Chapter 15

Anticipating Risk

Countries are yet to embrace a forward-looking and proactive approach to disaster risk management. A key component of such prospective risk management is the identification of appropriate risk management and financing strategies for different layers of risk. For events with low to medium-sized losses, it is more cost-effective to reduce risks than to rely on risk transfer strategies. And prospective risk management, involving factoring risk reduction into investment planning is more cost-effective than having to correct risk levels once the investment is made.

Many national risk-financing strategies still reflect a vision of disasters as exogenous shocks rather than of risk as an endogenous characteristic of investment flows. As such, the cost of risk financing is likely to grow except in countries that are making major investments in risk reduction.

15.1 How prospective is prospective enough?

Without prospective risk management, countries will lose competitiveness and the inability to guarantee the infrastructure that business requires to be competitive itself. A number of nascent shifts in approach, however, are emerging from several countries that contribute to a move towards prospective disaster risk management—in the areas of legalisation, institutional arrangements and strategic programming.

More than ever, it is recognised that ultimately, disaster risk will be reduced only if mechanisms are implemented to avoid risk accumulation in new public and private investment (Heitzmann et al., 2002; Blaikie et al., 2004; UNDP, 2004; UNISDR, 2007; DFID, 2006; Thomalla et al., 2006; UNISDR, 2011). Although the trend of growing investment in corrective risk management noted in the previous chapter is positive and encouraging, to be effective, it needs to be matched by prospective disaster risk management (UNISDR, 2011; Lavell, 2003), which means employing a truly anticipatory rather than reactive or corrective approach to disaster risk. Without prospective risk management, countries will lose competitiveness and the inability to guarantee the infrastructure that business requires to be competitive itself.

The Hyogo Framework for Action (HFA) identified several key components that contribute to a truly prospective approach, including understanding the risk footprint of a country; providing full access to risk information; and addressing the underlying drivers of risk. Prospectively managing risks related to business investment, however, has not yet been given full consideration in the HFA.

Progress in adopting a prospective approach to disaster risk reduction is still limited. Costa Rica, Panama and Peru (Bernal, 2012), for example, have now incorporated an analysis of disaster risk into public investment planning (UNISDR, 2009; UNISDR, 2011).

These efforts, however, are still challenging. In Panama, disaster risk analysis applies only to large-scale projects and national investments.[i] This means that smaller-scale local level investment decisions are not included. And because most disaster losses in Panama are associated with damage to local infrastructure, this weakens the effectiveness of the measure.

Where political pressure exists in favour of investment in particular industries or regions of a country, these imperatives may override the risk and project analysis promoted by technical units of finance ministries (Orihuela, 2012). If systems of national investment planning are bypassed, disaster risk criteria lose their relevance, and investment projects may get the green light even without mandated risk assessments completed.

Land-use planning is another area with unresolved challenges. Few disaster risk management systems

have been able to employ land-use planning and management and influence investment policies to encourage effective disaster risk management (Johnson, 2011; UNISDR, 2011). Instead, different public and private institutions transform the landscape of city regions; they push different agendas and operate outside of an overall coherent risk management framework.

In Costa Rica, for example, for more than 44 years, successive governments have not been able to finalise and implement the National Land-Use Plan (Brenes and Bonilla, 2012). The Controller's office considers that the absence of this Plan contributes to development that is characterised by high social costs, deficient infrastructure and urban development in ecologically fragile and hazard-exposed areas. Unregulated urban development has increased flood risk in many areas and has been identified by the National Emergency Commission as a principal cause of the severe losses registered during the 2010–2011 ENSO episode in Costa Rica.

A number of nascent shifts in approach, however, are emerging from several countries that contribute to a move towards prospective disaster risk management—in the areas of legalisation, institutional arrangements and strategic programming.

For example, Colombia passed a new disaster risk management framework, including establishment of a multi-sector and multi-stakeholder national committee that will be in charge of both prospective and corrective risk management. Peru has moved responsibility for disaster risk management to a new agency located in the Ministry of the Presidency. Also, about 25 percent of countries that assessed their progress against the HFA in 2011–2013 reported that responsibility for oversight of disaster risk management was located in the highest office, i.e. of the Prime Minister or President. Another 13 percent reported that these functions reside in a central planning or coordination unit.

