less the members of an organization have to change from their normal routine to do emergency work, the more effective they will be in an emergency. Organizations whose daily operational routines can be used in the emergency do better than organizations that must adopt new ways to do work that are unique to the emergency. For example, if the person in charge of press releases normally expects a secretary to do the typing and a secretary will not be provided during an emergency, that person may experience problems in issuing the press release. Mobilization is quicker and less problematic for organizations whose normal duties resemble emergency duties. Disaster experience and training both help remove this constraint since they make unique emergency duties more familiar to workers.
6. Emphasize the importance of the organization's role in the warning system. The people who perform warning roles in organizations should view their responsibilities as important to the overall objectives of the emergency response effort. Otherwise, the performance of warning responsibilities can be seriously undermined. When responsibilities are taken seriously, work group cohesion and work effectiveness is enhanced. Likewise, people should believe it is important to perform their warning responsibilities because the hazard threat will, in fact, materialize. If people do not believe that the disaster will occur or believe an alert is a false alarm, they are less likely to act.

7. Ensure that roles and tasks are well known and understood. Little is accomplished in developing a plan if people do not know or understand their own responsibilities and those of others before the warning is needed.
8. Open communication channels from a physical as well as a cognitive perspective. If people who need to communicate in an emergency do not normally do so, it is helpful to use exercises or other means to let them communicate before an actual warning situation exists. Isolated people and organizations that receive little or late information also are less likely to get information and pass it along to others.
9. Document what decisions will be made by the organization, who will make them, and how and when they will be made. This type of planning can help avoid surprises and eliminate poor decisions in the emergency.
10. Provide warning organizations with adequate resources (people and hardware) to do the job. While organizations are usually adaptive in obtaining resources, pre-emergency agreements to assure adequacy are desirable.

4.2.1 Dealing with Other Organizations

A second focus of research has been to explore why organizations are or are not effective in dealing with other organizations in emergencies. These findings are useful for understanding warning systems, since one system is typically comprised of many organizations (see Sect. 2).

An overriding conclusion of research is that coordination between organizations is essential. Commonly, the finding is that coordination is poor. Research documents many useful factors that help achieve coordination between organizations. Many of the factors facilitating interorganization coordination are the same as those discussed in the last section:

1. Understand the roles and responsibilities of other warning system organizations. This understanding helps an individual organization do a better job and increases the effectiveness of the entire warning system. Shared knowledge about responsibilities increases coordination between organizations. In addition, if everyone who has a warning system job is aware of the duties of others, more people will understand the boundaries of their work and how all parts of the system fit together.
2. Establish clear lines of authority between organizations with related jobs in the warning system. Clear authority lines between organizations help to expedite decision making, avoid conflict between organizations, and facilitate interaction between organizations in the system. When authority is unclear, competition for authority can focus attention away from emergency responsibilities.

These first two factors help to define and legitimate the range of related warning system jobs across organizations. When these two steps are carried out, all involved organizations are seen as legitimate and important parts of the system by all other organizations. Such a viewpoint facilitates coordination between organizations and enhances system effectiveness. If an organization is not viewed as legitimate, it can be excluded from communications even if it has an important responsibility.

There are six other factors in effective interorganizational coordination:

3. Establish agreements regarding priorities. In some cases, priorities between organizations may differ from those within organizations. If so, potential conflicts need to be understood and avoided.
4. Limit the number of organizations involved in the warning system. This is sometimes difficult to accomplish because warning systems tend to involve many organizations almost by definition, but a multitude of organizations cannot be easily coordinated. The number of organizations that can readily be coordinated increases with the availability of resources, and especially communications equipment. Also, it is usually easier to coordinate local organizations with each other than with those from outside the area since local groups are more likely to interact with each other during routine operations. Often, outside organizations on the scene some time after the onset of the disaster create conflict and uncertainty.
5. Identify where compatibility and cooperativeness with other organizations exists and where it is a problem. Where problems do exist (e.g., disputes between city and county fire departments), it may be possible to eliminate or reduce the impact on a warning system. If problems cannot be eliminated, their recognition may be helpful in dealing with disputes in an emergency.
6. Establish system oversight. An interorganizational panel, board, or committee is often useful for this purpose. Representation in that oversight organization increases an individual organization's effectiveness through enhanced coordination.
7. Establish efficient communication between organizations in a warning system. Communication between member organizations is critical because a warning system is a communication system. Efficient communication depends on resources and pre-emergency patterns. Organizations are more likely to communicate during an emergency if they do so routinely. When routine communications do not exist between organizations, drills to exercise the warning system may be particularly useful.
8. Be aware that organizations can resist giving up autonomy to participate in an emergency warning system because some command and control comes from outside the organization. This can be a major constraint to system coordination. Participating organizations need to be convinced that some loss of autonomy is worth experiencing in exchange for an effective warning system.

