CHAPTER 2: PEOPLE AND COORDINATION

I have already observed that the 'right' people provide the input that energises the whole information infrastructure and the disaster management process that it underpins. The 'right' people are those who are competent, committed, communicative and cooperative. The importance of taking a cooperative and coordinated approach to information management, at the personal, corporate and jurisdictional levels, is recognised in the SII literature where it is usually referred to as the 'clearinghouse' component.

THE RIGHT PEOPLE

Competent People

Competent people are those who have and maintain the skills needed to do their job. This requires ongoing education and training, a fact well recognised in the disaster management field.

Identifying appropriate standards of competency in the administration of disaster management (how to manage disaster management) and many vocational aspects (mainly training in skills such as map reading and first aid or the operation of radio networks, flood boats or chainsaws) have already received attention in the PICs. I have not, however, been able to find in either the PICs or Australia, any guidance that identifies the particular fields, other than management, in which disaster managers should be competent.

Given the real world, holistic nature of disaster management, as discussed in Chapter 1, and its place in the wider risk management and community governance processes, it is clear that professional disaster managers would ideally have a broad span of knowledge, but should they be expected to have, for example, a competency in, or understanding of:

- the sciences associated with the various hazard phenomena (geology, meteorology, hydrology, vulcanology, etc);
- structural or civil engineering;
- the demographic, social, economic and cultural aspects of the people that make up their communities;
- the psychology, sociology and politics of disaster;
- the logistic, communications and transport resources that support the community; and/or
- all of these and more?

And if the answer to any or all of these is 'yes', then to what level should that competency or understanding extend? If the answer is 'yes, but', 'perhaps' or 'no', is it sufficient that their competency simply extend to having an understanding that information on these topics is important and to know who to contact (in the broader disaster management community) to get the necessary input and advice? I am sure that within the professional disaster management community there is a spectrum of competence in these topics ranging from strong academic background and experience to passing familiarity with the general concepts and terminology.

The Australian *National Emergency Management Competency Standards* (EMA, 1995) developed for professional and volunteer disaster managers, does not help to answer those questions definitively, but it does identify the need for emergency managers to be competent in the use of (unspecified) information. It contains two explicit competency units relating to information (Unit 10 - Manage Information and Unit 11 - Process Information). Both are 'core' (i.e. compulsory) competencies and are described in terms of the 'processes of collecting, recording, verification, interpretation, structuring, collation and dissemination of emergency management information' – i.e. they relate to the information (intelligence) cycle described in Chapter 1.

The Australian competency standard also contains reference to the use of GIS, as one of the activities under Unit 2 – Assess Vulnerability, a process described in the standard as examining 'the interaction of hazards, communities, agencies and the environment'.

There is another spectrum of competencies involving GIS. These range from the highly technical levels of professional GIS analysts who have strong skills in programming and spatial modelling; to those who use GIS to analyse spatial issues as part of their core work; to those who simply use GIS to display a map.

The Suva workshop clearly demonstrated that there is a good pool of competent people ranging across this spectrum of GIS use. At the professional and applications end, most of these are graduates from the University of South Pacific (USP) in Suva, the PNG University of Technology (Unitech) in Lae or from universities in Australia or New Zealand. USP offers a range of courses in disciplines including earth science, geography, land management, sociology, population studies, environmental science and tourism, some of these involve, or can include, training is the application of GIS A good contact at USP is Mr James Britton, a senior lecturer in geography (britton_j@usp.ac.fj) A similar range of disciplines are available at the University of Papua New Guinea (UPNG) in Port Moresby. Unitech, however, is the acknowledged centre for education in spatial sciences such as surveying and the technical aspects of GIS and technologies such as GPS. Professor Rod Little, who heads the Department of Surveying and Land Studies (rlittle@survey.unitech.ac.pg) is the best contact at Unitech.

For those at the more casual applications and desk-top mapping end, specific vocational training and experience is available through short courses and on-the-job training provided by SOPAC and in some countries by both private and public sector agencies. Some non-government organisations (NGO) also provide training and experience in GIS use. SOPAC also provides technical support for GIS hardware and software installation and maintenance and a 'help desk' function that supports users throughout the PICs.

Whilst there may not be a large number of NDMOs or their staff who have yet gained access to, or experience in, the application of GIS and other spatial technologies, there are certainly competent people available in most PICs to provide that type of support to disaster managers.

Committed People

Skills alone do not guarantee a successful use of information or tools such as GIS (or indeed, disaster management). That requires a strong measure of commitment to the process involved. Again it is clear that there is a good resource of people in the PICs who understand the issues and challenges they are meeting in the GIS and disaster management processes and want to make a difference. They are dedicated to solving the problems that confront their communities.

Communicative People

Competence and commitment are of little value if the people with those attributes are not willing to pass on their knowledge of both GIS and the information they produce using those tools. In PICs the widely disbursed population and, at time, tenuous links calls for special efforts to be made to facilitate that communication. This requires the operation of both formal processes, such as workshops, conferences and newsletters such as those facilitated by SOPAC, and informal networks, such as the GIS User Groups that exist in some centres such as Suva. Promotion of the benefits gained by the community by the use of GIS and the operation of the SII will enhance this process.

It is useful to remember that the word 'communicate' is derived from the Latin *communicatus*, which means 'shared'. Communicative people, therefore, are people who share their information and experience.

Cooperative People

It is clear that no individual or organisation has all the answers, either in disaster management or in the use of GIS. To maximise the acknowledged benefits of both, it is essential that an environment of cooperation both within organisations and between organisations is strongly maintained There is clearly a strong level of cooperation within and between the various NDMO organisations. That commitment is not, however, always experienced between organisations that develop, manage or look after spatial information and GIS resources.

This situation is not peculiar to the PICs. In the multi-hazard risk assessment undertaken by the AGSO *Cities Project* in Cairns, data was assembled from at least 35 different sources, most of whom, at the time, did not share information with any of the others. In some instances, some were not even aware that the others actually existed!

INFORMATION: COOPERATION AND COORDINATION

It is quite clear from both workshops that PIC disaster managers acknowledge that information is an essential ingredient to effective and sustainable decision making at personal, organisational and jurisdictional levels. A culture of information is well established in this community. The practice and experience of using it, however, is yet to develop to the same degree

It was also clear that the information needed for decision making tends to be developed, used and managed in an insular fashion (also by individuals and organisations) without much reference to others who may have an interest or need for the same or very similar information. There are many instances of expensive information collection programs being undertaken by two or more different agencies, more or less simultaneously and in the same community, without the knowledge of, or reference to, agencies with similar needs.

