Chapter 6

Warning Dissemination & Notification

The activities that define a multi-hazard early warning system (EWS), from the collection of data to the decision to warn to actions taken by constituents, will only protect the people within a forecast center's area of responsibility (AOR) if individuals and groups receive the warning message in a timely fashion, understand its meaning, and take appropriate action. The initial link in the end-to-end EWS chain — earth data observations — often requires partnerships between a warning center and international community members to access global observation networks as in the CAFFG approach discussed in Chapter 5. Similarly, the dissemination and notification link requires partnerships between the center and many national and local groups and individuals within its AOR. Thus, not only are incoming data collection communication systems crucial to the success of the warning system, so is the outgoing communication of critical information to those affected by an event. The perfect warning is of no use unless proper life saving and property mitigation actions are taken quickly enough to be effective.

What Is in this Chapter?

This chapter first provides a description of a flash flood warning program based on the multi-tiered Ready, Set, Go product suite that has proven effective in the United States. The chapter then discusses the distinctions between dissemination — the process of physically delivering the message to customers within a center's AO — and notification, — the understanding of the message by its recipients. The chapter also describes how outreach and education should focus on methods that increase the likelihood that customers will take appropriate actions. It ends with a discussion of what a NMHS should consider when establishing a research and development program. This chapter should be read by persons who need to understand the importance of consistent, easy-to-understand warning products, the difference between dissemination and notification, and what an NMHS Center needs to do to issue warnings that successfully trigger the proper actions by constituents.

The chapter contains sections discussing:

- **Warnings and other flash flood products** – the Ready, Set, Go concept
- **Dissemination** – physically delivering a warning message to constituents
- **Notification** – the understanding of the received message by the target audience and the initiation of appropriate actions by those at risk
- **Research and Development** – developing new methods and products

Warnings and Other Flash Flood Products

Once a flash flood has been detected or it has been determined that one has a reasonable likelihood of occurring and a decision has been made on its potential impact on a center's AOR, information must be provided to government agencies, the media, the public, and other persons and groups that will be affected by the event. Information, especially that contained in life-saving warning messages, will have a much better chance of being understood if it is conveyed in concise, easy-to-understand language, in a predictable (and hence familiar) format. Based upon many years of experience numerous NMHSs have settled on several standardized products with somewhat standardized structure and content. These products issued by an NMHS are crucial to the success of that center's end-to-end system. If the information that the products contain is not understood then it is less likely that the proper actions will be taken by recipients.

Multi-tiered, "Ready, Set, Go" Concept

Many NMHSs issue products using a three-tiered, "Ready, Set, Go" concept to convey the severity and timing of a forecast hazard and the level of forecaster confidence. This concept is reflected in the following four hydrologic product categories and applies to virtually all hazards:

- **The hydrologic outlook ("Ready")** – used to indicate that a hazardous flooding event **may develop**. It is intended to provide information to those who need considerable lead time (days) to prepare for an event. It is generally issued as a plain language narrative
- **The flash flood watch ("Set")** – used when the expectation of a flood event **has increased, but its occurrence, location, and/or timing is still uncertain**. It is intended to provide enough lead time (hours) so those who need to set their mitigation plans in motion can do so
- **Flash flood warnings ("Go")** – issued without regard to time frame, whenever an event **is occurring, imminent, or has a very high probability of occurrence**
- **Flash flood statements** – various advisories and update information issued as needed to **cancel, expire, extend, or continue** a Flash flood warning

Tip

A center should strive to issue products in the Outlook → Watch → Warning/advisory sequence as the confidence increases that a flood event will occur.

Appendix E contains examples of outlook, watch, warning, and flash flood statements that follow the above Ready, Set, Go formula. The examples are based on content and formats that have been found to be effective in the U.S. They are examples of one approach to establishing a warning product suite. Each NMHS must assess what works best for the culture and other unique aspects of that center's constituent base.

