

# INFORMATION SIMULATION MODEL: EFFECTIVE COMMUNICATION AND DISASTER MANAGEMENT IN A MIXED-CULTURAL SOCIETY\*

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## 1. Introduction

A critical prerequisite to effective disaster management is the minimization of related impacts through communication of risk information in a timely manner and in a format that all stakeholders can understand. Attaining this mandate can be a major challenge for disaster managers, especially in an increasingly globalized world characterized by higher levels of multi-culturalism as increasing numbers of people migrate to locations outside their culture-zones where, not only language differs, but also perceptions of and attitude towards hazard/disaster risk (Martin, 2003). The challenge for disaster managers is therefore to design effective tools/strategies that not only span language differences, but also take into consideration cultural perceptions and attitudes so that the objectives of disaster risk-reduction can be achieved.

## 2. Outline of Information Simulation Model

The information simulation model uses various communication modes such as mass media, loudspeakers, patrol cars, and cellular phones, to disseminate warning and other relevant information from the authorities to the public. In addition, the model depicts informal means of communication between residents, using telecommunication and face-to-face contact. The basic structure of this simulation model is constituted according to the Biased Net Model<sup>2</sup>. The simulation model proposed here, takes into consideration the: i). Establishment of various communication mediums (patrol car, cell phones, oral communication, media and loudspeakers). ii). Setting up of communication facilities parameters (audible distance for loudspeakers and patrol car speakers and frequency of and timing of information dissemination). iii) Siting of communication facilities and shelters. iv) Shortest and safest evacuation route (parameter: evacuation by foot). v) Relationship between information receipt-time, residents' behaviour and impact of disaster.

## 3. Contribution of the Model to Effective Disaster Management

Ensuring that effective mitigation measures are in place so that disaster managers and residents can effectively respond to disasters is important to disaster loss-reduction. In that regard, the model focuses on the key components of effective disaster management, namely: planning, communicating, and response during emergencies.

### (1) Planning

Key aspects of disaster planning addressed by the model involve:

- a) Identification of vulnerable populations, location of shelters and assessment of evacuation routes.
- b) Planning communication networks to be used for dissemination of emergency information.

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a) Use of Model in Shelter Location and Assessment of Evacuation Routes

By using GIS as a base framework, the model has the capacity to simulate inundation depth associated with a tsunami or high magnitude rainfall and can therefore inform the safe location of shelters. In addition, through the use of an x and y coordinate system, the model allows establishment of the relative locations of shelters and residences and by extension, the shortest and/or multiple evacuation routes to each shelter. The same principle can be used to determine vulnerability of existing shelters and evacuation routes and inform decision-making in relation to their continued use.

b) Planning Communication Networks to be used for dissemination of Emergency Information

The model allows disaster managers to determine strategic locations for positioning each loudspeaker so as to maximize their audible range. Likewise, optimum routes for dispatching patrol cars for dissemination of disaster information to areas that fall outside the audible range of the fixed loudspeakers can be determined by the model. The maximum distance and the speed that each patrol car will be required to travel can be pre-determined by the simulator, and as such, disaster managers can establish the information-receipt time for each area (Figure 1) as well as the minimum time required for residents to evacuate (Figure 2).

