Damage: the truth but not the whole truth

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Introduction

Disaster management at its best is concerned with reducing the risks offered to people, buildings, infrastructure, and a range of economic activities. Too often it is concerned with little more than saving lives, saving the little that can be saved immediately before the impact, cleaning up after the event, and providing short- and long-term disaster relief.

Damage reduction for buildings, infrastructure or economic activity is at least half of what disaster management is about—and it is the neglected half as most emphasis has gone into saving lives and reducing trauma, both physical and mental. The theme of this paper is 'we don't know much about damage, so how can we manage disasters?'

Defining damage

Losses in natural disasters can be divided into *direct* (when damage is produced by physical contact with the hazard agent or debris) and *indirect* (when the losses result from the disruption of normal economic and social activities during and after the impact, for example disruption to transport, industrial or agricultural production and the cost of clean up). Tangible damages can normally be valued in monetary terms, while intangible losses include items that are not normally bought or sold (Handmer, 1989).

This paper is mainly concerned with direct tangible damage to property; in particular the concern is with damage to buildings, particularly small buildings including houses and their contents. While this is a rather limited definition of damage, the emphasis is warranted by Walker's (1987) observation that small buildings comprise more than half the capital value of all buildings and in aggregate they are occupied by more people than large buildings for more of the time. For some communities, small buildings will be 100% of all buildings.

Who pays for damage?

Figuring who pays for damage in Australian natural disasters is no small task. Leigh (1998a, 1998b) produced estimates for four events. These data, summarised in *Figure 1*, are likely to include most direct tangible damage and some indirect or intangible losses from the four events.

Figure 1 indicates that the proportion of the cost borne by the affected parties varied from 9 to 38% and the percentage shouldered by governments (i.e. taxpayers) ranged from 21 to 65%.

Contributions from charity ranged from 2 to 17%, though one might draw the conclusion that the charitable contribution is generally well below 10%. Insurance paid from 9 to 39% of the total cost. The varying proportions paid by each group rely on a host of factors including the size of the disaster, the role of the media, the nature of the damage, and the degree of under- or non-insurance.

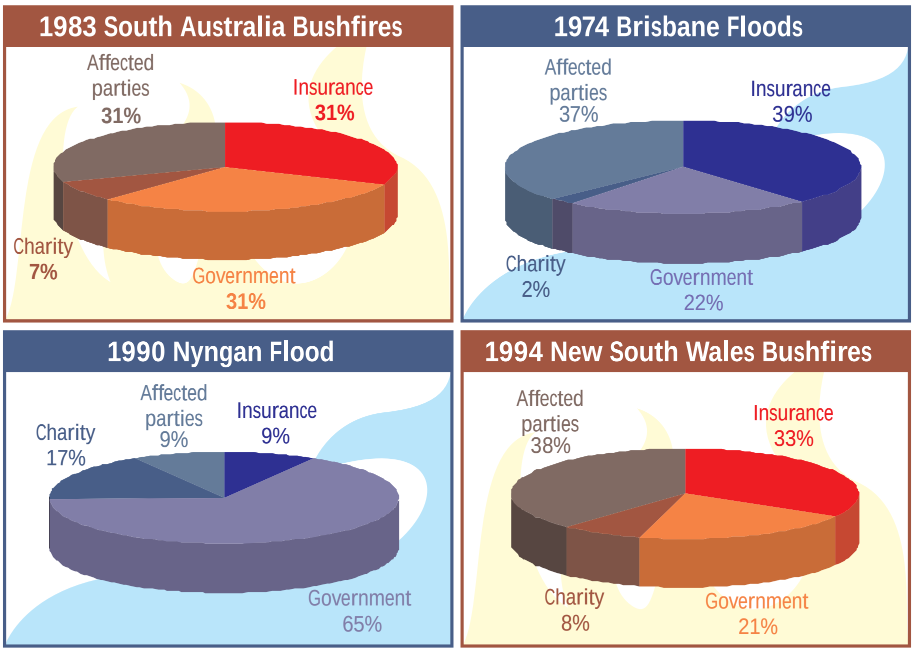

Figure 1: Relative damage costs borne by insurance, government, charities and the affected parties for four natural disasters (Leigh 1998b)

The proportions estimated in *Figure 1* are, no doubt, quite reasonable and it would require a lot of work to improve on them. These estimates probably encompass most of the range in the proportions for bushfires and floods, but they may not reflect the breakdown for other hazards.