The 2011–2013 HFA review also highlights new policies, strategies and laws for disaster risk management; many provide for sharper focus on both prospective and corrective risk management and an integration of disaster risk management with climate change adaptation.

Ethiopia, for example, adopted policies for integrated environmental management and rural development, which include disaster risk reduction elements. One such policy, the five-year Growth and Transformation Plan, has integral elements on disaster risk reduction and climate change adaptation; the forthcoming DRM Strategic Programme and Investment Framework also integrates disaster risk reduction with climate change adaptation.

Namibia in 2012 passed a new Disaster Risk Management Act establishing a new National Disaster Fund that supports not only relief and recovery but also disaster risk management (Government of Namibia, 2012).

The United States of America recognizes that disaster resilience is an important aspect of overall economic health of the nation and sustainability of communities (National Academies, 2012). Community resilience indicators are being explored to help drive more effective integration of disaster risk considerations into sustainable development policies, planning and programming (CSRI, 2011).

In Vanuatu, the National Disaster Risk Management Office (NDMO) has been strengthened and new arrangements finalised for integrating governance of disaster risk reduction and climate change adaptation efforts. In addition, a new National Advisory Board for disaster risk reduction and climate change adaptation will soon be approved.

15.2 Growing commitment to risk financing

As long as risk financing strategies reflect a vision of disasters as exogenous shocks rather than of risk as an endogenous characteristic of investment flows, the cost of risk financing is likely to grow—except in countries that are making major investments in risk reduction.

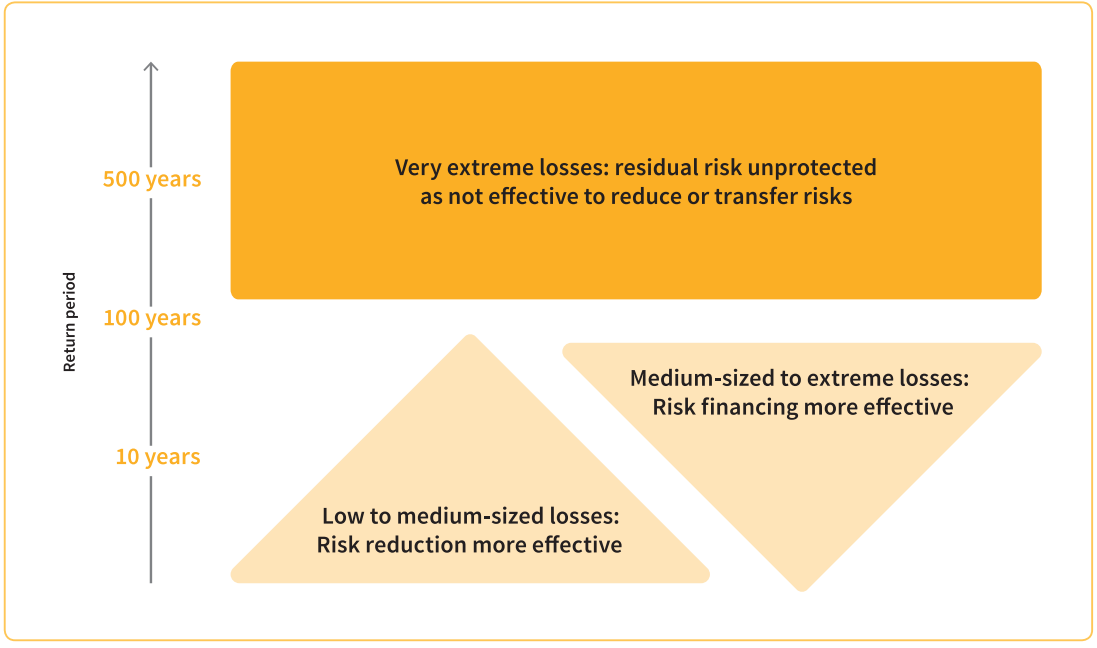
In times of constrained public budgets, strengthening financial resilience is becoming a critical task for hazard-exposed economies worldwide (Government of Mexico and World Bank, 2012). As Figure 15.1 highlights, for events with low to medium-sized losses, it is more cost-effective to reduce risks than to rely on risk-financing strategies. And factoring risk reduction into investment planning is more cost-effective than having to correct risk levels once the investment is made (UNISDR, 2011).

