Economic Impact of Terrorist Attack

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ABSG Consulting

September 8, 2005
**ABSG Consulting**

A leading independent global risk management consulting company based on a solid foundation of engineering, science and technology.

<table>
<thead>
<tr>
<th>Company</th>
<th>2001 Revenues</th>
<th>Total Clients</th>
<th>Professionals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ABS CONSULTING</td>
<td>$108,550,000</td>
<td>1,500</td>
<td>720</td>
</tr>
<tr>
<td>2. Arthur Andersen</td>
<td>$106,239,782</td>
<td>1,095</td>
<td>362</td>
</tr>
<tr>
<td>3. PricewaterhouseCoopers</td>
<td>$89,320,000</td>
<td>3,600</td>
<td>N/A</td>
</tr>
<tr>
<td>4. Deloitte &amp; Touche</td>
<td>$81,500,000</td>
<td>1,000</td>
<td>500</td>
</tr>
<tr>
<td>5. Ernst &amp; Young</td>
<td>$31,150,000</td>
<td>850</td>
<td>120</td>
</tr>
<tr>
<td>6. Tillinghast-Towers Perrin</td>
<td>$31,000,000</td>
<td>850</td>
<td>55</td>
</tr>
<tr>
<td>7. Cannon Cochran Management</td>
<td>$21,000,000</td>
<td>3,000</td>
<td>25</td>
</tr>
<tr>
<td>8. Health Insurance Specialists Inc.</td>
<td>$10,425,000</td>
<td>126</td>
<td>17</td>
</tr>
<tr>
<td>9. J. H. Albert International Insurance Advisors, Inc.</td>
<td>$7,000,000</td>
<td>700</td>
<td>33</td>
</tr>
<tr>
<td>10. RMI Consulting Inc.</td>
<td>$6,500,000</td>
<td>375</td>
<td>17</td>
</tr>
</tbody>
</table>

Reference: Business Insurance, February, 2004
Specialized Risk Management Software & Analysis Tools

**NATURAL HAZARD RISK**
- **EQECAT:** Global natural hazard software
- **EQESMART:** Multi-hazard risk assessment
- **HAZUS:** Earthquake, Flood and Wind Loss Model Developed for FEMA

**OPERATIONAL RISK**
- **ERM:** Enterprise-wide risk management software
- **RISKMAN:** Operations & processes risk analysis model
- **VERN:** Incident command center system (Virtual Emergency Response Network)

**TERRORIST RISK**
- **MIDAS-AT:** Counter-terrorism planning and response software
- **GCOAT:** Gross Consequence of Attack for high profile targets
- **CFD Programs:** Blast analysis & testing

ABS Consulting
Example of Modeling Process
(Earthquake Example)

Step 1 - Quantify Hazard

- Epicenter (Point on surface directly above the hypocenter)
- Hypocenter (Point at which rupture starts)
- Rupture Surface (Area that moves in EQ)
- Fault Plane (Defines fault surface)
- Dipping Angle of Fault
- Surface Fault Line
  (The orientation of fault is known as the Azimuth)
- Premium by country, etc.

Step 2 - Define Exposure

- Decreasing Quality of Data
- Increasing Uncertainty
- Location Structural Insurance
- Structural
- Insurance
- Postal Code
- Standard Structural Classification

Step 3 - Determine Severity

- Wind Speed
  Calculated for each Location
  \( V_w = f(P_c, d, \text{regional topography}) \)
- Ground Motion
  Calculated for each Location
  \( PGA = f(M_1, d, \text{regional geology}) \)
  MMI = \( f(PGA, \text{soil}) \)
- Local Site Factors (Terrain/Soil)

Step 4 - Estimate Damage

- Probability density function of damage
- Vulnerability Curve
- Distribution of damage based on hazard severity
- Distribution of hazard severity at the site

Step 5 - Compute Loss

Probabilistic analysis involves running this process for all possible events, where each event has an associated probability of occurrence or frequency.
Purpose of Methodology

- Designed for the Department of Homeland Security
  - Allow DHS to identify the potential Gross Consequence of Attack (GCOA)
  - To be used for a national risk assessment of facilities in the National Asset Database
Method of Development

• Based on most current scientific knowledge
  – Internal expertise related to blast, plume dispersion, building impacts, casualty modeling
  – Technical support from select industry and academic experts
  – Peer review within DHS, Subject Matter Expert Panels
# Attack Modes Analyzed [1]

