Department of Industry, Science and Resources

Minister for Industry, Science & Resources: Senator the Hon Nick Minchin
Parliamentary Secretary: The Hon. Warren Entsch, MP
Secretary Russell Higgins

Australian Geological Survey Organisation

Chief Executive Officer: Neil Williams

ISSN: 1039-0073
ISBN: 0 642 39796 1

Bibliographic reference: Granger, K., 1999. An Information Infrastructure for Disaster Management in Pacific Island Countries, Australian Geological Survey Organisation, Record 1999/35.

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ACKNOWLEDGEMENTS

This study would not have been possible without the financial support of the Australian Coordination Committee for the International Decade for Natural Disaster Reduction (IDNDR) who made available a grant in 1998-99 to run workshops in Suva and Cairns. The particular support of Mr Alan Hodges, Chair of the Committee and Director General of Emergency Management Australia and Ms Pip Marks, Committee Secretary, is gratefully acknowledged.

The Australian Geological Survey Organisation (AGSO) permitted me to undertake the study as part of my work for them on the *Cities Project*. Particular thanks go the Dr Colin Chartres and Dr Wally Johnson, successive Chiefs of the Geohazards Division, and Ms Trish Yates, the divisional assets controller, for their support and assistance.

The study was strongly supported by the South Pacific Applied Geoscience Commission (SOPAC). Of particular assistance were the SOPAC Director, Mr Alf Simpson, Dr Graham Shorten (Hazard Assessment Unit), Mr Joe Chung and Mr Atu Kaloumaira (Disaster Management Unit). The administrative staff of SOPAC also greatly assisted in the organisation of the Suva workshop.

The Cairns workshop was made possible by the James Cook University Centre for Disaster Studies who assisted us to take advantage of the attendance of several disaster managers from the Pacific Islands at a conference they had arranged in Cairns. The attendance of the Pacific Island delegates at this conference was sponsored by AusAID, and their assistance is also appreciated. The assistance of Ms Linda Berry of JCU in organising the workshop is especially appreciated.

The most important input to the study came from the delegates who attended the two workshops and the specialists (Harald Schoelzel, Suse Schmall, Wolf Forstreuter, Franck Martin and James Britton) who gave presentations to the Suva workshop. To them go my sincere thanks for their professional input, interest and fellowship.

The study would undoubtedly have been far more technical and focused on GIS issues had it not been for the input of both my wife Judy (who was involved in the running of both workshops) and Angelika Planitz of SOPAC. They provided me with their very perceptive insights on the less tangible and less technical issues that have, hopefully, made this study much more complete. I hope the scope of this report has done justice to their invaluable and most welcome input.

I am also very grateful to Dr Wally Johnson and Mr Ian O'Donnell of AGSO and Dr Graham Shorten and Ms Angelika Planitz of SOPAC for reviewing a draft of this report and providing valuable comments and suggestions.

Ken Granger

Brisbane
July 1999

EXECUTIVE SUMMARY

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.

This report is the outcome of a study into the information needs of disaster managers in Pacific Island Countries (PICs) and the nature of the information infrastructure needed to ensure the delivery of that information. It addresses two key aspects. First, it provides a guide to follow by those engaged in disaster management and research in building their own project, national or regional disaster information collections It is specifically targeted at the National Disaster Management Officers (NDMO), regional agencies such as the South Pacific Applied Geoscience Commission (SOPAC) and aid donors. Second, it makes some observations on a range of technical and organisational issues, such as data formats, transfer standards and custodianship arrangements, that need to be considered in establishing and operating any modern information infrastructure.

The research undertaken clearly demonstrated that PIC disaster managers recognise and appreciate the need to have appropriate information available to them at all stages of the disaster management process. It was not possible, however, to investigate the reality of information use during an actual disaster situation. None-the-less, a culture of using information certainly exists.

It is also clear that disaster managers throughout the PICs possess a broad range of skills and experience in managing and applying information for decision making in disaster situations. Clear also is the fact that there is a nucleus of technical and professional staff throughout the PICs that have skills, training and experience in the use of geographic information systems (GIS) and the manipulation of spatial information – a major component of disaster management information. The level of collaboration and interaction between these two groups, however, is less certain.

As part of the research, 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. Given the narrow focus of that survey, it is not surprising that the topics identified reflected a strong bias towards disaster response needs and closely parallel the needs identified in similar surveys of response-oriented emergency workers in Australia. It needs to be recognised, however, that 'disaster management' covers a much broader field than those whose primary responsibility is to manage the response phase. The scientists who develop an understanding of the hazard phenomena and operate monitoring and warning systems, for example, require a broad range of information, as do those responsible for designing and implementing mitigation activities and for planning and managing the recovery process. Disaster management, after all, is part of the total community governance process and its information needs fit within the broad needs of that process

An impression was gained that disaster managers have an expectation that much of the information they need will be provided by other agencies should or when the disaster managers need it. Experience suggests that this is a very hazardous approach to disaster management unless those agencies who are expected to hold and manage that information see themselves as part of the disaster management process and are aware of the requirements of disaster managers for their information

A key first step in establishing a information infrastructure, therefore, is the creation of a clearinghouse mechanism, including an information inventory through which disaster managers can find and arrange access to the information they need to make decisions. There is evidence, for example, that in some PICs, such as PNG, Vanuatu and Cook Islands, government agencies and/or universities of the former colonial administering nations such as Australia, New Zealand and the United Kingdom, have more complete and detailed inventories (and collections) of information than now exist in the country itself. This is clearly an area that needs much work, however, most PIC have access to the technology that can make such a mechanism accessible across the country and across the region.

The creation of an effective information clearinghouse to support disaster management throughout the PICs will inevitably mean the development of technical standards and institutional arrangements. Both of these factors lie well outside the realm of disaster managers. Disaster managers, however, will need to play a role in the development of both because it is simply not possible to reduce the impact of disasters without appropriate information. That may require using outside experts to influence the process, 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. There is also a major role for agencies such as SOPAC and the regional universities to assist in the more technical areas of developing, negotiating and introducing standards – as they already do.