Uncertainty in Issuing Warnings

There can be a significant amount of uncertainty in issuing warnings. Uncertainty in estimation of rainfall (QPE) is the greatest contribution of error and can be 500% under or over actual rainfall when estimated from satellites, especially at small scales (less than 100 km^2). Radar is much more accurate, but biases can distort rainfall estimation at the 1-2 km resolution. Rain gauges are accurate, but do not sufficiently capture situations where spatial variability of precipitation is high. This is especially true during convective situations. In addition to rainfall estimation, model uncertainty from sources like estimation of soil moisture can produce runoff errors. There is always a balance between providing a forecast or warning with lead time versus obtaining accuracy so that the warning is credible. The more lead time involved in a warning the less accuracy in the forecast. Warnings must have credibility so that users believe the forecast and take action to reduce losses. On the other hand, delaying the issuance of a warning can result in catastrophic losses. Emergency management officials often prefer over-warning because of the uncertainty involved at the scales warnings are issued, and the risk of experiencing large loss of life and property through under-warning.

Important Points to Remember about Warnings and other Products

- Many NMHSs issue products using a three-tiered, "Ready, Set, Go" concept to convey the severity and timing of a forecast hazard and the level of forecaster confidence.
- Hydrologic Outlook products give users lead time to consider response options and execute mitigation activities, thus helping to protect life and property.
- Flash Flood Watches are issued when the expectation of a flood event has increased, but its occurrence, location, and/or timing is still uncertain.
- Flash Flood Warnings are issued when flooding is occurring, imminent, or likely. This product should be reserved for those short-term events which require immediate action to protect life and property.
- Flash Flood Statements provide supplemental information on active flash flood warning products, such as updated observations, impact information, and cancellations.

Dissemination

Dissemination refers to an NMHS physically delivering a message to its customers. This is in contrast to *notification*, which is the understanding of the received message and, through prior outreach and education, customers taking appropriate actions. Warnings for events that are seconds, minutes, or hours away need to be disseminated rapidly through special warning systems using messages that have been designed during calmer times. These messages should be crafted in such a way that they encourage desired behaviors. They may be for hazards that people can clearly perceive, such as a hurricane, or they may be for hazards that cannot be

perceived without specialized equipment. In these latter cases, it is critical that the warning system and its operators have a high level of credibility so that people feel compelled to take action based solely on the warning message. For instance, some important characteristics of warning programs in the United States (Partnership for Public Warning Report 2002) include:

- **Warnings are primarily a local government responsibility.** Disasters are local, and local government in the United States has the primary responsibility to look after the welfare of its citizens according to laws and legislation. Thus local government has the primary legal responsibility and authority to warn its citizens and help them to prepare for, respond to, and recover from disasters. However, it is beyond the capability or capacity of local governments to see that a unified, multi-channel, nationally standardized system is available to them for delivering warnings to their citizens. This is the responsibility of the national government.

- **Most warnings originate from government organizations.** Some state and many federal agencies develop warnings after extensive research and through specialized instrument or intelligence networks. In these cases, warnings are often issued by federal agencies, but usually in close cooperation with state and local emergency managers. For example:

  – National meteorological services issue warnings of severe weather and flooding focused on specific localities throughout their countries and have done so for many years

  – National meteorological services or other national government agencies issue warnings of earthquakes, tsunamis, volcanic eruptions, and landslides

  Most public disaster warnings are issued by government agencies because, in the absence of clear standards of best practices, private organizations could incur significant liability. Many private organizations do issue warnings — for example for weather — but these are usually covered by contracts that limit liability. Media weathermen may refine local warnings for their community but must remain mindful of standards of best practice.

- **Warning systems require a national partnership between government and industry.** Mass warning devices such as sirens are typically owned and operated by local governments or managers of critical private facilities. Warnings can be issued through telephones, pagers, computers, and many other personal communications devices, both wired and unwired. Thus, most personal warning delivery systems need government input, but are manufactured, owned, and operated by private industry and individuals. The government cannot afford to provide the devices that reach every person at risk (although some communities assume this responsibility). Industry can and will provide such devices or include this capability in many types of devices sold primarily for other purposes if there are clear national standards that create a national market. There must be an effective public-private partnership between government and industry to deliver warnings.

Tip

The MEDIA play a crucial role in an effective warning dissemination system.

As pointed out by Samarajiva (2005), the private sector offers complementary resources and necessary infrastructure such as telecommunications networks that are needed for disseminating warnings. The use of already-existing capacities is not only cost-effective, but ensures the continuity and maintenance of the system during periods where there are no hazard events. The cost to the government of implementing a nationwide warning system is significantly less when all stakeholders share the costs for maintenance, management, and service.