In the case of medium-sized to extreme losses, however, risk financing is essential to ensure macroeconomic stability and to facilitate financing of recovery and reconstruction. As Chapter 4 of this report highlighted, many countries with high levels of disaster risk would face a serious financing gap in the event of a major disaster.

Table 15.1 shows the diversity of recent experience in risk financing. For example, Mexico is transferring risk to capital markets via catastrophe bonds. The parametric index used in this case allows prompt payment, made as soon as the predefined event occurs while ensuring relatively high levels of transparency (Swiss Re, 2011b; G20/OECD, 2012). Although the Caribbean Catastrophe Risk Insurance Facility was the first regional scheme to use a parametric mechanism, the Central America Natural Disaster Insurance Facility has introduced a new approach based on an estimation of the population normally affected by a disaster. This scheme is expected to be applied to more countries and beyond physical hazards (Swiss Re, 2011b).

There are other examples reported by countries through the HFA Monitor. The Government of Ethiopia has established robust mechanisms to finance

Figure 15.1 Efficiency of risk management instruments and occurrence probability



(Source: Mechler et al., 2012)

Table 15.1 Risk financing in selected countries

	Caribbean Catastrophe Risk Insurance Facility	MultiCat Mexico	Central America Natural Disaster Insurance Facility
Established year	2007	2009	2010
Instrument	insurance / reinsurance	Catastrophic Bond	insurance / reinsurance
Insured risk	Earthquake - Hurricane	Earthquake - Hurricane	Earthquake - Hurricane induced risks (eg: landslide)
Policy coverage	Country-specific, up to an aggregate US$100 million per disaster	US$290 million	Country-specific
Index	Modelled loss	Parametric index	Parametric index
Trigger	Pre-defined level of government loss	Quake magnitude, barometric pressure	Defined size of population affected by disaster
Insured party	16 CARICOM governments	Fund for Natural Disasters (FONDEN)	Country-specific captive insurance companies
Sponsor	World Bank	World Bank	Inter-American Development Bank

(Source: UNISDR, based on Swiss Re, 2011)

preparedness measures, including the National Disaster Prevention and Preparedness Fund and the Risk Financing Mechanism—the latter, a multi-million dollar contingent fund employed at the time of major droughts.

As highlighted in Chapter 7, the Pacific Catastrophic Risk Assessment and Financing Initiative (PCRAFI) is currently being developed and will be tested in the Marshall Islands. The PCRAFI assists the Pacific Island Countries (PICs) in shifting from post-disaster donor assistance to ex ante budget planning. The Pacific Disaster Reserve Fund is being established as a prototype risk pooling mechanism. This joint reserve mechanism would allow PICs to build up regional reserves against intensive disasters, supported by initial donor contributions and, if necessary, protected by global reinsurance. The Fund will provide incremental resources to restore essential services to countries after disasters and would help them in their recovery and reconstruction.

Colombia has emerged as a leader in its efforts to fully assess its contingent liabilities. It has begun to integrate liabilities emanating from disaster risk into its management of government liabilities; the effort is led by the Deputy Directorate of Risk within its Ministry of Finance and Public Credit (MHCP) (Government of Mexico and World Bank, 2012). It is also developing a strategy to deal with fiscal vulnerability to disaster risk, which would align with existing risk management strategies related to contingent liabilities from credit operations, public-private partnerships (PPPs) and legal proceedings against the nation (Ibid.).

Although this momentum in selected countries is encouraging, the global debate still reflects a vision of disasters as exogenous shocks (G20/OECD, 2012) rather than of risk as an endogenous characteristic of investment flows. As such, the cost of risk financing is likely to grow except in countries that are making major investments in risk reduction. This highlights that while risk financing is an important component of a comprehensive disaster risk management strategy, to be successful, it depends on complementary efforts to reduce risks.

15.3 Expanded risk governance: integrating public and private approaches

Governance structures, particularly at the local level, can build on the experience and vested interest of businesses with large fixed assets, such as real estate companies, developers, investment banks, large stores and property management firms to more effectively manage disaster risk. The successful partnering of such large companies, as well as small and medium suppliers, with public planning bodies should play an important role in reducing vulnerability and exposure to physical hazards.