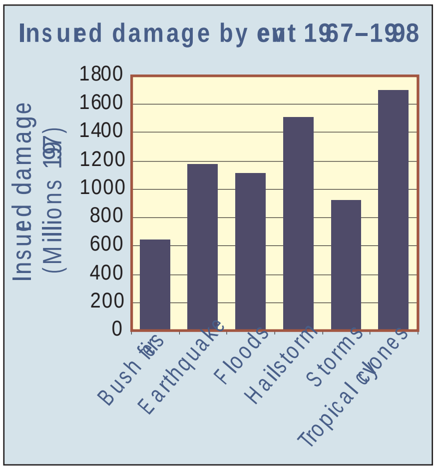

Figure 2: Insured damage 1967–1998 (based on ICA data)

Insurance data

Since 1967 the Insurance Council of Australia (ICA) have collected data on the costs of claims paid resulting from major events. For the early period only those events producing aggregate losses greater than $2 million were included; later this cutoff was changed to $10 million. For most events only the claims paid by ICA members are included. The ICA estimates are dominated by direct tangible damage, but clean-up costs and business interruption payments (indirect tangible losses) will be included in some cases. Some significant companies such as the GIO (with >10% of the national property market), remain outside the ICA so it is likely that these are underestimates.

Expressed in 1997 dollars, the 106 events in the ICA database total $7.068 billion for the period 1967–1998. *Figure 2* indicates that tropical cyclones account for nearly one-quarter of all claims paid, hailstorms more than one-fifth, and earthquakes and floods one-sixth each. *Figure 3* indicates the mean loss per event. Earthquakes plot in a class of their own because of the Newcastle earthquake ($1.124 billion in 1997 dollars), with all other hazards grouped. Of the total payout of $7.068 billion, 47% is for losses in New South Wales and 20% in Queensland.

Fifteen events in the ICA list have produced losses of more than $100 million, including 5 hailstorms, 3 tropical cyclones, 2 floods, 2 bushfires, 2 storms and one earthquake. *Table 1* lists in descending order

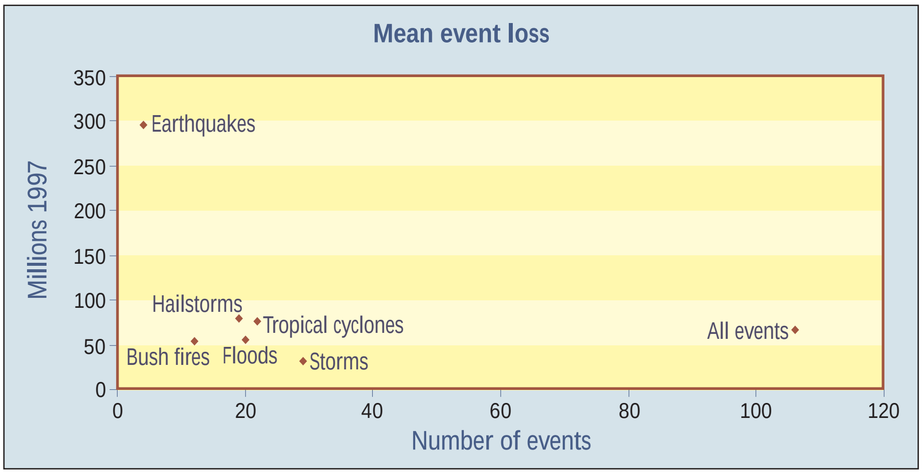

Figure 3: Number of hazard impacts and mean insured losses per event, 1967–1998 (based on ICA data).

those events producing total insurance claims greater than $200 million. These 7 events produced a total loss of $3.453 billion, or nearly 49% of insured losses in the 32-year period. The Newcastle earthquake and Cyclone Tracy together represent 28% of the total insurance payments. It is noteworthy that six different insured perils are included in the seven events (though storms and hailstorms could both be considered thunderstorms).

