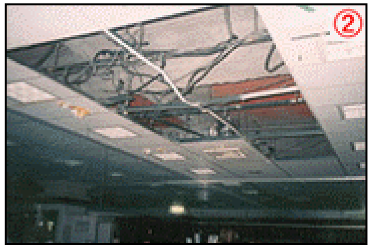
Building Damages

Damages of Non-Structural Components

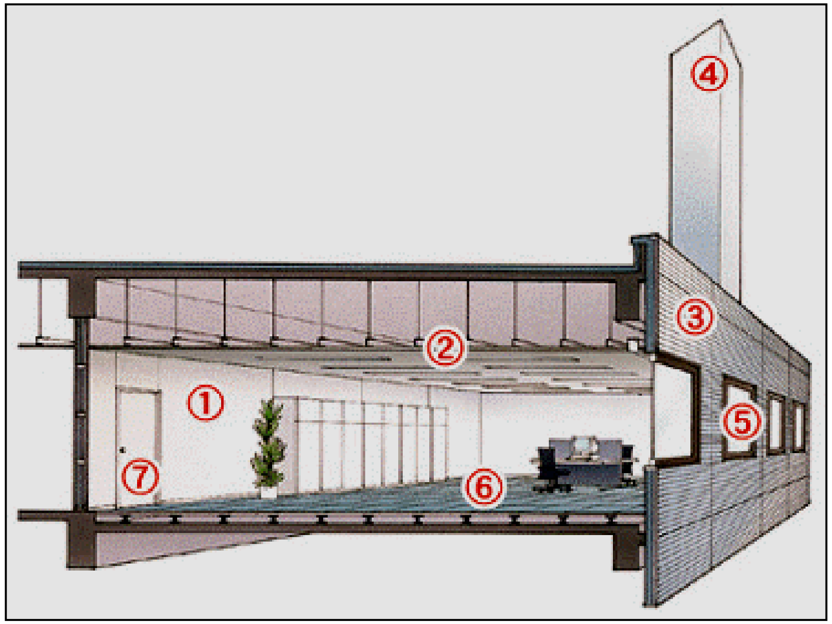
Right Partition Walls

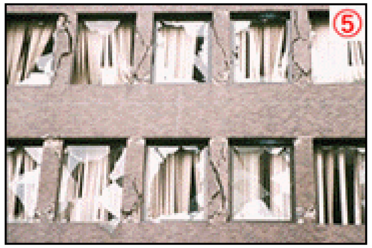


Ceilings

Outer Walls

Rooftop Advertising Tower



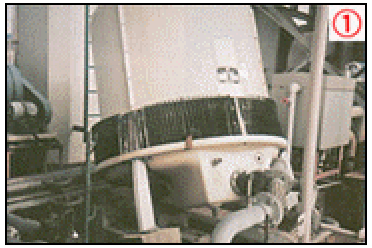


Windows

Floors

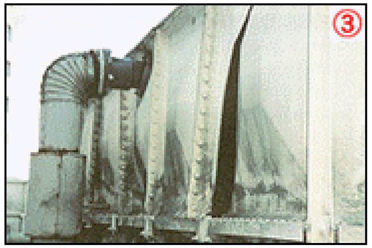
Doors

Damages of Building Utilities



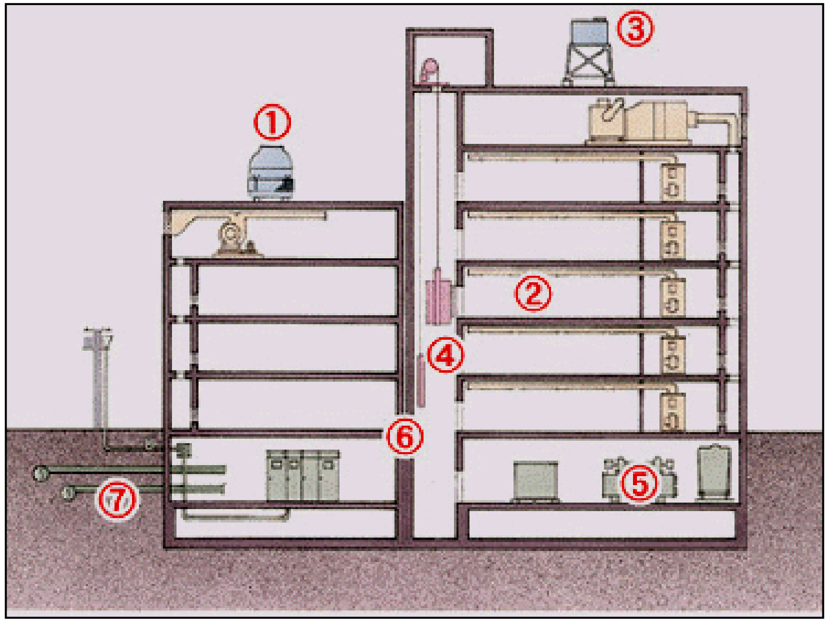
Cooling Tower

Ceiling Equipment



Elevated Water Tank

Elevator

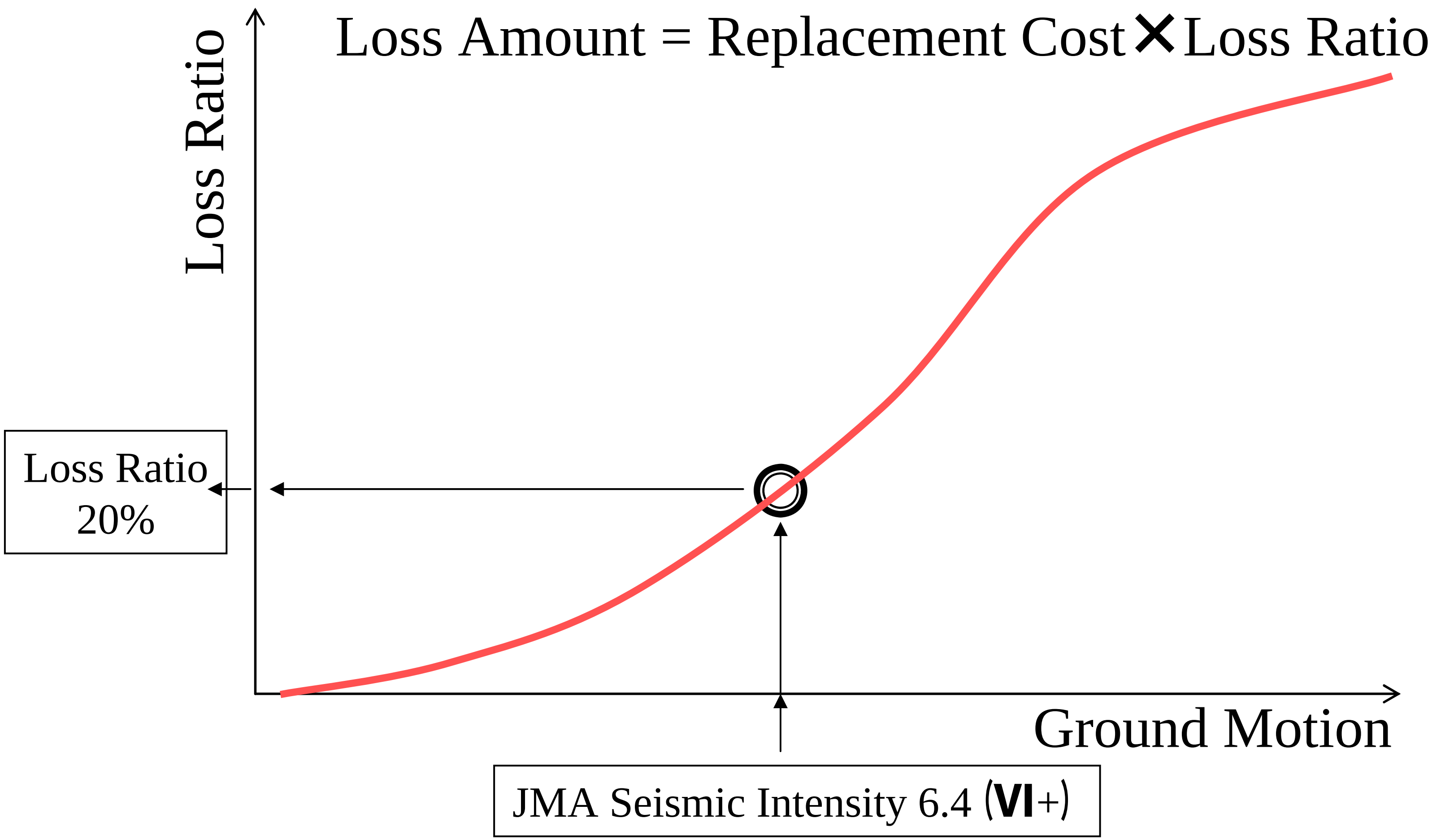


Boiler/Cooling Machine

Expansion Joint

Underground Pipe

Loss Estimation Model – Vulnerability Curve



Risk Management OYO RMS

Levels of Analysis Rigor

- Three Levels
  - Level 1 Statistical "desk top" analysis
    - ✔ Replacement Value ✔ Location ✔ Construction Class
    - ✔ Year Build ✔ # of Stories ✔ Occupancy
  - Level 2 Enhanced analysis based on engineering review of design drawings and calculations. Yields customized performance modeling
  - Level 3 Level 2 with inspection to determine "as-built" condition vs. original design. Yields customized performance modeling. Most rigorous, yet cost-effective assessment of risk.
- Combination of different levels

Level-3 Analysis –
Break down a Building to Components

Constructional Element of a Building

- Beam, Columns
  Earthquake-resisting wall
- Exteriors
- Partition walls
- Ceilings
- Electrical equipment
- Pipes, Ducts

etc.

Structural Components:
Damaged by Horizontal Force

- Beam, Columns
- Earthquake-resisting wall etc.