It was acknowledged that this insularity is inefficient, uneconomical and (typically) socially inequitable. Whilst we can pour scorn on some of the more outrageous examples of duplication, such examples continue to flourish:

- in part because we want to 'control' our own material (*that other mob won't do it is well as we will, so we had better do it ourselves*);
- in part because we don't bother to find out (*there is no use asking that mob, they are useless*);
- in part because we are not willing to share our information with others (*we can't tell that mob because they might use our information against us*);
- in part because we are not prepared to reveal the detail of our information (*we can't make this public because it might scare people or cause a political row*); and,
- in part because it may be funded by an aid donor or under some other appropriation (*we have been given the money to do it, so it must be OK*).

Such a situation can only flourish where there is a lack of coordination and cooperation between information gatherers and users. It is typically made worse where there is a lack of commitment to work in open and active partnership with the community and where there is no mechanism by which information about information can be easily accessed.

There are solutions available to facilitate the linkage of the many 'islands' of information and thus break down this insularity. Whilst many of these solutions today are built around technology, the principles of coordination and cooperation, on which they are based, are non-technical. The development of these links is the objective of what is usually referred to in the literature on spatial data infrastructures as the 'clearinghouse' network or mechanism.

THE CLEARINGHOUSE

The US literature on their National Spatial Data Infrastructure (NSDI) describes the clearinghouse concept as 'a system of software and institutions to facilitate the discovery, evaluation, and downloading of digital geospatial data' (FGDC, 1997). This description identifies two distinct aspects, namely:

- from an *institutional* perspective, it is a referral service, or a 'library index' used to discover who has what information; and,

- from a *technical* perspective, it is a set of information stores that use hardware, software and telecommunications networks to provide access to information

Institutional issues

The key objective of the clearinghouse is to identify what information is available, where it came from and who has it. In reality, a clearinghouse can be as simple as a box full of reference cards, or as complex as some of the directories, such as the Internet-based Australian Spatial Data Directory (ASDD) or the CD-ROM-based Queensland Spatial Information Directory (QSID), that are already in place. Details of these representative clearinghouse directories can be seen at:

- for ASDD see www.environment.gov.au/net/asdd/)
- for QSID see www.qsiis.qld.gov.au/spat_info_directory/qsid.html).

SOPAC's Internet-based 'virtual library' provides another, more general, example of a technology-driven directory (found at www.sopac.org.fj).

Like any 'library index', the clearinghouse directory does not contain the actual information, it only contains information that will help the researcher to make a judgement as to whether it is what they are looking for, and if so, where to find it. This information is typically referred to as metadata (data about data).

Metadata describes the content, quality, condition and other characteristics of the material of interest, be it data in a database, a satellite image or a coverage of aerial photography, a report or a map. The key headings for a metadata directory for spatial information (i.e the SII 'library index') should include·

Identification

- title of the database, map, report, etc;
- area, place, region, etc covered,
- themes and subjects addressed,
- currentness – when was the material produced or last updated or validated,
- can the material be released to anyone or are there access restrictions.

Data quality

- accuracy;
- completeness;
- logical consistency;
- lineage (where did the data originate and what has been done to it since).

Data organisation

- is it spatial or non-spatial, structured or free text, digital or analogue, etc;
- if it is spatial data
  - is it vector data with or without topology;
  - is it raster data;
  - what type of spatial elements are involved (point, line, polygon).

Spatial reference

- projection;
- grid system;
- datum;
- coordinate system.

Entity and attribute information

- features (topography, buildings, social value, cultural feature, etc);
- attributes;
- attribute values (quantitative, qualitative, names, scales, etc);
- time perspective (historical, real-time, forecast, etc).

Distribution

- distributor or custodian (who to contact);
- on line or postal access address;
- language or languages available;
- formats available (database, table, MapInfo table, map, book, etc);
- media available (audio tape, video tape, floppy disk, CD-ROM, paper, film, etc);
- price and payment details.

Metadata reference

- when was the metadata developed;
- who was responsible for the metadata.

This scheme can be applied to any form of information, be it the most sophisticated *Risk-GIS* information, or an oral history recorded in a remote village; a satellite image or a sketch in a field notebook, and so on – it is all information and it all needs to be properly indexed.

ANZLIC has established a standard for spatial metadata, the details of which can be found on their Internet site at www.anzlic.org.au/metaelem.htm. This is a highly technical standard, designed mainly for traditional spatial data products such as cadastral and topographic databases. It is, none the less, in increasingly wide use in Australia and it might be a useful model for SOPAC and PIC authorities to look at if it is decided to go down a more formal information infrastructure path.

Technical issues

Once the information needed has been identified and access has been arranged, the next issue is to transfer it from its source to the user. Traditional 'hard copy' material such as books, reports, maps, films and photos, is typically transferred physically i.e. it is sent by hand, post, courier, and so on. For material that is in digits, or can be converted to digits, the transfer options are somewhat greater, though in many cases the actual transfer will still rely on physically carrying or posting the transfer medium from the originator to the user.

Audio and video tape: A great wealth of information is captured on audio and video tape. Whilst these forms are not typically associated with spatial information they often contain information that is related to 'somewhere' – an interview with a village elder about traditional food preservation can be related to the village location, whilst a video of damage done during a cyclone relates to the localities affected. Transfer can be through physical transfer (post the tape) or by electronic means (broadcast the story or the imagery).

There is also an increasing range of software tools that enables audio and video material to be converted directly into word processor text (e.g. Dragon Natural Speech) or to introduce video (both analogue and digital) into a computer environment where it can then be transferred via the Internet.

Data tape and disk transfer: Until very recent times, most digital material was transferred by tape or disk. For data sets in which the constituent files are smaller than 1.4 megabytes this simply involves copying files onto a floppy disk and passing it on. Where individual files are larger than 1.4 megabytes, compression using software such as PKZIP can bring them down to a small enough size If that is not practical, especially where numerous large files need to be transferred, tapes or disks of greater capacity are available. Amongst the more common of these are the 40 megabyte *Clik PC Card*, 100 and 250 megabyte *Zip* drives and 2 gigabyte *Jaz* multimedia drives produced by Iomega (www.iomega.com). All of these devices have to be physically transferred by conventional means for the data they contain to be accessed.