Table 1 illustrates the dominance of a few events in the insurance loss statistics and that a range of hazards can produce big insurance losses. The most expensive year in the insurance record was 1974 with just two events contributing 16% of the aggregate loss for the 31-year period. The summer of 1989–1990 contributed 21% of the total. *Table 1* suggests that, on average, the insurance industry might anticipate a $200 million loss for a single event once in 4 or 5 years. Such losses come from any of half a dozen hazards.

Insured and total damage

Chris Joy (1991) provided a summary indicating the subjective impressions of ratios of insured loss to total loss based on the experience of an unknown source in the ICA rather than analytical estimates. These estimates are reproduced here as *Table 2*. Zero values indicate that damage produced by these hazards is not insurable.

The 10% ratio for floods in *Table 2* can be compared with the proportions of 9% and 39% in *Figure 1*. Similarly, the 35% for bushfires can be compared with 31% and 33% in *Figure 1*. However, in 1991 Chris Ryan, based on detailed Bureau of Meteorology estimates, suggested the ratio for bushfires was about 12% (Blong, 1992).

The ratio of insured to uninsured losses is complicated by the fact that significant numbers of buildings and contents are uninsured or underinsured. A recent survey by the Insurance Council (ICA, 1966) suggests that 9% of buildings and 39% of contents are uninsured. For owner-occupied houses about 9% of the buildings and about 20% of the contents have no insurance. Surveys following the 1989 earthquake suggest that the uninsured buildings and contents figures were 4% and 40% respectively. Similar figures for the 1994 NSW bushfires were 18% and 52%. Buildings and contents under-insurance percentages are higher than the estimates for un-insurance.

There may well be marked regional differences in non-insurance and underinsurance, reflecting a range of socio-economic factors. Certainly, the proportion of non-insured households (either buildings and contents or just contents) increased from 28.8% to 31.2% between 1988 and 1993 (ICA, 1996).

These aspects suggest that it will be difficult to use a single ratio of insured to total damage for each natural hazard. It is clear that considerable further work is necessary to produce useable estimates of insured and total direct loss ratios.

What gets damaged?

The insurance data, coupled with the broad figures on who pays and the ratios of insured to total costs, indicate that there is a lot of damage out there. One of the big questions is: 'what gets damaged?'

This question can be considered at two levels. Firstly, for some of the insurance data broad breakdowns into classes of insurance are available for some recent events. Some of these data are summarised in *Table 3*. These estimates should be regarded as preliminary, particularly for the 1998 events.

Domestic household losses (buildings and contents) range from 21 to 56% across the 5 events, perhaps suggesting that for more events this range might be as much as threefold. This is perhaps about the same range as for motor vehicles, while the range for commercial losses appears to be greater. While it is not surprising that the motor vehicle losses form such a significant proportion of the total claim for hailstorms, it is more surprising that such claims are so significant in the storms and floods in *Table 3*.

Instructive as *Table 3* is, these data don't get to the core of what gets damaged. Which buildings are most damaged, or damaged most frequently? Unless such estimates can be made, damage management cannot be risk-based.

Table 4 provides a brief example from the 21 January 1991 thunderstorm in Sydney. Damage to buildings was produced by wind gusts up to 230 kmh, hail to 7cm diameter and rainfall exceeding the 1-in-100 year falls in some suburbs. At least 50,000 trees were blown over, snapped off or suffered long-term damage. Household insurance claims numbered more than 28,000 (Blong, 1997). *Table 4* is based on insurance data—presumably, these data suffer from the limitations already discussed.

Table 4 indicates that claims were made for damage to brick houses preferentially and that claims for brick and fibro houses

