# Definitions of Comprehensive Examinations: Depth

**(Approved)**

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## Comprehensive Exam Definitions: Depth

My project, communication-orientation towards an early warning (EW) system, largely concerns the design and implementation of effective EW systems as an important means to reduce disaster losses. According to International Strategy for Disaster Reduction (UN/ISDR), EW is defined as "the provision of timely and effective information, through identified institutions, that allows individuals exposed through a hazard to take action to avoid or reduce their risk and prepare for effective response" (UN/ISDR, 2002). This definition has been promoted worldwide for conceptualizing and designing effective EW systems.

Throughout the 1990's, the improved access and greater effectiveness of EW have been fundamental issues leading to the accomplishment of the IDNDR objective: the reduction of loss of life, damage to property and fragile environment, and social and economic disruption caused by natural disasters, through concerted international action (IDNDR, 1997, p. ii). According to Jeggle (2003), the IDNDR has worked to promote and establish the importance of seeing EW as a process relating activities that involve scientific and technical abilities of hazard identification and forecasting together with effective communications, the commitment of public policy and understanding and active participation of local communities. As a result, a rich body of literature now exists on the topic of EW and a variety of successful local initiatives are in place.

However, there have been some problematic issues related to development of effective EW systems. Firstly, its actual implementations and actions are still very limited, as demonstrated by the papers presented and workshops held at recent conferences organized around themes such as "Research to Action" (World Conference on Disaster Reduction, Kobe, 2005) and "Concept to Action" (EWCIII, Bonn, 2006). Other evidence of this deficiency can be seen from the "Hyogo framework for action" which also emphasizes the importance of implementing early

warning systems "that are people centered … and that support effective operations by disaster managers and other decision makers" (Hyogo Framework, 17 (ii), p.9).
Secondly, until very recently, development of EW systems has continued to lay emphasis on expanding technical capabilities rather than in meeting the needs of actual emergency responders and the public (Hall, 2007). Today, the communication of EW, to at-risk populations, emergency concerned organizations (both governmental and non-governmental) and the general public, has still been the key challenge of EW's effectiveness.

Lastly, current dominating EW models are not yet sufficiently when especially considering the highly complex phenomena of present disasters. As discussed in the breadth reading, it is acknowledged that disasters are social phenomena and closely relate to development and climate change. In developing an effective EW model, it is thus necessary to be orientated towards the integration of disaster reduction, sustainable development and adaptation to climate change.

With respect to the above problematic concerns, my depth reading therefore covers central debates in ways to improve the effectiveness of early warning for natural and similar disasters. Various studies of different perspectives on EW and guiding and framework papers on EW systems in different countries are examined to understand the progress and challenges of this development. However, the literary reviews on the social science of public warnings are more focused in this research. The critical themes include early warning as an integrated system, early warning capability, last-mile early warning network, warning dissemination and communication network, and the role of media in public warning.

**Early warning as an integrated system**

This approach primarily holds that a warning system involves the installation of a range of instruments and technologies to enable early detection and monitoring of hazards, scientific and organizational programs for analyzing the collected data to determine the extent of associated risk exposure, probable impacts, and processes for notifying those at risk in a timely fashion. Therefore, there is the complexity of having various functions and organizational connections involved with an EW system.

Regarding this complexity, Mileti & Peek (2000), focusing on effective operation, offer a well respected functional model of an EW system comprising three basic subsystems: Detection subsystem, Emergency management subsystem and Public response subsystem.

Similarly, according to IDNDR's "Living with risk: a global review of disaster reduction initiatives" (2002, p.261), to serve people effectively, EW must be developed as an integrated system comprising three critical elements: 1) forecast and prediction of impending extreme events, on the basis of scientific knowledge and monitoring results; 2) warning processing and dissemination of information from the first segment, together with information on both the possible impacts on people and infrastructure and appropriate response-oriented recommendation to the political authorities and to the threatened population; 3) reaction to warning, based on a people understanding the information by the population at risk and local authorities and subsequent implementation of protective measures.