CD-ROM: Where the number of files to be transferred are large and/or where it is not practical to compress files to fit on a floppy disk, the files can be copied to a CD-ROM. This medium is clearly superior to floppy disks, and most modern personal computers now come with a CD-ROM reader as a standard feature. Most current models of PC can also be optioned to include a CD-ROM writer. Fortunately the providers of the largest data sets today typically have that technology. CD-ROM also provide an excellent form of data archiving.

LapLink: Machine-to-machine copying via a connecting cable, employing software such as LapLink, is an extremely accurate and fast method of data exchange where practical. The very large hard disk capacity of modern laptop computers (typically greater than 2 gigabytes) makes it possible to transfer extremely large quantities of data by this means, however, it requires Mohammed to go to the mountain or *vice versa.*

Email: I have had some success with sending smaller data sets between Brisbane and Suva, in both compressed and uncompressed form, via Internet email, though the transfer of larger files (say more than one or two megabytes) has not always been reliable. Simple table data sets and text files tend to be easier to transfer than graphic files.

ftp: I have also had considerable success (within Australia) in transferring large uncompressed files of up to 50 megabytes using the Internet file transfer protocol (ftp) capability This is clearly the way of the future for the rapid transfer of large data sets. It opens the prospect of transferring large and urgently needed files under disaster operational conditions to laptop computers in the field using the telephone/modem route. This technique, however, is completely dependent on telecommunications systems with good capacity and speed, a resource that is not always reliable across the Pacific.

Intranet: Access to data within organisations, such as SOPAC, is facilitated by their corporate local area or wide area networks (LAN or WAN). These arrangements certainly facilitate information management and issues such as version control i.e making sure that the version of a database in use is the most recent. Evolution of this current technology towards an 'end-user' computing environment (the promise of the Intranet) will further enhance not only access to the data but also to applications and decision support tools such as *Risk-GIS.*

Most of these technologies are fairly intuitive to use under the Windows 95, 98 or NT operating systems, even by one who is not especially skilled in the use of that software or the Internet.

One of the hidden benefits of all of this transfer technology is that it adds significantly to preserving and protecting valuable data from loss, vandalism, technical failure and IO (idiot operator) problems. It certainly saved my bacon during the Cairns work under the AGSO *Cities Project* when I inadvertently corrupted the master copy of the primary database for the project. I was able to recover it from the copy I had sent to Cairns City Council.

OBSERVATIONS

There is certainly a good (and expanding) pool of the 'right' people to implement and operate an information infrastructure in most of the PICs and at a wider regional level.

There appears, however, to be a limited appreciation of the value of establishing an information infrastructure, or the SII component of it, in most PICs. It is evident that the greatest obstacle to be overcome in this regard is the lack of either a coordination mechanism, a tradition or spirit of cooperation between stakeholders, or both of these.

Given that disaster managers tend to have very limited influence in the agencies that would most likely be given responsibility for developing a national-level information infrastructure or SII, such as the Department of Lands or its equivalent, they may need to develop a range of strategies to bring pressure to bear to have such a mechanism developed. That may require using outside 'experts', as suggested by one of the NDMOs, or using the experience of a significant disaster event to convince the 'powers that be' that the outcome would have been more favourable if the country (region, district, etc) had an appropriate information infrastructure in place. They can not make effective decisions without the appropriate information – and in disaster management that could cost lives. The lack of appropriate information also retards development, a factor that will inevitably have long term consequences.

A key first step in establishing a information infrastructure is the creation of a clearinghouse mechanism, including a metadata directory, through which disaster managers can find and arrange access to the information they need to make those decisions. Most have access to the technology that can make such a mechanism accessible across the country and across the region.

The experience of local governments and small regional groupings of spatial data users in Australia could serve as a useful guide for PIC and regional agencies such as SOPAC to look at if it is decided that a formally structured information infrastructure is to be developed. This experience may be more appropriate that the higher level experience at state and national level in Australia where issues such as metadata standards and clearinghouse directories tend to be rather formalised and heavily dependent on technology and a relatively large and skilled work force.

CHAPTER 3: DATA AND INFORMATION PRODUCTS

WHAT INFORMATION?

Disaster management is, by its very nature, an information-hungry activity. It must deal with real world issues in a holistic way and covers the full range of activities involved in preventing, preparing for, responding to and recovering from disaster impacts. It is also important to reiterate that the PPRR (prevention, preparedness, response and recovery) of disaster management is but one of the treatment strategies of comprehensive community risk management. It should, therefore, be supported by the process of risk assessment as outlined in Chapter 1. The information needed across this combined span of activity must, consequently, be capable of describing or defining the widest possible range of real world issues. This differs markedly from most other activities, such a land management or regional planning, for example, which tend to have a significantly narrower subject focus.

Not only must the subject coverage be broad, the temporal span may also need to be comprehensive. Throughout its various stages, disaster management can require information that is, at least by human timeframes, timeless (such as climate, terrain or geology); it needs information on past events, it needs immediate information about the current situation; and, it needs information about the future, in the form of forecasts or predictions. Disaster managers may need access to great detail down to the level of individual buildings or people, conversely, they may need general information across wide areas such as sea surface temperatures across the whole Pacific Basin

This is no small challenge, a fact recognised by disaster managers at the Suva workshop. It clearly does not, however, mean that disaster managers need to know everything about everything. This is clearly impossible, even for such paragons as PIC NDMOs! The trick is to identify what information and information products are required at which stages of the risk assessment and disaster management processes so that the they can be prioritised. It is important, therefore, to follow a systematic process that maximises the efficiency of information management and minimises duplication of information collection and, more importantly, gaps in information – hence the need for an information infrastructure.

In the following discussion I will outline the general information needs and some of the more obvious sources for that information across PIC. A more detailed listing of subjects is provided in Annex D.