4.2.3 Integrating the Warning System

Ultimately one organization or person is in charge of a warning system. The goal of this entity is to make sure that the entire warning system functions effectively. This requires some degree of integration among the many different parts of the system. Several activities facilitate integration.

1. The lead warning agency should make sure that the expectations about the responsibilities of all participating organizations are known and shared. If participants have different perceptions of what others do or are responsible for, gaps in the warning process may occur ("I thought they were going to do it"). In addition, the lead agency has the responsibility for making sure each organization accepts the responsibility of all other participants in the system and resolving problems if they occur.

2. The lead agency should estimate the resources needed for implementing a warning and assess and inventory what resources are and are not available. When deficiencies exist, linkages should be established to share resources or a plan should be developed to obtain permanent or emergency resources.
3. The lead agency should assume responsibility for developing smooth-running relationships between all organizations in the system. This may involve cataloging which personnel in each organization to interact with or deciding who will be sent to serve on an advisory or oversight group. The lead agency should also make sure that the structure of authority in an emergency is comparable to existing relationships. If organizations do not interact, the lead agency needs to increase interaction and make sure that interaction benefits each organization involved. Communication should be clear and open. Situations in which one organization uses the warning system to achieve other goals must be avoided.

4.2.4 Maintenance of Flexibility

A major problem facing many warning systems is maintaining vigilance and flexibility over time. Watchfulness lags because warnings are often not needed for long periods of time. Agreements or plans grow old and are forgotten. Furthermore, flexibility is threatened by overly rigid rules and procedures, particularly when the rationale for the procedure is forgotten.

It is important for organizations to develop rules and procedures that are general enough to adapt to unforeseeable emergency conditions and contingencies. Overly detailed plans are not desirable; instead, plans should reflect principles for response. This is not to say that certain standard procedures or details outlined earlier are not warranted.

A key to maintaining flexibility is to conceptualize warning as a planning process instead of the preparation of a document or a plan. Frequent testing and updating of the system will help maintain knowledge useful for adaptive warning response. The research literature firmly supports the idea that organizations that are better able to vary from standard operating procedures during the disaster are typically more effective than those that cannot be flexible.

4.3 CONCLUSIONS

Emergency planning for warning systems is not always necessary for warnings to be successful. History is riddled with examples of very effective public warnings in communities without warning system preparedness. Unfortunately, history catalogs other cases where warning systems failed or suffered from organizational flaws in organizational procedures and equipment. Planning increases the odds that warning systems will be effective when they are needed. Effective warning systems require that planners seek to achieve two goals.

First, planners should do all they can to minimize the natural tendency for organizational dilemmas to plague warning systems. Warning system actors should be as free as possible from problems of interpretating risk, hazard, their role in the system, authority, and relevant versus nonrelevant information. Communication problems such as who and how to notify should be removed. In addition, happenstance perceptual dilemmas based on personality quirks, perceived fears and apprehensions, and experience should be addressed and removed through organizational aspects of planning.

Second, those responsible for warning systems should clearly recognize and incorporate both the organizational and interorganizational character of warning systems and preparedness. It must be clear who does what when; and those persons or groups must have the ability and authority to do it. These actors, and the organizations they represent, must be integrated as part of an interorganizational system. The timely and open exchange of clear information must be facilitated. Finally, people must be well trained, but the plan must provide for on-the-spot flexibility in order to adapt to unanticipated circumstances.

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