However, four years later, the UN's "Global Survey on Early Warning System" (2006) reports that there are many gaps and shortcomings and the world is far from having a global system for all hazards and all communities. The survey states that the experiences of the Indian Ocean tsunami, the hurricanes in the Gulf of Mexico and many other events such as heat waves, droughts, famine, wildfires, floods and mudflows, demonstrate significant inadequacies in existing EW systems. In many cases, especially in developing countries, warning systems lack the basic capacities of equipment, skills and resources. Systems for some hazards, such as tsunamis and landslides, are often absent. The survey finally recommends the need for national effective EW systems which are people-centered and the need to integrate four inter-related elements: 1) risk knowledge, 2) monitoring and warning service, 3) dissemination and communication, and 4) response capability. A weakness or failure in any one part could result in failure of the whole system. In accordance with this recommendation, the report affirms that early warning is not a technical and even less a technological issue, but a human and organizational one.

Another interesting study associated with warning systems in the United States and which emphasized social aspects was conducted by Sorensen (2000). By examining

two decades of research on natural hazards, Sorensen finds that warning systems must be considered as having scientific, managerial, technological and social components that are linked by a variety of communication processes. A breakdown in the process can result in an ineffective warning, even if each individual component is properly performing its internal role, such as monitoring a hazard or making a decision that a threat to the public exists. The overall conclusions in Sorensen's review are that warning systems can reduce death and injuries among at-risk populations, but they have not shown a significant effect on reducing losses to property, infrastructure, and economic disruption (p. 123). This may be a result of an EW system having been designed with a narrow emphasis on short-term effectiveness. Here, we should note that it is critical to shift our emphasis to a long-term dimension of warning to improve forecasting and modeling as a means of enhancing community planning.

The above conceptualizations provide many advantages to developing and implementing effective EW systems in many societies. For example, in doing an assessment of the British Columbia Tsunami Warning System (B.C. TWS), Anderson & Gow (2004) adopted the Mileti & Peek's functional model of warning systems to categorize major elements of the B.C. TWS, and then modified it into a communication-oriented model that portrays the B.C. TWS as a three-stage dissemination network: detection, emergency management and public response. The study shows that an integrated TWS involves a wide range of considerations across all three stages of the dissemination network. According to the research's findings, the best practices in the design of an effective warning system must be based on sociological and operational considerations relating to three factors: individual risk perception, nature of the warning information and social context and personal traits of the recipient.

Then, in developing "B.C. Tsunami Warning Methods: A toolkit for community planning", Anderson (2006) adopted the three-stage dissemination network modified from functional model to clarify the functions of three subsystems of B.C. TWS. Their functions are identified into the particular TWS as: 1) detection subsystem involves "the monitoring and detection of certain seismic events, the anticipation and detection of tsunami generation, the tracking and monitoring of any generated waves, and the forecasting of wave arrival times and heights along the coast;" 2) emergency

management subsystem functions "to determine the extent and magnitude of the tsunami threat to B.C. and assessment of public safety threat, property loss potential, environmental damage potential, and economic loss potential;" and 3) public response subsystem, which emphasizes reaching the last mile, functions "to inform local population of a potential or imminent threat to the area and to initiate and coordinate protective-action response measures, such as evacuation." It must be noted here that Anderson views EW as a system, not simply as a technology, and rather as "a unified system made up of five critical and inter-related elements: 1) hazard identification, risk assessment and vulnerability analysis; 2) detection and monitoring; 3) emergency management structure; 4) local dissemination; and 5) public education." According to this broad view, an effective warning system must provide information about how to prevent and mitigate against disasters and information and knowledge to aid timely response, relief and recovery efforts.

In contemporary developing EW systems, however, some challenges are faced including the need to link extensively the knowledge and information on climate change into the approach of "all hazards". It is also essential to put an emphasis on the long-term dimension of warning as a means to both reduce communities' vulnerability and enhance communities' sustainable development, resilience, and adaptation to climate change. The other significant difficulty, which may be the greatest challenge, in developing an effective EW system, is the subsystem of warning dissemination network (Sorenson, 2000, p.120). While there is considerable progress in knowledge sharing and networking on scientific information for hazards monitoring and forecasting, the effective communication of warning to the population at risk and general public can still be inadequate. This will be discussed more in the particular theme of "warning dissemination and communication network"

**Early warning capability**

With respect to EW capability, it is not enough to have a thoughtful and detailed discussion of EW framed in terms of specific systems and sub-systems. Rather than only emphasizing system, Hall (2007) disputes that we would be better able to envision and discuss EW strategically if it were considered as a capability. He argues that "the word 'early' in EW emphasizes the need to improve and optimize not only

the science and technology, but also the human capability throughout the entire range of interactions that support emergency management" (Hall, 2007, p.33). While there are important benefits to be gained from improving our detection and interpretation systems for natural hazards, these benefits will not be realized unless these systems are fully integrated into the all-hazards emergency management capability.