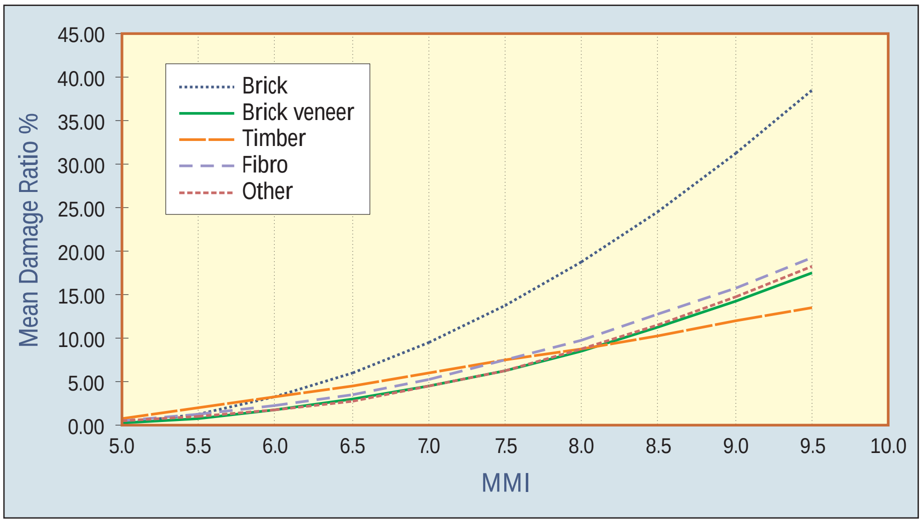

Figure 4: Loss curves reflecting construction and Modified Mercalli Intensity – based on insured damage to domestic houses in the 1989 Newcastle earthquake (after Blong and Hunter, 1997).

Date		Event	Location	$ million (Dec 1997)
1989	*December*	Earthquake	*Newcastle, NSW*	**1124**
1974	*December*	Cyclone Tracy	*Darwin, NT*	**837**
1990	*March*	Hailstorm	*Sydney, NSW*	**384**
1974	*January*	Floods	*Brisbane and Qld*	**328**
1985	*January*	Hailstorm	*Brisbane, Qld*	**299**
1983	*February*	Bushfires *(Ash Wednesday)*	*Victoria and SA*	**255**
1991	*January*	Storms	*Sydney, NSW*	**226**

Table 1: The big seven insured losses

Hazard	Ratio
Drought	**0.00**
Bushfires	**0.35**
Storms	**0.35**
Floods	**0.10**
Cyclones	**0.20**
Earthquakes	**0.25**
Storm surge	**0.00**
Coastal erosion	**0.00**

Table 2: Ratio of insured loss to total loss (Joy, 1991)

were more expensive relative to the sums insured. Surprisingly, there were fewer claims for fibro houses and these claims were cheaper than one might anticipate.

While the data in *Table 4* provide a firmer grip on damage, we still don't know the distribution of damage with respect to the intensity of the storm. It is possible that brick houses were damaged preferentially because they were located in the areas where the storm was most intense, or on the terrain and topography most exposed to the strongest wind gusts, or in those areas with the most trees.

We also need detailed damage surveys that record for each hazard the building elements and contents items that are damaged and the extent of damage to each element or item. Damage surveys only rarely record the incidence of items that are not damaged—a major flaw in the survey methodology. For example, there is a suggestion that houses with (heavy) tiled roofs were damaged preferentially compared with houses with lighter roofing materials in the 1989 Newcastle earthquake. While we have data on the locations of (insured) damaged houses and the costs of repairs down to the level of street addresses we don't know which houses had tiled roofs.

Smith *et al*. (1990) provide a valuable example of a detailed residential damage survey following the 1986 Toongabbie Creek floods in Sydney's west. *Table 5* summarises the Youth and Community Services' (YACS) component of the survey, based on average relief payments to 527 properties experiencing overfloor flooding.

Clearly, *Table 5* allows a great deal to be inferred about the items that are damaged by above floor flooding, contributions to the total cost, the distribution of damage from room to room etc. This particular table does not, however, establish a relationship between the extent of damage to items and the depth of overfloor flooding. Moreover, as Smith *et al*. (1990) point out the damage estimates provided by loss adjusters for a sample of 72 residences averaged 30% more than the YACS estimates in *Table 5*.

There are some valuable data in *Tables 3, 4, and 5*. A variety of damage surveys provide data in relation to a number of natural hazard impacts in Australia, even though many of these surveys can be found wanting from the point of view of the researcher and, I suggest, the disaster manager.

The number of buildings damaged, the proportion of buildings damaged, damages expressed as equivalent buildings, loss ratios, qualitative damage scales, loss curves. Each measure of damage is different. Each measure focuses on a different aspect of damage. Each measure has a different use. Perhaps we need to consider which measures are most appropriate for disaster management?