The experience of local governments and small regional groupings of spatial data users in Australia could serve as a useful guide for PICs, SOPAC and aid donors to look at if it is decided that a formally structured information infrastructure is to be developed. That experience may be more appropriate than the higher level experience at state and national level in Australia, New Zealand or the USA 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.

It is a relatively simple task to describe and define the components of an information infrastructure that would be suitable to support disaster management in PICs. Implementing such a process, however, will not be so simple. It will take time and it will take commitment on the part of all those involved because there are at least four sources of frustration that will need to be addressed before it can become a reality.

A recurring view was expressed by NDMOs that they had 'heard it all before' at various conferences and workshops, but nothing practical had ever eventuated. They are looking for a worked-through example that they can follow and the resources to do it. That can not be achieved in a workshop; it can only be achieved on the ground in a real-world situation.

The lack of communication reaching both down to, and up from, the village level was also seen as a major source of frustration, and consequently a major hurdle. For a process that is all about information and improving the effectiveness with which it may be disseminated and used, the sharing of information about the process is critical – and that depends on communication.

The third frustration revolves around a stated lack of coordination and cooperation between the people and agencies that should be working together to improve community safety. This was seen as part of the power and political processes that tend to build barriers, rather than bridges.

The fourth key frustration relates to the perceived lack of resources – human, financial and technical. This is probably a universal frustration for all disaster managers. Typically, they are allocated only limited resources because senior policy makers seem to hold the view that a disaster is unlikely to happen during their term in office, so why spend too much money on a disaster management system that does not bring significant votes with it. This may be a simplistic and cynical view, but it seems to correlate well with reality.

These are not technical issues, they are human issues - an information infrastructure is not a physical thing, it is more of an accepted way of doing things. An information infrastructure is a philosophy, not a technology.

Fortunately, frustrations can be overcome, even those as seemingly intractable as the four identified here. There are significant components of an information infrastructure already in place in most PICs and a number of real-world case studies are either under way or planned that can demonstrate and promote the value of the support an information infrastructure can provide to disaster management.

These include programs such as the SOPAC *Pacific Cities* and *Communities at Risk Projects* and SPDRP initiatives such as the Community Vulnerability Analysis process.

These established foundations are very sound indeed, and provide an excellent base on which to build an appropriate and sustainable information infrastructure that can address issues from the village level to the level of the national capital and beyond. There are undoubtedly frustrations and problems that will need to be addressed along the way, however, it is clear that NDMOs are committed to embarking on this journey. It is also clear that they will make a good job of it because they are committed to the task.

The way ahead

This report provides a 'road map' for NDMOs and others to follow in building and managing the information resources they need to manage disasters. Having a map, however, is of little value unless one is both prepared to start the journey and committed to completing it. The commitment appears to be there in PICs, so how best to help NDMOs and others to start the journey?

The following simple pointers might help:

- the best place to start is with the information that is already held by disaster managers. Develop an inventory of existing material as the first step so that it is easier to identify where the significant gaps are;
- sketch out an information management plan, as part of the disaster management plan;
- be prepared to take time - it is important to be practical in setting targets because if they are too ambitious at the outset and subsequently fail, the whole process of developing the information management process could be seriously set back;
- establish priorities using the 80/20 rule - that says that 80% of the answers can be provided by 20% of the information;
- develop partnerships with key data custodians and research agencies and involve as wide a cross section of stakeholders as possible in the process;
- whilst the ultimate objective may be to employ GIS and other computer decision support tools, it is not necessary to have such technology in place before starting to either use information or to build an information infrastructure. Hard copy maps, manuals, reports and so on, will always be needed and used, regardless of how many computers are available;
- it is much easier to 'sell' the message of information and information infrastructures if their benefits can be demonstrated in a real-world case study. Having a worked-through example to demonstrate is far more believable than a 'dummy' or artificial example. It is also human nature to want what the neighbour has, so by being able to demonstrate what one village or town has done and the advantages that they have gained, tends to stimulate other villages and towns to want the same advantages. Case studies are also very useful for disaster managers to share their experience and to exchange ideas that might be useful in other areas. The work completed by the *Pacific Cities Project* in establishing a broadly based information infrastructure for its case study cities provides an excellent starting point;
- insist that disaster management research and aid programs involving outside experts contain a strong information management component that can easily be incorporated into national and local systems; and,
- don't be afraid to ask for help – you are not alone.

CHAPTER 1: AN OVERVIEW

INTRODUCTION

This report is the outcome of a study into the information needs of disaster managers in Pacific Island Countries (PICs)[1] and the nature of the information infrastructure needed to ensure the delivery of that information. It addresses two key aspects. First, it provides a guide for National Disaster Management Officers (NDMO) and regional agencies such as the South Pacific Applied Geoscience Commission (SOPAC) which are engaged in disaster research, to follow in building their own national and regional disaster information collections. Second, it provides some observations on a range of technical and organisational issues, such as data formats, transfer standards and custodianship arrangements, that need to be considered in establishing and operating a modern information infrastructure.

This study was made possible by **Grant 19/98** from the Australian Coordinating Committee for the International Decade for Natural Disaster Reduction (IDNDR) and the support of the Australian Geological Survey Organisation (AGSO) under its National Geohazards Vulnerability of Urban Communities Project (more commonly known as the *Cities Project*). Support was also provided by the staff of the SOPAC, especially those in the Hazard Assessment Unit (HAU) and the Disaster Management Unit (DMU).

Key input was gained through two workshops. The first was held in Suva, Fiji, on 2 and 3 October 1998 in conjunction with the 7th IDNDR Pacific Regional Disaster Management Meeting and the 27th SOPAC Council Meeting. This workshop could be said to have reflected a national-level, urban centre focus. The second was held in Cairns, Australia, on 4 November 1998 and took advantage of the attendance of several PIC disaster managers at the *Disaster Management: Crisis and Opportunity* conference run by the Centre for Disaster Studies at James Cook University. This smaller workshop had a stronger focus on community or village-level needs. Appendix B lists the delegates at the two workshops. This study also builds on the experience I gained in co-facilitating a workshop held in Port Moresby, Papua New Guinea (PNG), in March 1998 aimed at initiating the development of a national spatial data infrastructure for PNG (Granger and others, 1998) and through the development of an information infrastructure to support the AGSO *Cities Project* study of Cairns (Granger, 1998).