Based on his strategic viewpoint, Hall (2007) defines EW capability as "the management integration of expert local knowledge with existing specialized systems and process, each of which are separately owned and operated by a variety of service providers" (p. 33). As required, towards achieving a more effective and sustainable capability, emergency management and its stakeholders have an essential role to assess the functionality and integration of these systems and processes for suitability of purpose relative to a specific hazard, and work with the service providers to extend the functionality or improvement of the integration of their systems and processes.

In governing the early warning capability, Hall (2007) emphasizes on the unambiguous communication of roles and responsibilities of five primary participants including emergency managers, scientists, the media, public officials, and the community. With this emphasis, Hall eventually claims the need for emergency managers to assume "the role of 'Champion' and actively lead the dialogue at all levels" in working with the community and other key participants (p.36).

It is generally accepted that the ultimate element in the success of an EW is that people in danger actually receive the warning and then can appropriately respond to make themselves safe. Therefore, developing effective EW capability must include appropriate communication of warnings based on an understanding of communities' perceptions and needs (Twigg, 2003). Moreover, in accordance with the concept of self-determination as discussed in the breadth reading, developing an effective EW system should not only emphasize building the capability of a national network, but rather must shift its emphasis to the community-based, last-mile early warning network's capability.

**Last-mile early warning network**

The impact of an emergency on a community where there has been little or no warning to that community often prompts public criticism and has reinforced the public's perception about the necessity and value of receiving early warning and information communication. In developing effective EW capability, therefore, efforts should place more emphasis on work at the local level on the basis of dialogue with all participants. In other words, community-based approaches should be applied in developing people's capacity to take upon themselves the responsibility of monitoring hazards and issuing warning to save the entire population of their respective communities.

Towards this approach, at-risk communities need to be involved in the design, development and operation of their warning system. This develops confidence in the system, understanding of the roles of various agencies and awareness of how people can assess the information they need. This approach also believes that people can make appropriate decisions and actions if they have adequate information. There are many studies strongly supporting this assumption. For example, Thomson, Jenden and Clay (1998) conducted the study to investigate the dissemination of information on the 1997 El Nino events and their likely impacts on drought in Sub-Saharan Africa. In some African countries, the study finds that farmers had acquired information independently from a variety of sources, including the internet and cable television; they formed their own judgments on the validity of that information; then they made calculated decisions about what types of seed to plant, and when; and they finally acted upon those decisions.

Taking a lesson learned from the disastrous Tsunami 2004 event, Gurstein (2005) finds that "the Net wasn't able (yet?) to bridge the information divides between those who had some idea about what might be coming (the scientists and those immediately impacted) and those who might have been able to make some use of that information in the places where the impact took appreciable time to be realized" (p.14). According to his analysis, the problem was not only a lack of "access" to information but also (or rather) a lack of social infrastructure which can turn Internet access into an "effectively usable" early warning system. This gap has resulted in some degrees of

separation imposed by nationality, language and perhaps most importantly, domains of knowledge and profession, as well as the related lack of social linkages, network based trust relationships, communication pathways, etc., impeding the communication between the two groups (who have the information but couldn't use it and who need the information but are not able to get it in a timely and usable form).

To develop an effective early warning system, Gurstein (2005) therefore suggested that the affected communities and their governments should put more emphasis on developing the "Last Mile Warning System" (LMWS). Being an "effective use" approach, LMWS aims to develop local means for scanning the information universe to find the information concerning possible local threats and then create the social means for linking the knowledge that results from this scanning into local structures that can translate that knowledge into effective uses, such as early warnings, and from there into active disaster response.

There are, however, two critical needs in developing and implementing the LMWS. First is the need to figure out ways of translating the outputs of what are likely to be hi-tech warning systems into messages that can be interpreted and used effectively at the local level (the need for Last-Mile information dissemination strategy). Secondly, it is the need to support the kind of bottom-up, socially-based, local emergency/disaster early warning systems and preparedness that would allow local commitments to absorb and adapt such information into ways that could be locally useful (the need for Last-Mile information system) (Gurstein, 2005).

Correspondingly, the HazInfo project, whose pioneering established last-mile networking capability for 32 tsunami-affected villages in Sri Lanka, finds that the implementation of an effective last mile warning system cannot be dependent upon ICT alone. An effective system must first include development of the necessary human capacity including "HIH-Monitors, ICT Guardians, and ERP Coordinators, along with proper local risk management and public education to supplement the deficiencies of an end-to-end fully-automatic early warning system" (Waidyanatha, Anderson and Gow, 2007, 293).