Successful partnerships can be fostered by identifying the key beneficiaries of a warning system, such as the hotel industry and the insurance industry, in addition to the general public. The government can work with such partners in developing and implementing a warning system. The government can provide authority for the system, while the private and civil society sectors provide the mechanisms to get the warning out as fast as possible to all the potentially affected people. There is also an ongoing role that the private sector, especially the media, can play in raising education and awareness. The tasks of education and trust-building at the community level are often best done by organizations like the International Red Cross, television channels, and newspaper environmental reporters.

Authority is something that has to come from the government. The government must take the ultimate responsibility for the issuance of a warning. Government must have legal warning responsibility in its laws to issue warnings. People need assurance that a warning message is legitimate before making the sudden decision to abandon their possessions and evacuate the area. They cannot afford to waste precious minutes verifying warning messages to ensure that they are making the right decision.

Warning Message Timing

False alarms cost money, breed cynicism, and undermine the credibility of the warning organization but are generally much less costly than an unwarned event. Centers should be prepared to disseminate some warnings even if there is a high level of uncertainty about the threat because the information needed to reduce that uncertainty might arrive only shortly before the incident occurs. In such cases, casualties could occur because an official warning could not be received and acted upon in time by all of those at risk.

Authorities must not withhold information because of concerns for public panic (which is commonly anticipated by authorities but almost never occurs). If authorities do not provide information, people will seek it from other — usually less reliable — sources.

Repeating warning messages at regular intervals can ensure that those who missed an earlier warning have another chance to receive it, and those who ignored an earlier warning will have another opportunity to respond. Repetition also provides those who did not understand an earlier warning another opportunity to comprehend it and those who did not believe an earlier warning another opportunity to reconsider. However, recent studies (Ding 2009) have shown that continued receipt of a warning message can also have negative effects. If a warning continues for too long and too regularly, rather than increasing a person's awareness of it, the person actually becomes accustomed to it and less aware, and then begins to ignore it.

Therefore, when issuing warnings to the public, if authorities want to issue the warning repeatedly to ensure they reach those who may not have heard the warning before or to indicate the severity of a threat, they should issue the warnings at different time intervals to achieve an effective stimulation each time.

Equally important, information must be updated quickly when conditions change significantly so that people can adapt their responses to the new situation.

Bulletin Dissemination

Each center needs to inventory all international, national, and local government agencies and media that require timely receipt of its warning messages. Recipients and communication methods should be identified, established, and tested on a routine basis. Dissemination processes should not be manual; they should be automated as much as possible in order to improve efficiency and decrease the time required to issue warnings. Automation also decreases elements of human error. Whenever possible, centers should use redundant communication paths to ensure both the receipt of critical data to the center and the dissemination of important bulletins to its audiences.

The center should establish protocols for acquiring information in a timely manner and for seamless transfer of information and data between agencies. This ensures the warning system is both efficient and effective. Interagency coordination, operations, and policy issues must be addressed by the NMHS. These include, but are not limited to:

- Developing a "Matrix of Roles and Responsibilities for Key Agencies" supporting the center
- Solidifying political commitment regarding interagency coordination to improve data sharing and agency support to the center
- Allocating sufficient personnel to develop and sustain the center's early warning system
- Avoiding duplication by delineating clear lines of agency support. A Memorandum of Understanding (MOU) between pertinent organizations is useful in delineating roles and responsibilities. An overview of guidelines for preparing a successful MOU can be found at: **http://www.nws.noaa.gov/cfo/budget_execution_accountability/agreeover.htm** and also in Chapter 5 of the U.S. NWS Manual 10-942.

To meet international standards, at a minimum the following national and local dissemination channels should be used to disseminate bulletins:

- GTS (Global Telecommunications System of the World Meteorological Organization)
- Internet (frame relay)
- E-mail
- Telefax
- Internet websites

The following multi-hazard communications systems are operating internationally and are also available for use by countries:

- EMWIN (Emergency Managers Weather Information Network)
- RANET (Radio and Internet for the Communication of Hydrometeorological and Climate-related Information)
- GEONETCast (global network of satellite-based data dissemination systems)

Figure 6.1 Flash flooding of the Urubamba River through Aguas Calientes, Peru

Warning centers have found that it is important to limit the number of primary dissemination channels and to steer customers to those channels. As discussed in Chapter 3, the WMO Global Telecommunications Service is the backbone of the international hydrometeorological data dissemination system, but telefax and email are also widely utilized. GEONETCast, a developing global multi-hazard dissemination system within the Global Earth Observation System of Systems (GEOSS), shows promise as a reliable primary dissemination method for routine products and warning messages.

