New Developments in Modeling of Catastrophic Events

AIR Terrorism Loss Estimation Model

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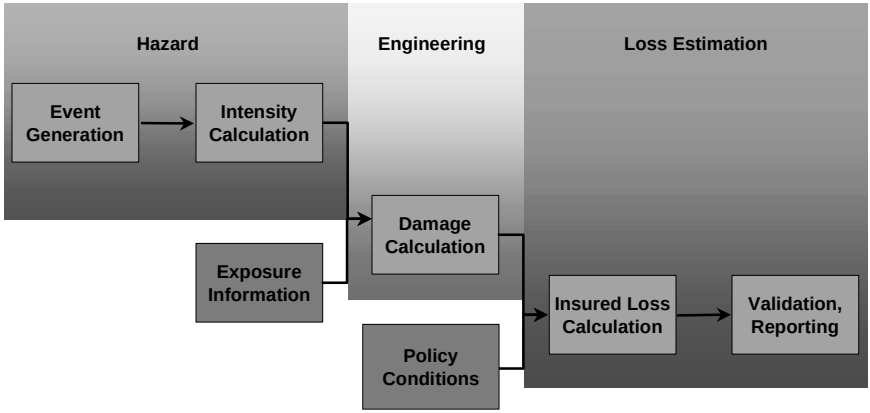
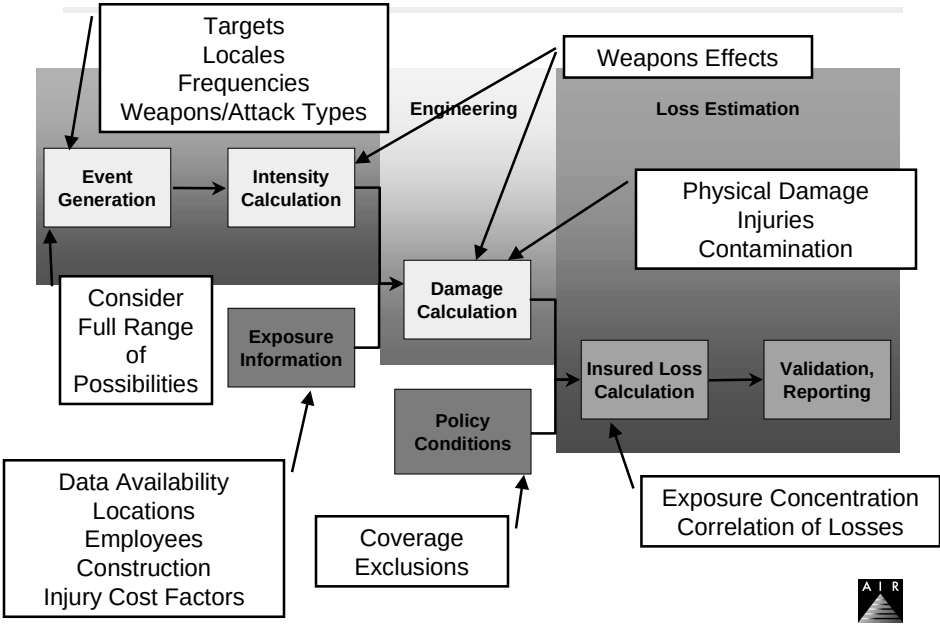
BETTER TECHNOLOGY
BETTER DATA
BETTER DECISIONS