Researchers and disaster managers need more carefully designed damage surveys—surveys that not only locate damage adequately in terms of latitude and longitude but also place damage in the context of undamaged property. We need damage surveys for all natural hazard impacts. This year alone we have missed opportunities to collect valuable damage data in relation to floods in Katherine, Townsville, East Gippsland, Narrabri and other towns in the northwest of NSW, and Wollongong as well as the Sissano tsunami in Papua New Guinea. We probably need to consider the sort of organisation and multi-disciplinary membership of survey teams utilised by the New Zealand National Society for Earthquake Engineering.

Damage and disaster management

In the terms presented at the beginning of this report, disaster management is an exercise in risk management. Risk management is a process that begins with *risk identification*, proceeds through *risk analysis* and *risk reduction* to *risk transfer*, whereby the intractable risks are passed on to someone else. Unless risk management proceeds through these steps in an orderly and sequential fashion it is difficult to be sure that one is passing on the right risks.

	Domestic household non-farm	Farm incl. domestic & commercial	Commercial	Motor	Total no. of claims
Katherine flood, *January 1998*	40.5	0.7	42.4	16.5	2747
Townsville cyclone and flood, *January 1998*	42.7	0.6	47.2	9.5	9643
Coffs Harbour storm, *November 1996*	21.3	1.4	63.9	13.4	2203
Armidale hailstorm, *September 1996*	55.7	7.3	20.1	17.0	10 364
Singleton hailstorm, *December 1996*	55.4	2.0	18.7	23.8	4692

Table 3: Insured damage in selected categories (%) (Source: ICA statistics)

	Brick %	Timber %	Fibro %	Other %
Policies	80.6	5.8	10.8	3.8
Claims	89.0	4.8	4.9	1.3
Total sums insured	86.2	4.6	7.2	2.0
Sum of claims	90.4	5.5	2.9	1.3

Table 4: Summary data household damage–21 January 1991 Sydney thunderstorm (after Blong, 1997)

Item	% of total cost
Structure	**20.8**
Contents	
Floor coverings	21.3
Furniture	8.0
Bedding and bedrooms	8.2
Lounge	4.9
Kitchen	2.5
Refrigerator	4.2
Stove	1.5
Washing machine	3.9
Clothes/personal	9.7
Other	6.2
Contingencies	8.8
Total	**100.0**

Table 5: Average residential damage components – 1985 Toongabbie floods (after Smith et al., 1990)

The 1998 Wollongong rainfalls, floods and landslides have demonstrated the ability of politicians at all levels of government to sidestep the first three stages of the risk management process. To be even-handed, the 1996 Coffs Harbour and the 1998 Katherine floods allowed some insurers to implement a process of risk acceptance (the reverse of risk transfer!) even when their policies quite clearly stated that the flood damage was not covered.

The above analysis suggests that we should not be complacent about the damage statistics that we have available as equipment to focus disaster management on risk reduction or risk transfer. We have not progressed very far along the risk management chain; it can be argued that there is considerable room for improvement in risk identification and risk analysis.

How would disaster management be improved if we had better information about damage? There are probably a lot of answers to this question but I will focus on just four.

Warnings

At 0215 on Tuesday 29 January 1974 the Brisbane River peaked at 6.60 metres on the Port Office gauge. Twelve and a half hours earlier the Bureau of Meteorology issued a flood warning that predicted the flood height to within 11 cm and the timing of the flood crest to within 15 minutes (Heatherwick, 1974). Despite the accuracy and timeliness of this warning, significant damage occurred to house contents and vehicles. While there were undoubtedly a variety of reasons that the *actual* damage was close to the *potential* damage (cf Smith, 1994), one of the key factors was that few people understood how a flood height on the Port Office gauge related to their local situation. Technically the flood warning was as good as it could get; in practice, too many of those at risk failed to respond in an appropriate fashion.

Some of the data in *Tables 3* and *5* suggest that moveable objects such as motor vehicles and a range of small, valuable household contents are still damaged unnecessarily. Detailed surveys indicate frequencies and values of items that are damaged in disaster impacts. The challenge for disaster management is to focus warnings and responses to warnings so that the gap between actual and potential damage is increased.

Building codes and building advice

Australian building codes seem to make a pretty good job of providing design requirements for small buildings in many situations. The earthquake code (AS1170.4 –1993), for example, has provisions for domestic structures and specifies earthquake coefficients for a range of architectural components such as parapets, connectors for wall attachments storage shelves etc. The New Zealand Standard, *Seismic restraint of building contents*, (NZS 4104–1994) provides many more details, although the contents domestic dwellings are excluded unless specifically requested by an owner or occupier. A new standard has also been released with details for the upgrading of existing buildings (AS3826–1998 *Strengthening existing buildings for earthquake*).