DIVIDING THE TASK

There are many ways of systematically dividing the task of information management. Many systems in use in Australia, for example, take a thematic approach based largely on the main users and/or the custodians of the information. The scheme described here is based on the experience we have gained under the AGSO *Cities Project.* To understand this approach, however, it is useful to outline some of the key principles followed. In our approach to risk assessment, for example, we have adopted the Office of the United Nations Disaster Relief Coordinator (UNDRO) definitions from 1979 and cited by Fournier d'Albe (1986) as follows:

- ***Natural hazard*** *means the probability of occurrence, within a specified period of time in a given area, of a potentially damaging natural phenomenon.*

- ***Vulnerability*** *means the degree of loss to a given element at risk or set of such elements resulting from the occurrence of a natural phenomenon of a given magnitude..*

- ***Elements at risk*** *means the population, buildings and civil engineering works, economic activities, public services, utilities and infrastructure, etc., at risk in a given area.*

- ***Specific risk*** *means the expected degree of loss due to a particular natural phenomenon: it is a function of both natural hazard and vulnerability.*

- ***Risk*** (i.e. 'total risk') *means the expected number of lives lost, persons injured, damage to property and disruption of economic activity due to a particular natural phenomenon, and consequently the product of specific risk and elements at risk.*

Total risk, the approach required by disaster managers, can be expressed simply in the following pseudo-mathematical form:

Risk $_{(Total)}$ = Hazard x Elements at Risk x Vulnerability

This terminology may be a little different to that used in some disaster management agencies and because it is derived from work done twenty years ago it may be considered to be out of date. It remains, to my mind, the most comprehensive and inclusive set of definitions. I would encourage readers to consider what the words are being used here, rather than how they may use them in their current work. Certainly one of the most central terms here is 'vulnerability'. In this report I explicitly use the term to reflect the range of capacity from total susceptibility to the impact of a hazard event, to total resilience to the same event.

Regardless of the 'formula' or the definitions, 'risk' is the outcome of the impact of hazards on a community.

The organisation of information can, therefore be split between the two key factors:

- the hazards and environments in which they operate; and,
- the elements at risk and their characteristics that make them more or less vulnerable to disaster impact.

This approach, however, does not take account of the level of community awareness and acceptance of risk that is an important component in risk communication and in the prioritisation of risk treatment options, and hence disaster management. This factor also needs to be included.

These components come together in the *Cities Project's* understanding of the risk management process, and consequently our approach to information management. This is illustrated in Figure 7.

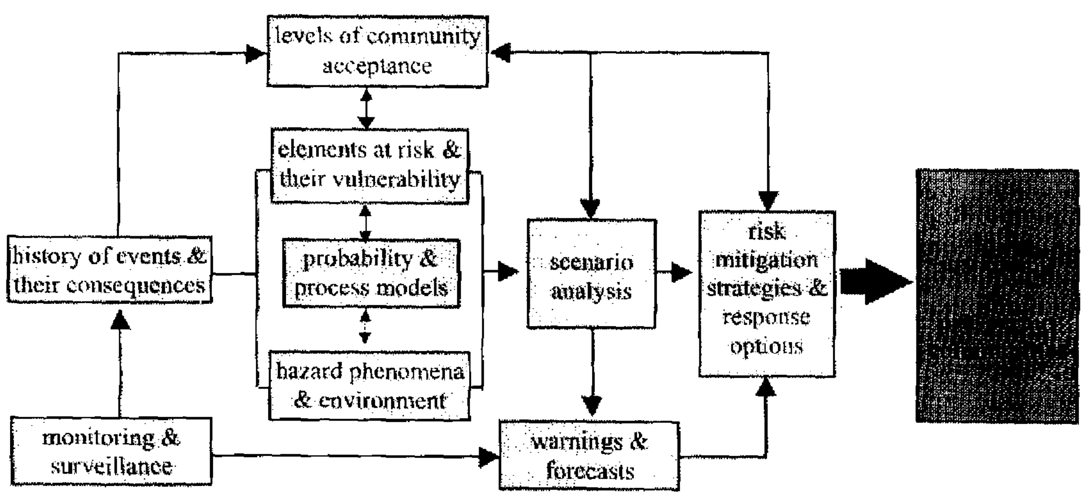

Figure 7: *Cities Project* understanding of the risk management process

HAZARDS

The hazard phenomena that are most relevant in PICs can be divided into four groups, on the basis of their origin, as shown in Table 1.

Table 1: Classification of hazards

ATMOSPHERIC	EARTH	BIOLOGICAL	HUMAN
tropical cyclones	landslides	human epidemics	industrial accidents
tornadoes	earthquakes	plant epidemics	transport accidents
storm surges	tsunamis	animal epidemics	crime
floods	volcanoes	plagues	political conflicts
frosts	lahar	bush fires	structure failures
droughts	erosion		structure fire
severe storms	ground failure		contamination

Obviously, not all of these hazards are experienced in all PICs. Frosts, for example, are probably only an issue in PNG, whilst tropical cyclones are a relatively rare problem in PNG and then only affecting a small part of that country; landslides are unlikely in countries such as Tuvalu and Kiribati; and so on. Overall, most countries can potentially be affected by most of these hazards as shown in Table 2 which was compiled by SOPAC from various sources.

The information required by disaster managers on the hazard phenomena are typically confined to:

- the history of hazard impacts and their consequences;
- warnings or forecasts of an impending hazard event; and,
- forecasts of the likely level of impact of events of different probability (i.e. hazard scenarios).

To provide that information on at least the last two of these, however, hazard scientists require a wide range of data on the respective phenomena and the environments that they function in. Whilst these data are of limited direct interest to disaster managers I have included them in this discussion and in the detailed listing in Annex D for completeness.

Hazard history

Information on the community's experience of hazard impacts is, in my experience, perhaps the single most important resource that should be available to disaster managers. It represents reality and helps to overcome the inherent problem that human memory tends to be significantly shorter than the return period of most hazard phenomena.

There are many sources for this information. The availability of well managed collections of such information, however, is highly variable and typically confined to the larger PIC and international agencies such as AGSO, the Australian Bureau of Meteorology (BoM), the Queensland Department of Natural Resources (QDNR), the New Zealand Institute for Geological and Nuclear Sciences (IGNS), the US Geological Survey (USGS) and the US National Oceanographic and Atmospheric Administration (NOAA). Many of these also provide current information on conditions such as global or regional El Nino and sea surface temperature conditions, as well as recent hazard events, via their respective Web sites.

