EARLY WARNING SYSTEMS: REFRAMING THE DISCUSSION

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INTRODUCTION

For decades, the international community has discussed and debated the important issue of natural disaster reduction – how can coordinated, collaborative international action reduce the loss of life, property damage, and social and economic disruption caused by natural disasters. The emphasis of the international community in relation to risk, disaster and emergency management has shifted over the years from the development of disaster response capabilities to the need to strengthen risk reduction and control mechanisms and policies. More recently, interest in the design and implementation of better early warning systems as a major mitigator of natural disasters has placed increased emphasis on improving science and technology. These considerations became the focus of the International Decade for Natural Disaster Reduction (IDNDR) declared by the member states of the United Nations in 1989. As a result of this focus, a rich body of literature now exists on the topic of Early Warning and a variety of successful local initiatives are in place. What has not resulted is coordinated, collaborative international action.

The lack of action is keenly felt within the international community, as is evidenced by the papers presented and workshops held at recent conferences organised around themes such as “Research to Action” (Programme, World Conference on Disaster Reduction, Kobe 2005) and “Concept to Action” (Programme EWCIII, Bonn 2006). A more formal acknowledgement that the years of talk, interest, and concern has yet to produce the desired results is the “Hyogo Framework for Action”, agreed by 168 nations at Kobe, Japan in January 2005. While the Hyogo Framework documents international agreement of the need to move from discussion and debate to tangible results, it lacks clear cut and precise goals which would constitute commitments and baseline points of reference for participating governments and any subsequent evaluation of achievements. The Framework, however, does specifically emphasise the importance of implementing early warning systems “that are people centered [sic], in particular systems whose warnings are timely and understandable to those at risk, which take into account the demographic, gender, cultural and livelihood

characteristics of the target audiences, including guidance on how to act upon warnings, and that support effective operations by disaster managers and other decision makers." (Hyogo Framework, 17 (ii) (d), p. 9)

With so many of us in agreement on the vision and the importance of translating that vision into a global reality, why is it, then, that we have not been able to generate a sustainable effort to make Early Warning an international achievement? I believe the answer is that the international community has lost sight of the fact that early warning is the integration and extension of existing emergency management capabilities, and therefore, efforts to establish any local, national, regional and international early warning capability must be led by emergency managers, not by scientists and technologists.

Emergency management is a range of measures that bring together the normal everyday endeavours of private, voluntary, and government agencies in a comprehensive and coordinated way to deal with the whole spectrum of emergency needs including prevention, response and recovery. Through this coordinated effort, emergency managers make use of existing tools and processes, such as weather forecasting, law enforcement, transport infrastructure, health services, scientific modelling, telephony, television and radio broadcasts, and legislation, all of which are used to provide specialised services to the community on a day-to-day basis. In the broadest sense, emergency managers are those who carry out any tasks before, during or after a disaster or emergency, which contribute to enhancing or maintaining the safety of communities from disasters by using whatever tools and processes that are available. The plans, structures and arrangements coordinated by emergency managers are people-centric, recognising that the community owns the risk and must be given all possible assistance in identifying and dealing with it. (EMA Web Site)

PUTTING EARLY WARNING SYSTEMS INTO PERSPECTIVE

In 1997, the UN's Guiding Principles for Effective Early Warning stated that the objective of early warning "is to empower individuals and communities, threatened by natural or similar hazards, to act in sufficient time and in an appropriate manner so as to reduce the possibility of personal injury, loss of life, and damage to property or nearby and fragile environments." (Guiding Principles, p. ii) Later that year, the IDNDR Working Group on Early

Warning Capabilities summarised years of international debate and expert advice in a report on global experience and current practice on the subject, as well as making recommendations for improvements with particular emphasis on how to ensure that hazard warnings contribute to risk reduction. The result was a thoughtful and detailed discussion of early warning, framed unfortunately in terms of specific systems and sub-systems rather than capabilities. (Maskrey)

I say 'unfortunately' because despite the fact that few have disputed the validity and importance of the concepts presented in the IDNDR Working Group's report, the international community continues to debate whether early warning systems should involve the creation of effective preparedness and response mechanisms. (Viewbook, p. 11) I believe that the terminology we are using is causing much of this confusion. A 'system' is generally described as organised or structured, with specific functionality. This description encourages us to think about systems as particular ways of doing specific things, implies scientific and technical leadership, and leads to the kind of questions discussed at the EWS Workshop in Shanghai in 2003. I believe that we would be better able to envision and discuss early warning strategically if it were considered as a capability rather than as a system. While clearly implying that the ability and means exist to achieve the desired results, 'capability' has little prescriptive connotation as to how the results are to be achieved.