The language of most standards is hardly transparent, being designed for specialist engineering audiences. However, Standards Australia Committee BD/64 on *Construction in bushfire-prone areas* was unable to reach agreement, resulting in the publication by Standards Australia and CSIRO of the excellent volume *Building in bushfire-prone areas—information and advice* (SAA HB 36–1993), intended for general consumption. It is noteworthy that so much of the advice in this volume stems from detailed CSIRO damage surveys in the aftermath of the 1983 Ash Wednesday bushfires.

Obviously, the substantial costs of building damage are borne by insurers, individuals, or communities. The starting point for improved building codes and appropriate building advice must be carefully-thought-out damage surveys.

Hazards that have been neglected in Australia in terms of both building codes and specific user-friendly advice include hailstorms and floods. This neglect is surprising given the importance of these hazards. For the Singleton (1996), Armidale (1996) and Sydney (1990) hailstorms the average domestic insurance claim for (predominantly) hail damage ranged from $5500–10900. Similarly, 1986 Sydney flood damage averaged $4800–6250 for houses flooded to overfloor depths (Smith *et al*, 1990).

The average insured damage claim for domestic structures from the Newcastle earthquake was about $8430. There were almost 64,000 household (buildings or contents) claims (Blong, 1995). There were about 30,000 household insurance claims from the 18 March 1990 Sydney hailstorm. The recurrence interval of this hailstorm is in the range 20–25 years (Andrews and Blong, 1997). The return period of the Newcastle earthquake is certainly less than once in several hundred years and may well be in the range of once in thousands to even tens of thousands of years. If all these values are roughly correct, for a reasonably long record the total household damage bill from hailstorms will be at least an order of magnitude greater than that from earthquakes.

Data presented earlier suggested that floods may be more important than hailstorms from the point of view of damage to small buildings. Perhaps our efforts with building codes and building advice require an additional focus?

Land use planning

Dr John Tomblin, until recently a senior member of the UNDHR team, once observed that successful mitigation is a succession of non-events. If all houses located on bushfire-prone slopes and aspects were designed appropriately and built of the most resistant materials, would bushfire vulnerability be reduced? If the soft soil site factor for domestic structures under earthquake loads was enforced (instead of being waived when the soil profile is not known), would we eventually see a reduction in damage to houses on soft clays, loose sands and uncontrolled fill? Do the topography and terrain factors in the wind code adequately reflect the associated risks? Presumably, the answer to all of these questions is 'yes', and rigorous application of these land-use planning principles has increased or would increase the number of non-events.

Hailstorms and floods lie at opposite extremes in relation to the value of land use planning. Despite assertions to the contrary, it is difficult to find evidence in cities like Sydney that some areas are more hail-prone than others. However, it must be conceded that not nearly enough effort has gone into the task.

On the other hand, for floods it is reasonably easy to identify the floodplain areas that are prone to riverine floods. It may be a reasonably straightforward task to delineate areas at risk from flash floods. New South Wales seems to have made a reasonable job of delimiting the 1:100 year flood on major rivers and in controlling building development below this level, at least in the last 15 years. Other states have been much less focussed on reducing flood damage.

My assessment is that the broad pattern of building codes and land use planning provides an invaluable start to risk reduction but that much more can be done with the detail. Integrated approaches to land use planning from the point of view of natural hazards and risk reduction seem to have a long way to go. For example, for most parts of eastern Australia, the return period for a Newcastle-size earthquake (M_L 5.6) is quite low—for Melbourne an M_L 5 to 6 earthquake has an estimated recurrence interval of 16,000 to 84,000 years per 1000 km^2 (Berryman *et al*, 1995).

On the other hand the 1:100 year flood has a 67% chance (on average) of occurring in a 100-year period. If the earthquake return periods for Melbourne are roughly correct (and it would be difficult to argue that they are much better than a guess), we can expect a Probable Maximum Flood in about the same time period.

Why are there such apparent discrepancies in our approach to land use planning?