<table>
<thead>
<tr>
<th>Attack Mode</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conventional Explosives</strong></td>
<td></td>
</tr>
<tr>
<td>Backpack</td>
<td></td>
</tr>
<tr>
<td>Car (400 lbs)</td>
<td></td>
</tr>
<tr>
<td>Van (4,000 lbs)</td>
<td></td>
</tr>
<tr>
<td>Truck (12,000 lbs)</td>
<td></td>
</tr>
<tr>
<td><strong>Dirty Bomb</strong></td>
<td>10,000 curie Cs$_{137}$</td>
</tr>
<tr>
<td><strong>Nuclear Bomb</strong></td>
<td>10 kton (i.e., equivalent to 1,000 tons TNT)</td>
</tr>
<tr>
<td><strong>Ammonia</strong></td>
<td></td>
</tr>
<tr>
<td>Truckload (15 ton)</td>
<td></td>
</tr>
<tr>
<td>Rail car (90 ton) – at nearest rail line</td>
<td></td>
</tr>
<tr>
<td>Rail car (90 ton) – at asset location (chemical/ petro-chemical plant)</td>
<td></td>
</tr>
</tbody>
</table>
## Attack Modes Analyzed [2]

<table>
<thead>
<tr>
<th>Attack Mode</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chlorine</strong></td>
<td>Truckload (15 ton)</td>
</tr>
<tr>
<td></td>
<td>Rail car (90 ton) – at nearest rail line</td>
</tr>
<tr>
<td></td>
<td>Rail car (90 ton) – at asset location</td>
</tr>
<tr>
<td></td>
<td>(chemical plant/petro-chemical)</td>
</tr>
<tr>
<td>Hydrogen cyanide</td>
<td>Outdoor release (50 gal)</td>
</tr>
<tr>
<td>Mustard gas</td>
<td>Outdoor release (50 gal)</td>
</tr>
<tr>
<td>Sarin</td>
<td>Outdoor release (1 gal)</td>
</tr>
<tr>
<td>Ricin</td>
<td>Indoor release (5 lbs)</td>
</tr>
<tr>
<td>Anthrax</td>
<td>Indoor release (1 oz)</td>
</tr>
<tr>
<td></td>
<td>Outdoor release (1 oz)</td>
</tr>
</tbody>
</table>
## Attack Modes Analyzed [3]

<table>
<thead>
<tr>
<th>Attack Mode</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botulinum toxin</td>
<td>Indoor release (1 oz)</td>
</tr>
<tr>
<td>Nuclear power plant</td>
<td>Radioactive material release (~2% core)</td>
</tr>
<tr>
<td>Aircraft impact</td>
<td>Cargo jet</td>
</tr>
</tbody>
</table>
Software Assessment of: [1]

- Estimate 7 levels of injury
  - DOA, die in hospital, admitted to hospital, treated and released, field treatment only, prophylaxis only, No injury
  - Impact to population:
    - Overpressure impacts for people outside buildings (does not consider projectiles)
    - Injury due to blast-induced building damage for people inside impacted buildings
Software Assessment of: [2]

• Casualties continued:
  – Aircraft impact building damage (cargo jet only)
  – Chemical exposure
  – Direct biologic exposure (does not model contagious transmission)
  – Nerve agent exposure
Software Assessment of: [3]

- Direct impact to buildings and contents:
  - Blast overpressure models for urban, industrial
  - Chemical, radiologic, biologic, nerve agent
    - Open release three terrain models (flat, suburban, urban), three wind speeds, two stability factors
- Census Block level of aggregation for analysis
Damage and Debris Estimation

- Occupancy Types
  - Residential
  - Commercial
  - Industrial
  - Agricultural
  - Religious
  - Government
  - Education
• Construction Types
  – Wood
  – Manufactured Housing
  – Concrete
  – Steel
  – Masonry
• Clean-up for buildings and contents:
  – Removal and replacement of damaged structural members, finishes and fixtures, other contents.
    ▪ Debris decontamination and removal,
    ▪ Exterior decontamination
    ▪ Cost and schedule for clean-up
Debris Handling and Disposal Conceptual Model
Software Assessment of [5]

- Indirect economic assessment
  - Over 20 synthetic economies assigned at the county level
  - Rebalancing algorithm that shocks the economy and rebalances based on anticipated federal / state assistance
IELM Details

- Initial conditions, Capacity Adjustment and Adjustment Process
- Rebalance and Exit Tests
- Household Demand, Export Adjustments and Excess Supplies
- External Impact Calculations
- Recovery Functions
- Results Page
Example of Attack Application
Analysis at Centroid of Block
ABSG Terrorism Model

Detailed Vulnerability - 400 and 4000 lbs.
Scaled Distance and Scaled Vulnerability

\[ y = 0.5167e^{-0.0568x} \]
\[ R^2 = 0.8137 \]

\[ y = 4.7149e^{-0.0422x} \]
\[ R^2 = 0.8768 \]

\[ y = 7.878e^{-0.0142x} \]
\[ R^2 = 0.5934 \]
Urban Model
Urban Model - Pressure
Urban Model - Damage
Questions?