Components of Catastrophe Models



Components of Catastrophe Models - Terrorism Challenges

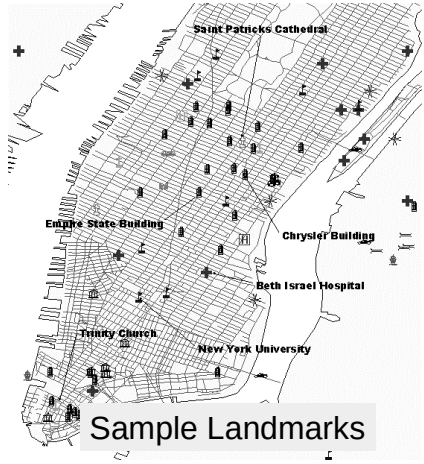


Event Generation and Intensity Approach

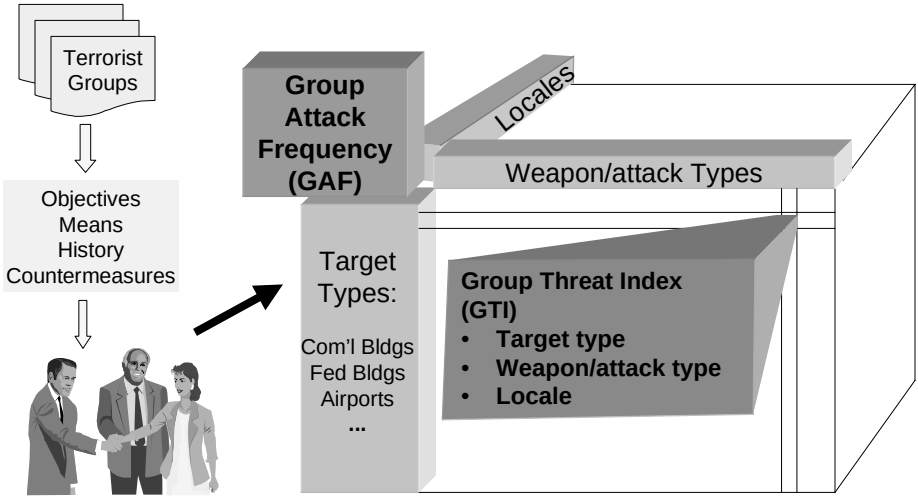
- Generate comprehensive landmark database
- Use expert opinion for attack frequency and allocation to landmarks
  - Delphi Method used to solicit expert opinion
  - Individual terrorist groups considered independently
- Resulted in attack likelihood distribution for each individual landmark (Landmark Attack Vector)
- Generates full range of events that could happen

Landmark Database - Classification of Potential Terrorist Target Types

- Commercial facilities
  - Prominent buildings
  - Corporate headquarters
  - Transportation facilities and critical infrastructure
  - Industrial facilities
  - Energy facilities
  - Retail centers and malls
  - Sport arenas and stadiums
  - Amusement parks
- Government facilities
  - Federal office buildings and courthouses
  - Embassies
  - Postal facilities
- Educational, medical, and religious institutions



Landmark Attack Vector (LAV) Development



Threat Index (TI) is Spread across Individual Landmarks

Threat Index (TI)
- **Target type**
- **Weapon/attack type**
- **Locale**

TI spread across set of individual landmarks for *Target Type* at *Locale*

Trophy Value

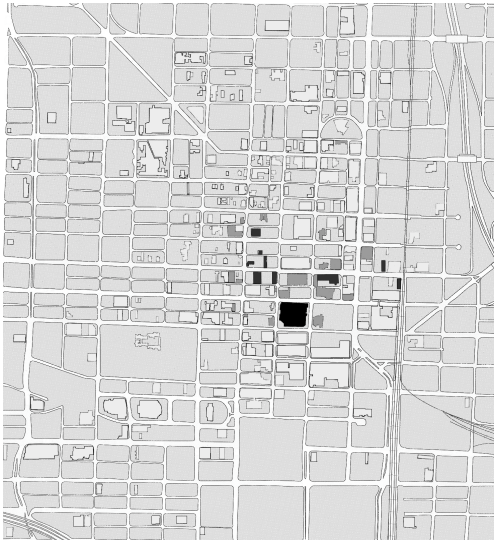
Bldg. 1	Bldg. 2	Bldg. 3	Bldg. 4	…	…	…	…	…	…	…

RESULT ⇨ Landmark Attack Vector (LAV)
- **For each individual landmark**
- **LAV indicates weighted likelihood of each weapon/attack type**

Bldg. 3	Port. bomb	Car bomb	Truck bomb	Crash	…..