Progress in truly prospective disaster risk management may be incipient at best. However, disaster risk management and reduction is starting to gain some space on the competitiveness agendas of governments. Policy-makers responding to a recent survey on perceptions of disaster risk and future uncertainty noted the increasing interconnectedness of economies and resulting vulnerability to synchronous and cascading failures and shocks (Kent, 2013; Ipsos MORI, 2013). It is also increasingly recognised that the more long term the perspective is on risk and uncertainty, the more it becomes an international and trans-boundary concern and less a national capacity issue (Ipsos MORI, 2013).

The focus on longer-term risks in governments and many international organisations is still relatively new (Kent, 2013). Countries are just beginning to develop a more strategic approach to planning for risks, and some are indicating that a cultural change is taking place in which awareness, supported by greater media coverage and open debate of disaster risk, is increasing (Box 15.1).

The impact of Hurricane Sandy in 2012 highlighted how risk governance frameworks need to consider these new dimensions of risk.

New York dealt comparatively well with the severe impacts of Hurricane Sandy, but the sheer scale of losses, such as the estimated US$10 billion to the New York subway system alone—the worst damage in its history, confirm that new dimensions of risk and resilience may need to be considered, particularly in large urban areas with interconnected and interdependent infrastructure systems.[ii]

Both Super-storm Sandy in 2012 and the Great East Japan Earthquake in 2011 were characterised by the breakdown of electricity generation and supply systems. In today's global economy, almost all critical infrastructures, including ICT and transportation, depend on electricity (OECD, 2011). This corresponds with the survey conducted in six cities of the Americas, described in Chapter 10, where more than half of the 1,332 businesses identified business disruptions owing to power outages as a main concern when disasters hit (Sarmiento and Hoberman, 2012). Therefore, local and national governments need to identify key risk amplifiers

Box 15.1 Making futures real – the importance of risk perceptions at senior policy levels

An innovative initiative looking at perceptions of current and long-term risks, conducted in partnership with two leading research institutes—Kings College and Ipsos MORI—and UNISDR, reached out to 30 senior policy-makers in planning and finance ministries of national governments and in relevant multilateral organisations. The initiative completed in-depth qualitative interviews that form the basis for a more systematic and regular assessment of changing risk perceptions among senior policy-makers.

Results from initial interviews mirror the findings of the HFA Monitor, and highlight the importance of continuing promotion of risk identification, data collection and risk assessment at the country level. Few country representatives reported engaging in a full risk identification process, meaning that their assessments and consequent decision-making are based mainly on known risks and uncertainty and future risks are not considered.

(Source: Kent, 2013; Ipsos MORI, 2012)

and understand the interdependencies of the many systems that carry today's societies (Menoni et al., 2012) and which create systemic vulnerabilities characterised by interconnectedness, lack of redundancy and transferability (Van der Veen and Logtmeijer, 2005).

For example, financial service organisations running business-critical applications need to ensure low latency for data transition, such as the sub-millisecond transactions required by the New York Stock Exchange. The closer the data centre is to the user, the faster data are transmitted. Thus these facilities tend to be heavily concentrated in or near urban areas. The impact of Sandy was a stark reminder that disasters can wreak havoc on these critical data centres and the companies that rely on them. In the United States of America, these facilities are all located in the same areas where over the last 50 years FEMA has declared a disaster at least once.[iii] Clearly, the need for backup strategies is crucial.[iv]

In Japan, during and after the 2011 Great East Japan Earthquake, several policies were reviewed, which resulted in changes to the existing risk governance structure. These have since been implemented (Box 15.2).

Changes such as these are occurring in other regions, based on experience of disasters and concerns about future uncertainty. The role of the private sector, both in response and recovery as well as in prospective disaster risk management, is gaining importance.

Local governments and in particular large municipalities can find strong allies among businesses with large fixed assets, such as real estate companies, developers, investment banks, large stores and property management firms to more effectively manage disaster risks (Elkin, 1987; Kataria and Zerjav, 2012; Johnson et al., 2012). 'Communities of interest' (Kataria and Zerjav, 2012) are being formed by businesses and local governments, which can

Box 15.2 Rethinking governance structures during and after the 2011 Great East Japan Earthquake

The unprecedented scale of the disaster following the Great East Japan Earthquake of 2011 meant that not only national and local governments but also private sector and civil organizations participated in recovery. Lessons learned from this integrated approach are being fed into new policies.

1. Strengthened Regional Cooperation: The disaster overwhelmed the capacity of individual local governments, which received support from other less-affected municipalities. Partnerships between local governments from different provinces have since been formalised.

