EARTHQUAKES, AGAIN

Dr Scott Steedman

The 1990s was the UN International Decade for Natural Disaster Reduction (IDNDR), launched with the objective of reducing loss of life, property damage and social and economic disruption from natural disasters. I remember attending the mid-term conference in 1994 in Yokohama. By the year 2000, all countries were to have comprehensive national assessments of risks from natural disasters along with mitigation plans and access to global, regional and local warning systems. The IDNDR had some value in raising awareness, but, looking at the catalogue of recent earthquake disasters around the world, you could be forgiven for thinking that it did not achieve its goals.

Despite all our efforts during that decade, memories were fading of the true scale of disaster that earthquakes could inflict. Before the 1990s, the worst known human disaster from earthquakes had been in Tangshan, China, in 1976. Great earthquakes had struck Chile in 1960 and Alaska in 1964, but the earthquakes of 1985 in Mexico, 1988 in Armenia and 1989 Loma Prieta, California, serious as they were, were not in the same league.

Although the earthquakes at Northridge, California, in 1994 and in 1995 at Kobe, Japan, set new benchmarks for their economic impact, by good fortune fatalities from earthquakes were comparatively low throughout the 1990s. After a decade of talking, the Boxing Day tsunami in 2004 changed everything. It seemed that everybody knew someone who had been caught up in the great waves that swept around the Indian Ocean. That earthquake, at Magnitude 9.1, was the third largest earthquake since instrumental records began, around 100 years ago. Over 230,000 people were killed, but the disaster did lead to the installation of a tsunami warning system around the Indian Ocean. Earthquakes and tsunamis were back on the global agenda.

In the past few years, a series of major earthquake disasters has rocked the world: Pakistan in 2005, China in 2008, Haiti and Chile in 2010, New Zealand in 2010 and 2011, and now Japan. There has never been a better time for engineers to make the case that managing the risk of extreme events requires more than higher flood walls and better emergency planning. It requires local, regional and national authorities to see disaster mitigation as an integrated system, so that no matter how severe the situation, control over critical infrastructure – transport, power generation and key facilities can be maintained throughout the event, or rapidly restored afterwards.

At Magnitude 9, the Tohoku earthquake that struck the north-east coast of Japan on 11 March is the fourth largest earthquake on record. The shaking in some areas was extreme, but above all it was the force of the tsunami that caused the most devastation and loss of life. A high proportion of those who died were over 60 years old, unable, unwilling or unaware of the need to reach higher ground. The height of the tsunami overwhelmed the flood defences of the ageing Fukushima Dai-ichi nuclear plant, causing the loss of the backup power systems, essential in controlling the reactors' shutdown process.

Both the Tohoku earthquake and the Christchurch, New Zealand, earthquake in February were on an unexpected scale for their region. The small but deadly thrust fault that devastated Christchurch was not known to be active. In Japan, the potential for offshore earthquakes was well known but few thought that such a large area of the seabed would move at once, in a single event. The cost of New Zealand's earthquakes could reach 15-20% of the country's annual GDP. The cost of the Tohoku earthquake in Japan could exceed $300 billion (over 5% of GDP), dwarfing all previous natural disasters in financial, if not human terms.

The important lesson for engineers is that hazard assessment is, by definition, an uncertain business. We need new ways of thinking through how our whole system of protection can remain under control, no matter what. Resilience is the key to deciding the extent of engineering countermeasures, such as flood defences, critical infrastructure or even evacuation plans. Resilience does not have to mean ever higher flood walls, or duplicated systems. Resilience means that engineers understand the consequences of failure of any single element and can communicate to governments that the system will still achieve whatever outcome is acceptable. More concrete is not the answer; more systems thinking is.

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