Weapon Intensity and Damage

Damage Pattern from Oklahoma City Bombing

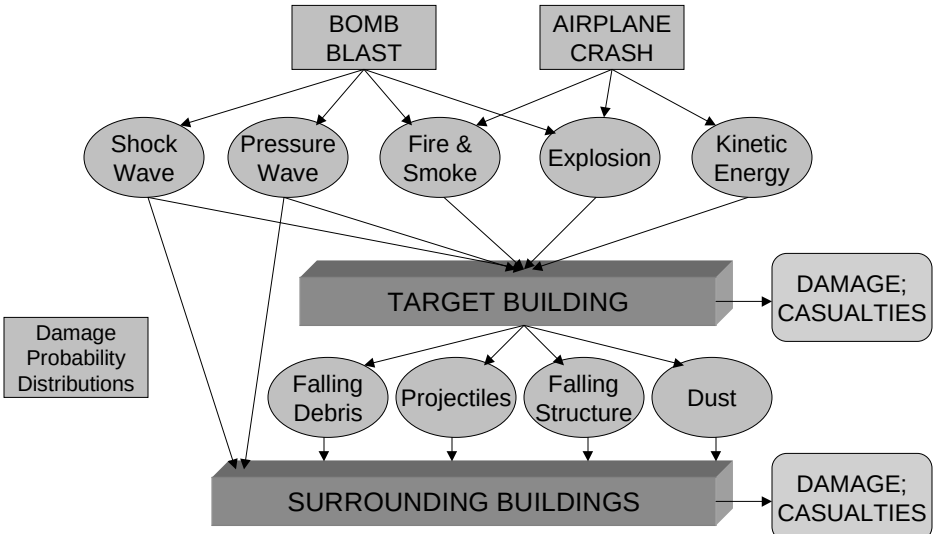


Collapse
Extensive Damage
Moderate Damage
Slight Damage

April 19, 1995
168 killed
642 injured
$145M insured loss

Source: FEMA, 1996

Damage and Casualty Estimates Consider Multiple Effects on the Target and Surrounding Buildings



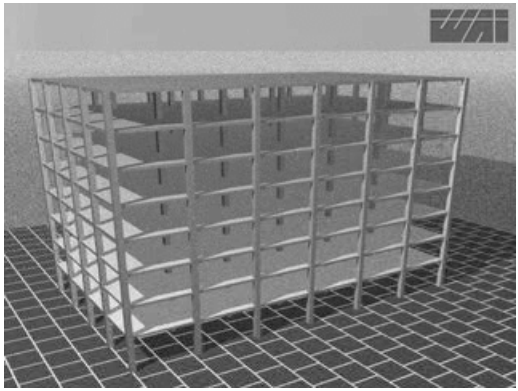
AIR Teams With Weidlinger Associates - Industry-Leading Blast Damage Expertise

- Leader in defense-related blast effects research and design for 50 years
- Only firm with experience in high rise, long span structural engineering and blast resistant design
- Developer of advanced analysis techniques for blast and impact calibrated with extensive field testing
- Performs terrorism vulnerability assessment and upgrade of major transportation facilities, courthouses, office buildings, and embassies
- Specializes in assessment of glazing and curtain wall hazards
- Simplified or detailed analyses

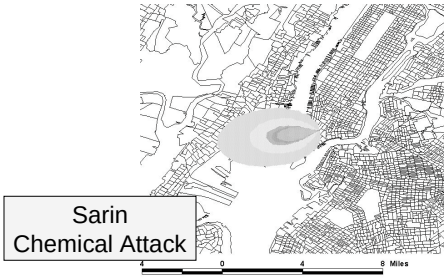
WEIDLINGER ASSOCIATES INC
Over 50 Years of Engineering Excellence