BACKGROUND

At the 6th IDNDR Pacific Regional Disaster Management Meeting, held in Brisbane in 1997, it was resolved that the primary IDNDR theme on which the South Pacific Region would focus for the remainder of the Decade would be '**Shared Knowledge and Technology Transfer**'. Amongst the key activities recognised as being necessary to achieve this was the development of an effective information infrastructure and geographic information system (GIS) capability to underpin disaster management activities.

The South Pacific Disaster Reduction Program (SPDRP) Phase II project proposal, as revised at the Brisbane meeting, set as an immediate objective:

> *to enhance national capacity to reduce natural disaster risk through development and implementation of mitigation measures*

and went on to establish, as its first output:

> *requirements for disaster management information and communication systems at the regional and national levels identified.*

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[1] A list of acronyms and abbreviations used in this report is provided in Appendix A.

These objectives were based to a significant degree on the report to the SPDRP by Professor Rob Stephenson on his analysis of the requirements for disaster management information systems in the PICs (Stephenson, 1995). Stephenson's study concentrated on the technology of information systems and communications components of an operational information infrastructure. This report concentrates on the non-technology components, especially the information that is needed to support disaster management in the PICs.

The development of a disaster management information infrastructure is already being pursued by SOPAC. This commenced with the establishment of the *Pacific Cities Project* which is developing comprehensive multi-hazard risk assessments of eight key PIC urban communities (Apia, Honiara, Lae, Luganville, Nadi-Lautoka, Nuku'alofa, Port Vila and Suva). Not only do these centres contain substantial populations themselves, they also provide the administrative, commercial, health, welfare, social and logistic services to much larger local, national and regional populations. The work done so far under the *Pacific Cities Project* has come largely from a scientific direction and has already adopted many of the more technical aspects of an information infrastructure. A proposal was accepted by the SOPAC Governing Council in 1998, to identify the rural population concentrations at risk from hazards such as tsunami, cyclones and volcanic eruptions following the major tsunami disaster experienced at Sissano in PNG. This project is titled *Communities at Risk*, and, whilst still evolving, it will build on the risk assessment approach already established under the *Pacific Cities Project*. That approach starts from an essentially external scientific perspective and integrates it with local community knowledge, experience and expectations. It takes an 'outside-looking-in' approach.

At the time of writing, a proposal is being developed in SOPAC to undertake a *Strengthening Community Resilience Through Applied Community Risk and Vulnerability Analysis* project. The concept established for this proposal is a fusion of the scientific (outside-looking-in) approach of *Pacific Cities/Communities at Risk* and the community self-assessment approach (or 'inside-looking-out' approach) known as Community Vulnerability Analysis (CVA). CVA was developed under the SPDRP and is outlined in UNDHA (1998). The development of a strong information infrastructure is also identified as a central feature of the *Community Resilience* concept.

Information, and its effective management, has been identified as the key to the success of these projects, as well as to operational disaster management. **Accurate, appropriate and timely information is clearly a key ingredient in effective disaster management – it can have life-or-death significance.** The key issues for information management for disaster management in the PICs was identified at the Brisbane meeting in the following terms:

> *Accessing and disseminating information is the core business of disaster managers. There is much information available within PICs both as raw data and as analysed data. This shows that apart from the technological requirements of information systems, the management process of information forms another crucial component. In order for the system to meet the needs of its users, namely Pacific disaster managers, the fundamental data/information needs must be understood. The following questions will help to create this understanding:*
>
> *a) What are the problems, the system should help to solve?*
> *b) What information does the system need to solve these problems?*
> *c) Where can this information be accessed?*
> *d) In which format should the information be disseminated?*
> *e) To whom should information be disseminated?.*
>
> *Some of these questions have been addressed already.* ***Ultimately all elements of the system have to be linked up in order to establish the information infrastructure.*** *The infrastructure will have various levels (local, national, regional and international) and must go hand in hand with administrative developments concerning hardware standards, data quality control etc. Inter-agency collaboration is not only crucial at the regional level but also at the national*

level. Information systems development will be considerably enhanced through inter-agency cooperation. National data centres corresponding to the regional data centre will be established, that will provide all in-country users direct access to data and information.

(SPDRP, 1998)

This project is aimed at addressing those questions and consequently providing PIC disaster managers at local, national and regional levels with the basic structure and guidance by which to build the essential information infrastructures. Given the overwhelming significance of spatial information in disaster decision making, and the increasing use of GIS as a disaster decision support tool in PICs and elsewhere, considerable emphasis is given to the development of an effective spatial information infrastructure (SII), as the key component in the wider information infrastructure.

DATA, INFORMATION & KNOWLEDGE

Before describing what is involved in an information infrastructure, it is useful to first consider the differences between data, information and knowledge, because these words are often used interchangeably, even though they are very different things. The relative availability of the material to support the decision-making process can be summarised as follows:

We have oceans of data, rivers of information, small puddles of knowledge and the odd drop of wisdom

(Nix, 1989)

Collections of data are the raw material. They are of little value taken on their own, but begin to gain value when they are drawn together to create information. Decisions can begin to be made at the level of information. Information elements, in turn, gain greater value and potency when they are integrated with other relevant information elements (and experience) to generate knowledge - as Einstein once observed 'the only source of knowledge is experience'. Sound decisions are based on knowledge. Wisdom, for disaster managers, emerges from learning the lessons of success and failure gained through managing actual disasters and wisdom requires a store of knowledge. It is clear that a large store of knowledge of disasters already exists in villages and communities throughout the Pacific. For modern disaster managers it will need to be built through the formal analysis and assessment of actual events and the post-disaster debrief process.