2. Role of National Government to Support Local Government: The disaster impacted directly on the functioning of local government and in many cities the subsequent lack of capacity, particularly of officials with experience in managing urban development projects, was an obstacle to recovery. In response, the national government mobilised experienced officials from all over Japan.

3. Horizontal Cooperation at National Level: The reconstruction process has also strengthened horizontal cooperation between all sectors. Established in February 2012, a Reconstruction Agency headed by the Prime Minister coordinates aligned activities as for example a joint effort of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and the Ministry of Education to develop schools as community centres and shelters for times of crisis.

4. Public-Private Partnerships (PPPs): Even the capital region of Tokyo faced challenges from the disaster. The government has amended legislation to allow Urban Renaissance Councils, consisting of national and local governments, real estate developers, railway companies and property owners, to develop plans for urban safety.

5. Public Involvement: The national government is also promoting transmission of disaster history and its lessons to future generations to decrease vulnerability; for example, through constructing archives in the National Diet Library.

(Source: Government of Japan, 2012b, 2012c)

play an important role in reducing vulnerability and exposure to physical hazards.

As identified in Chapter 14, however, the potential for prospective risk management is limited because those parts of government promoting investment rarely participate in national disaster risk management platforms or committees. Further, private sector participation is usually restricted to emergency management and preparedness (Johnson et al., 2012; IIHS, 2012).

Countries' self-assessments reflect this limitation, with only 36 countries out of 94 reporting on the number of private sector bodies represented in their national platforms. Of these 36, 19 countries have only 1-3 private sector representatives. Canada is a notable exception, with 20 private sector representatives; 24 academic institutions; 18 federal departments and agencies, including national finance and planning institutions; 9 provinces and territories; 15 municipalities and 2 representatives of the general public participating in its national coordination platform for disaster risk management.

In their self-assessment of progress against the HFA in 2011–2013, 52 percent of governments report on cooperation with the private sector in emergency preparedness and response. However, only a few describe a more proactive role of private businesses and ex-ante partnerships. Bangladesh, for example, reports investments to create new PPPs for integrated development with a focus on disaster risk reduction. Mauritius has made engagement in disaster risk management compulsory for businesses under a law on corporate social responsibility. Colombia has developed a new disaster risk management framework under which it explicitly sees the private sector as a strategic partner. The United States of America is addressing business interruption and helping to build resilience to disasters through a number of programmes, including 'Ready Business'.

Interestingly, the number of private sector entities included in national coordinating bodies is highest in Africa. This means that governments are looking to the private sector for support in disaster risk management, where risk governance budgets are limited and capabilities are weakest.

15.4 Filling the information vacuum

Revealing the ownership of risk and taking on joint responsibilities among private and public actors is a key step towards effective risk reduction. However, this can only be achieved when disaster risk information is available and accessible to make visible the risks generated by the investment decisions of businesses, governments and households.

The most important area for private sector engagementmay be around hazard information and joint public-private risk assessments. PPPs to manage disaster risk will only be effective when underpinned by open and accessible risk information and disaster loss data. This is in the interest of both governments and businesses, particularly small and medium local enterprises that lack the capacity to undertake their own risk analysis (Marome, 2012).

Lack of visibility of disaster risk, and clarity over who owns what risk, remains a major barrier to taking risk into account in investment decisions. Disaster losses are often not systematically accounted for; disaster risk information is rarely available to guide either private or public decision-making; and transfer of risk between the private and public sectors and between both and civil society are rarely explicit (UNISDR, 2011; Kent, 2013). In the survey conducted among senior policy-makers in 2012, inadequate availability of disaster data was one of the most commonly stated barriers to risk assessment and planning at the national level (Kent, 2013).

Of the countries undertaking self-assessments of progress against the Hyogo Framework for Action in 2011–2013, less than half report that national and lo-

cal risk assessments based on hazard data and vulnerability information are available and include risk assessments for key sectors.[v] And only 44 of 94 countries assess future and probable risk, whereas 45 countries undertake multi-hazard risk assessments.

Only 40 percent of countries reporting through the HFA Monitor in 2011–2013 note that they have agreed national standards for multi-hazard risk assessments. However, this already represents progress compared with the last review cycle in 2009–2011 when only 25 percent confirmed having such standards in place. In 2013, 32 countries report they have a common format for risk assessments and 31 report the existence of risk assessment formats that are customised for users. Of all countries, only 18 report having both.