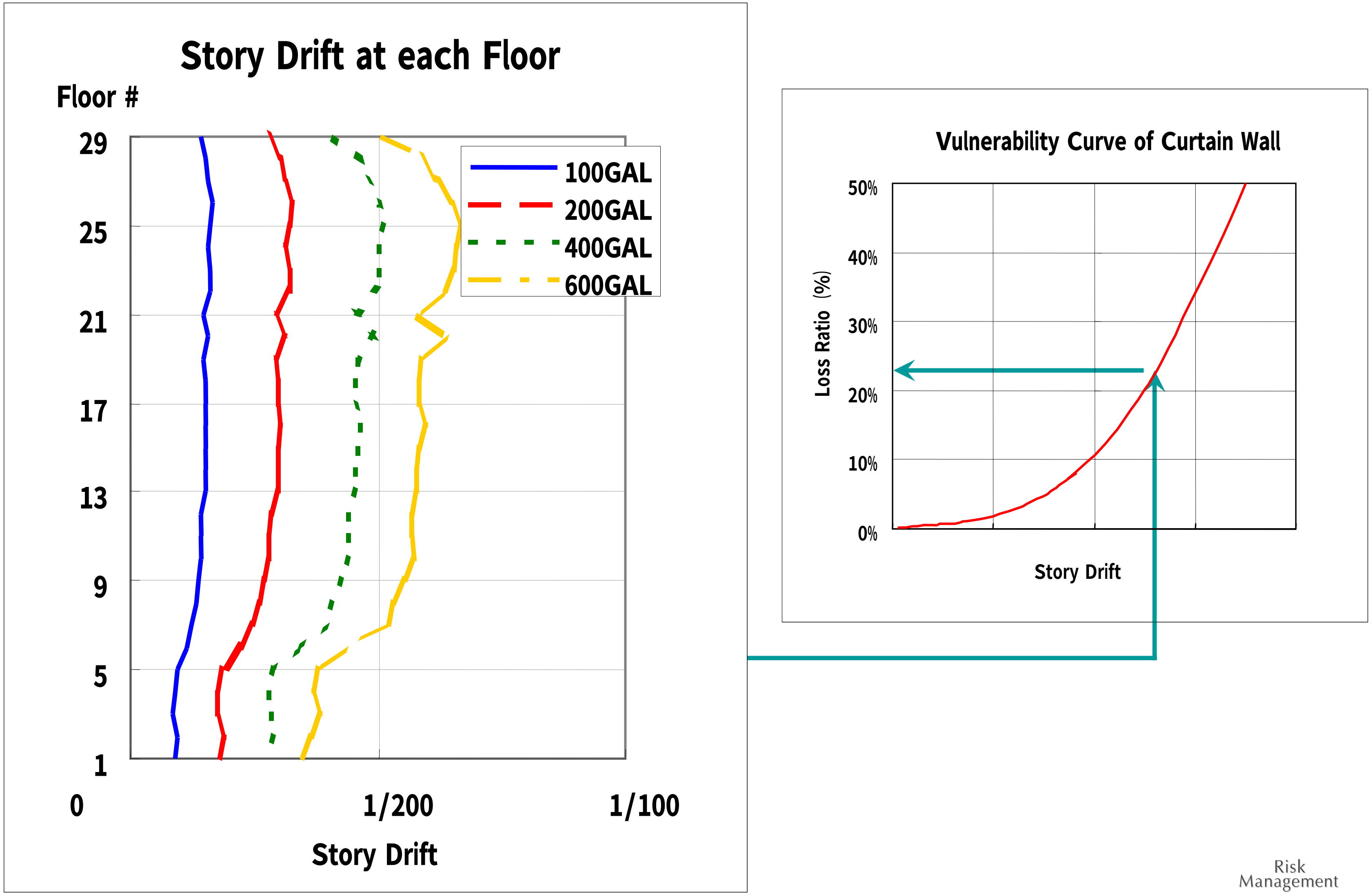
Non-Structural Components:
Damaged by Deformation

- Exteriors
- Partition walls
- Pipes, Ducts etc.

Non-Structural Components:
Damaged by Acceleration

- Ceilings
- Electrical equipment etc.

Response Analysis and Loss Estimation of Damaged Components



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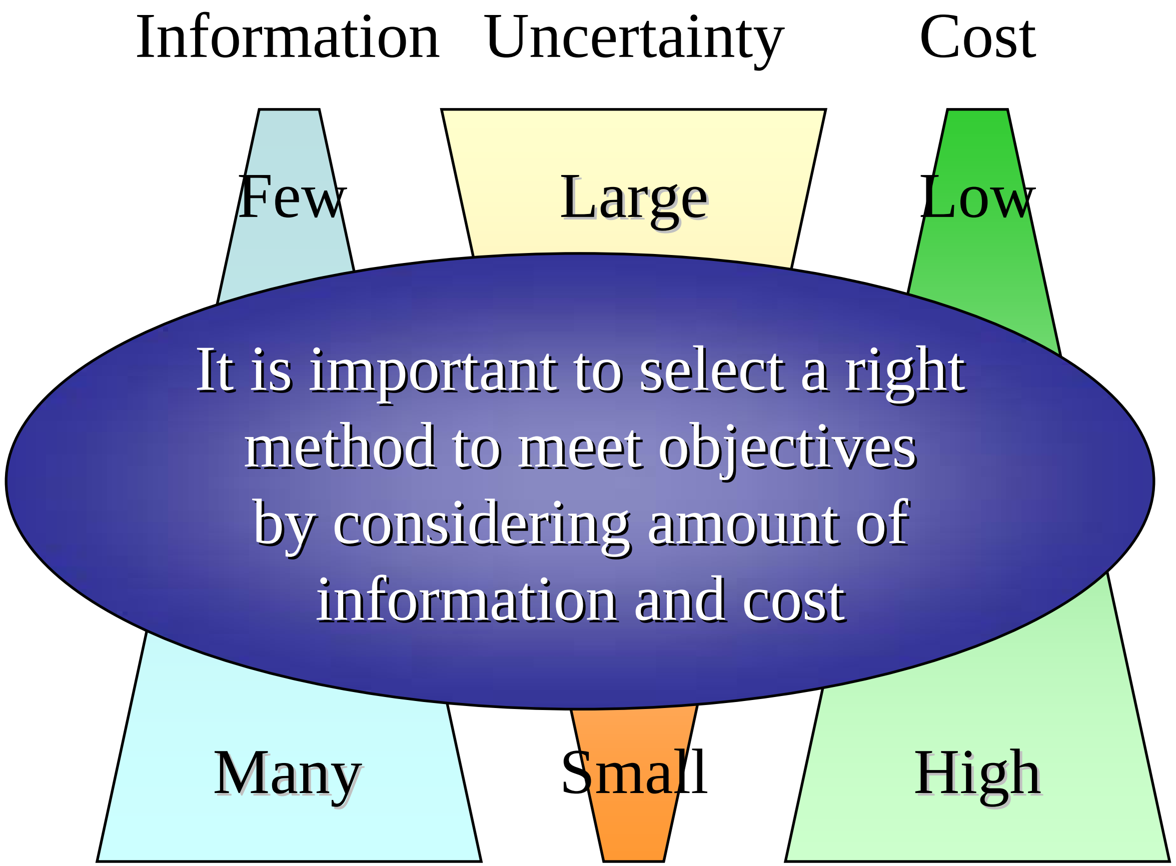
Various Analysis Levels for Loss Estimation



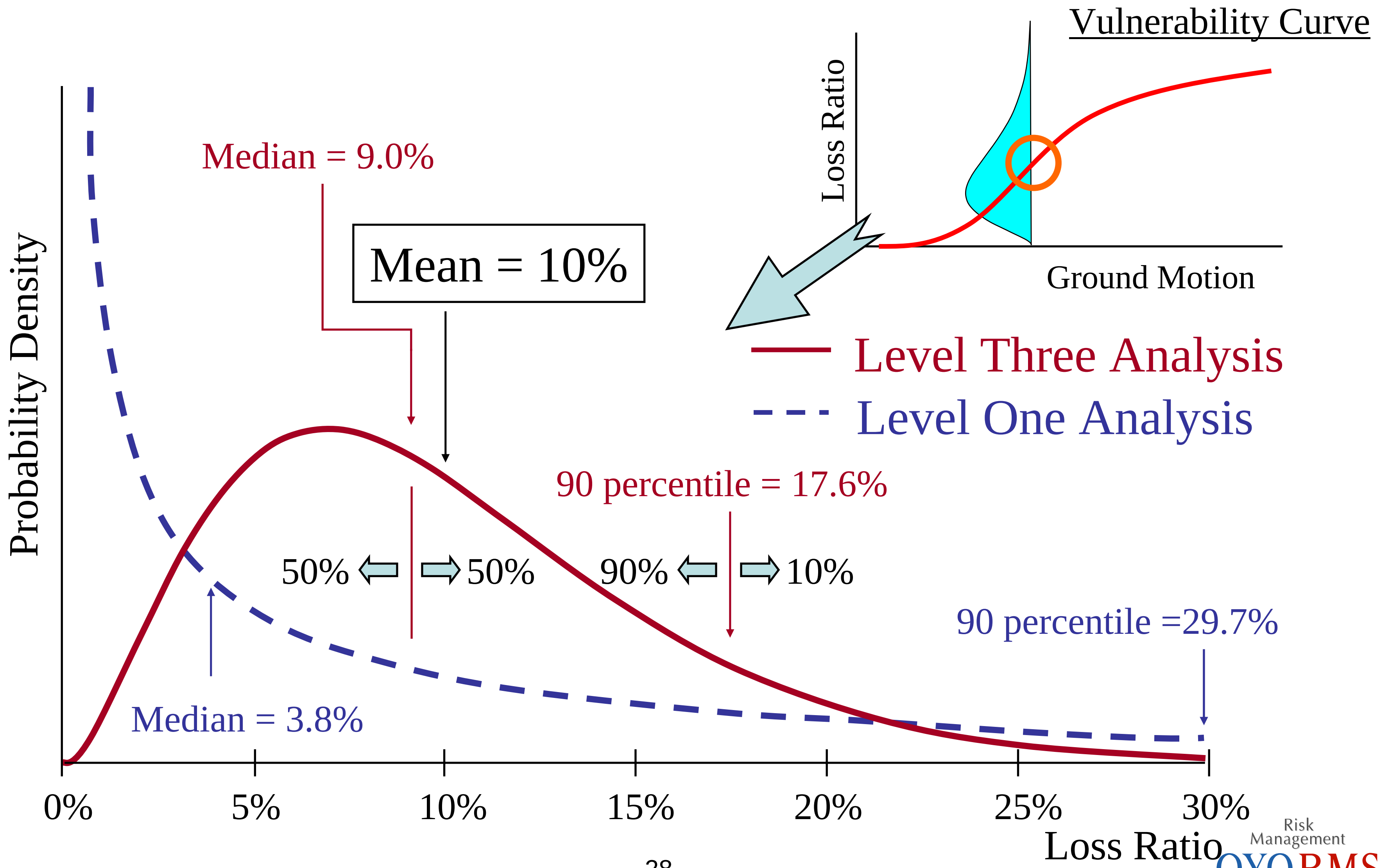
<u>Level One</u>
(Desktop)