Tip

Warning centers should strive to limit dissemination channels to a manageable number.

NMHSs should also strive to establish ways to confirm that both automatic and manual watch, warning, advisory, and test messages are received by responsible national, regional, and local government agencies. Dissemination techniques need to take advantage of new communications technologies, including cell phone text messaging via Short Messaging Service (SMS), syndicated news feeds via Really Simple Syndication (RSS), Extensible Markup Language (XML), and Enhanced Multilevel Precedence and Pre-emption Services (EMLPP).

Warning Receivers

Ideally, warning message electronic receivers should be part of appliances used on a daily basis, or they will be stored away and forgotten by the public. Hopefully warning capabilities will be found in commonly used appliances such as radios, cell phones, and telephones in the near future.

- Receivers must take into account the fact that many people are not adept in the use of advanced technology

- Warning alerts must be distinct, attention grabbing, and not appear to be another common occurrence. Ideally the alert will provide an indication of the hazard threat level
- Receivers should provide individuals with the opportunity to test the system themselves; for example, calling a 1-800 number which sends an alert message only to their receiver

Warning System Reliability

Even the most carefully designed warning system requires continual maintenance to ensure that it will be effective. Critical phases of maintenance include training, evaluation, and development (as discussed in the section on maintenance requirements in Chapter 4). Core elements must be used every day, with regular testing by the end user.

Important Points to Remember about Dissemination

- The media play a crucial role in the distribution of warning messages.
- The dissemination processes should be automated as much as possible to decrease the time required to issue warnings.
- Dissemination techniques should take advantage of new communications technology.
- Centers have found that it is important to limit the number of primary dissemination channels and to steer customers to those channels if they are readily available at that customer's location.
- Repeated warning messages ensure those who missed an earlier warning message will have another chance to receive it, and those who ignored an earlier warning message will have another opportunity to respond.
- The WMO GTS is the backbone of the international dissemination of hydrometeorological data products and watch, warning, and advisory messages, and is both point-to-point and point-to-multi-point.
- Secondary and complementary communications systems, such as the satellite-based GEONETCast, EMWIN, and RANET broadcasts should be established as backup dissemination channels, although in some developing countries, these may be primary means for receipt of warning messages.
- Telefax and email are also widely utilized.

Notification

Notification encompasses the understanding of the received message by the target audience and the initiation of appropriate actions by those at risk. In many ways notification is more difficult than dissemination, the latter simply being the act of physically delivering the message to stakeholders.

As noted in the Partnership for Public Warning Report (2002):

- **Warnings seek action.** A warning system is an organized process for detecting a hazard and rapidly disseminating information about the threat and about appropriate protective actions. An effective warning system is one that causes the maximum appropriate protective actions to be taken for a given commitment of resources because it has been designed to be compatible with the context in which it operates. Understanding this context requires knowledge of the other participants in the warning system for a given hazard, the other types of hazards faced by those participants, and the warning systems that are currently in use for those other hazards.

  Tip

  The primary goal of a warning system is to prevent hazards from becoming disasters.

  - The warning process consists of people with information communicating with people at risk, intermediaries, and emergency responders in advance of or during a hazardous event with the intent that those at risk will take appropriate action to reduce casualties and losses.
  - The success of a warning is measured by what actions people take. A warning might recommend immediate action or it might simply encourage people to seek more information.
- **Many people are involved in the warning process.** Warnings must be received and understood by a complex target audience including the general public, institutional decision makers (in business, state and local government, and NGOs), and emergency responders (firefighters, law enforcement officers, paramedics, public health workers, and emergency managers).

The news media and the emergency management community frequently act as intermediaries between those issuing warnings and households or other information end users. These intermediaries—together with independent experts in university research institutes, national laboratories, and other agencies—often independently evaluate the information disseminated by the forecast center to determine if it is accurate, internally consistent, consistent with other sources' messages, complete, specific, timely, relevant, and important. If a warning is judged to be inadequate in any of these respects, it may be challenged, supplemented with additional information, or ignored by these intermediaries. This is not necessarily a desirable outcome, but is one that the forecast center must be prepared to address.