From a strategic viewpoint, an early warning capability is the management integration of expert local knowledge with existing specialised systems and processes that are separately owned and operated by a variety of service providers. Emergency management and its stakeholders assess the functionality and integration of these systems and processes for fitness for purpose relative to a specific hazard, and work with the service providers to extend the functionality or improve the integration of their systems and processes as required toward achieving a more effective and sustainable capability. Without question, an early warning capability provides for preparedness, response, and mitigation mechanisms.

Where a capability does make use of specialised science- and technology-based systems and processes, such as those focused on the detection and interpretation of hazard events, issuing alerts and warnings for those events, and deploying responses to event alerts and warnings, early warning system is an accurate descriptor for the functionality provided by

those systems and processes. The science- and technology-based early warning system, however, is not the primary driver for emergency management processes, yet many current discussions of early warning requirements and functionality incorrectly position it in that way.

The scientific and technical research that create and continually improve the hazard detection, monitoring, predictive and communication services also provide important hazard-specific content to be used by other technologies, systems, processes and programs that already exist within the overall emergency management capability to build and exercise hazard preparedness plans, inform and educate communities at risk, develop and implement mitigation strategies, and communicate at all levels from local to international. It is when we focus on the science- and technology-based early warning system, however, that we find ourselves unable to decide on whether to include functions that are not scientific or technical. Functions such as community preparedness don't fit comfortably in discussions of the scientific and technical specifications for sensor networks and telecommunications links. When we focus on the science- and technology-based early warning system, we are limited by what science and technology is capable of or willing to do.

An effective early warning capability uses the best available science and technology to provide *some* of the information needed for decision making and to assist in *some* of the communications within the all-hazards emergency management capability, with respect to a specific hazard event. We are, therefore, far more likely to succeed in meeting the UN's objective for effective early warning if we recognise that emergency management agencies must lead the development and govern the operation of early warning capabilities as an integration of the extensive hierarchy of emergency management services and processes. To achieve effective risk reduction functionality, emergency management agencies must fully integrate science and technology into, but not allow it to drive, emergency management.

WHAT IS EARLY WARNING?

By reframing the discussion on early warning in terms of the physical issue (i.e. the hazard event), the place of early warning within the context of effective emergency management can be more easily understood. The hazard event is real; everyone, from the

international community of experts and specialists to the individuals living in areas that experience the hazard event, can talk about it in tangible terms.

With respect to the hazard event, these tangible terms relate to two operational or functional modes; either:

- Preparing for the hazard event should it occur (i.e. the Prepare State), or
- Dealing with the hazard event when it does occur (i.e. the Action State).

The hazard event itself triggers our transition from one state to the other; when it occurs, we deal with it and when we have dealt with it, we prepare in case it should occur again.

This presentation, simple and tangible, can be communicated clearly. It is understandable across all possible demographic, gender, cultural, education and livelihood characteristics of the target audiences. This presentation provides a realistic structure within which we can manage the myriad of community awareness, education, scientific, technical, political and logistical details required to prepare for and deal with hazard events. It provides a basic point of reference for emergency managers, planners, politicians, scientists, technologists, and the media; if their actions are not helping prepare for the hazard event should it occur, or helping deal with the hazard event when it does occur, then they are not helping!

This presentation also enables us to reposition and simplify our understanding and expectations of an early warning capability within the context of preparing for and dealing with hazard events. One of the most important objectives of an early warning capability is to maximise the benefit from our hazard preparedness strategies and plans through minimising the time from the detection or suspicion of a hazard event to the initiation of appropriate community responses to that hazard event. Science and technology must continually improve the design of systems and processes to accurately detect, assist human interpretation of, and report a hazard event at the earliest possible moment. The community must ensure through its vigilance and participation that the information from the scientific and technology systems is augmented and confirmed by local knowledge and observations; in many circumstances, the nature of the hazard event may dictate that local knowledge and observations will be the community's only early warning capability. The quality and timeliness

of information available to emergency managers are crucial to the ability of emergency managers to effectively mobilise and direct planned response measures. Emergency managers must have in place an infrastructure that integrates state-of-the-art and space-age communications technology with traditional methods of communication so that they can send alerts, warnings, and critical emergency response information out over the last mile to every community and person at risk. (Shah, p. 1-2)

The word “early” in Early Warning emphasises the need to improve and optimise not only the science and technology, but also the human capability throughout this entire range of interactions. “Early” does not simply mean doing things faster but just as importantly, it means doing things effectively.