Modelling damage in future disasters

Improved computer models of future disasters have several practical applications. For the moment assume that we have a good understanding of the physics of ground motion in earthquakes, wind gusts in the boundary layer, and the return periods for earthquakes, tropical cyclones, and thunderstorms. The additional data we require to build worthwhile damage models includes some form of loss curve which synthesises hazard intensity, building damage, building value, construction type and age. Damage models are much improved if each structure at risk can be located in terms of latitude and longitude. *Figure 4* (see page 8) provides an example of loss curves that take account of some of these factors.

The amount of detail required to build reasonably sophisticated models far exceeds the data available. Analysis of the building damage produced by the Newcastle earthquake (*Figure 4*) suggests that the most important single piece of information required about domestic houses is whether they are of double brick construction or some other construction (brick veneer, timber, fibro etc). At a more detailed level, it appears that the presence of heavy tile roofs adds to inertial forces and building damage.

Information, which allows distinctions between double brick and brick veneer construction to be made routinely, is collected by few local governments. Few insurers are able to make such differentiations for their entire portfolios. While we might have quite a deal of information about building vulnerability at a generic level, disaster management requires such information at the individual house level. Except for a selected few areas in North Queensland, we don't have enough information to manage damage.

The three examples below illustrate ways in which damage models could be used in Australia, possibly in the near future as all the technology is available. At least the first two disaster reduction strategies are used more or less routinely in North America.

Scenario 1: The damaging M 6.0 earthquake on the other side of the continent reminds our disaster managers that it makes sense to identify the dwellings in their city made most vulnerable to earthquake ground shaking by reasons of geological substrate, location, construction type, building age, quality of maintenance etc.

Scenario 2: After several losses from tropical cyclones insurer A, dismayed by the new reinsurance premiums, withdraws from the Queensland market. Insurer B, on the other hand, adopts a strategy that identifies insureds most at risk using a combination of building, terrain and topographical factors. Insureds will be charged premiums that reflect the contribution of each of these factors to the risks of damage in tropical cyclones.

Scenario 3: As the intense multi-cell thunderstorm that has just tracked across the city's northern suburbs passes out to sea, the disaster management call centre automatically dials the telephone numbers of the most vulnerable residents in the least resilient dwellings, offering practical assistance, reassurance and a prioritised response.

Conclusions

- In this study the focus on damage has been rather narrow with the concern only with small buildings. However, damage to buildings is significant; insurance data averaged over 32 years suggest average annual damage costs of more than $250 million, and total direct damage >$300 million. The latter figure is much larger if uninsured hazards are included, though there is too little information to allow sensible estimates of total damage to be made.
- It is difficult to determine which are the most important perils in terms of total direct damage because existing databases are of insufficient quality. If we take insured losses for individual disasters, the big 4 in descending order of importance are: *earthquake, tropical cyclone, hailstorm, flood*. In terms of events with insured losses >$100 million the big 4 are: *hail, tropical cyclone, flood, bushfire*. For the total number of events with insured losses the order is: *storms, tropical cyclones, floods, hailstorms*. Total insured losses for the 31-year period are in the order: *tropical cyclone, hailstorms, earthquakes, floods*.
- It may be that it is more difficult to determine the most important hazard, in terms of building damage, in Australia than it is elsewhere.
- Further analysis of losses are required to define insured to total damage ratios. However, there can be little doubt that the greatest uninsured losses to small buildings are produced by floods.
- For many natural hazards, we have a reasonable, but far from perfect, understanding of the types of small buildings that get damaged. For many hazards our understanding of the building elements that are damaged preferentially is inadequate. Improved understanding requires that undamaged as well as damaged buildings are surveyed—otherwise it is not possible to determine risk rates and the task of improving building codes and advice is made less efficient.
- Detailed damage surveys are required for all disasters where small buildings are damaged. There is considerable merit in establishing and co-ordinating appropriate response teams at a national level. If such teams existed we would not have missed the opportunities for long-term risk assessment and damage reduction presented by recent events such as the floods in Queensland, the Northern Territory, NSW and Victoria, and the tsunami in Papua New Guinea.
- Land-use planning for natural hazards is at best haphazard. It should include integrated assessments and be risk-based.
- The damage management half of the disaster management industry is in its infancy. The lack of focus on damage issues by the relevant disaster management agencies results from the lack of funds and skills, and the absence of the political will to focus on anything but the short term. In the private sector, insurers too infrequently charge premiums that reflect the real risks of damage to small buildings from natural hazards.