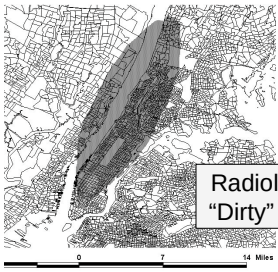
Advanced Blast/Impact Analysis

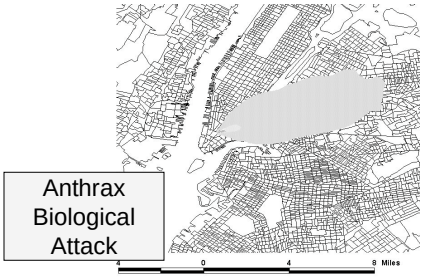
- Based on detailed information about building structure and occupancy
- Advanced analysis of structures using in-house transient nonlinear dynamic finite-element software code

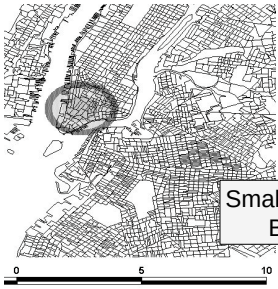


Exposure, Mortality and Damage Contours for CBRN









Now Being Used for Property and Workers Compensation Loss Analyses

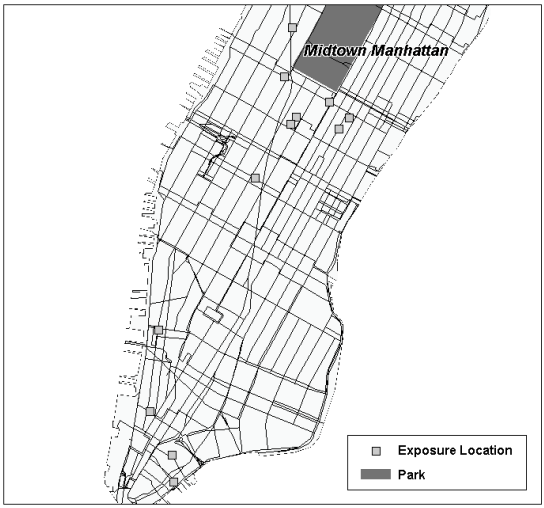
- Evaluation of proximity of exposures to landmarks
- Deterministic analysis of specific exposures
- Fully probabilistic analysis of a special or general book of business

Concentration of Exposures Analysis

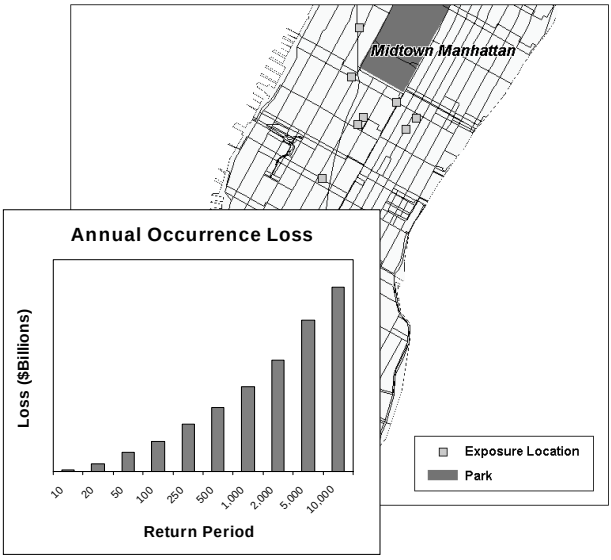
Deterministic Analysis - Midtown Manhattan

- Delivery truck bomb
- 80,000 workers in surrounding area
- Damage sustained in 29 buildings
- 5,000 estimated disability and fatality casualties