Table 2: Estimated level of PIC vulnerability to specific natural hazards

Country	Population	Land Area (km^2)	Cyclone	Storm Surge	Coastal Flooding	River Flooding	Drought	Earthquake	Landslide	Tsunami	Volcanic Eruption
Cook Islands	19,500	240	H	H	M	M	H	L	L	M	-
FMS	114,800	701	M	M	H	-	H	L	L	M	-
Fiji	752,700	18,272	H	H	H	H	H	H	H	H	L
Kiribati	76,000	725	L	M	H	-	H	L	L	H	-
Marshall Is	50,000	181	H	H	H	-	H	L	L	H	-
Nauru			L	L	L	-	H	L	L	L	-
Niue	2,300	258	H	H	L	-	H	M	L	M	-
Palau	21,600	494	H	H	M	-	H	L	L	M	-
PNG	4,056,000	462,243	H	H	H	H	H	H	H	H	H
Samoa	163,000	2,935	H	H	H	H	L	M	H	H	M
Solomon Is	337,000	28,370	H	H	H	H	H	H	H	H	H
Tokelau	1,600	12	H	H	H	-	H	L	L	H	-
Tonga	97,400	720	H	H	H	M	H	H	L	H	H
Tuvalu	9,100	24	H	M	H	-	M	L	L	H	-
Vanuatu	156,500	12,200	H	H	H	H	H	H	H	H	H

(compiled by SOPAC DMU staff from various sources)

Note: The vulnerability of PNG to cyclone and storm surge is rather higher than I would have assessed it. Coast-crossing cyclones in PNG are very unusual and then confined largely to the smaller islands to the east of the mainland, though high seas and intense rainfall generated by more distant cyclones are a much more frequent hazard.

Some of these are:

AGSO	*www.agso.gov.au*
BoM	*www.bom.gov.au*
IGNS	*www.gns.cri.nz*
NOAA	*www.ceos.noaa.gov*
QDNR	*www.dnr.qld.gov.au/longpdk*
USGS	*gldss7.cr.usgs.gov/neis/bulletin/bulletin.htm*

Documentary records of disaster events can, in some areas, extend back to the mid-to-late 19th Century or (in rare cases) even as far back as the 16th Century. These records are found in the journals of explorers, missionaries and other travelers, official government reports and through contemporary press reports. These reports are valuable because they frequently contain much information on the consequences of the disaster and how the affected community coped with the experience, though they are largely presented from the perspective of those 'outside' observers.

Oral tradition, local myths and creation legends can also provide evidence of such events. These records also often contain information on how the affected community experienced the event and how they responded. Typically, they are associated with major events in specific named locations and can be of value as a guide to modern scientific investigation by geomorphologists and others.

More detailed scientific records, especially those in which instrument measurements are available, tend to date from the 1940's at best. The availability of satellite data on cyclones over much of the Pacific generally dates from the 1970's. The instrumental coverage of hazards such as earthquakes, volcanic eruptions, cyclones, severe storms and tsunamis is constantly improving, as is the number of researchers who take an interest in those phenomena in the Pacific.

The 'damage assessment workshops' held in three PICs under the SPDRP in 1997 and 1998 have established an excellent framework on which to collect post-event impact information. The generic 'initial damage report' forms developed for Cook Islands, Samoa and Tonga, and the 'drought assessment' forms used in Fiji and Solomon Islands during 1998, are very comprehensive. In the case of Tonga, their form has been translated into Tongan and has been distributed to outer island District Officers. They were used for the first time following Cyclone *Cora* in February 1999 (Angelika Planitz, SOPAC, personal communication).

It is, however, one thing to have the proforma in place, another to have it used, and yet another thing for the data collected to be subsequently collated, analysed and preserved to ensure that the maximum value can be gained from the effort of collecting it. At this stage completed forms tend to be accumulated at the National Emergency Operation Centre in the respective country.

It is worth observing that these proforma place the PICs well ahead of most Australian jurisdictions where there is a very poor record of detailed and coordinated post-event studies. The most comprehensive collection of post-event collection of information for Australia is that collated by the Newcastle Region Library on the experience of the 1989 earthquake in that city. This contains a wealth of documentary and visual material as well as interviews with survivors, rescue workers and so on. It is a very good model for such collections.

The Web site *www.newcastle.infohunt.nsw.gov.au/library/eqdb/earthq.htm* provides details.

Warnings and forecasts

There are only two hazard warning and forecasting services that cover all PICs. They are the Tropical Cyclone Warning Centre (TCWC) based in Nadi and the Pacific Tsunami Warning Centre (PTWC) based in Hawaii. The Pacific ENSO Applications Centre (PEAC) in Hawaii also provides forecasts of

El Nino events, though their primary clients are the US and former US Territories. These centres have well established procedures and communications networks to provide warning and tracking of their respective phenomena. Many of the active volcanic centres that are close to populated centres are also monitored for activity and warnings of impending eruption are provided. Perhaps the most comprehensive of these is that centered on the Rabaul Volcanological Observatory in PNG.

Apart from the flood warning system on Fiji's Rewa River, there appear to be no local warning systems available in PIC. The dissemination of the warnings from the Rewa system to the communities under threat relies on established telecommunications systems, especially broadcast radio.

Since the severe El Nino-created droughts in PNG, Solomon Islands, Fiji and elsewhere in 1997/98, there has been some research undertaken to explore the feasibility and practicality of developing an early warning system for drought across PICs, however, this is still to be developed.

Hazard scenarios

Perhaps the most familiar way of providing hazard information to disaster managers and others is through the use of maps which portray the extent of the area likely to be affected by scenario events such as the '1:100 year' flood or storm tide or the likely ash fall or blast areas for a given volcano. These are frequently referred to as 'risk maps' though they typically relate only to a modelled, or postulated, hazard scenario.

There are many hazard or site-specific studies that contain hazard scenario (or probability) information. These include Trevor Jones' earthquake hazard assessment of Fiji (Jones, 1997), Brian Gaull's MSc thesis on seismic risk in the principal towns of PNG (Gaull, 1979), various volcanic disaster plans in PNG, Solomon Islands and Vanuatu and the Suva earthquake risk management scenario pilot project (SERMP) developed under SPDRP (Rynn, 1997).

One of the key outputs from the SOPAC *Pacific Cities Project* will be specific hazard maps as part of their urban community risk assessments in eight PIC cities. The *Communities at Risk* project will provide similar hazard maps of areas of rural population concentration.