Although far from the majority of countries worldwide have mechanisms for collecting, storing and analysing disaster loss data regularly and systematically, a fast-growing number have recognised the importance of this relatively low-cost, high-benefit strategy. Out of 94 countries, 73 report that they collect, monitor and analyse disaster loss data, and 58 countries confirm the existence and regular updating of national disaster loss databases. Of these, 46 make use of reports based on loss data for planning in finance, planning and sector line ministries.

Several low and middle-income countries report that systematic data collection and sharing depends on resources provided through bilateral and multilateral cooperation. Efforts in establishing systematic disaster information systems, therefore, are hampered by short-term, one-off project approaches, which are difficult to institutionalise and sustain (UNISDR, 2012).

Progress, however, is being made, as seen in Box 15.5, which provides examples on partnerships in building information bases for earthquake risk reduction.

Box 15.5 Improving the information base on building vulnerability to earthquakes

Assessing the vulnerability of the built environment to earthquakes is extremely important in assessing potential consequences of an event, as well as mainstreaming earthquake risk reduction into the local development planning process. Understanding the response of existing structures to potential earthquakes requires the knowledge of building materials and engineering practices, which vary widely at the local level. This information base can only be reliably and sustainably developed at the local level; however, this is rarely done.

Buildings' exposure and vulnerability is an important part of the Rapid Earthquake Damage Assessment System (REDAS) developed by PHILVOLC, the Philippine Institute of Volcanology and Seismology. The Institute, in partnership with Geoscience Australia and supported by the Australian Agency for International Development (AusAID), has been developing the first national-scale building exposure database. Validation and enhancement of this database at the local level started with Iloilo City, facilitated by the Institute of Civil Engineering of the University of the Philippines Diliman (UPD-ICE) with the support of professional structural engineering societies in the Philippines. Through this engagement, the local engineering community agreed to deliver a building classification schema and corresponding earthquake vulnerability models.

Another example of successful and long-term partnership in enhancing the information base for earthquake risk reduction is the Australia Indonesia Facility for Disaster Risk Reduction (AIFDR).[vi] After the September 2009 earthquake that struck West Sumatra in Indonesia, AIFDR supported a team of Indonesian and international engineers and scientists who collected and analysed damage information. This team, co-led by Geoscience Australia and the Institute of Technology, Bandung, examined damaged buildings to identify the structural characteristics that may have contributed to their damage state, and provided a systematic survey of the complete populations of both damaged and undamaged structures. The project has provided a broad categorisation of the Indonesian building stock and it provides the basis for developing for a national model of the vulnerability of building structures in Indonesia.

(Source: Geoscience Australia)[vii]

Importantly, new initiatives bridging public and private risk assessment are emerging. Several new tools are now offered for business, including Swiss Re's Global Flood Zones component of its CATNet information platform or Maplecroft's Natural Hazards Risk Atlas.[viii] Although these are based on proprietary risk information and models, the insurance industry is now beginning to use public domain risk information, including information produced for the GAR, to produce new applications for corporate clients (Box 15.6).

New PPPs are emerging for risk modelling, such as the Global Earthquake Model (GEM), which will generate common standards and platforms for both users and producers of risk information (Box 15.7).

In addition, also at local levels, alternative assess-

Box 15.6 Atlas empowers risk managers

Willis, one of the world's largest insurance brokers, has developed a unique risk management solution for company boards, CFOs and corporate risk managers. Atlas is a platform that assists clients to assess disaster risks across their asset base to limit their exposure to direct losses or business interruption. It gathers and interprets a range of open source and proprietary datasets, which are blended with a client's own risk information, to deliver deep insights into a company's risk profile around the world. In the development of Atlas, Willis worked closely with UNISDR and used information produced for the GAR by UNEP/GRID-Geneva from 2007 to 2011.

By using Atlas as part of their regular workflow, corporate risk managers can visualise how a range of risks can adversely affect their property and asset portfolios. The UNISDR data are used in Atlas to score each site location against a catastrophe risk index. The risk manager is also able to visually explore the sites and each global hazard within the Atlas map to quickly illustrate how, why and where the company is exposed, thereby enabling the identification of risk hotspots.