In summary, last mile, in the context of early warning, is "a 'social mile' and to support or create a process of community development and learning is the most fundamental means for community 'security' and community based ICTs can play a significant enabling role for both of these" (Gurstein, 2005, p.17).

**Warning dissemination and communication network**

Effective warning dissemination and communication is related to three critical factors: 1) who are EWS users or stakeholders, 2) what are appropriate communication methods for them and 3) what are their appropriate response to a warning. Definitely, the first users of an EW system must be at-risk populations or vulnerable sectors of a community of an impending threat since the purpose of EW is to alert them and thus, to bring about an appropriate response that could minimize exposure to hazard. This includes those directly and indirectly affected by the hazard, which could occur sequentially or conjunctively, as well as those who are at risk to the secondary impacts. Some segments of a population require special warnings simply by virtue of their unique character. Gross (2003) states that special populations can be defined in many ways, and they vary according to their level of risk, their particular characteristics or the amount of time they need to respond. According to Gross, these population segments include "those in special facilities such as schools, prisons, old-age homes, hospitals and other institutions are probably not different from the sort provided the general public" (p. 68). Additionally, people who are hearing or sight impaired may require special alert and notification devices to be delivered effective warnings; and people who have mobility disabilities or who do not read or understand the local language have special warning needs. The "Independent Panel Reviewing the Impact of Hurricane Katrina on Communication Networks" (2006), for example, points out that ensuring warning and emergency communication reach Americans with hearing or visual disabilities or who do not speak English was a major challenge.

Besides, as noted earlier, the design of an effective EWS must be orientated towards the integration of disaster reduction, sustainable development, and adaptation to climate change. Therefore, its stakeholders or users would also include wide varieties of governmental and non-governmental organizations associated with all those three

realms of actions. In this regard, media including community, local and national media are also viewed as stakeholders of an EW system.

Stakeholders need to be involved in the development of an effective EWS not only in preparing appropriate response to warning but also in supplying input, sharing information and opinions, to the EWS process (Glantz, 2004). The failure of warning systems caused through stakeholders not supplying any input to the EWS process can be learned from the experience of the 2003 disastrous heat wave in France. In fact, the heat wave in Europe had apparently been forecast by various national meteorological services. Glantz points out that it does appear "no apparent cascade of early warnings was set in motion following the reliable forecast of a protracted high heat period on the continent" (p.29). In France, as early as 9-10 August, informed individuals such as physicians tried to raise the alarm by talking to the media but the reaction of official health and emergency structures was very slow. Moreover, insufficiency in sharing data and information or cross-checking of information among stakeholders resulted in a wrong assessment of situation. For example, on 8 August, the Prefect of Police, Paris, instructed Fire Brigades "not to be alarmist and not to disclose the number of deaths" (Glantz, 2004, p.29). Because a sign of serious emergency of an epidemic nature was not recognized, standard administrative procedures, insufficient procedures to cope with the situation were followed.

With respect to communication methods, multi channels of delivery are needed not only because every technology has its vulnerabilities, but also because people almost always require confirmation of warnings from multiple sources before they act (Botterell & Addams-Moring, 2007). Likewise, Anderson (2006) states that to be effective the EW system should use multiple channels and methods of communication since 'there is no single best method that fits all circumstance." Anderson also points out key factors for consideration before using numerous available methods for delivering public warnings and related information. These factors are critical questions which need to be identified: "who needs to be informed; where they are located; what they are doing; what they rely upon to receive local news and information; what special needs they may have; and how well they understand and accept the warning in order to take action". The combination of communication methods and technologies should be designed and implemented to achieve an overall

capability to meet four key criteria including reliability, coverage, messaging and emergency issues (Anderson, 2006).

Social scientists conceptualize disaster warning systems as a product of social organization rather than simply a technological or mechanical process (Quarantelli & Taylor, 1978; Drabek 1986). Such systems are generally viewed as complex ones of information exchange between and among people at risk and authorities charged with public safety. Attention has been drawn to the elements of warning systems and to the role of the community including their social networks, often in terms of the effect on warning process and warning message (Parker & Handmer, 1998; Drabek, 1986; Perry, 1985).