<u>Level Two</u>
(Expert Opinion)

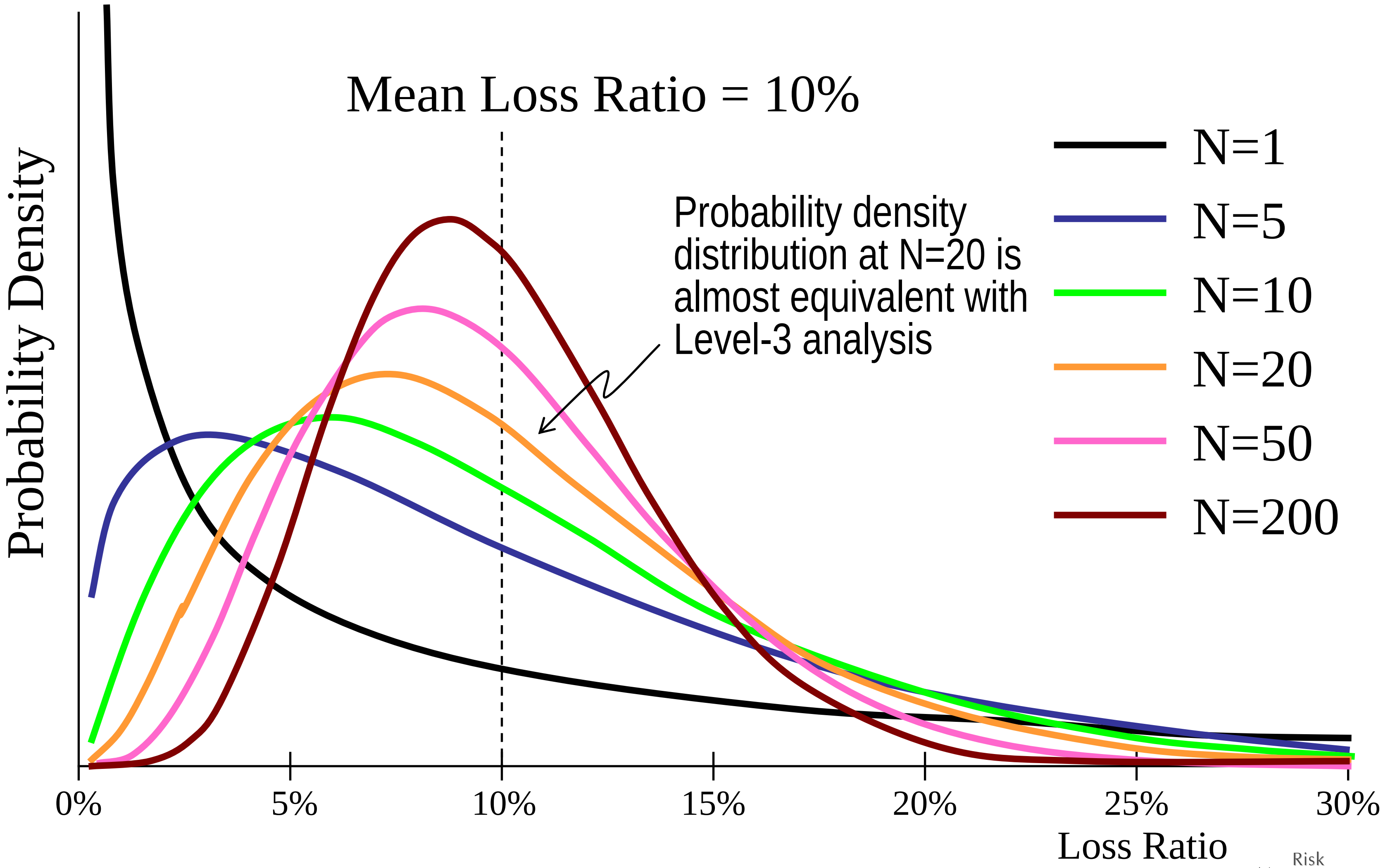
<u>Level Three</u>
(Engineering Review, Inspection)

<u>Sophisticate Analysis</u>
- Rupture Source Model
- 3D Dynamic Analysis
- Non Linear
  Dynamic Analysis

Probability Distribution at 10% of Mean Loss
(Secondary Uncertainty)



Portfolio Effect
Change of Uncertainty by Summing



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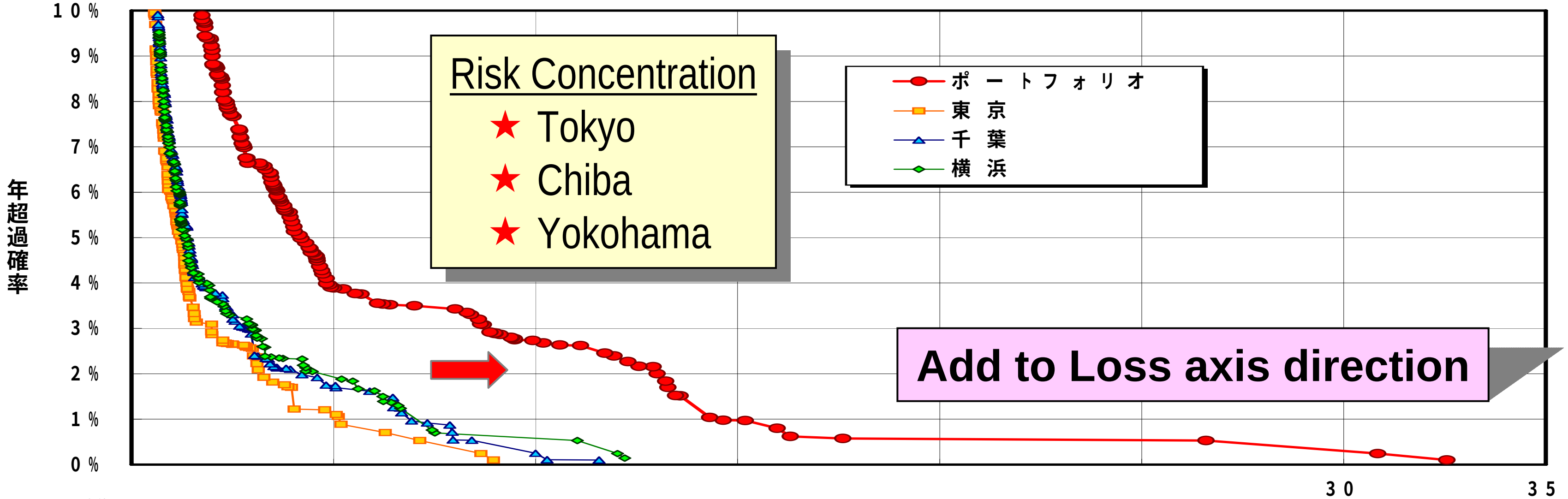
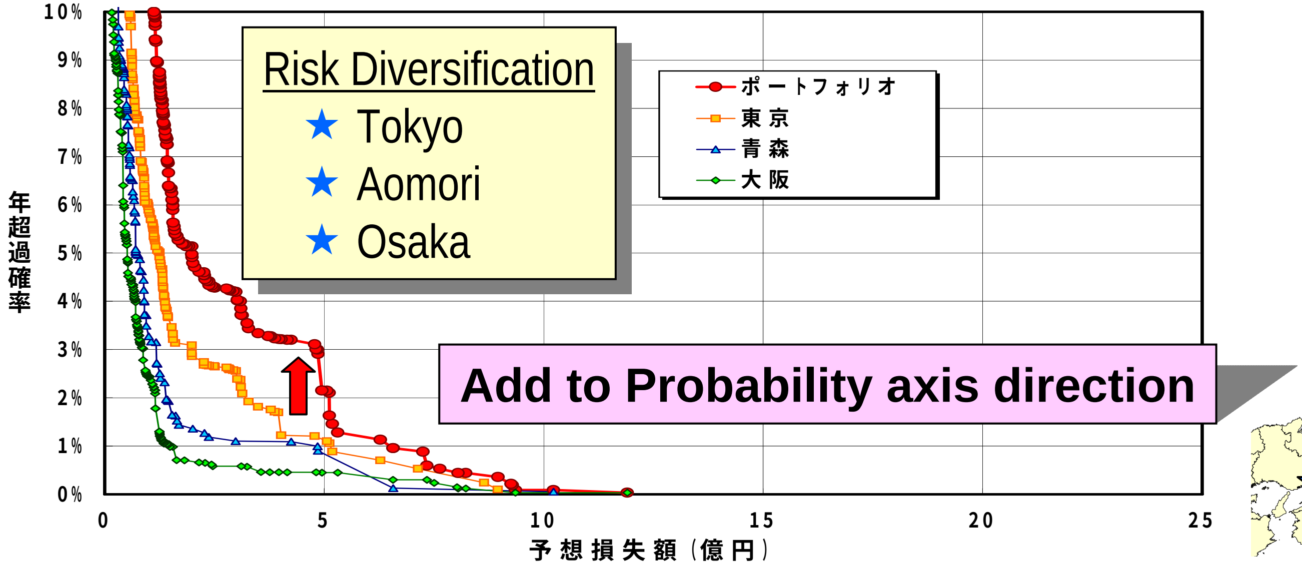
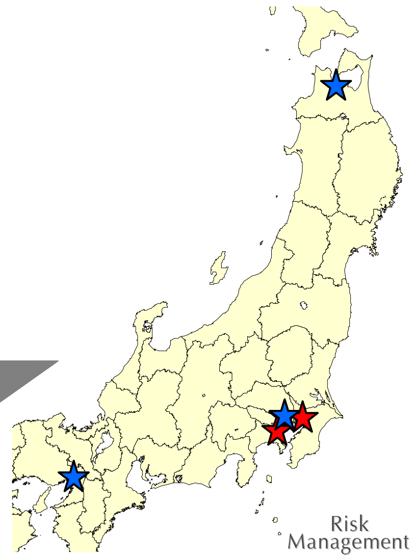
Portfolio Effect