Moreover, end users evaluate the warnings they receive from all sources in terms of their prior knowledge about the hazard and the recommended response actions. End users also evaluate the warnings they receive about any given hazard in terms of their knowledge about other safety and health hazards and recommended actions for those other hazards. It is also important to remember that "the general public" is not a homogenous group since it involves:

- Decision makers at all levels in the community
- People with many different levels of education
- People with many different levels of financial ability and responsibility
- People of different races and beliefs
- People with many different primary languages
- People with widely varying experience with the hazard
- People with varying levels of physical ability

It is critically important for centers to test their message dissemination communication channels frequently and identify dissemination problems so the warning messages reach end users when a real event occurs.

Warning Delivery System Design

NMHSs should not assume that there will be immediate reception of a warning, unlimited attention to the warning message, perfect comprehension of message content based upon accurate prior knowledge about the threat, and perfect compliance with the recommended actions. It is possible that all, some, or none of these conditions will occur, even though reception, attention, comprehension, and personalization increase when there is an imminent threat. Consequently, warning systems and warning strategies must be carefully designed to make it more likely that warnings will be as effective as possible. Effective warning system design consists of four main steps:

1. Define the desired message effects, especially the behavioral objectives of the system. What actions do authorities want end users to take?
2. Identify any distinctively different segments of the target population. How do people differ in terms of their abilities to receive a warning, attend to it, comprehend its content, personalize the threat, choose an appropriate protective action, and implement that protective action?
3. Identify the channels through which warning messages will be transmitted. What technologies and what intermediate sources are needed?
4. Define who the public's direct message sources will be (the intermediaries) and develop their perceived credibility by taking steps to ensure their expertise and trustworthiness.

Warning Channels

As noted in the section on dissemination, centers should identify all the communications channels to which different segments of the population have access. It is especially important to identify the channels that people monitor routinely, as well as those that can reach people rapidly during emergencies. Use multiple methods and channels to disseminate messages. These include print and electronic media, the internet, and even face-to-face presentations from credible original and intermediate sources. Encourage people to tune in to reliable sources of local broadcast news.

Warning Message Content

NMHSs should be as specific as possible about the nature of the threat, the anticipated impact location, and the expected time of impact. Decision makers in business, government, and NGOs need to have as much information as possible so they can weigh the consequences of alternative actions (including inaction) before expending significant resources on protective measures.

Recommend one or more specific protective actions. One of the major incentives is protection of persons and property from the hazard. Determine how to describe the hazard so that the message generates a high level of protection motivation. Explain to those who are *not* at risk why they are not believed to be at risk and why they do not need to take protective action. Use terminology in warning messages that is consistent across time for a given hazard and, to the extent possible, compatible with the terminology that is used for other hazards. Let people know when the threat has ended so they can resume normal activities as soon as possible. As much as is practical, NMHSs should create standard forms for text messages and oral messages and store them for use during future events. The U.S. examples provided in Appendix D can serve as a starting point for international NMHS efforts at designing pre-formatted messages.

Tip

Create standard forms for text messages and oral messages for use in times of emergency.

Warning Sources

Centers must recognize that no single source has complete credibility regarding all aspects of the threat and protective actions. Federal, state, and local government agencies vary in their credibility, as do news media, business, and NGOs. Identify in advance which organizations (and individuals within those organizations) will be responsible for communicating with those at risk, as well as with other population segments that are not at risk. Identify procedures by which information from different sources can be combined to ensure that all messages are consistent and that, all official sources' messages are accurate, complete, specific, timely, relevant, and clear.

Tip

Develop and utilize trusted media personalities who the public know and respect.

Recognize that source credibility can be established initially by credentials such as agency mission and educational degrees, but is enhanced by preparing objective (transparent) procedures in advance rather than improvising during an incident, by obtaining endorsement by external experts (peer review), and by establishing a satisfactory record of performance over time. Users' confidence is based on past performance and experience. Build credibility and understanding that the warnings are based on the best available professional practice. NMHS's must educate users that there are uncertainties in forecasts and warnings that must be incorporated into the decision making process. Develop credible, articulate authorities to use consistently as intermediaries or as endorsers.