By measuring the warning dissemination network concerning reach, compliance, and time to respond, Sorensen (2000) finds that up to 50% of initial warning notification can come through informal social networks rather than official channels.
This finding corresponds to Handmer's review (2002) on "Flood warning reviews in North America and Europe" where he notes the importance of understanding links between informal and official networks as a step toward enhancing overall warning system design. Examining the widespread use of unofficial flood warnings networks, Parker & Handmer (1998) find that unofficial warning networks "will attempt to satisfy a variety of needs which are unmet by official systems" (p. 49). Their advantages are, for example, getting the warning to those at risk; increasing the quantity of warning messages being received, reducing the need for confirmation and increasing warning belief; increasing the quality of information received; giving greater local credibility (addresses emotional needs); translating warning message into the vernacular; and delivering the warning message as a dialogue (p. 51). Nevertheless, the study addresses potential problems with unofficial warning networks such as: may promote rumors which may create needless anxiety; those not part of a network or without local network will be missed; may not provide the credibility of an official source (p.51). Due to evidence of no single perfect network, rather than working in competition or serving as alternatives, it is more fruitful to find ways of combining official and unofficial warning systems, taking advantage of the strengths of both to enhance warning capability.

In designing effective warning communication, it should be concerned with not only dissemination methods, but also with the response of agencies and the public in the threatened community to the warning and related information. As mentioned earlier, success in the warning talk is measured not only by the extent to which individuals feel empowered, but also by whether they exercise this to reduce damage and increase their safety. In regard to public response to warnings, the social aspects must then be emphasized in designing and implementing an effective early warning system.

Sorensen (2000) mentions a set of popular myths and perceptions about warnings and public response to warnings which often constrain the effectiveness of warning systems when implemented. The most common myth is that the public panics in response to warnings of impending disasters. Social studies show this is not the case except in situations where there is a closed physical space, an immediate and clear source of death, and where escape routes are available but obviously not accessible to everyone. Second, officials are usually worried about overwhelming people with too much information even though, in fact, the public rarely gets too much emergency information in a warning. Third, officials are concerned with issuing false alarms. Although the repetitive false alarms may decrease response, the likelihood of people responding to a warning is not diminished by what has come to be labeled the "cry-wolf" syndrome if the basis of the false alarm is understood. Fourth, officials think that a single spokesperson is a good practice for disseminating emergency information. On the contrary, people at risk actually need information from a variety of sources, not from one single source. Fifth, officials think people will take action immediately on the receipt of a warning. Most people simply do not take action in response to warning messages as soon as they hear their first warning. Sixth, officials often think that people will follow recommendations made in a warning. Research shows, however, people will not blindly follow instruction in a warning message, unless the basis for the instruction is given in the message, and the basis makes "common sense."

In Gordon's review (2006) on responses to emergencies, the findings highlight that people experience a range of responses built on the basic human mechanisms for survival and are not usually as intense as the stereotypes of 'panic' and 'helplessness'. Reviewing previous studies, Gordon (2006) draws attention to some interesting

findings of these studies. Firstly, warnings of emergency activate arousal and initiate complex social processes, initially strengthening bonds between community members, but they are ineffective without practice and familiarity. Secondly, there is, initially, a tendency to minimize, deny, misinterpret or ignore danger; confirmation is sought from family, friends and neighbors regardless of their expertise rather than from authorities. Thirdly, family and group attempt to reunite and people in groups are more likely to heed warnings. However, peer group interaction may reinforce disbelief. Focusing on demographic factors, older, isolated, inexperienced people and members of minority groups are less likely to heed them than younger people. Lastly, people are most likely to respond to clear, specific, accurate, detailed information from a credible source with clear advice, disseminated by multiple media. Conversely, unclear, generalized or non-specific warnings are likely to be ignored.

The effectiveness of EW highly depends on peoples' perception of the coming danger, level of understanding of the hazard type and acceptance of the warning issued to them. Equally important is the credibility of the agency, whose reliability in alerting the public is measured according to its track record in prediction and warning. Moreover, the usefulness of an EW system is judged not on whether warnings are issued per se, but rather on whether warning facilitates appropriate and timely decision-making by those at risk (Maskrey et al., 1997).

Above reviews demonstrate that we must put more emphasis on the notion of cultural and social study in developing an effective EW system. The diversity of risk perceptions which are likely to vary considerably between different communities, and even within communities, introduces a particular challenge to the delivery of the early warning message over a wide area.