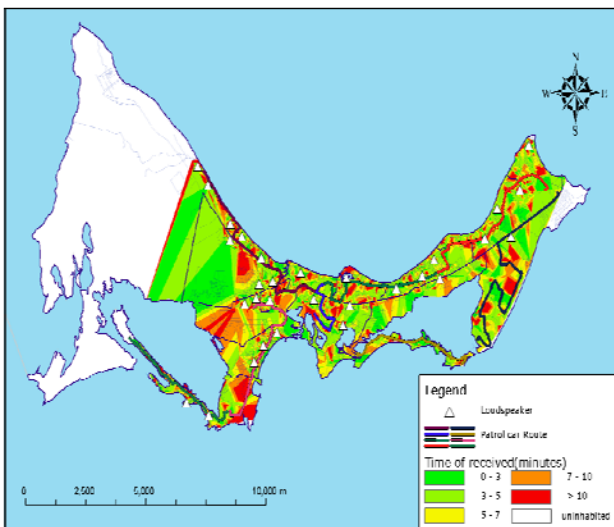


Fig. 1 Estimated Information Receive Time by District in Providenciales

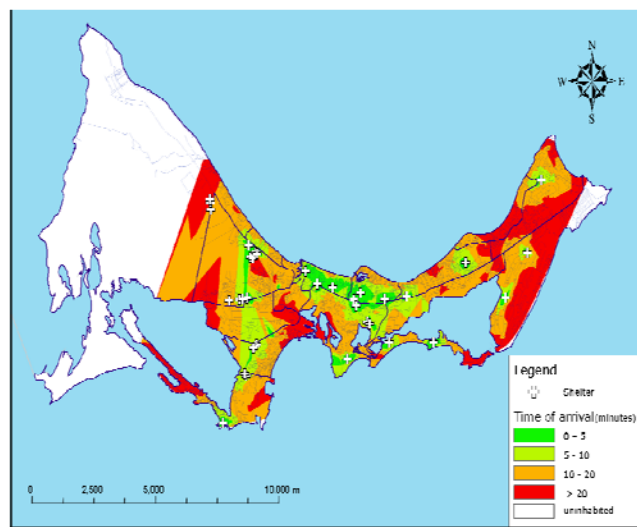


Fig. 2 Estimated Evacuation Time by District in Providenciales

(2) Communication

Communication is critical during an emergency and needs to be thoroughly addressed in the disaster-response plan because prompt and efficient transmission of emergency information during an emergency is critical for related loss-reduction. The range of communication media proposed in the model is to ensure that disaster managers are mindful of the cultural context of their landscape and that the language of information disseminated is reflective of the cultural networks that are present in the society. The use of media such as loudspeakers and patrol cars in the model is intended as insurance against potential eventualities such as power outages that could cripple normal communication media during an emergency.

a) Use of Loudspeakers

The model proposes the use of loudspeakers to transmit a 'unique sound' (such as the sound of the blowing of a conch shell) for communicating disaster information to the residents of Providenciales. For instance, three pitches (musical notes) can be composed with each pitch communicating a different level of alert in a three-phase emergency alert plan:

- i. *Pitch 1*: A large earthquake has just occurred at X location.
- ii. *Pitch 2*: There is a possibility that the island might be affected by a tsunami, prepare to evacuate.
- iii. *Pitch 3*: Evacuate immediately.

The use of sound instead of language via the loudspeaker system ensures that there is no ambiguity or incorrect translation of the risk information being communicated irrespective of language background in this mixed-culture

landscape. The model also recognizes that if loudspeakers are to be efficiently located without transmission overlap, some areas will be peripheral to the transmission range and will therefore not be covered. It is in this context that the use of patrol cars is designed to provide information to these peripheral areas.

b) Use of Patrol Cars

As in the case of the fixed loudspeakers, the audible range of the patrol-car speakers can be pre-determined, allowing disaster managers to know the percentage of the population that falls within the audible range of either a fixed loudspeaker or the speakers on the patrol cars. As such, the number of people that will receive emergency information within a specified time-frame can be pre-established. The emergency communication strategy can be used in conjunction with attribute information derived from mapping of household size, nationality and primary language of each household to determine 'pockets' of ethnicity so as to ensure that the transmitted emergency information is targeted according to ethnic needs.

c) Use of Cellular Phones

The model proposes use of two features of cellular phones in the transmission of emergency information: text messaging (SMS) and ring tune.

i. Text Messages (SMS)

Use of text messages to transmit warning information to the public can be an effective medium but one that is generally underutilized during emergencies. Owing to the growing use of cell phones world-wide, it is believed that use of this medium to communicate will enable disaster managers to quickly transmit information in multiple languages.

ii. Ring Tune

An emergency ring tune with different pitches, similar to the one designed for use in the loudspeakers, can be used to alert residents of the imminent threat of a hazard. Pre-emergency cooperative planning between government and cellular phone service providers in the Turks and Caicos Islands can allow emergency managers to transmit the pre-determined ring tune to all cell phone holders. This sound would be heard even if the person's cell phone were turned off or is on silent mode, thereby increasing the distribution of information.