ELEMENTS AT RISK & THEIR VULNERABILITY

Information on the hazard phenomena alone does not provide an adequate base for disaster management, after all, if there are no people involved then there is really no disaster. The development of an understanding of the elements at risk in communities (also termed 'assets' or 'capacity' by some agencies), and their vulnerability (susceptibility to resilience) to a given hazard impact, involves input from a very wide range of disciplines such as geography, demography, psychology, economics and engineering. It also involves many sources from both public, private and academic sectors.

A significant effort may need to be made by disaster managers and others to develop the very detailed data on the principal elements at risk, if they aim to create a comprehensive risk assessment. This is reflected in the approach followed by the SOPAC *Pacific Cities/ Communities at Risk Projects* and the evolving *Community Resilience* concept.

There is undoubtedly a substantial amount of background or 'baseline' information available, such as maps, population figures from national censuses and other population counts and statistics from surveys of land use and so on. The biggest challenge is to find out that it exists, what form it is in and who has it – i.e. there is a need for a 'clearinghouse' directory. A systematic approach to listing the information needed – so as to more easily identify where gaps exist – is strongly recommended.

The experience we have gained under the *Cities Project* has led us to follow a system based five broad groups of elements at risk, we refer to as the 'five esses' – shelter, sustenance, security, society and setting. We have also developed an understanding of the attribute information needed to assess relative vulnerability of each element at risk.

Shelter

The buildings that provide shelter to the community at home, at work and at play, vary considerably in their vulnerability to different hazards. There is considerable diversity throughout the PICs as far as building structure and material is concerned. This ranges from engineered, high rise buildings in urban centres, to temporary, 'bush material' shelters in many rural areas, and virtually everything else in between. The nature of shelter also ranges from family or communal housing, be it in single detached houses, or in multi-occupant blocks of flats and barracks, in commercial accommodation such as tourist resorts, hostels and guest houses, to institutional accommodation such as hospitals, hostels and school dormitories.

For disaster managers there is also a need to have details of emergency shelter and buildings that can serve as safe haves from events such as cyclones and storm tides. There is also a need for information on the availability of material, such as tents, tarpaulins and rolls of plastic, to provide temporary shelter.

To assess the vulnerability of buildings, a range of information relating to their construction is required. These building characteristics contribute to the relative degree of vulnerability associated with exposure to a range of hazards. In Table 3, the number of stars reflects the significance of each attribute's contribution to building vulnerability.

Table 3: Relative contribution of building characteristics to vulnerability

CHARACTERISTIC	FLOOD[1]	WIND	FIRE	QUAKE	VOLC[2]
Building age	***	*****	*****	*****	****
Floor height or vertical regularity	*****	*	****	*****	***
Wall material	***	***	*****	****	**
Roof material		****	*****	****	****
Roof pitch		****	*		*****
Large unprotected windows	**	*****	*****	**	***
Unlined eaves		***	*****		
Number of stories	****	**	*	*****	*
Plan regularity	**	**	***	*****	***
Topography	*****	****	****	***	****

Notes 1: Includes all forms of inundation hazard including storm surge and tsunami.
2. Volcanic hazards including ash fall and blast.

A standard set of attribute information is now being collected in the urban centres covered by the SOPAC *Pacific Cities Project*. Details are provided in Annex E. It is very similar to the approach followed under the AGSO *Cities Project*. This system is probably appropriate for any urban centre or for non-village settlements in rural areas such as mines, logging camps and sawmills, missions, boarding schools and so on. They are, however, perhaps too detailed and complex for use in rural village communities. The UNDHA CVA method provides an alternative approach which classifies village buildings along the lines shown in Table 4.

Table 4: Example of a model building classification for village communities

TYPE OF BUILDING	USE	MATERIAL
Timber house class A	Family	Sawn timber, nails, fibro walls, corrugated iron roof
Timber house class B	Family	Bush timber, nails and bush rope, corrugated iron
Timber house class C	Family	Bush timber, bush rope, matting walls, thatch roof
Concrete block house	Family	Concrete block walls, corrugated iron roof
Kitchen shed	Cooking	Round poles, thatch roof
Toilet	Toilet	Round poles, matting walls, corrugated iron roof
Community hall	Meetings	Concrete frame and block walls, corrugated iron roof
School classroom	School	Sawn timber, fibro walls, corrugated iron roof
Church	Meetings	Concrete frame and block walls, corrugated iron roof

Note: The CVA methodology envisages such a classification be developed specifically for each community.

Based on UNDHA (1998) Table 5.9, p 39

A version of the AGSO *Cities Project* building database format, modified for use in PIC villages, has been used by Unitech in the Duke of York Islands near Rabaul, PNG. This modified AGSO model (in its MapInfo format) is also included in Appendix E.

Joe Barr suggested to the delegates at the Cairns workshop that to get a village mapping and building inventory working, it might be appropriate to run a contest with a good prize for the village that produced the best map. Those maps would be copied and laminated and returned to the villages to serve as the base for their community disaster plan, whilst copies could be accumulated into a district and national inventory. The village survey and mapping methods outlined in the CVA methodology, would provide a good model for this type of activity.

Obviously, the nature of building materials and the degree to which they are used will vary greatly from village to village and from country to country, however, the basic principle of measuring the potential vulnerability of shelter buildings remains. The availability of building materials and skilled workers to undertake repairs or to re-build after a disaster are resources that also need to be considered.

Access to shelter is also significant, so information on mobility within the community is needed. Within urban areas, details of the capacity and vulnerability of the road network, for example, are important, e.g. flood points, bridges, steep-sided cuttings, traffic 'black spots' and so on.

The vehicles that use the road and the availability of those vehicles can also be important, especially for disaster managers who need to undertake an evacuation. For example, are there buses or trucks available to evacuate people who do not have their own transport or ambulances available to move people from hospitals, and so on? The availability of plant and material with which to repair or rebuild roads and bridges after disaster also needs to be known.

Information on internal access tends to be less significant at the village level where walking or bicycles tend to be the principal modes of transport. The information relating to mobility between settlements are covered under the 'setting' heading.

Sustenance

All communities are dependent on a safe and adequate supply of both water and food and to a slightly lesser extent on the fuel (or energy) for cooking and warmth. These are the minimum requirements for a sustainable community.