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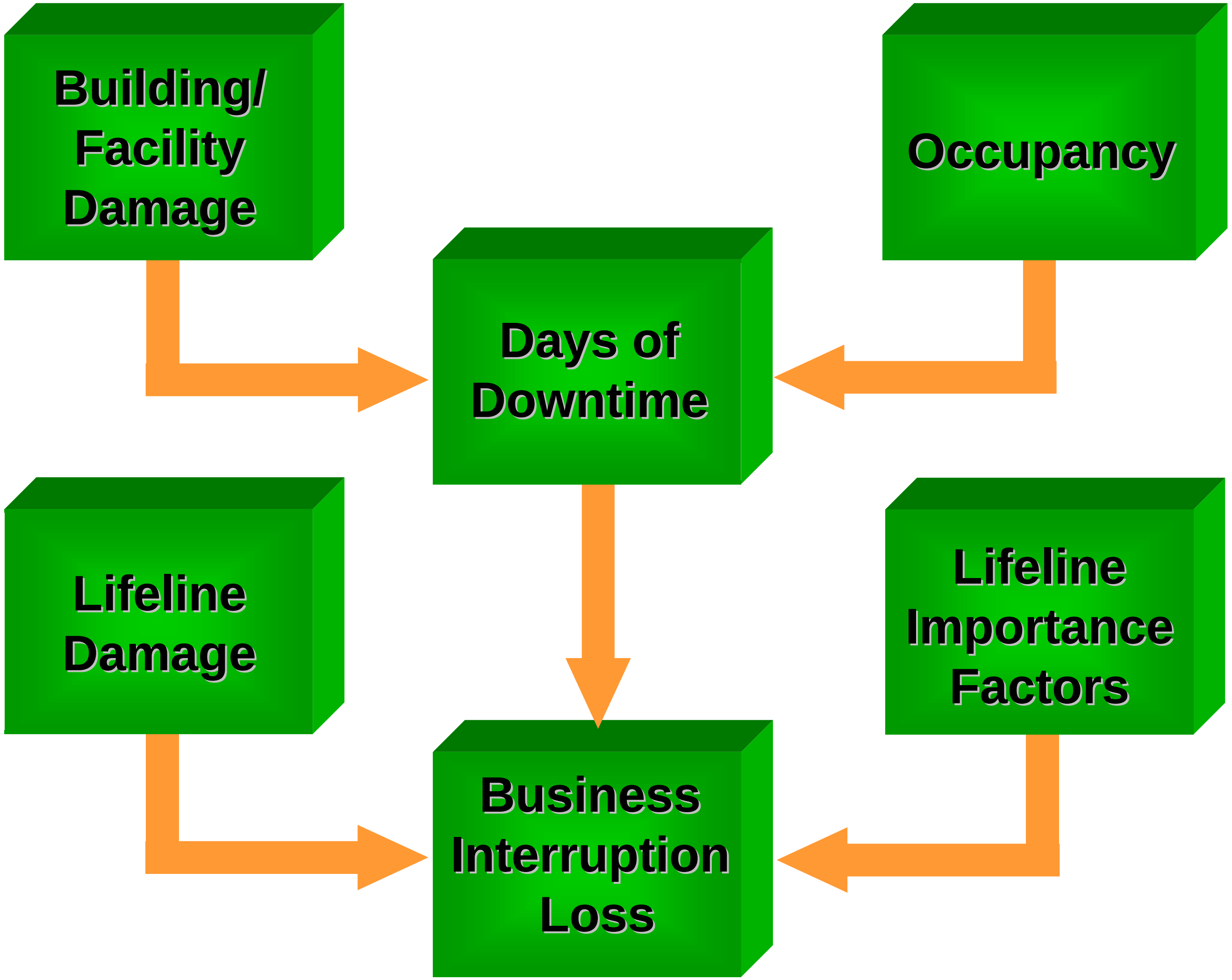
Business Interruption Model



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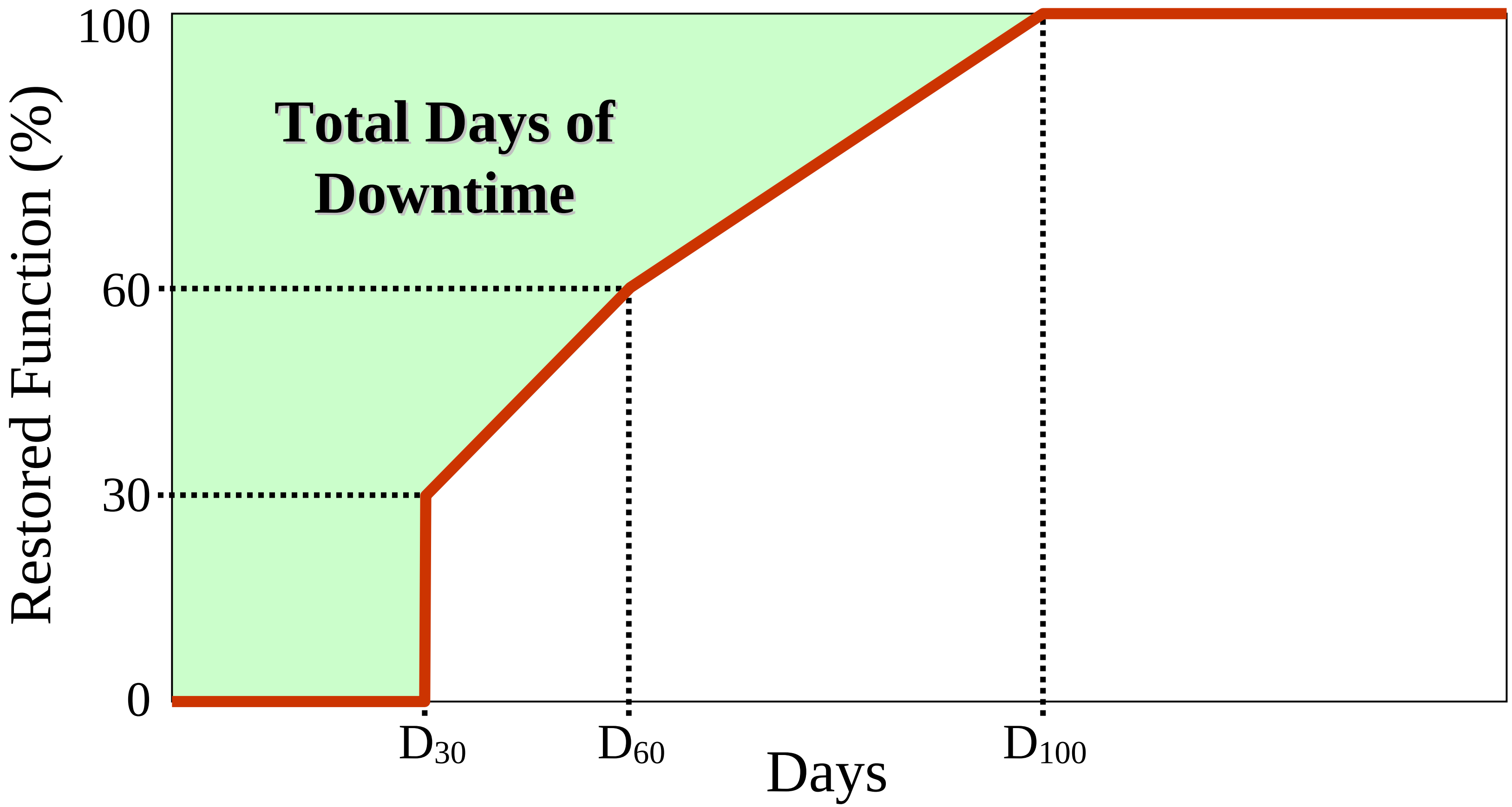
Facility Restoration Function – BI Model

BI Loss ＝ Days of Downtime × Income per Day



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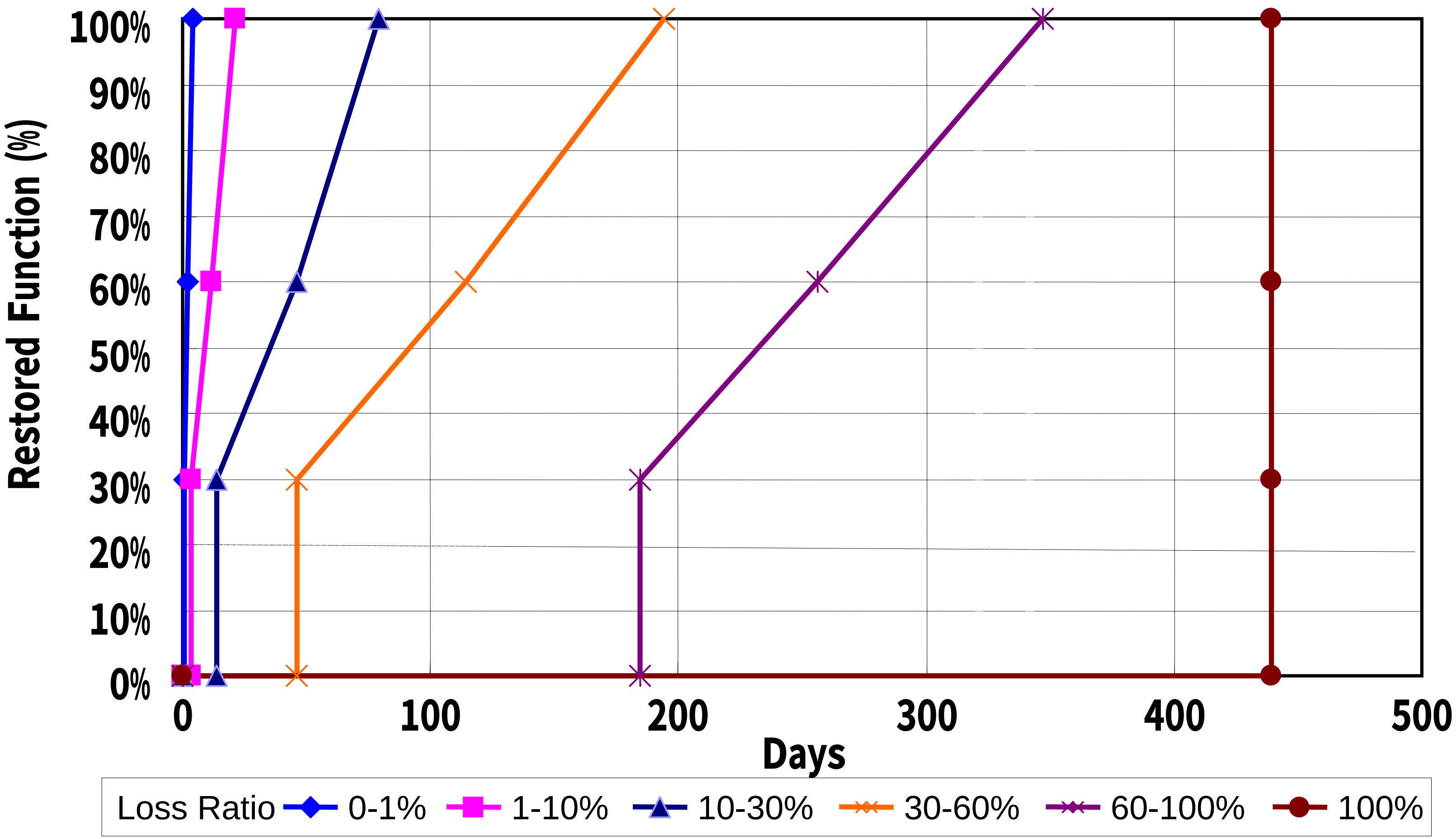
Facility Restoration Function
(Specific Occupancy Class)