Sample Exposure Portfolio



Workers' Compensation Loss Potential



Modeling Workers' Compensation

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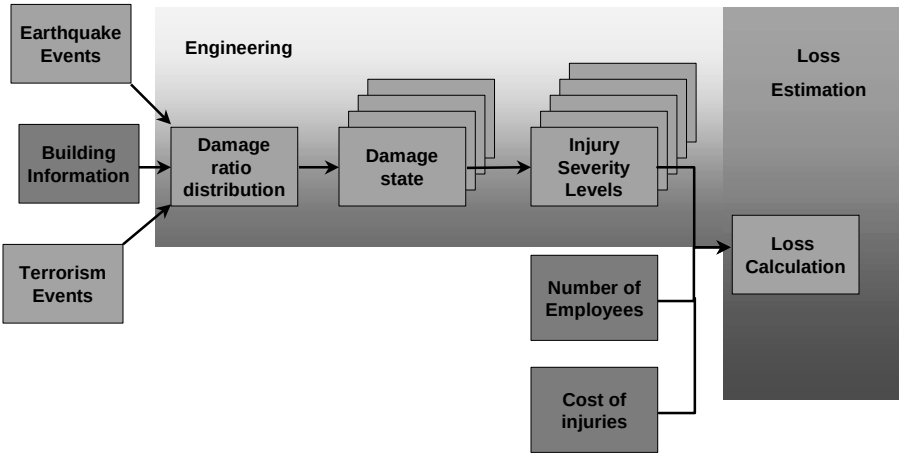
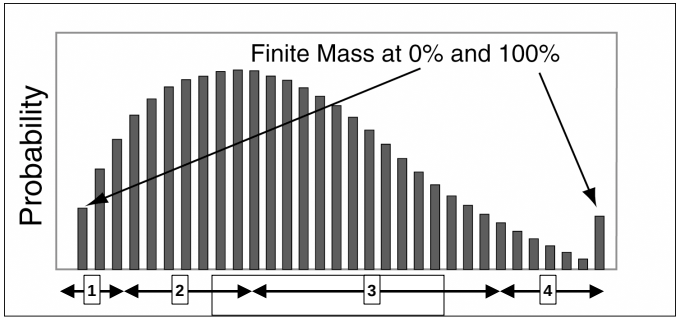
BETTER DECISIONS

Components of AIR's Workers Compensation Model



Building Physical Damage Distribution Mapped to Damage States



1 - Slight Damage
2 - Moderate Damage
3 - Extensive Damage
4 - Complete Damage
- collapse
- no collapse

