

## Executive Summary

A devastating earthquake hit the Southern Hyogo Prefecture of Japan on 17<sup>th</sup> Jan 1995 causing more than 180,000 buildings to be damaged or destroyed and 6,400 deaths in Kobe city. Direct damage to businesses has been estimated to be about 13 Trillion JPY (not including business interruption or loss of production). In another earthquake, a 6+ magnitude earthquake hit the Niigata Prefecture causing Niigata Sanyo Electric in Ojiya city to suffer damage to business estimated to be 42.3 billion JPY in direct impact and 31 billion JPY in business interruption. Most recently, after the Niigata prefecture Chuetsu-oki earthquake, the automobile industry suffered a production drop of about 120,000 units caused by damage to a critical supplier's facility that manufactured piston rings. The Ministry of Economy, Trade and Industry estimated that this earthquake caused industrial production to shrink by 0.4%. (Japan Times, 1<sup>st</sup> Sept 2007). It is very obvious that earthquakes can severely affect business revenues and profits, besides inflicting heavy property damage and loss of life.

In response to these events, and the recent updated seismic risk studies sponsored by the Japanese government, ABS Consulting has completed a research study that quantifies the earthquake risk for direct and indirect damage for a selected list of 32 corporations in eight industries. The industries included in the study were, Steel (three enterprises), Nonferrous metals (three enterprises), integrated chemistry (four enterprises), Automobiles (four enterprises), Oil (three enterprises), Precision machines (three enterprises), Electronics (nine enterprises), and Pharmaceuticals (three enterprises).

The top five industries suffering the most potential earning loss are shown in the table below. The earnings impact losses are calculated as a percent of quarterly pre-tax earnings, assuming a 500-year return period event.

**Industries suffering the largest potential impact on earnings**

Industry Group	Damage (direct + indirect) divided by Quarterly pre-tax earnings (times 100)	Ranking
<b>Chemical</b>	<b>930%</b>	<b>1</b>
<b>Precision Machinery</b>	<b>429%</b>	<b>2</b>
<b>Petroleum</b>	<b>411%</b>	<b>3</b>
Steel	399%	4
Non Ferrous	330%	5

The study used ABS Consulting's highly advanced probabilistic *JapanQuake™* earthquake model, to simulate the ground motions from earthquake events and to estimate the consequent damage in each of the eight industry groups. The model incorporates the most recent Japanese government findings of heightened risk in portions of Japan, including the probability of a magnitude M8.0+ earthquake caused by a rupture in the Tonankai deep sea ocean trenches. Such an event is estimated to have an occurrence probability of 60-70% in the next 30 years. It is clear that in Japan, where 20% of the world's earthquakes occur on only 0.25% of the world's landmass, the Chemical, Precision Machines and Petroleum industries will potentially suffer devastating impacts to their quarterly earnings, exceeding 400% (or the equivalent of one year of pre-tax earnings). It can be further extrapolated that since all the industries in Japan depend on one another for raw material inputs, or are related in the supply chain in the famously efficiently Just-in-Time (JIT) manufacturing method, additional business interruption losses could add to the reported estimates. It is important to note that this study does not represent all Japanese industrial companies, but demonstrates that the earnings impact for many industries can be very substantial.

In summary, CEO's, CFO's and Chief Risk Officers of all companies in Japan should undertake a study to fully understand their earthquake exposure and if warranted, implement an active mitigation strategy for earthquake risk. Though mankind cannot prevent earthquakes, it must be said that business owners can protect themselves from much of the adverse financial impact, by having prudent risk transfer and mitigation strategies in place. Direct mitigation measures could include strengthening property structures, critical equipment anchoring and using earthquake isolation systems to reduce overall vulnerability to earthquake damage. Indirect mitigation measures could include strengthening the supply chain to minimize business interruption risk. Risk can be also mitigated via the use of traditional insurance products or alternative risk transfer (ART) instruments such as Cat Bonds and derivatives.

Securitization of earthquake risk has been successfully implemented by several leading organizations in Japan, including Tokyo Disneyland and most recently, The East Japan Railway. These organizations utilized risk analysis studies by ABS Consulting to support the Cat Bond issues. ABS Consulting has the expertise and experience to help businesses assess and mitigate earthquake property risk, minimize business interruption risk through supply chain strengthening and also transferring risk by insurance or via ART such as Cat Bonds.