  Damage management seems to me to be in crisis—if only for the reason that there isn't nearly enough of it. We have missed numerous opportunities to understand damage and to begin damage risk management. But there will be plenty of future opportunities.

Acknowledgements

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References

Andrews K.E. and Blong R.J. 1997, 'March 1990 hailstorm damage in Sydney, Australia', *Natural Hazards*, 16 (2–3), pp 113–125.

Berryman K.R., Hull A.G. and Smith E.G.C. 1996, *Deterministic estimates of earthquake hazard in Australasia: a comparison of Wellington, Auckland and Melbourne*, Pacific Conference on Earthquake Engineering, Melbourne, 20–22 November, pp. 49–58.

Blong R.J. 1992, *Impact of Climate Change on Severe Weather Hazards—Australia*, Department of the Arts, Sport, the Environment and Territories, AGPS, Canberra.

Blong R.J. 1995, 'Reassessing the physical impacts of the Newcastle earthquake and looking at the implications of an earthquake in Sydney', in N.R. Britton, J. MacDonald and J Oliver (eds.), *Insurance viability and loss mitigation: partners in risk resolution*, Proceedings of a conference sponsored by Alexander Howden Reinsurance Brokers (Australia) Ltd., Gold Coast, pp. 143–162.

Blong R.J. 1997, 'Thunderstorms as insured hazards', in N.R. Britton and J. Oliver (eds.), *Financial risk management for natural catastrophes*, Proceedings of a conference sponsored by Aon Group Australia Limited, Gold Coast, pp. 59–84.

Blong R.J. and Hunter L. J. 1997, *Earthquake PML–Household Buildings, Sydney II*, Greig Fester (Australia) Pty Ltd.

Handmer J. 1989, 'The flood risk in Australia', in J. Oliver and N.R. Britton (eds.), *Natural hazards and reinsurance*, Proceedings of a seminar sponsored by Sterling Offices (Australia) Ltd., Cumberland College of Health Sciences, pp.45–59.

Heatherwick G. 1974, 'Flood forecasting and warnings, Moreton region', *Proceedings of a Symposium, January 1974 floods Moreton Region*, Institution of Engineers, Australia, Queensland Division, pp. 56–80.

ICA 1996, *Report to insurers on Underinsurance and Non-insurance*, Insurance Council of Australia.

Joy C. 1991, *The cost of natural disasters in Australia*, paper presented at the Climate Change Impacts and Adaptation Workshop, Climatic Impacts Centre, Macquarie University, 13–15 May.

Leigh R. 1998a, *Adaptation of the insurance industry to climate change and consequent implications*, Climatic Impacts Centre, Macquarie University, Report to Department of Environment, Sport and Territories, Government of Australia.

Leigh R. 1998b, 'Natural hazards in Australia: who ultimately bears the cost?', *Natural Hazards Quarterly*, Natural Hazards Research Centre, Macquarie University, Vol 4, No. 2.

Smith D.I. 1994, 'Flood damage estimation—a review of urban stage-damage curves and loss functions', *Water South Africa*, Vol. 20, No. 3, pp. 231–238.

Smith D.I., Handmer J. W., Greenaway M.A. and Lustig T.L. 1990, *Losses and lessons from the Sydney floods of August 1986*, Centre for Resource and Environmental Studies, Australian National University, 2 vols.

Walker G.R. 1987, 'A simplified wind loading code for small buildings in tropical cyclone prone areas', *7th International Conference on Wind Engineering*, Aachen, West Germany, July 1987.

Bushfire '99 Conference

The next national bushfire conference
Bushfire '99
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The theme is
**'Flammable Australia:
the fire regimes and biodiversity of a continent'**

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Correction

In the last issue of the *Australian Journal of Emergency Management* an article on page 46 by John Pisaniello and Jennifer McKay, entitled 'The need for private dam safety—a demonstrative case study' contained some small inaccuracies.

A corrected version of the paper is available from the EMA website at http://www.ema.gov.au/pdffiles/vol13/Pisaniello.pdf
Note: This article is in Adobe Acrobat format.

The mistake was made when the wrong version was sent for typesetting.

We apologise for the error.