Warning System Context

Authorities who are responsible for warning frequently think only of disseminating threat information to the general public, but it is important to recognize that the target audience is much more complex than this. Centers need to recognize that "the public" is not a homogeneous entity. Households, businesses, government agencies, and NGOs vary in size, demographic composition, geographic location, and economic resources.

Chapter 7 will provide Centers with some ideas on how to identify the ways in which population segments differ in their perceptions of the credibility of different sources, their access to different warning channels, their reactions to warning message content, and the incentives, disincentives, and constraints they are likely to experience in attempting to take protective actions.

Important Points to Remember about Notification

- An effective warning system is one that causes the maximum appropriate protective actions to be taken.
- The news media and the emergency management community frequently act as intermediaries between the center issuing warnings and a complex target audience that includes the general public, institutional decision makers, and emergency responders.
- NMHSs should create standard forms for text messages and oral messages and store them for use during events.

Research and Development

An NMHS can function acceptably without a rigorous research and development program. The center can rely on improvements and new techniques developed at other centers and at academic and government research institutions. However, a center can often better address its own unique local problems by performing its own research and development on such things as improving warning dissemination and notification and applied science. Additionally, a local research and development program creates an atmosphere of progress within an NMHS center. A mix of meteorologists, hydrologists, computer programmers, and networking/communications experts is optimal as it gives the center the skills needed to address research and development in all three of the broad categories of applied research and program development:

- **Science:** Applied meteorological and hydrological research that leads to better models of precipitation intensity and amount, etc. The field of probabilistic forecasting also falls in this category. At present the accuracy of flash flood forecasts and warnings is not very good at small scales of time and space (less than 300 km^2). This is primarily due to data limitations. Radar is the best tool but even radar has significant data accuracy limitations at these scales.
- **Processing:** Development of computer methods for speeding the processing and collection of earth observation data, disseminating products and new technologies, and programs that assist forecasters in maintaining situational awareness.
- **Social science:** Development of education programs, warning messages, and other communications that produce the desired reactions by constituents.

Tip

A center's own local research and development program can often best address local problems.

In additional to building a multi-disciplinary staff, warning centers are urged to establish and exercise strong links with academic institutions and other professional research centers. These links often lead to advances in procedures and help the center remain on the cutting edge of new technology and techniques. Collaborative ties can be established at nearby or co-located institutions, by staff who are alumni, or through contacts made at meetings and workshops.

Experimental Products

The four basic standard products (warning, watch, advisory, and statement) may not meet all the needs of an NMHS center. For example, a center may need to develop or modify a specialized product to meet the needs of one or more of the customers it serves. Similarly, NMHSs may contemplate providing a new service or changing an existing one. In all these cases the warning center should establish and follow an *a priori* process that has been thought through and discussed with the center's customer base well before the change process begins. Such an approach will help the center avoid many of the pitfalls associated with making changes.

A new or changed product or service begins as a concept that is then developed into a proposal. Once the proposal has been articulated, but before development begins, the warning center should ensure that implementing the new or changed product or service would be acting in a fair and evenhanded manner with respect to all stakeholders and is accomplished in a manner that maximizes fairness and openness. Figure 6.2 describes the process to follow in developing and implementing a new or enhanced product or service. Products and services in this process can be national or local in scope. The six guiding principles outlined below should be followed when considering whether a new product or service or change to an existing product or service can or should be made.