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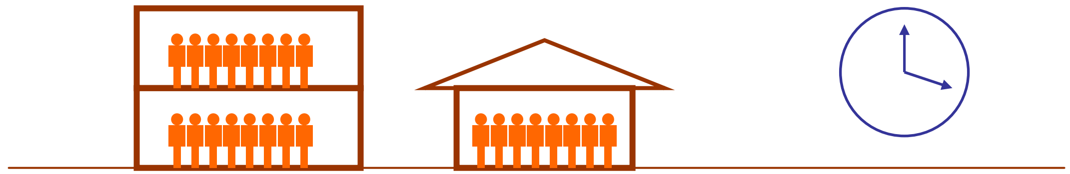
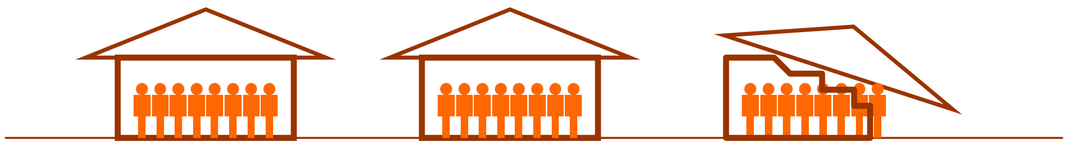
Casualty Model

Exposure Data



Geographic distribution of people, building type, time of day

Simulated Catastrophic Events



Building damage and collapse distributions by building type; population injured, entrapped, rescued, and injury distributions

Casualties & Losses by event for Risk Curve

Fatal | Permanent Total | Permanent Partial-Major | Permanent Partial-Minor | Temporary Total | Medical Only

Treatment costs
Insurance claims
settlements

Scenario Results

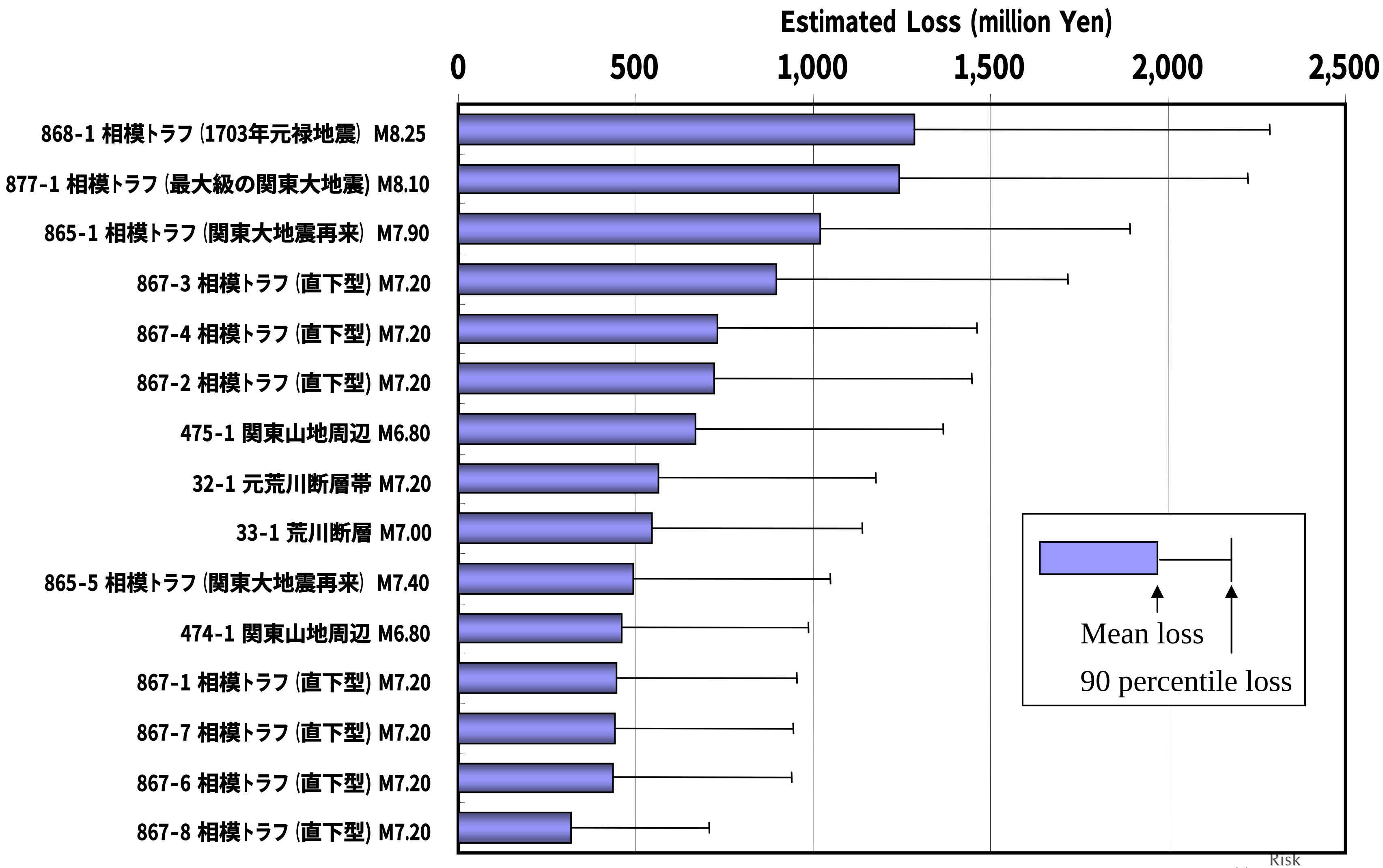
Kobe,
1/17/1995, 5:46, M7.2

Estimated Actual		Modeled
Temporary Total	8,000	12,000
PP-minor	2,400	2,800
PP-major	1,000	1,100
Permanent Total	300	325
Fatalities	5,500	5,300

Niigataken-Chuetsu,
10/23/2004, 17:56, M6.8

Estimated Actual		Modeled	
Serious	635	Temporary Total	42 5
		PP-minor	45
		PP-major	15
		Permanent Total	1
Fatalities	25	Fatalities	24