Discussion of 'information' these days inevitably includes discussion of technology Indeed, 'information' is commonly used interchangeably with 'information technology'. These are not the same things. Whilst the technology is important, it is the information that it helps to assemble, store and manipulate, that is paramount. It is as well to remind ourselves that human-kind had been using and storing information for tens of thousands of years before the invention of the printing press, let alone the computer. Without data and information, a computer is just an expensive desk ornament!

One of the first systematic reviews of the needs for information and the application of information technology in the disaster management field was undertaken by a subcommittee of the US Congress following the Mount Saint Helens volcano disaster of 1980. That group observed:

Improvement of the quality of information – narrative, statistical, graphic – which must be accessible to emergency managers is a sin qua non. *'Profiles' of need and use must be established, and data categories of overlapping utilization have to be identified. Methods of keeping such files current, and dispatching updated 'essential elements of information' to outlying users, deserve review and refinement. In essence, there is a requirement to create a coordinated hierarchical information and communications capability that can fulfil known emergency management needs.*

(US Congress, 1983)

The development of 'profiles of need' and the identification of the 'essential elements of information' are integral parts of the information management process that lies at the heart of any information infrastructure. Indeed, at the heart of any **use** of information, is the process of information management.

INFORMATION MANAGEMENT

Information management is a simple cyclical process (known in some areas as the 'intelligence cycle') that takes the form shown in Figure 1. It has four stages – direction, collection, processing (or collation) and dissemination.

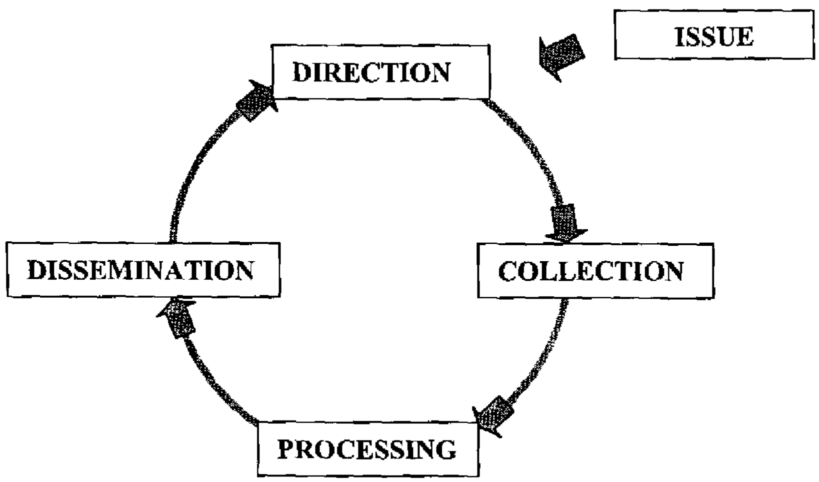

Figure 1: The information management ('intelligence') cycle.

Direction: The first steps in establishing any information management regime are to:

- monitor the external environment to identify problems as they evolve and to be responsive to issues that are identified from outside the 'system';
- define the problems to be addressed;
- identify the information requirements that flow from them; and,
- identify who is to benefit from the information.

This assumes that those involved accept that information is an essential ingredient in decision making – i.e. it assumes that an information culture exists.

It is through this problem identification and definition process that the elements of information and profiles of need discussed in the US Congress report are established. In that process, the very broad nature of the information requirement becomes clear. Identifying the beneficiaries (frequently the same people who identify that a problem exists) also helps to establish the level of detail that might be required, the area or extent needed to be covered, and so on.

Once the problem has been defined, it is possible to prepare an information collection plan to satisfy the profiles of need and to assign responsibility for gathering and maintaining the information. This will include the broad background information (sometimes called 'baseline', 'foundation' or 'fundamental' information) as well as the more immediate information relating to a specific situation.

In a disaster management context, delegation of responsibility for information collection and maintenance might parallel the responsibilities outlined in the disaster plan. For example, the agency with responsibility for the provision and management of emergency shelter would, as part of that responsibility, gather and maintain information on shelter resources and their status. Such an approach avoids the need to set up an information collection and management system completely separate from the disaster management system. This is commonly referred to as custodianship.

A central point of control for directing the information management process is, none-the-less, needed within the disaster management process. That point of control will also need to interface with the wider local, provincial or national information management control arrangements to ensure that the disaster management information requirements and needs are adequately represented in the wider process.

Collection: Implementation of the collection plan should be focused on the essential elements of information that have been identified (both baseline and situation-specific), with collection priorities flowing from the profiles of need. Working to the standards established by the directors of the information management system, information collectors need to employ all the data capture resources available to them. These include making use of existing information that may have been developed for other purposes, such as land management or social planning, but which is also relevant to disaster management.

Modern technology can have a significant impact where data must be captured from scratch. Remote sensing technologies, whether carried by satellites or on aircraft, hold great potential for providing specific information of great value in a disaster situation, especially in remote areas, whilst the Global Positioning System (GPS) now makes accurate position finding very simple. The bulk of information collection, however, will need to rely on more basic and traditional methods such as getting out and asking questions or making measurements on the ground. Satellites can not tell us what people are thinking or feeling, nor can they educate us about the experience of villagers in coping with disasters over generations.

Getting the information that is gathered to those who have a need for it is part of the collection process. Here again, technology provides many advantages such as the instantaneous transfer of data and information from the field to a distant headquarters via satellite communications systems. Though traditional methods, such as writing a report or drawing a sketch map or plan on paper, and sending them by mail or by runner, continue to remain important in PICs.

It is important to involve the eventual users of the information in the design and development of the collection process, not only to ensure that their needs are fully taken into account, but also to maximise acceptance of the process by users. This is a central focus of the CVA methodology, for example.

Processing: It is in this stage that the answers to the various questions are developed by converting data into information. This calls for a system that facilitates the collation, analysis, evaluation and interpretation of the data. It is in this process that tools such as GIS and other information technologies (such as databases and spreadsheets) provide considerable help. It is important, however, to ensure that information processing for disaster management is neither totally dependant on technology nor on the skills and experience of a single person. The processing function should be quite robust, especially during disasters where they are under the most extreme pressure.