The larger and more complex the community, the greater the range of infrastructures and services that have been established to sustain it. Modern urban communities, for example, are highly dependent on their utility and service infrastructures such as water supply, sewerage, power supply and telecommunications. These so-called *lifelines* are, in turn, significantly dependent on each other and on other logistic resources such as fuel supply.

The interdependency aspect is shown in Figure 8. In this figure the loss of the lifeline in the left-hand column will have an impact on the lifelines across the row to a significant (**S**) or moderate (**M**) degree.

	POWER	FUEL	WATER	SEWER	COMMS	ROAD	RAIL	BRIDGE	AFLD	PORT
POWER		S	S	S	S	M	S		S	S
FUEL	S		M		M	S	S		S	S
WATER	M			S					M	M
SEWER			S						M	M
COMMS	S		S	S		M	S		S	S
ROAD	M	S	M	M	M		M	M	M	M
RAIL		M				M		M		M
BRIDGE	S	M	S	S	S	S	S			
AFLD		S								
PORT		S								

(based on Granger and others, 1999, Table 3.9)

Figure 8: Interdependency of lifeline assets

It is clear from this analysis that power supply and telecommunications ('comms') are overwhelmingly the most important of all lifeline assets in terms of what is dependant on them, followed closely by fuel supply, bridges, roads and water supply. Their significance to community sustainability, however, may be somewhat different - e.g. people can not survive for long without a safe water supply, but they can survive (albeit with some inconvenience) without the telephone, fuel, light and even power for some time. Ports, airports and fuel supply are the most exposed in terms of their dependence on the widest range of other lifelines.

In most PIC villages, supplies of lighting kerosene and fuel can, to some extent, replace the dependence on power, whilst water sources such as roof catchment, wells and streams substitute for a reticulated water supply.

The community is also dependent on the supply of food, clothing, medicine and other personal items. Information is needed on all of these, as well as on the enterprises that wholesale, distribute and service these sectors (especially facilities such as cold stores, warehouses and bulk storage depots).

In village communities the sources of food can be very diverse, ranging from garden crops and fishing to animals (such as pigs and cattle) and 'bush tucker' gathered from the surrounding countryside. The availability of these foods may be seasonal and in some communities there may be traditional methods of food storage to cover times of hardship or to cover the seasons when produce is in short supply. A good knowledge of these food sources and their susceptibility to hazards, such as drought, frost or pests, is every bit as important as a knowledge of the availability of rice and tinned fish in an urban warehouse.

Security

The security of the community can be measured in terms of its health and wealth and by the forms of protection that are provided.

To establish a better understanding of health factors, information is needed on issues including:

- hospitals, nursing homes, clinics, aid posts, doctors, nurses, dentists, x-ray services, etc;
- endemic diseases and efforts to control them, e.g. inoculation and screening campaigns;
- demographic characteristics such as the very young (under 5) and elderly (over 60 or 65);
- disabilities that reduce mobility or a capacity to cope with disaster and people who need to be accompanied by carers.

To better understand economic factors, information is needed on issues including:

- the primary industries such as commercial crops and grazing, mining, fisheries, etc;
- basic processing industries such as sawmills, abattoirs, copra mills, basic ore treatment, fish processing plants, etc;
- other secondary industries such as ship building, concrete batching plants and construction industries;
- principal tertiary industries including banks, insurance, clothing and footwear manufacture, crafts, tourist industry, repair services, etc
- the degree of dependence on subsistence agriculture and fishing – i.e. the significance of the informal economy;
- in the more formal economy, information on issues such as household income, unemployment and home ownership may be relevant.

To better understand protection factors, information is needed on issues including:

- ambulance stations, fire stations, police stations, defence force posts, etc;
- engineered works such as flood detention basins, levees, sea walls, etc;
- traditional defences such as mangrove belts to protect the coastline, etc;
- contact details for hazard specialists such as meteorologists, geologists, engineers, etc;
- contact details for key emergency services staff including disaster managers, police, fire service, military, etc;
- the resources available at the fire and police stations and military posts;
- local, district and national disaster plans.

It is particularly important to identifying those facilities and services, the loss of which would magnify the impact of the disaster on the affected community. These 'critical' facilities, such as hospitals and disaster management headquarters, may call for additional protection or planning because of their significance to the wider community.

Society

Here we find most of the more intangible, non-physical factors such as language, ethnicity, religion, nationality, community and welfare groups, education, disaster awareness, custom and cultural activities and so on. These are the aspects that define the social fabric of the community and the degree to which communities, families and individuals are likely to be susceptible or resilient to the impact of disaster.

Information required to better define and describe the social environment of the community can include consideration of:

- community and official languages and the levels of literacy in those languages;
- ethnic and racial groups and their inter-relationships, tensions, etc;
- religions represented in the community and their inter-relationships, tensions, etc;
- cultural, social or religious constraints such as dietary restrictions, funeral requirements, cultural tabus, etc;
- representation by NGOs such as Red Cross, Saint Vincents, etc;
- contact details for key community and welfare staff such as ministers/priests/pastors, NGOs, business leaders, teachers, parliamentarians, local councilors, etc;
- contact details for traditional leaders such as chiefs and other custom leaders and community elders;
- levels and availability of education and the contact details of teachers;

Some of this information may be available from the periodic censuses conducted nationally, however, the more detailed information will rely very heavily on site-specific studies such as those envisaged under the CVA methodology.

Some factors under the society theme may be measured in terms of the facilities that they use. These would include churches, meeting places, government buildings, libraries, museums and sporting clubs. These alone, however, do not provide an adequately meaningful measure of the social make up of the community.

Setting

To place communities in a broader spatial and disaster management context it is beneficial to develop information on factors including:

- the broad regional physical environment including climate, vegetation, geology, soils, land use, topography, elevation, etc (much of which may already be covered under the hazard component),
- population distribution and basic demographic information;
- external access, including links by road, rail, air, sea and telecommunications infrastructures;
- the services that provide that access, such as postal services, airline and shipping service schedules, charter services, radio broadcast programming, etc;
- external sources of power and water supply, such as remote hydro-electric and water supply dams;
- administrative arrangements, including local government, suburb, police district, electoral and other administrative boundaries;
- legal arrangements such as cadastre and land tenure.