Estimated Loss of each Stochastic Events



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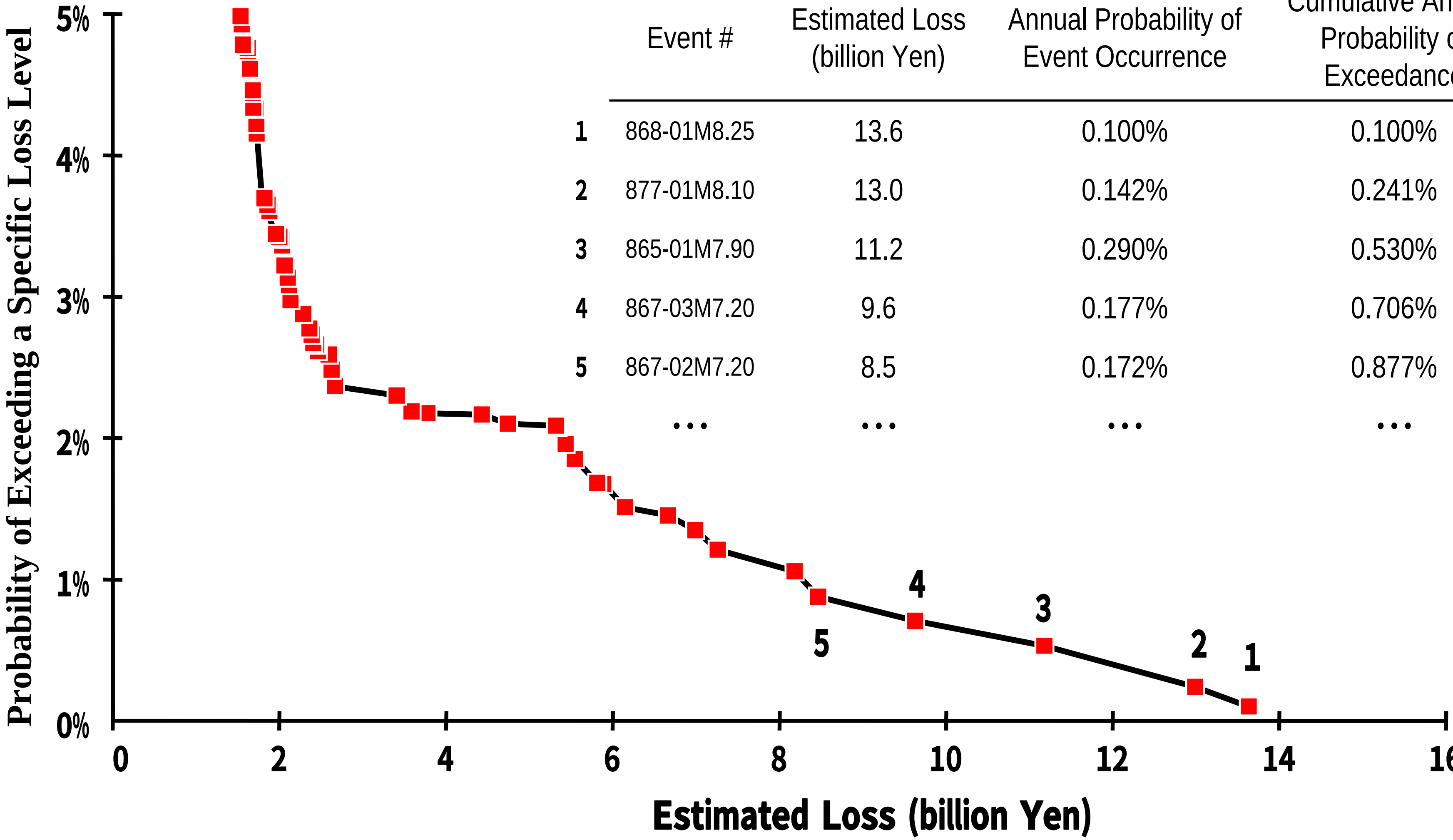
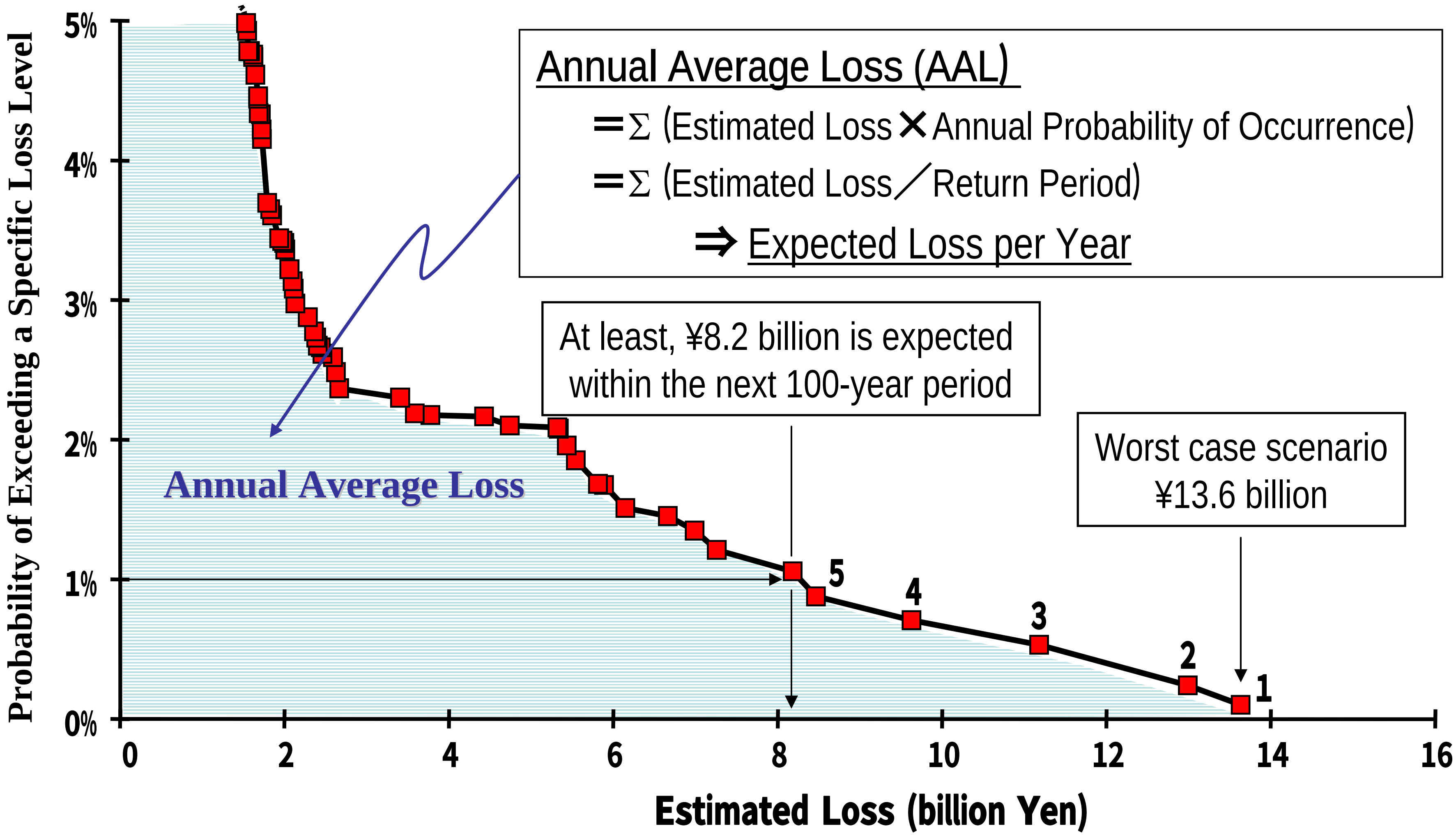
Event Curve



	Event #	Estimated Loss (billion Yen)	Annual Probability of Event Occurrence	Cumulative Annual Probability of Exceedance
1	868-01M8.25	13.6	0.100%	0.100%
2	877-01M8.10	13.0	0.142%	0.241%
3	865-01M7.90	11.2	0.290%	0.530%
4	867-03M7.20	9.6	0.177%	0.706%
5	867-02M7.20	8.5	0.172%	0.877%
	…	…	…	…

Interpretation on Event Curve



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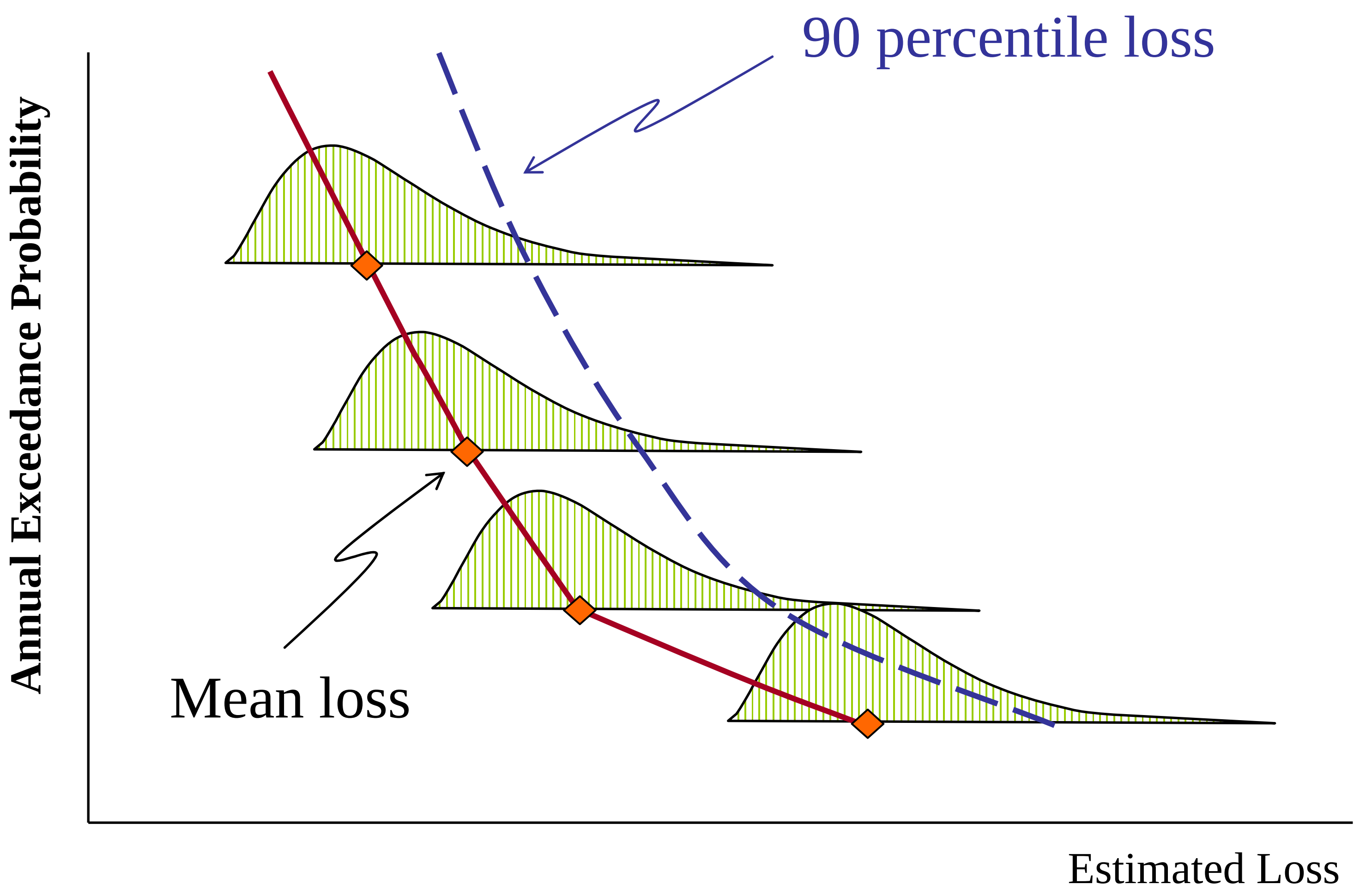
Loss Distribution Reflects Potential Levels of Damage from a Single Event