GOVERNANCE OF THE EARLY WARNING CAPABILITY

Reframing the discussion on early warning relative to the hazard event provides a practical framework for the governance of the early warning capability by emergency managers. The overall emergency management communications strategy, through which emergency managers agree the terms of and manage relationships with all of their stakeholders, is the mechanism by which emergency managers govern the early warning capability. The strategy must identify appropriate interfaces with and between those strategic service providers whose support is crucial if the early warning capability is to be effective – strategic service providers such as scientists, engineers, infrastructure providers, public officials, community emergency service providers, and the media.

Effective governance always depends on the unambiguous articulation of roles and responsibilities, and provides for clear prioritisation and delegation. With respect to the early warning capability, I believe it is essential that we clarify and understand the roles and responsibilities of five primary participants: emergency managers, scientists, the media, public officials, and the community.

In the Prepare State, the role of an emergency manager is more akin to that of a Project Manager. They have the responsibility for coordinating the design, development, implementation and testing the plans, systems and processes that facilitate the community’s capability to deal with specific hazard events should they occur. They are also responsible

for strengthening and sustaining that capability through a continuous cycle of review, assessment and improvement involving all participants.

Science must provide risk information on hazards that may impact the community, and with assistance from the media, communicate that information in meaningful ways to the community. The community has both the right and the responsibility to be informed about risks on which it is expected to have an opinion or to take action. Therefore, it must actively participate with emergency managers in the development and presentation of hazard preparedness and community education and awareness programs, ensuring that local knowledge and history is included to augment and contextualise the scientific information available. Science, the media, public officials and the community must collaborate with emergency managers on the development of hazard preparedness and response plans that take into account such things as what can be done to reduce the potential risks the community faces with respect to a particular hazard; whether and how an early warning can be realistically provided to the community for a given hazard; how notifications relative to a given hazard should be provided to the community for optimal effectiveness; and how both the strengths and weaknesses of traditional knowledge and local resources can be managed to ensure the most effective response.

Science and the community are responsible for maintaining diligent observations and monitoring with respect to hazards in both the Prepare State and the Action State. Scientific monitoring systems operate continuously, providing information that must be quickly and expertly analysed and interpreted to determine if detected variations pose significant risk; science is responsible for maintaining and managing these systems as well as reporting to emergency managers when pre-agreed thresholds have been reached or exceeded. Local observations reported by the community not only assist emergency managers to ground truth the scientific data and interpretations derived from the technology-based systems but in some hazard event situations, such as lahars and local tsunami, local observations by the community may be the primary or only source of detecting the hazard and raising the alarm.

Responding to alerts and warnings is the responsibility all stakeholders, led by emergency management. The role of an emergency manager in the Action State is more akin to that of an Operations Manager; they have the immediate relationship with those at risk

and the responsibility for activating and managing the response systems established to facilitate their ability to deal with the hazard event. They are assisted in their decision making by the continual feed of information from science and the community (monitoring and interpretation), and from all stakeholders on the effectiveness of, and their on-going capability to carry out, planned actions.

Under many hazard response plans, science is responsible in the Action State for issuing alerts and warnings to the community through its normal communications channels. In these situations, the governance model must require that science maintain a close collaborative relationship with emergency managers on the issue of alerts and warnings so as to facilitate the appropriate community response. Science must also maintain a continuous dialogue with emergency managers about the on-going status of the hazard event and, supported by the media, adhere to the agreed communications strategy for the specific hazard by providing the expected information to target audiences to re-enforce the established hazard response measures. The media, in accordance with the agreed communications strategy, must support emergency managers in the on-going communication with the community, reminding the community of the actions set out in the hazard preparedness plans and informing them of the changing events that guide emergency management decisions on whether to expand or decrease the community's response level. Public officials must activate designated resources and engage with infrastructure providers in accordance with the hazard response plan to support the emergency management measures being initiated.