Atlas empowers risk managers to take proactive control of the risks they face. It highlights strengths, weaknesses and where improvements need to be made in a company's risk management programme. This helps a risk manager prioritise investments in risk reduction and improves business resilience and performance. At the same time, increased risk visibility and an enhanced risk management programme enables brokers, such as Willis, to secure more competitive insurance premiums from the commercial market.

(Source: Willis Re[ix])

Box 15.7 Global partnership, forefront science and standardisation to characterise earthquake risk: the collaborative GEM initiative

The Global Earthquake Model (GEM) was launched in 2006 and has since brought together an extensive community of earthquake scientists, social scientists, including economists, as well as IT specialists, in consultation with the private sector and governments. Together they are developing a global model of earthquake hazard, exposure, vulnerability and risk, as well as tools and resources to use the model and its outputs. GEM is a non-profit initiative, driven by a PPP whose mission is to "raise risk awareness and promote preparedness" on earthquake risk.

The project is continuously evolving, and the outcome will include exposure databases containing information on socio-economic characteristics as well as physical features such as building types; an extensive catalogue of past earthquakes; and tools for characterising earthquake hazard, including modelling global stress, subduction zones and active faults, ground motion, etc. As these products become available through an open source and dynamic platform, they will be constantly updated as the science evolves and new data are collected. The GEM project further aims to develop and promote standards that will enable improved data and knowledge exchange.

(Source: GEM[x])

Box 15.8 A 'Public Hurricane Loss Model' for Florida

To address the challenge of limited access to proprietary risk models available from the insurance industry, Florida International University (FIU) in Miami has begun developing a public loss model to assess hurricane risk in Florida. The model provides results on expected annual insured losses for specific properties or by coverage, construction type, ZIP code and county for the state of Florida. It also calculates the probable maximum loss that should be insured for any specific property that can then be compared with results and premiums proposed by insurance companies.

This model does not compete with proprietary models, but instead seeks to complement them and provide additional sources of information. Thus, it was developed with the support of nine public institutions and private sector organisations and certified by the Florida Commission on Hurricane Loss Projection Methodology. Although the model already includes the quantification of economic benefits of hurricane mitigation, FIU is working to enhance the model with storm surge and flood hazard components.

(Source: Florida International University, Extreme Events Institute[xi])

ment instruments and risk models are being employed to provide checks and balances to proprietary models that for public entities, such as local governments or scientific institutions, can be a 'black box' (see Box 15.8). These new initiatives open the path to improved access to multi-dimensional risk information for a variety of stakeholders.

Notes

i For example, in Panama, the System for National Investment Planning (SNIP) regulation only applied to large-scale projects of more than US$10 million (Orihuela, 2012).

ii The statement made by New York's Metropolitan Transit Authority chairman Joseph J. Lhota in the aftermath of Sandy could not be clearer. On the morning of 30 October 2012, he said: "The New York City subway system is 108 years old, but it has never faced a disaster as devastating as what we experienced last night. Hurricane Sandy wreaked havoc on our entire transportation system, in every borough and county of the region." (http://live.reuters.com/Event/Tracking_Storm_Sandy/54277687).

iii http://www.fema.gov/disasters/grid/year.

iv http://gigaom.com/2013/01/10/the-states-with-the-most-data-centers-are-also-the-most-disaster-prone-maps.

v 41 of 94 countries, as of January 2013.

vi The Australia Indonesia Facility for Disaster Risk Reduction is a partnership between the Australian and Indonesian governments aiming to reduce the impact from natural disasters by "strengthening national and local capacity in disaster management in Indonesia, and promoting a more disaster resilient region".

vii Information provided directly to UNISDR by Geoscience Australia in Support of the 2013 Global Assessment Report.

viii www.globalquakemodel.org.
http://www.swissre.com/reinsurance/insurers/property_casualty/Swiss_Re_Global_Flood_Zones_enabling_better_business_decisions.html and http://maplecroft.com/themes/nh/.

ix Information provided directly to UNISDR by Willis Re in support of the 2013 Global Assessment Report.

x Information provided directly to UNISDR by GEM in support of the 2013 Global Assessment Report. For more information on GEM, see: http://www.globalquakemodel.org/.

xi Submitted as an unpublished case study to the 2013 Global Assessment Report. For more information on the Model, see: http://www.cis.fiu.edu/hurricaneloss/.