Some of the more complex forms of processing, such as terrain modelling or the analysis of multi-dimensional inter-relationships such as the effect of wind at different levels on the spread of ash during a volcanic eruption, are simply too slow, too difficult, or too daunting to undertake manually. They are also the types of processing that can (and should) be undertaken before the onset of disaster. It is also important to recognise that much of this processing does not need to be undertaken by disaster managers. This is the role of specialists such as vulcanologists, meteorologists, social scientists, engineers and so on. Disaster managers do, however, need to receive that processed information in a form that they can understand and use.

The processing phase is also the stage at which baseline information, such as population statistics, land tenure, terrain mapping and so on, is maintained and enhanced. It is also the stage in which data quality is checked and, if necessary, brought up to the desired standard.

Dissemination: The final process in the cycle is the timely distribution of the information to those who need it to make decisions. With modern systems, the ability to present the processed information in a variety of forms including text, tables and graphic products adds greatly to the capacity to both disseminate the information and for it to be understood. This reduces the chance of disaster managers and the general public falling into the old trap of 'information-free decision making'.

And then the process starts all over again as more disaster lessons are learned, problems posed and questions arise.

THE DISASTER MANAGEMENT AND RISK CONTEXT

In developing an information infrastructure for disaster management it is important that it be seen in the context the broader community-wide information infrastructure, and that the disaster management process be seen in the broader context of community governance and risk management. **Disaster management is not an end in itself, but one end point in the much larger process of community governance.** As such it involves a wide range of people and disciplines, not just those designated as 'disaster managers'.

The holistic nature of this broad view of disaster management can be illustrated by reference to the risk management process which is described in *AS/NZS 4360:1999* in the following terms:

> *Management of risk is an integral part of the management process. Risk management is a multifaceted process, appropriate aspects of which are often best carried out by a multi-disciplinary team. It is an iterative process of continual improvement.*
>
> (Standards Australia, 1999, p7)

The process is shown in overview in Figure 2.

I repeat the words of the Standard, that this is 'a multifaceted process' that should be carried out by 'a multi-disciplinary team'. That is to say that the prevention, preparedness, response and recovery (PPRR) components of disaster management requires a multi-disciplinary approach. The medical staff that are involved in treating victims; the agricultural people who monitor crop production; the businessmen that understand the supply and transport of food and other essentials; the Red Cross organiser involved in public awareness programs at the village level; for example, are all 'disaster managers' in their own right. Collectively they are involved in all stages of the PPRR process, even though they may not identify it as such until there is a need to respond to an actual disaster event.

The information that is required to support disaster management is, to a significant extent, the output from a wide range of other processes that are seemingly remote from disaster management. Professional disaster managers should, therefore, not attempt to carry out the whole process by themselves, but they should participate in the various stages so that the information that flows from each stage is understood and appropriate to the needs of disaster managers. If these linkages are established within the information infrastructure, then the process of communication and consultation is greatly enhanced and the disaster management effort is significantly more robust.

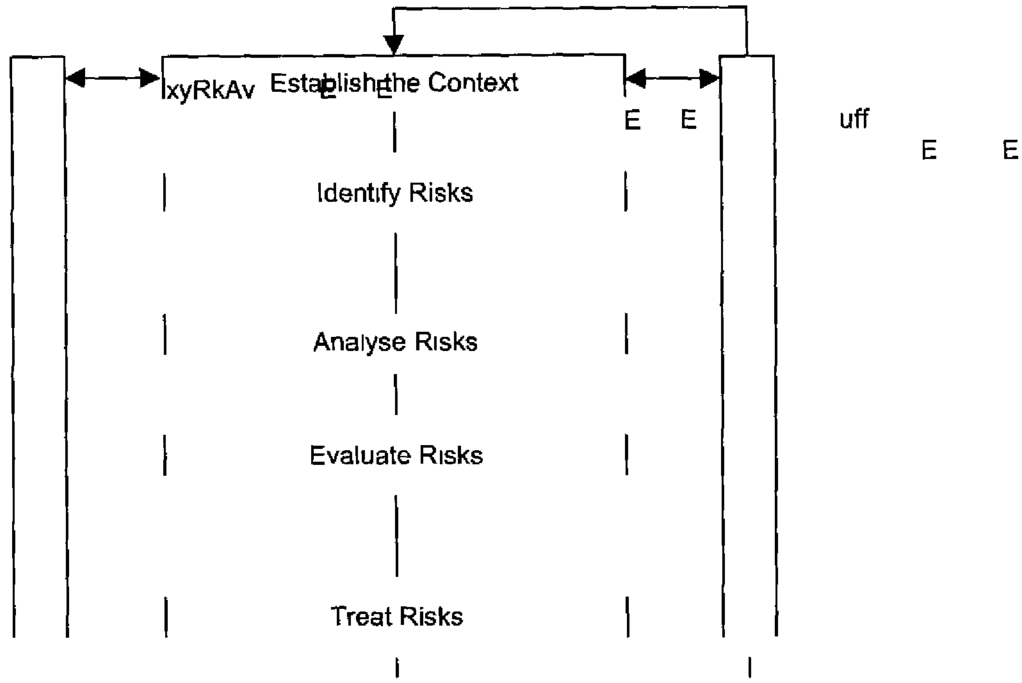

Figure 2: Risk management overview (Standards Australia, 1999, Fig 3.1, p 8)

SPATIAL INFORMATION AND *RISK-GIS*

I have already drawn attention to the fact that a very large proportion of the information needed by disaster managers to make effective decisions is to do with location – i.e. 'everything is somewhere' This is spatial information. Spatial information typically includes the information that appears on maps but it can also include information that is linked to places or localities by name or by a variety of other referencing systems.