In governing the early warning capability, emergency managers must take the lead in dealing with two recurring areas of conflict. One is the reluctance of science to provide information about a hazard event until the details have been conclusively confirmed. Science is concerned about the public response to false or inaccurate warnings, which might result in lack of faith in subsequent warnings and loss of credibility for the scientists. However, even when unable to confirm detection or interpretation, science must provide emergency managers with early notification of a suspected event that may impact the community so that the appropriate levels of response can be initiated. Tim Radford, Science Editor of The Guardian, aptly summarised the situation: "scientists and engineers concerned with natural

disasters have compelling reasons to speak clearly, vividly and in the vernacular; for them, simple words can and do, literally, save lives." (Radford) Because it is essential that emergency managers be notified of a detected event, or alerted of a suspected event, without delay, emergency managers must collaborate with science and the media to inform the community and to establish realistic expectations of the extent and limits of scientific knowledge with respect to the hazards that threaten the community. An informed community, with realistic expectations, can accept false alarms without becoming apathetic or devaluing the professional capabilities of the scientists involved.

A second recurring area of conflict involves public officials who often resist initiating or escalating within the hazard response plan because they are concerned that information and warnings about hazard events will create panic and have adverse reactions within the community. Rational fear – fear of situations that are liable to occur – does not usually result in irrational actions. (Sandman) In fact, rational fear often motivates people to engage in constructive actions to deal with the situation they fear. Emergency managers must collaborate with public officials and the media to provide the community with factual information about the risks the community faces and the options the community has to mitigate and manage those risks. An informed community is unlikely to panic, and adverse economic reactions will be directly related to the hazard event itself.

To successfully govern an early warning capability, emergency managers must provide active leadership, not only in engaging both the community and the strategic service providers (such as scientists, engineers, infrastructure providers, public officials, community emergency service providers, and the media) in the development of the early warning capability, but also in strengthening and sustaining that capability through a continuous cycle of review, assessment and improvement activities with the community and the strategic service providers.

CONCLUSION

The international emphasis on early warning systems has shifted the focus, and the funding, from emergency management to science and technology. As a result, scientists and technologists are more and more considered to be leading the development of a global early warning capability. While there are important benefits to be gained from improving our

detection and interpretation systems for natural hazards, these benefits will not be realised unless these systems are fully integrated into the all-hazards emergency management capability. Adopting an all-hazards approach, in which local needs are clearly identified and provided for in national and regional policies, generates synergies and efficiencies that can – and must – be leveraged in international strategic planning for early warning capabilities.

To do this, emergency managers need to establish additional, and strengthen existing, international collaboration and exchange of information mechanisms on early warning capabilities just as science has done with early warning system technology. Emergency management must assume the role of 'Champion' and actively lead the dialogue at all levels, working with the community at risk and strategic service providers – in particular science, public officials and the media – to develop effective local, national, regional and international early warning capabilities.

REFERENCES

EMA Web Site, www.ema.gov.au I have adopted the definition of Emergency Management developed by Emergency Management Australia as it reflects the all-hazards approach endorsed by the international emergency management community. EMA's definition also recognises the need to make use of business tools and practices such as risk management and performance improvement, contextualised for emergency management, as a part of mainstreaming emergency management.

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response to disasters — that is, widespread public emergencies. It seems like common sense that the bigger the catastrophe, the greater the risk of mass hysteria. But the evidence is overwhelming that in this case common sense is wrong."

Shah, Haresh. "The Last Mile: Earthquake Risk Mitigation Assistance in Developing Countries", published July 15, 2003 (www.radixonline.org), presented at Stanford University John A. Blume Distinguished Lecture, 15 Jan 04. "In telecommunication industry, they define the most crucial link between available technology…and the use of that technology by a typical homeowner as the problem of the "**Last Mile**". The reasoning being that unless the last connection between the homeowner and the most sophisticated available technology is not there, all the available technology cannot be effective…Coming back to our focus of risk mitigation in developing countries, it seems to me that we have not done all that we could do in making the connection between those who are trying to help and those who need help."

Viewbook, Early Warning System Workshop, "Early Warning Systems Do's and Don'ts", 20 – 23 October, 2003, Shanghai China. Six years after the IDNDR paper was published, the discussions at the Early Warning Systems Workshop in 2003 illustrate the continuing lack of clarity on what early warning systems actually are or should be. International experts in disaster management and the science that informs it exchanged views on "What is encompassed in a EWS?" and whether a EWS "must involve creating effective preparedness and response mechanisms?" Other questions dealt with at the Workshop demonstrate the participants' awareness that confusion about the realities of an early warning system extended beyond the experts. The session on Expectations of Early Warning Systems debated "Do we expect too much of an EWS?", discussed "Hype v. Hope in the use of EWS?" and concluded with an inquiry into whether we should "consider lowering expectations of what EWSs can do for society." (Viewbook, p. 11)