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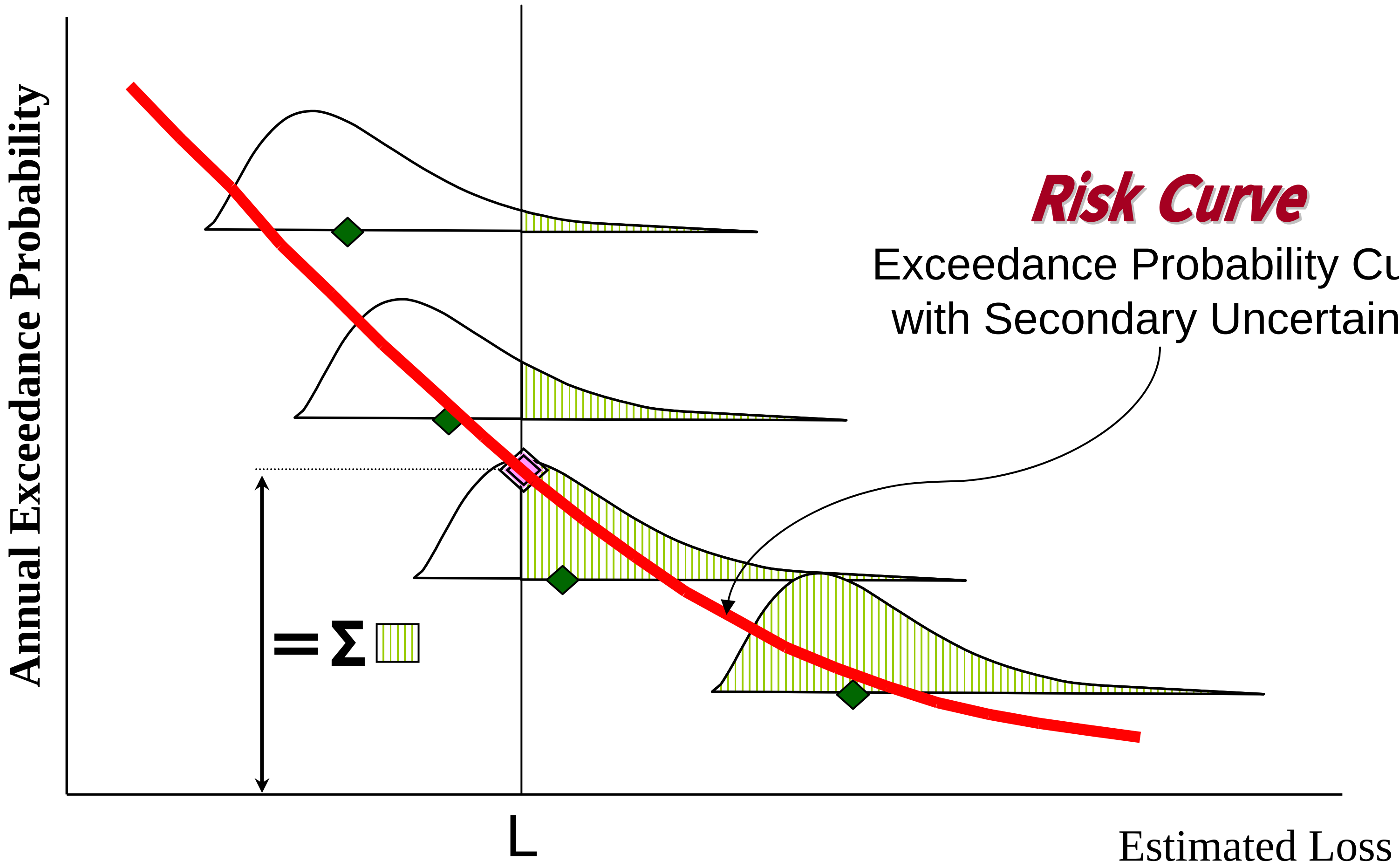
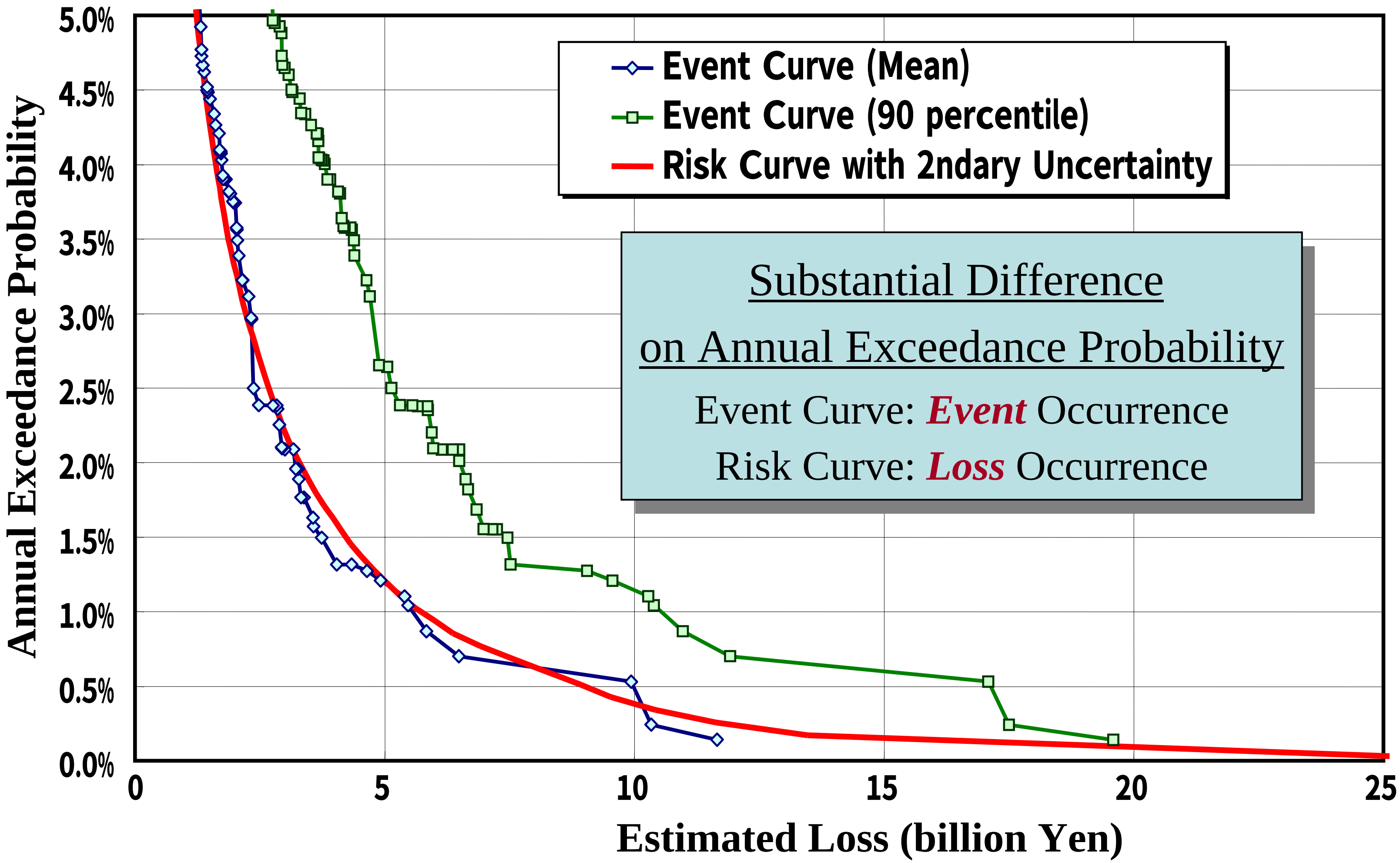
Risk Curve

Exceedance Probability Curve with Secondary Uncertainty



Event Curve vs. Risk Curve



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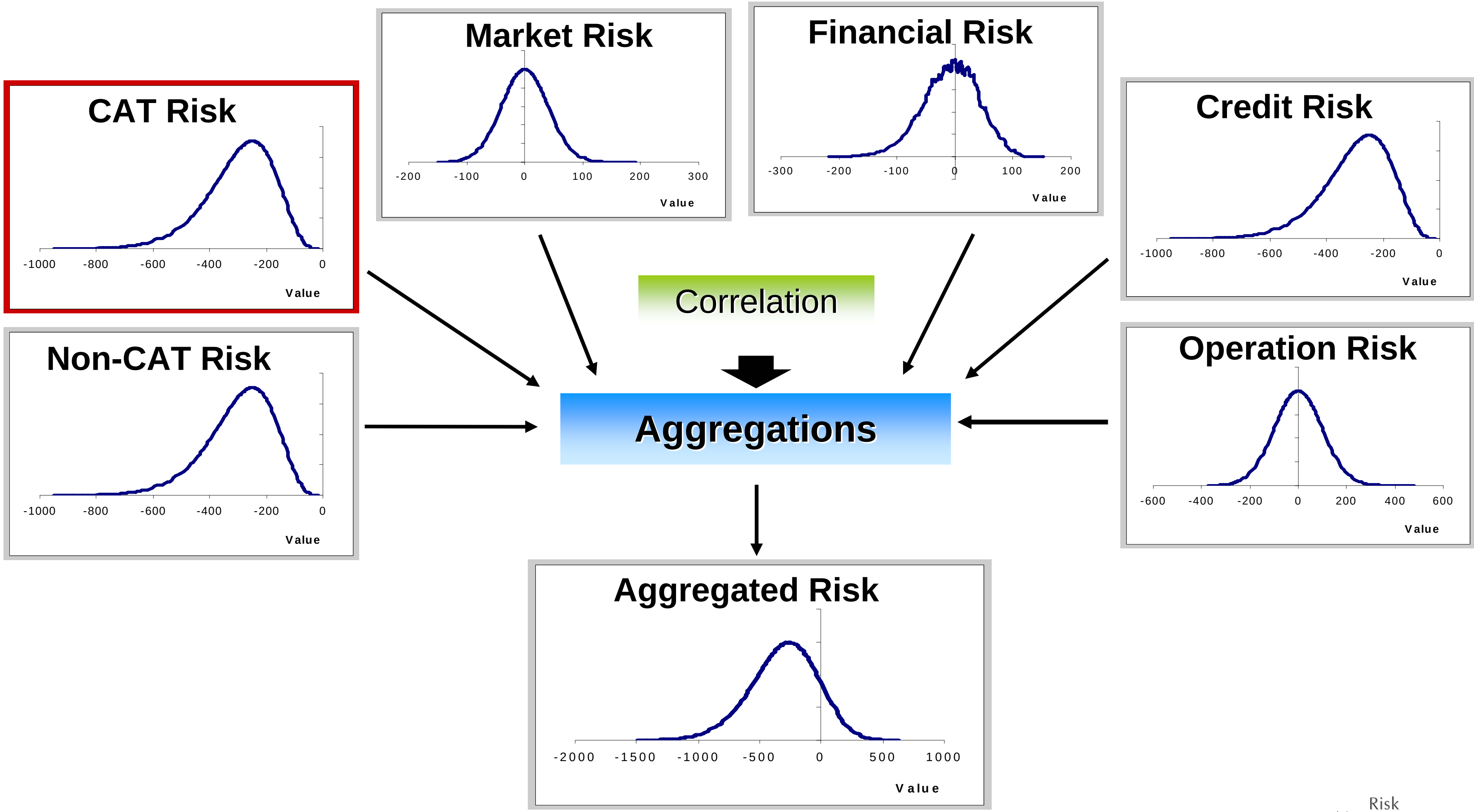
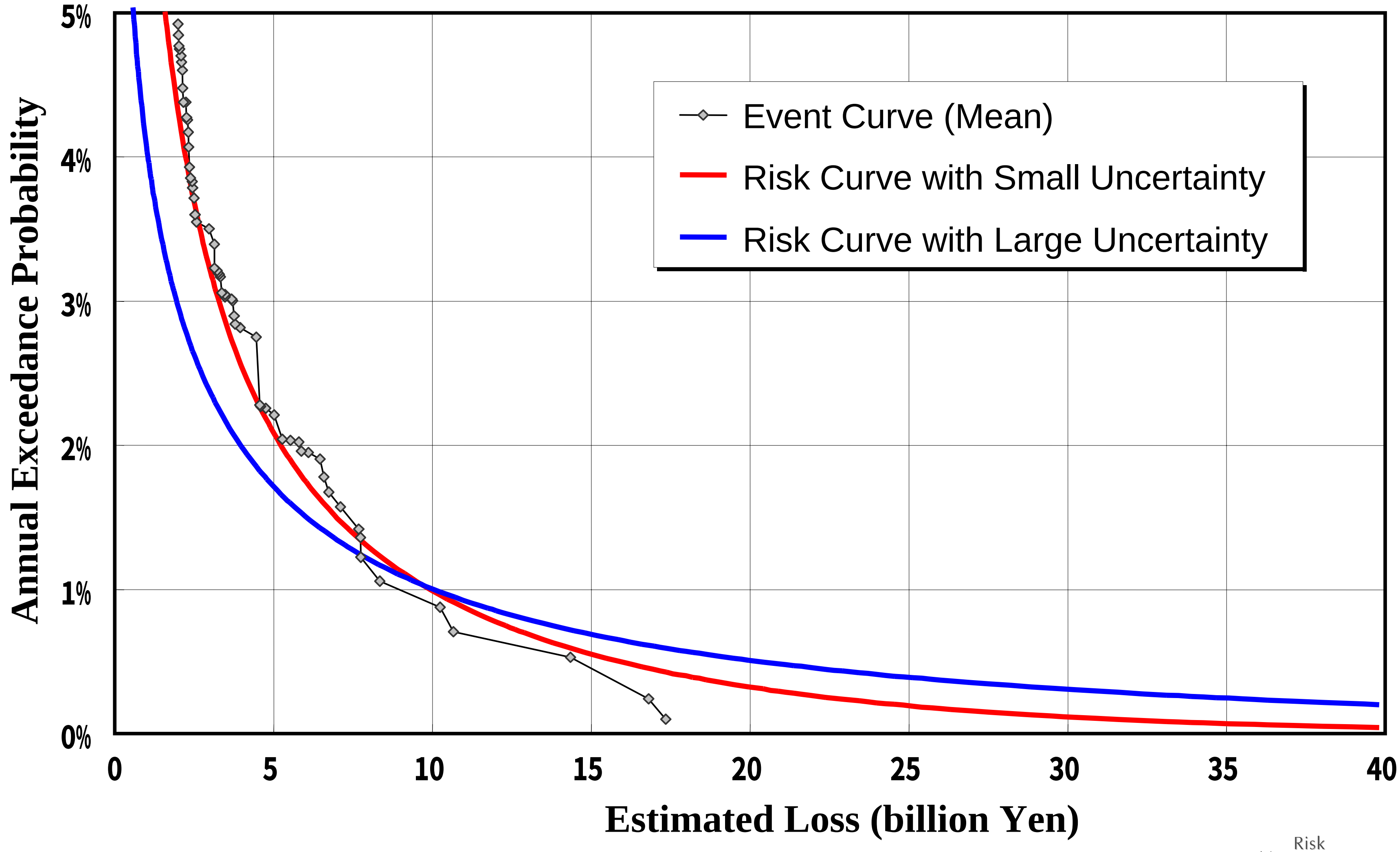
Aggregation of Risks