Over the past decade or so, GIS have been used increasingly as tools to provide information to address specific aspects of the disaster management problem, especially in hazard mapping and modelling for phenomena such as flood and storm tide inundation. Burrough (1987, p 6) provides a typical definition of GIS, the tool, as:

> *a powerful set of tools for collecting, storing, retrieving at will, transforming, and displaying spatial data from the real world for a particular set of purposes.*

This definition has a clear focus on the technology, and in this report I use the term 'GIS' to specifically refer to the technology component. There are clear advantages, however, in developing a fusion between the broad philosophy of risk and/or disaster management and the power of GIS as a decision support tool, hence *Risk-GIS* as it has been christened in the AGSO *Cities Project.* It has, as its philosophical roots, the comprehensive risk management approach outlined in the Australia and New Zealand risk management standard *AS/NZS4360.1999* (Standards Australia, 1999) and the view embodied in Dave Cowan's (1988) definition of GIS as:

> *a decision support system involving the integration of spatially referenced data in a problem solving environment.*

In this context, the 'problem solving environment' is risk or disaster management. I use the term '*Risk-GIS*' to refer to the broader application of the technology to disaster decision making.

The disaster management process imposes a significant demand for a wide range of information products. To cater for this demand, *Risk-GIS* must be structured to cope with all external inputs, internal operations and output to a wide range of external consumers. Figure 3 summarises the key structural elements of *Risk-GIS*.

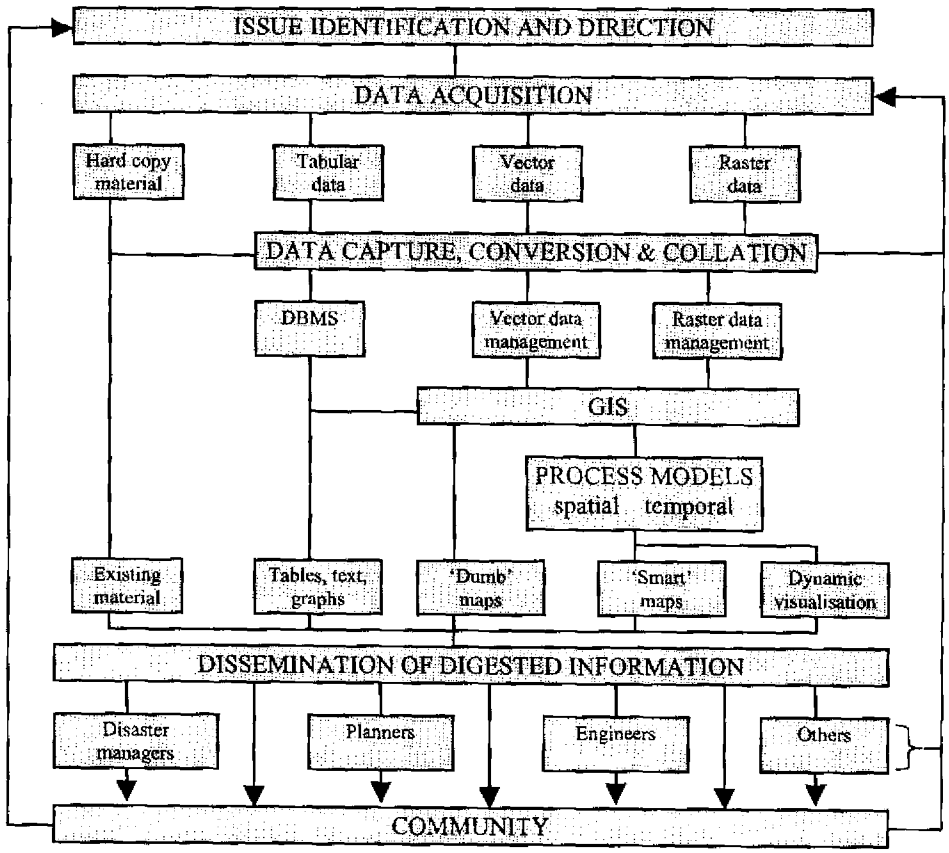

Figure 3: *Risk-GIS* structural elements

This model goes somewhat beyond the conventional view of GIS as being made up primarily of hardware, software and data. It also incorporates the people, administrative arrangements and infrastructure issues as well as recognising the significance of:

- the information management ('intelligence') cycle process. Implicit in this is the progressive enhancement of data to create information and the eventual formation of knowledge and wisdom;

- the range of information products that satisfy the diverse needs of risk managers and the communities they serve and the diverse source material that must be drawn on to create those products. These include conventional and well established 'hard copy' products such as printed maps, books, manuals and so on; simple (one-dimensional) tables, graphs or textual descriptions drawn from databases and spreadsheets; customised, but essentially 'dumb', two-dimensional maps and graphics; three-dimensional maps (i.e. those in which the attributes of map features contained in databases are interactively linked within a GIS); and dynamic visualisation including simulations, animations, 'virtual reality' and other 'multi-media' (i.e. four-dimensional) products;

- the information infrastructure that facilitates the flow of data and information throughout the model (shown as the linking lines);

- the recognition that the process and structures are aimed at meeting the needs of the community as the ultimate beneficiaries who in turn provide input to the system.

AN INFORMATION INFRASTRUCTURE

The process of information management and the structural requirements of *Risk-GIS* provide the foundations on which to build an information infrastructure, especially a SII. **It should be emphasised here that an information infrastructure is not a physical thing, it is more of an accepted way of doing things.**

There are six elements that go to make up this model of an information infrastructure. They are:

- an information culture;
- the right people;
- a coordination process;
- data and information products;
- guidelines and standards; and,
- an institutional framework.

This model is applicable at any level of jurisdiction - from the smallest local village or project; to the local council or business level; to the provincial and departmental level; to the national level; to the international level. It is also applicable to any 'industry' focus. In this report, however, I will generally relate to the disaster management 'industry' in its widest context.