d) Use of the Mass Media

The mass media can be used at all phases of the disaster management cycle as long as communication facilities have not been destroyed. Before the onset of the hazard the mass media can be used to prepare residents for the impact of the hazard. During the emergency it can be used to provide situational information to residents. Emergency information should be issued directly by relevant government officials in the respective languages. This helps to ensure uniformity and reliability of the information that is disseminated to the public irrespective of the language it is being disseminated in. If individuals are located outside the audible range of both the loudspeakers and the patrol car speaker's routes, then the media can be relied upon for transmission of risk information to those residents.

e) Use of Oral Communication

A key feature of the information simulation model is its integration of oral communication among residents. In this component of the model, communication takes place between residents via telecommunication and face-to-face contact. This parameter was incorporated in because in many societies and especially those that contain large mixed-culture groups there is a tendency for mistrust of government officials and therefore a reduced likelihood for the acceptance of and response to emergency warnings without confirmation with other sources, such as family and social networks. This tendency results in response delays and by extension greater potential for casualty<sup>3-4</sup>. Katada et al<sup>5</sup> concurs with this view in their observation that the level of oral communication between residents increases during emergencies and that communication parameters such as distance of each contact, number of contacts (receivers) and timing of each contact, which usually exist during normal days tend to decrease. In the Caribbean, communication between neighbours, family and friends to verify an official warning message is commonplace and is the basis on which evacuation response is hinged<sup>6</sup>.

(3) Response

People at risk from disasters, whether natural or human induced, can take actions that save lives, reduce losses and

speed response, and reduce human suffering when they receive accurate warnings in a timely manner. As such effective warnings should, reach in a timely fashion every person at risk who needs and wants to be warned, regardless of current location or activity being undertaken. However, in order to achieve this broad distribution of information a partnership for utilizing both government and private owned systems will be necessary.

a) Timing of Information Dissemination and Behavioral Response

After the occurrence of for example a large earthquake and the imminent threat of a tsunami, the prompt and efficient communication of disaster information to residents is based on the parameter of timing of information dissemination by the authorities and the time required by residents to complete evacuation. The model uses the shortest evacuation route and calculates the duration of evacuation if undertaken on foot at a speed of 80 meters per minute. Therefore, the model is able to simulate the significance of a delay in information transmission and the likely impact on loss of lives. For example, in May 2003 a large earthquake occurred in Sanriku-Minami, Japan, an area known for having large earthquakes and possible tsunami threats. A tsunami warning was issued 12 minutes following the earthquake but only 1.7 percent of residents evacuated. Based on this fact, if a tsunami had occurred high number of casualties would have been inevitable<sup>5)</sup>. The model addresses this issue by being able to simulate multiple scenarios of the relationship of timing of warning transmission and resident's evacuation behaviour in terms of the resulting number of casualties. These various scenarios revealed that a correlation exists between information receive time and number of casualties. In that regard, the model would be a good tool for educating residents about the importance of responding to evacuation warnings promptly and when appropriate, undertaking evacuation based on their own cognition of the threat, since communications from government officials can be delayed due to damages.

#### 4. Conclusion

The model can be considered a type of dynamic digital "hazard map" as it informs, educates and identifies vulnerable populations. Utility of the model is enhanced by its capacity to depict various scenarios in three-dimensional or graphical formats. This makes presentation of the results more realistic and thus more appealing to residents, irrespective of cultural and language differences. The realistic nature scenarios in the model should better persuade residents of the need to take appropriate measures to protect themselves, their family and property from various disasters. The wide range of devices/media used to communicate risk information should ensure maximum and comprehensive coverage of all residents in the Providenciales mixed-cultural landscape thus allowing for effective communicating of risk information that should result in prompt evacuation from vulnerable areas in the face of an imminent threat. From the disaster managers perspective the tsunami model can be considered as a type of digital disaster manual as it can be used to assess the effectiveness of current disaster management strategies that are in place.

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