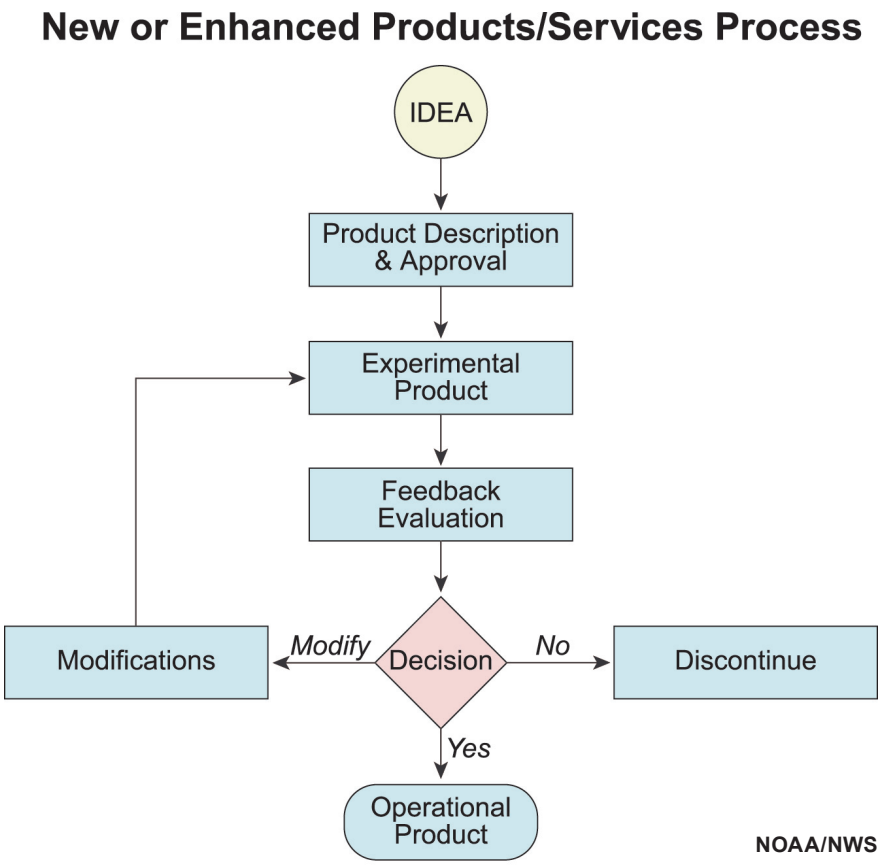

Figure 6.2 Steps to implementing an experimental product

Six guiding principles when considering beginning or changing an existing product or service:

1. **Mission connection** – The product or service must be connected to the center's mission.
2. **Life and property first** – Protection of life and property must be placed first in the allocation of resources and the development and dissemination of products and services.
3. **No surprises** – All users, including those in the private sector, must be provided adequate notice and opportunity for input into decisions regarding the development and dissemination of products and services.
4. **The stakeholders own the data** – Open and unrestricted dissemination of publicly funded information is good policy and may be the law. The World Meteorological organization specifies that countries should share hydrometeorological data to assure this information is available for forecasts and warnings to save lives (Resolutions 40(Cg-XII) and 25 (Cg-XIII).
5. **Equity** – All dealings with various constituents must be equitable and not show favoritism to particular partners, particularly those in the academic and commercial sectors. A service to a segment of the user community should not be provided that cannot be provided to all similar types of users. For example, if agricultural forecasts are offered to one segment of growers, they should be available to all similar segments of growers.
6. **Maintain and explain the routine products** – When faced with requests for specifically tailored services, make sure the user fully understands the products which the center "routinely" provides.

Important Points to Remember about Research and Development Programs

- Applied research and program development activities at NMHSs generally fall into three broad categories: geophysical science, processing, and social science.
- A warning center's research and development program creates an atmosphere of progress.
- Collaboration with other institutions helps a center remain on the cutting edge of new technology and techniques.
- A new product should pass a rigorous testing program before becoming operational.

References

Samarajiva, R. 2005: National Early Warning System: Sri Lanka (NEWS:SL). A Participatory Concept Paper for the Design of an Effective All-Hazard Public Warning System (Version 2.1) LIRNE*asia,* Sri Lanka. Available at: http://www.lirneasia.net/2005/03/national-early-warning-system/

Partnership for Public Warning (2002). Developing A Unified All-Hazard Public Warning System, Report by The Workshop on Effective Hazard Warnings, Emmitsburg, Maryland November 25, 2002. McLean, VA. At: http://www.ppw.us/ppw/docarchive.html

Partnership for Public Warning (2003). A National Strategy for Integrated Public Warning Policy and Capability. McLean, VA. At: http://www.partnershipforpublicwarning.org/ppw/docs/nationalstrategy.pdf

Wogalter, M. and David M. DeJoy, Kenneth R. Laughery 1999: Warnings and risk communication. Taylor & Francis. 365 pp. ISBN: 0-7484-0266-7

Ding, A.W. 2009: Social Computing in Homeland Security: Disaster Promulgation and Response. Information Science Reference. 320 pp ISBN 978-1-60566-228-2. At: http://www.igi-global.com/reference/details.asp?ID=33139