These components have been placed in the above order to reflect their relative importance and the priority they might receive in the implementation process. This reflects a 'bottom-up', user-oriented emphasis that was consistently identified as being the requirement during both workshops, rather than the 'top-down' control-oriented approach that seems to be reflected in models such as the Australian Spatial Data Infrastructure (ASDI) outlined in Appendix C. Vertical integration, whether top-down or bottom-up, is very important in maximising the level of coordination, collaboration and integration that is the major objective of implementing an information infrastructure.

An Information Culture

I have already introduced the notion of an information culture and its role in stamping out the practice of 'information-free decision making'. This practice is not confined to disaster managers or the Pacific – it a very widespread phenomenon.

There are at least four powerful forces working against developing and sustaining an information culture. The first such force is what I have called 'spinformation' (i.e. the output from 'spin doctors') which distorts, misuses or censors knowledge for the purposes of exerting power and influence (Granger, 1997). This is epitomised in the 'First Law of Journalism', namely that *facts should not get in the way of a good story*. It is not the same thing as wrong or incorrect information; it is much the same thing as propaganda. It works against the development of an information culture because it devalues information and creates mistrust in it by decision makers.

The second limiting force is the general lack of spatial awareness exhibited by many decision makers, despite the fact that the overwhelming majority of decisions made in most fields contain a spatial element. How often have we seen decisions handed down by economists, politicians, engineers or planners that do not make sense environmentally or in terms of community safety, simply because spatial relationships have been ignored? Housing developments on flood plains or areas prone to coastal inundation, hazardous or noxious industries developed up-wind from residential areas, or waste disposal facilities sited in aquifer recharge areas, are just a few of the more obvious decisions that are spatially stupid, if not reprehensible.

The third force is the widespread fear of information and knowledge. There appears to be an unwritten law that the higher up the corporate or institutional ladder one climbs, the less knowledge one should seek because of the constraints it places on 'independent' decision making. In describing what he terms the 'brain-force economy', the American futurist Alvin Toffler observed in an interview published in *Wired* (November, 1993):

> *If you have the right knowledge, you can substitute it for all the other factors of production. You reduce the amount of labor, capital, energy, raw materials, and space you need in the warehouse. So knowledge is not only a factor of production, it is the factor of production. And none of the powers that be, in Washington and in the industrial centres of our country, seem yet to fully comprehend it. It scares them. It's threatening.*

The same observation could be made of any other country and, again, in any industry.

The fourth, and possibly most wide spread, force is an aversion to systematic record keeping and documentation – i.e. a general lack of good information management practices. The 'file and forget' and the 'why bother to file' approaches are said to be very much alive and well in PICs – and elsewhere.

These barriers have got to be overcome before an information infrastructure can become a reality. Disaster managers need to remind themselves regularly of the observation made by that other great futurist, Aldous Huxley, in his essay *Proper Studies*, that 'facts do not cease to exist because they are ignored.'

The Right People

GIS (the technology) is not a 'black box' solution that only requires the right buttons to be pushed to obtain 'the truth'. It requires people who not only understand the technology of GIS and its associated systems such as GPS and remote sensing, but who also understand the real world problems they are trying to solve with GIS (the disaster, natural resource, planning, engineering and human services managers, for example). The 'right' people provide the input that energises the whole infrastructure. The 'right' people are those who are competent, committed, cooperative and communicative. These human resources issues are discussed in more detail in Chapter 2.

Co-ordination Process

Given the widespread and diverse nature of the information required to support disaster management, a mechanism is needed through which knowledge of the nature and availability of spatial data products and data sets, both within the country and outside, can be made available and access facilitated. A central feature of this process is the operation of a directory, or network of directories. This directory serves as the index to the 'library' of data held across the country and beyond. It does **not** hold or control the data itself, it simply identifies where it is and who to contact to get it. These issues are also explored more fully in Chapter 2.

Data and Information Products

The identification and provision of the data sets and products that are required by the widest range of users is a central aspect of any information infrastructure. These data sets and products provide the foundation on which all GIS applications may be built. It is usual to establish minimum (or fundamental) requirements for both baseline data sets and those data sets required for direct disaster management, including scale, accuracy and the range of attributes to be included. Those requirements will evolve as experience in the application of spatial information increases in disaster management in PICs. It is a function of the coordination process to monitor and manage that evolution. These issues are covered in considerable detail in Chapter 3.

National Guidelines and Standards

To maximise the integration and exchange of spatial data it is necessary to establish a range of standards and guidelines as an integral part of the information infrastructure. Some of the more technical standards, such as the implementation of the national or regional spatial datum (such as WGS 84) may be mandated by legislation, whilst others may be established by default (e.g. through the widespread use of a specific GIS, such as MapInfo). The guidelines and standards developed will need to cover:

- transfer standards (detailed technical standards to enable data to be moved from one GIS environment to another without loss of information);
- geographic guidelines and standards include coordinate systems and projections, location keys (such as property address), attribute content and classification standards (e.g. standard soil or vegetation classifications);
- algorithm guidelines and standards to cover computational operations of GIS such as slope analysis or DEM generation; and
- interpretation guidelines and standards to cover aspects of accuracy, uncertainty statements, descriptions of ground truthing and so on.

These issues are addressed in Chapter 4.

Institutional Framework

The oversight of the policy and administrative arrangements for building, maintaining, funding, accessing and applying the national standards and guidelines and their application to the basic information products used across the nation requires an institutional framework. These matters typically lie outside the realm of disaster management, however, NDMOs will need to become involved so that their requirements and priorities are reflected in national and provincial spatial information programs These matters are also covered in Chapter 4.

THE DESIRED OUTCOME

If the various components of the information infrastructure/SII come together, then disaster managers will be in a much stronger position to make better decisions at all stages of the PPRR process. This information will be more comprehensive, more current and more integrated than it presently is. I can illustrate this by way of an excellent quote and a few cartoons.