In Delica's review (2003) examining community mobilization for early warning in some communities in the Philippines, the effective warning highly depends on people's perception of the coming danger, level of understanding of the hazard type and acceptance of the warning issued to them. As maintained by Delica (2003), EW system should not be treated separately from disaster preparedness as early warning capability.

In order to meet the needs for those they seek to protect more effectively, an appropriate approach is now needed for developing and improving EW systems. It involves cross-cultural communication between outsiders (disaster professionals) and people at the grass roots, as well as among different involving agencies. Instead of seeing EW as a one-way communication of top-down hierarchical approach where the authorities send information to the affected population, it is necessary to apply a more appropriate approach of two-way communication with much more emphasis on the bottom-up approach to open up the dialogue among all participants, particularly at-risk people. Consistent with this more demand-led approach, communities at risk are seen as active citizens who acquire information from different sources, exercising a right to choose what information to use and where to obtain it (Twigg, 2003, p.25).

**The role of media in public communication of warning**

An effective public warning service is based on before-the-event emergency planning which procedures include cooperation, coordination and partnerships between the government and non-governmental organizations, the media and private sector and all key players in the warning process. The task of the media, including community, local and national media, is in its widest sense the communication of information to the population. Cooperating efforts with community, local and national media outlets can greatly expand an EW capability to reach the public at-large.

The report of the workshop on "Usable Science 8: Early Warning Systems: Do's and Don'ts" summarized by Glantz (2004) affirms the importance that an EW system must partner with the media in a way that is mutually beneficial and for the public good. The report also points out that "there is a need to convince the media of the importance of an EW system, an organization that issues early warning" (p.32). However, such systems are not of great nor urgent interest to the media unless they have identified a "trigger" to a hazard, or are responding to dire warnings of an imminent threat. It should be realized that creeping environmental problems and the long-term dimension of warning do not easily capture the attention of journalists because the day to day changes are imperceptible and less newsworthy when seen by media who seek "news scoops."

Public communication of warning is also associated with the problems of public communication concerning risks originating primarily in the marked differences that exist between two languages which are used to describe our experience with risks: the scientific and statistical language of experts on the one hand and the intuitively grounded language of the public on the other. The report on "Early Warning Systems: Do's and Don'ts" recommends that there is a need for an intermediary to act as a translator of the warning's technical contents and background to the media (Glantz, 2004 p.33). Glantz states that the intermediary would convert technical language into text to which the general public could understand and relate. An intermediary could also assist in convincing the media to focus more on reporting the facts rather than rumors or bad news, which happen to be news that usually sells papers.

However, Leiss & Powell (2004) argue that the different languages between "expert" and "public" contrasts not only the ways of talking about risks, but also the matter of which standpoint anyone decides to take in commenting on a risk issue. In other words, the using of different languages is due to the social context of risk perception and risk communication. With respect to this acknowledgement, an EW system must accept media as stakeholders who may help in improving the quality of the dialogue about risk across the gap that separates experts from the general public. They may also be able to mobilize this improved dialogue about risk for achieving a higher degree of social consensus on the inherently controversial aspects of sustainable development and climate change.

Regarding communication at community level, community radio in many countries, especially developing countries, plays very active role in emergency communication and community development. For example, in 1995, community radio in Japan was looked at again when the Kobe earthquake occurred. Kanayama (2006) states that this disastrous event gave local governments and communities an opportunity to rethink the role of community radio, particularly community FM radio, in order to provide local information in preventing and responding to natural disasters. According to Kanayama's study, at that time, several tiny community radio stations in Kobe played important roles in relieving the disaster, particularly with helping foreigners living in Japan who did not understand Japanese. Right after the earthquake, the government granted community radio an increase in transmitting power from one watt to ten

watts. Since then, community radio in Japan has received attention as regards to a critical media for disaster reduction including communicating EW. In addition, Kanayama's study reveals that community radio in Japan can play a vital role in community revitalizing: 1) connecting various people in the community, 2) constructing mutual trust in the community, 3) discovering resources in the community and 4) reaffirming relationship to the community. It can be said that community radio has been expected to serve people and community with its capability to emphasize the long-term aspect of EW in enhancing community's resilience, sustainability, and adaptability.

**Bibliography (depth area)**

Akhand, M. H. (2003). Disaster management and Cyclone Warning System in Bangladesh. In J.Zachau and A.N. Kuppers (Eds.), *Early Warning Systems for Natural Disaster Reduction* (pp. 49-64). Berlin: Springer.

Anderson, P. S. (2006). *British Columbia Tsunami Warning Methods: A toolkit for community planning*. Burnaby, B.C.: Telematics Research Lab, Simon Fraser University.