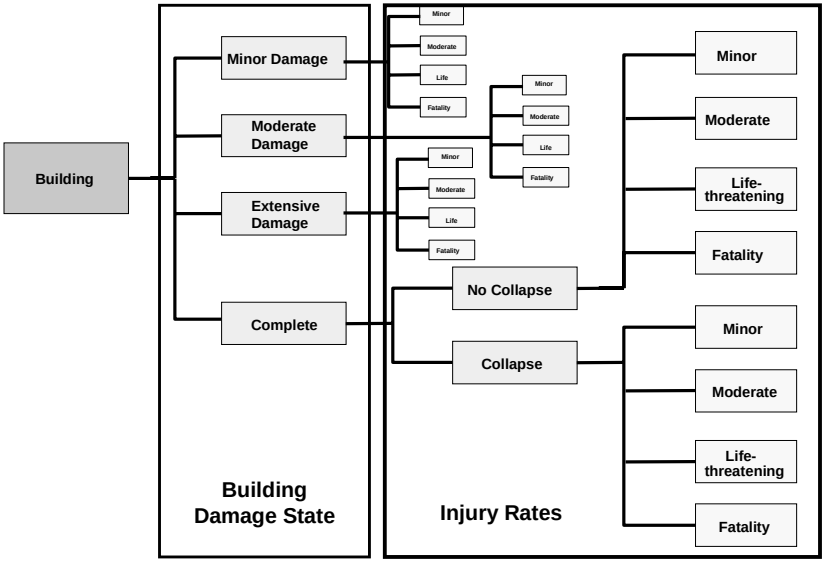
Injury Severity Levels Defined

Injury Classification Scale

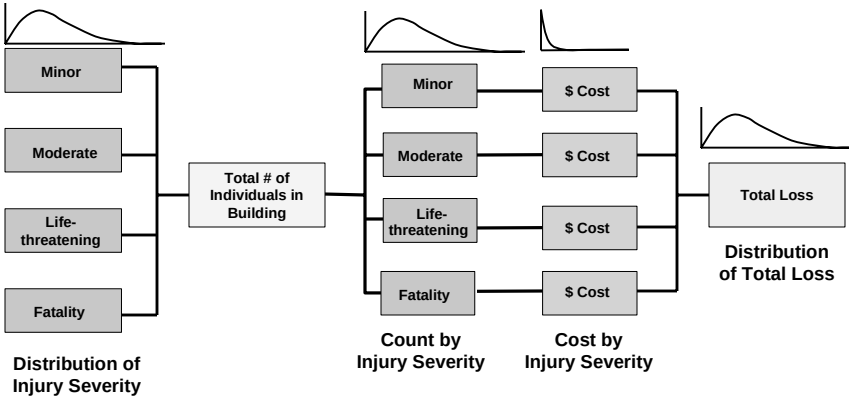
Injury Severity Level	Injury Description
Severity 1: Minor	Injuries requiring basic medical aid without requiring hospitalization
Severity 2: Moderate	Injuries requiring a greater degree of medical care and hospitalization, but not expected to progress to a life threatening status
Severity 3: Life Threatening	Injuries that pose an immediate life threatening condition if not treated adequately and expeditiously. The majority of these injuries are the result of structural collapse and subsequent entrapment or impairment of the occupants.
Severity 4: Fatality	Instantaneously killed or mortally wounded

Source: HAZUS®

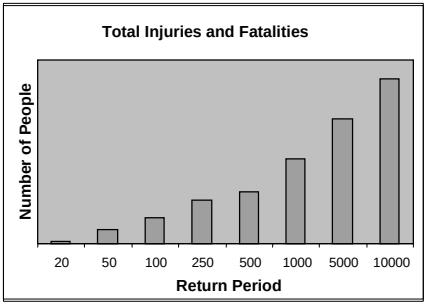
Damage States Determine Injury Severity Distribution

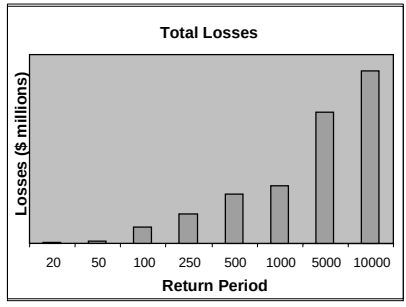


Calculation of Injury/Fatality Loss for Individual Building in One Event



Total Injury and Loss Distributions





Data Needs

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BETTER DATA
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Desired Data Requirements

- Number of people insured
- Building information for each location
  - Address
  - Construction type
  - Building age
  - Number of floors
- Typical location by time of day
  - Daytime, nighttime
- Benefits levels
  - AIR default values for workers' compensation
  - Average benefits under a policy
  - Full distribution from company experience

Typical Data Available

- Number of employees and payroll
- Company location
- Benefit levels under each policy

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Geographic Resolution of Input Data

- Detailed data, down to the location level, is preferred
- If not available the data can also be provided in the following geographic resolutions
  - ZIP Code
  - County
  - State
- Aggregate level data will be distributed to the detail level before the model is run

Simulated Industry Losses for Historical Earthquakes If They Were to Occur Today

Time of Occurrence	1906 San Francisco*	1811 New Madrid*
Night	76,672	671,789
Day	3,756,918	32,917,748
Commute	1,916,801	16,794,788

*Values in thousands of dollars

AIR Recommends You Use the Best Available Information to Manage Your Exposure to Terrorism

- ❑ Better data results in better analysis
- ❑ Understand your potential losses
- ❑ Evaluate your reinsurance needs
- ❑ Negotiate a better price
- ❑ Manage exposure