The broad administrative arrangements under which disaster management services are provided (whilst well known to insiders such as NDMOs) also needs to be well documented, especially for outsiders.

For a more detailed listing of potential topics in each of the above themes, readers are referred to Appendix D.

COMMUNITY AWARENESS & RISK ACCEPTANCE

PIC communities are said to have a good level of awareness of the hazards that could have an impact on them. Certainly where such events are fairly common (such as cyclones) or more obvious (such as an active volcano), a strong level of awareness is clearly the case. Where events are less frequent, such as tsunami and major earthquake, the level of awareness is less well developed. For communities to take active steps to reduce risks, they must obviously be aware that the risk exists and is real. This is central to determining issues such as risk tolerance or risk acceptance. To a large degree this is a key output of the risk assessment process.

In the approach to risk assessment set out in the Australian risk management standard (Standards Australia, 1999), it is the practice to compare the level of risk found during the assessment process with previously established risk criteria, so that it can be judged whether the risk is 'acceptable' or not. At first glance this may seem to be something of a chicken-and-egg process - if you do not know what the level of risk posed by earthquake is in a given locality, for example, how can disaster managers and other government authorities realistically determine what level of risk is acceptable?

Levels of acceptability are, however, built in to such things (where they exist) as urban planning constraints and building codes. In many formal urban planning schemes, for example, the '1:100 year flood level' is often set as a constraint for residential development, whilst building code criteria are based on 'design levels' of hazard impact. For example, under the Australian earthquake loading code the 'design level of earthquake shaking' is one in which there is an estimated 10% probability of the ground motions being exceeded in a 50 year period, i.e. the acceptability criterion is set at a 10% chance of excedence over the nominal lifetime of a typical building. A similar approach is followed in the wind loading and earthquake loading codes adopted in some PICs.

Not all acceptability criteria can be expressed as categorically as this because they deal with human nature and the political *outrage* dimension of disaster management. They also vary considerably over time. The threshold of acceptance is typically much lower immediately <u>after</u> a hazard impact than it was immediately before the impact. This reinforces the need for a strong feedback mechanism between establishing acceptability and the formulation of risk mitigation and disaster response strategies.

The acceptability factor is central to the process of risk prioritisation, and hence the development of appropriate treatment strategies, including disaster plans. This is the first step in the allocation of resources to risk mitigation, especially if considered in a multi-hazard context. Under the AGSO *Cities Project*, and with our SOPAC *Pacific Cities Project* colleagues, we are beginning to address the complex issue of comparing the risks posed by hazards with greatly different impact potential. In many coastal areas, for example, there is often a strong spatial correlation between the areas that are most at risk from major inundation hazards (river flooding, storm tide and tsunami) and those in which deep soft sediments are most likely to maximise earthquake impact. Conversely these are the areas that are at least risk from landslide impact and, to some degree, from severe wind impact. These issues are, to a degree, able to be addressed scientifically by computing probabilities and modelling *Risk-GIS* scenario impacts and so on.

This scientific approach, however, does not really tell us what the community understands about the risks of disaster impact and how they believe those risks might be treated. It is here that the community consultation process embedded in the CVA approach really comes into its own. It will enable the community and the disaster management consultants working with them to develop the information needed to make decisions about their own vulnerability and capacity to cope, and to develop prioritised 'action plans'. According to Angelika Planitz of SOPAC (personal communication) the process of prioritisation the community's treatment options under the CVA methodology implicitly measures the level of acceptance. It is not clear, however, how the CVA process deals with risks of which the community is not aware but which the hazard scientists consider likely.

There are very few examples in the international literature to serve as a guide to what type of questions need to be answered in this process. One of the few I have encountered is the work undertaken in Cairns by Linda Berry of James Cook University. Her report (Berry, 1996?) includes a copy of the questionnaire used to survey some 600 Cairns households regarding their understanding of the risk of storm surge and their preparedness to cope. Whilst that questionnaire would need to be modified for use in PICs it provides an excellent starting point.

OBSERVATIONS

During the Suva workshop PIC disaster managers were asked to complete a survey that asked them to rate a comprehensive range of topics according to their perceived need for information on those topics. The results are summarised in Appendix F. The themes identified as being needed by more than 75% of respondents were:

- hazard history – details of previous earthquake, landslide, flood, etc
- hazard history – previous cyclones, severe storms, drought, etc
- population – census and estimates of numbers, age, sex, etc
- settlement type – city, town, village, hamlet, etc names and locality
- settlement structures – houses shops, schools, resorts, etc
- health services – hospitals, doctors, clinics, dentists, ambulance, etc
- welfare services – Red Cross, St Vincents, NGOs, etc
- agriculture – subsistence & other crops, livestock, storage, etc
- roads & streets – surface, capacity, bridges, etc
- telecommunications – phone, radio, TV, Web, mobile phone, etc
- water supply – source, storage, treatment, reticulation, etc
- technical experts – GIS & computer staff, plant operators, builders, etc.

This result is remarkably similar to the results of a similar survey I conducted within the police and emergency service agencies in Queensland in 1991. In that study the Queensland State Emergency Service respondents (the equivalent of the NDMOs) identified the following themes as 'must have' information.

> Rank 1: emergency service facilities, telecommunications, population, emergency shelter arrangements, urban hazards (fire, flood, etc), health services, natural hazards (cyclones, earthquake, etc), plant & animal hazards;
> Rank 2: power supply; transport hazards, settlement structures (buildings, etc), secondary hazards (fire, explosion, pollution, etc);
> Rank 3: settlement patterns, fuel storage, airfields, roads, water supply, local government services, community and welfare services, terrain;
> Rank 4: the rest

Both reflect a strong bias towards a response culture, rather than embracing a broader risk management culture. They also convey to me that there is an expectation that other information will be provided by other agencies should or when the disaster managers need it. I would suggest that this is a very hazardous approach to disaster management, let alone risk management, unless those agencies who are expected to hold and manage that 'extra' information see themselves as part of the disaster management process and are aware of the requirements of disaster managers for their information.

There is nothing more certain in the disaster management business than the fact that once a disaster starts to unfold, it is too late to start looking for the information needed to manage it. The risk management process tends to overcome this potential problem because much of the information needed to manage disasters has already been developed in the risk assessment process and is in a form best suited to the needs of disaster managers.