Anderson, P. S. (2003). Bringing early warning to the people: Electronic technology – the role of the internet. In J.Zachau and A.N. Kuppers (Eds.), *Early Warning Systems for Natural Disaster Reduction* (pp. 85-87). Berlin: Springer.

Anderson, P.S. & Gow, G.A. (2004). *An assessment of the B.C. Tsunami Warning System and related risk reduction practices: Tsunamis and coastal communities in British Columbia*. Ottawa, Ontario: Public Safety and Emergency Preparedness Canada (PSEPC).

Anderson, P. S., & Stephenson, R. (1997). Disasters and the information technology revolution. *Disasters: the Journal of Disaster Studies, Policy and Management* 21 (4).

Barnes, P. (Autumn, 2002). Approaches to community safety: risk perception and social meaning. *The Australian Journal of Emergency Management.* 17(1), p. 15-23.

Betts, R. (August, 2003). The missing links in community warning systems: Findings from two Victorian community warning system projects. *The Australian Journal of Emergency Management.* 18(3), p. 37-45.

Benfield Hazard Research Centre. (2006). Disaster early warning systems: People, politics and economies. Disaster Studies Working Paper 16 (June 2006) from the 3rd International Conference on Early Warning (EWC III) held in Bonn, Germany. Retrieved from 2008 Virtual Disaster Risk Reduction Library.

Botterell, A. & Addams-Moring, R. (2007). Public warning in the networked age: Open standards to the rescue? Communications of the ACM, 50 (3), 59-60.

Brooks, M. (May 2006). Challenges for warning populations with sensory disabilities. In B. Van de Walle and M. Turoff (Eds.), *Proceedings of the 3rd International ISCRAM Conferences,* p.137-140. Netwark, NJ.

Delica, Z.G. (2003). Community mobilization for early warning in the Philippines. In J.Zachau and A.N. Kuppers (Eds.), *Early Warning Systems for Natural Disaster Reduction* (pp. 36-47). Berlin: Springer.

Drabek, T.E. (1986). *Human System Responses to Disaster: An inventory of sociological findings*. New York: Springer-Verlag.

Glantz, M.H. (2004). Usable Science 8: Early warning systems: Do's and Don'ts. Report of Workshop "Early Warning Systems" held 20-23 October 2003, Shanghai, China.

Gordon, R. (2006). Acute responses to emergencies: Findings and observations of 20 years in the field. *The Australian Journal of Emergency Management.* 21(1), p. 17-23.

Gross, E.M. (2003). Public communication of warnings. In J.Zachau and A.N. Kuppers (Eds.), *Early warning systems for natural disaster reduction* (pp. 67-70). Berlin: Springer.

Gurstein, M. (2005). Tsunami warning systems and the last mile: Towards community based and ICT enabled disaster response systems. The Journal of Community Informatics, 1(2), 14-17.

Hall, P. (2007). Early Warning Systems: reframing the discussion. *The Australian Journal of Emergency Management*, 22(2), 32-36.

Handmer, J. (2002). Flood warning reviews in North America and Europe: statements and silence. *The Australian Journal of Emergency Management*, 17(3), 17-24.

Independent Panel Reviewing the Impact of Hurricane Katrina on Communication Networks (2006). Report and Recommendations to the Federal Communications Commission, June 12, 2006.

Jeggle, T. (2003). Bringing early warning to the people: Public and partnership responsibilities for early warning. In J.Zachau and A.N. Kuppers (Eds.), *Early warning systems for natural disaster reduction* (pp. 13-14). Berlin: Springer.

Kanayama, T. (2006, July). *Community ties and revitalization: the role of community FM radio in Japan*. Paper presented at the International Association for Mass Communication Research, The American University in Cairo, Egypt.

Leiss, W. & Powell, D. (2004). Mad cows and mother's milk: the perils of poor risk communication (2nd ed.). Montreal: McGill-Queen's University Press.

Martin, N. (2007). The Asian Tsunami: An urgent case for improved government information systems and management. *Disaster Prevention and Management* 16 (2): 188-200. Emerald Group Publishing Limited.

Maskrey, A. et al. (1997). *Report on national and local capabilities for early warning.* IDNDR Early Warning Programme, October 1997, Geneva, Switzerland.

Mileti, D. & Peek, L. (2000). The social psychology of public responses to warnings of nuclear power plant accident. *Journal of Hazardous Materials*, 75, 181-194.