Psychologists Joseph Reser and Michael Smithson (1988) have observed that:

> *A hallmark of many ignorant people is their unflinching confidence that they possess total knowledge. Likewise, truly deep knowledge may bring with it a sober cautiousness about issues most people regard as settled, and a wider appreciation of how much remains unknown.*

The 'total knowledge' that we all seek requires information to be complete and properly organised. In the GIS literature this is typically shown by a diagram like Figure 4. The reality, that should give rise to 'sober cautiousness' is, however, more akin to the situation illustrated in Figure 5, or more frequently as shown in Figure 6.

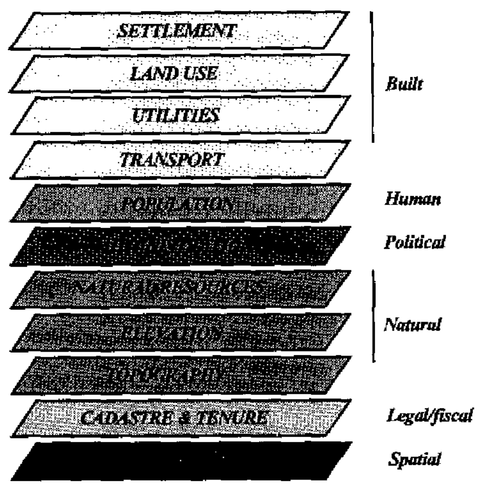

Figure 4: The idealised spatial information situation

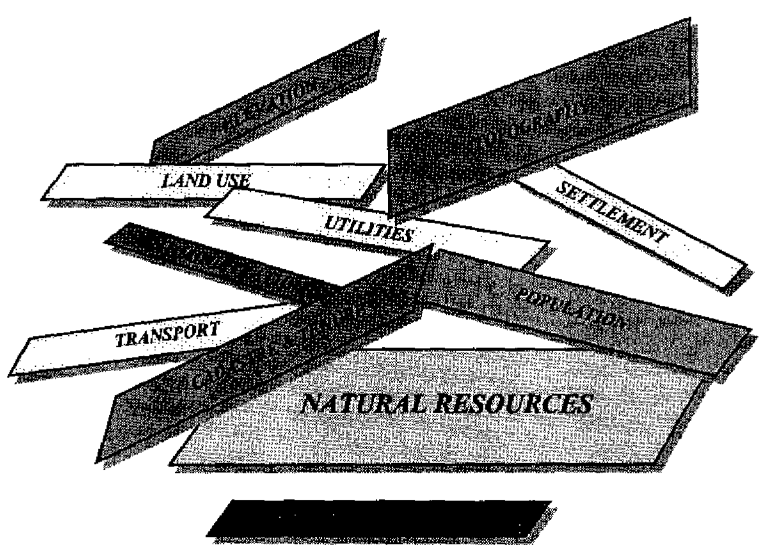

Figure 5: The complete spatial information 'reality'

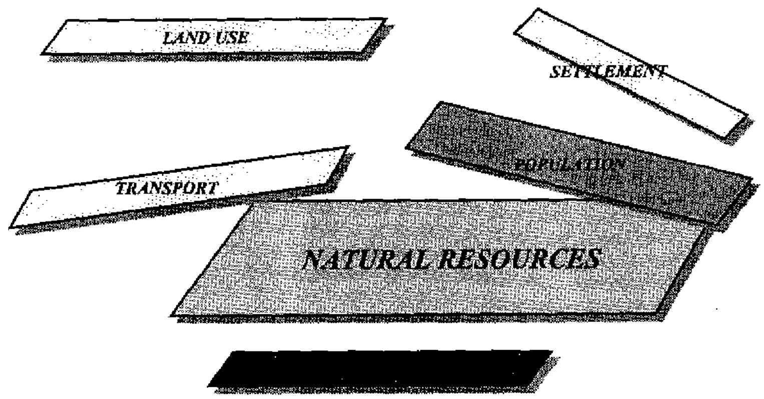

Figure 6: The incomplete spatial information 'reality'

The effect of the situation in Figure 5 would turn the Reser and Smithson quotation into a garbled mess like the following:

> *much remains unknown of many ignorant people is their unflinching confidence that they a hallmark possess total and a wider knowledge likewise truly regard as settled deep cautiousness about issues knowledge may bring with it a sober most people appreciation of how*

All of the words are there, but it would take time to unscramble them and, with luck, get the correct meaning of the statement. With the situation illustrated in Figure 6, it would be clearly impossible to get the complete message, with the result that a conclusion like the following could be the outcome!

> *truly* *sober*
> *people* *remain unknown.*

Unless it were known that this was not the complete story, remarkably different conclusions would be reached from those intended.

This is not unlike the situation faced by PIC disaster managers on a daily basis!

OBSERVATIONS

It was abundantly evident in both workshops, and in other contacts, that PIC disaster managers recognise and appreciate the need to have appropriate information available to them at all stages of the disaster management process. An information culture certainly exists, though it does perhaps need to be strengthened in some areas. It is also clear that disaster managers throughout the PICs possess a broad range of skills and experience in managing and applying information for decision making in disaster situations. Clear also is the fact that there is a nucleus of technical and professional staff throughout the PICs that have skills, training and experience in the use of GIS and the manipulation of spatial information.

It is equally clear that there is very little coordination either within countries or between countries as far as the maintaining of directories of information is concerned. In some PICs it would seem that government agencies and/or universities of the former colonial administering nations such as Australia, New Zealand and the United Kingdom have more complete and detailed inventories (and collections) of information than now exist in the country itself. This is clearly an area that needs much work.

Much of the time in both workshops was devoted to developing a better understanding of the information needs of PIC disaster managers and the information resources that existed in PICs. This work has enabled me to develop a generic profile of need that can be applied from the national/international level to the community/village level across the full risk management process.

Very few standards enjoy formal or widespread acceptance though it is evident that there are many actually in use that could be more widely promoted, if not formalised. This lack of formal adoption is perhaps a strong reflection of the lack of strong institutional arrangements within PICs.

The impression gained is that there is a very strong foundation in place on which to build an information infrastructure, with a solid SII base, for disaster management in PICs, however, much work remains to be done in building the structure on that foundation.

It goes without saying that in this report terms such as data and information are gender neutral and inclusive.