Niedek, I. (2003). The role of the media in public communication of early warnings. In J.Zachau and A.N. Kuppers (Eds.), *Early Warning Systems for Natural Disaster Reduction* (pp. 73-75). Berlin: Springer.

Omulo, M. (2003). Natural disaster early warning: The role of NGOs. In J.Zachau and A.N. Kuppers (Eds.), *Early Warning Systems for Natural Disaster Reduction* (pp. 33-35). Berlin: Springer.

Parker, D.J. and Handmer, J.W. (March, 1998). The Role of Unofficial Flood Warning Systems. *Journal of Contingencies and Crisis Management*, 6(1), 45 – 60. Blackwell Publishers Ltd.

Perry, R.W. (1985). *Comprehensive Emergency Management: Evacuating threatened populations*. London: JAI Press Inc.

Quarantelli, E.L. and Taylor, V. (1978). *Some Views on the Warning Problem in Disasters as Suggested by Sociological Research* (Article 115). Disaster Research Center, University of Delaware.

Samarajiva, R. (2005). Mobilizing information and communications technologies for effective disaster warning: lessons from the 2004 Tsunami. *New Media & Society* 7 (6): 731-747. London: Sage Publications.

Schindele, F. & Kong, L. (2005). *Communication plan for the Tsunami Warning System in the Pacific* (Draft Edition).

Scott, J.C. (2003). Disaster early warning and individuals with special needs: In aggregate, the underserved represent a significant portion of society. In J.Zachau and A.N. Kuppers (Eds.), *Early Warning Systems for Natural Disaster Reduction* (pp. 81-83). Berlin: Springer.

Sharma, A. (2003). Early warning: Community interpretations and perceptions – A case of recurrent floods and their warnings in Delhi (India). In J.Zachau and A.N. Kuppers (Eds.), *Early Warning Systems for Natural Disaster Reduction* (pp. 77-80). Berlin: Springer.

Sorensen, J.H. (May 2000). Hazard warning systems: Review of 20 years of progress. *Natural Hazards Review*, 1(19), p. 119-125.

Twigg, J. (2003). The human factor in early warnings: Risk perception and appropriate communications. In J.Zachau and A.N. Kuppers (Eds.), *Early Warning Systems for Natural Disaster Reduction* (pp. 21-26). Berlin: Springer.

Thomson, A., Jenden, P., and Clay E. (1998). Information, risk and disaster preparedness: responses to the 1997 El Nino event. Research report, SOS Sahel, London.

United Nations (2006). *Global survey of Early Warning Systems*. Final report prepared at the request of the Secretary-General of the United Nations.

United Nations, ISDR (2006). Early warning – from concept to action. The conclusions of the Third International Conference on Early Warning (EWC III), 27-29 March 2006, Bonn, Germany.

United Nations, ISDR (2005, January). *Hyogo framework for action 2005-2015: Building the resilience of nations and communities to disasters*. Extract from the final report of the World Conference on Disaster Reduction, Kobe, Hyogo, Japan.

United Nations, ISDR. (2003). *Information systems and disaster risk reduction.* Paper contributed to the World Summit on the Information Society (WSIS), Geneva 2003 – Tunis 2005.

United Nations, ISDR. (2002, July). *Living with risk: a global review of disaster reduction initiatives* (Preliminary version). Geneva.

United Nations, IDNDR. (1997, August). *Guiding principles of effective early warning*. IDNDR Early Warning Program, Geneva, Switzerland.

Vessey, R.D. & Aponte, J.A. Needed: the right information at the right time. Retrived from http://www.annenberg.northwestern.edu/pubs/disas/disas5.htm .

Waidyanatha, N., Anderson, P.S. & Gow, G.A. (2007). Hazard warnings in Sri Lanka: Challenges of internetworking with Common Alerting Protocal. In B. Van de Walle, P. Burghardt and C. Nieuwenhuis (Eds.), *Proceedings ISCRAM2007*, p.281-293.

Wang, Zhen-Yao; Zheng, Yaun-Chang; and Li, Ji-Xun (2003). Early warning systems for the reduction of natural disasters in China. In J.Zachau and A.N. Kuppers (Eds.), *Early Warning Systems for Natural Disaster Reduction* (pp. 15-18). Berlin: Springer.

Zachau, J and Kuppers A.N. (Eds.) (2003). *Early Warning Systems for Natural Disaster Reduction*. Berlin: Springer.