Event Curve vs. Risk Curve



Risk Management
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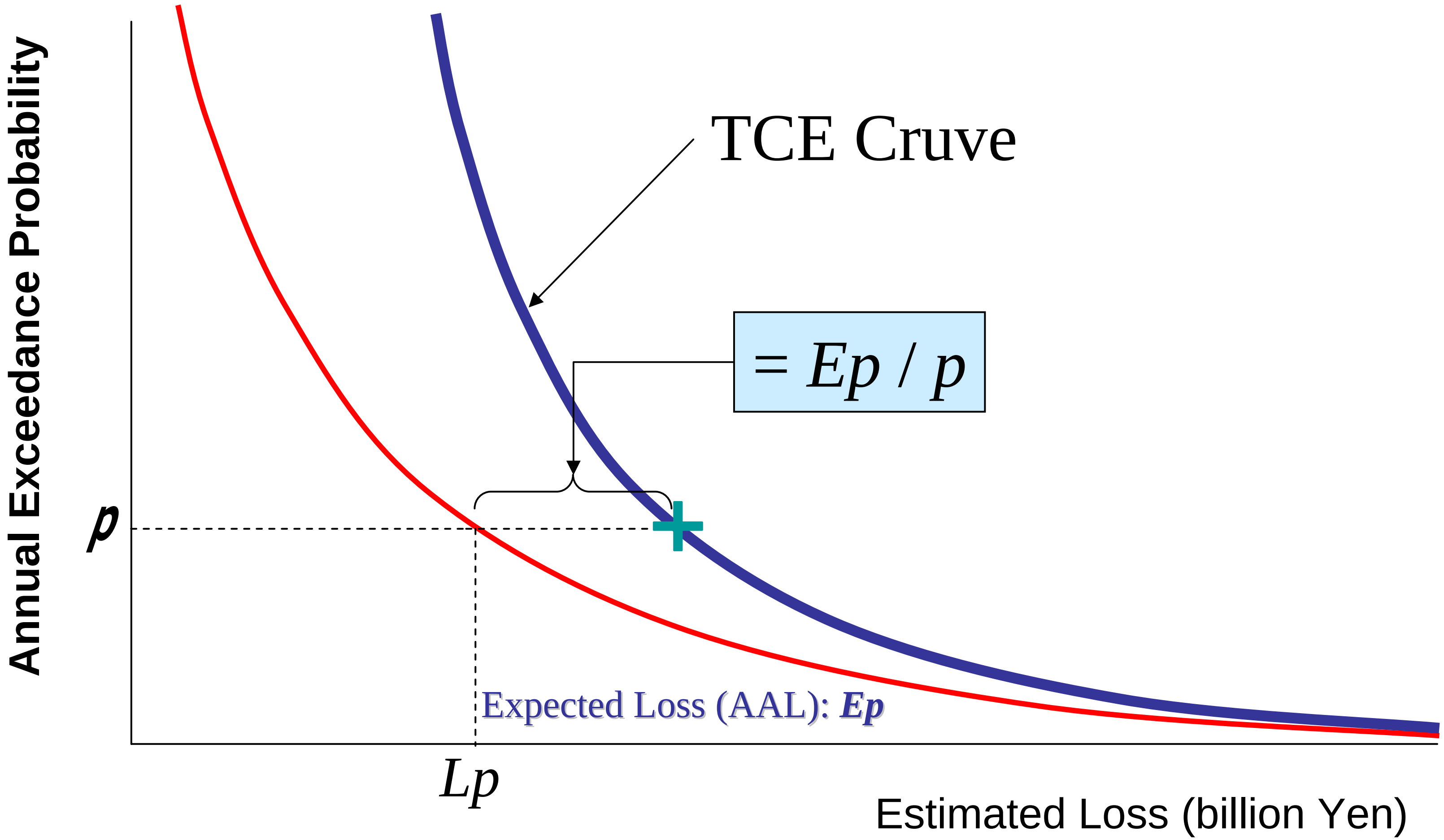
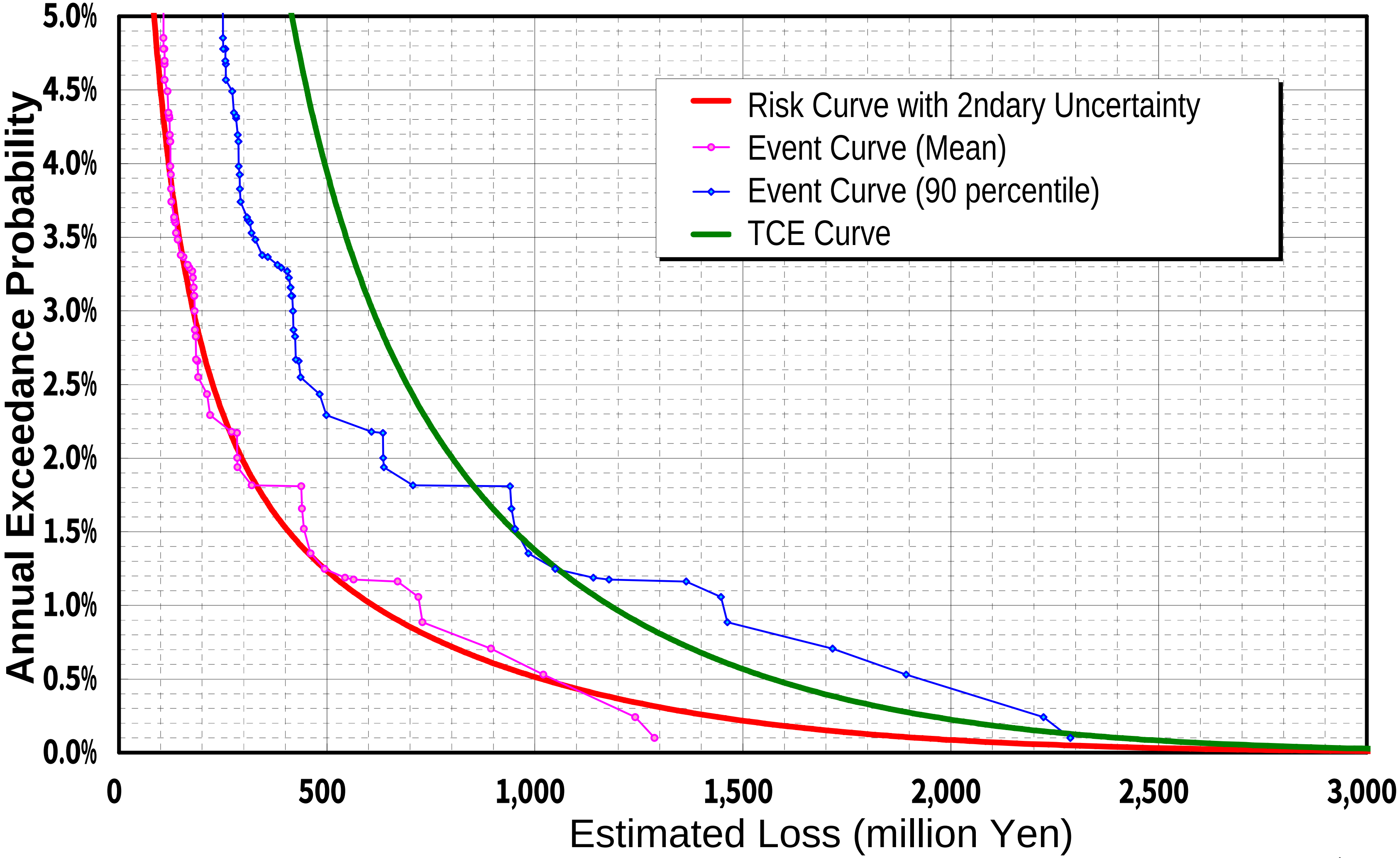
TCE (Tail Conditional Expectation)



TCE (Tail Conditional Expectation)



Risk Management OYORMS

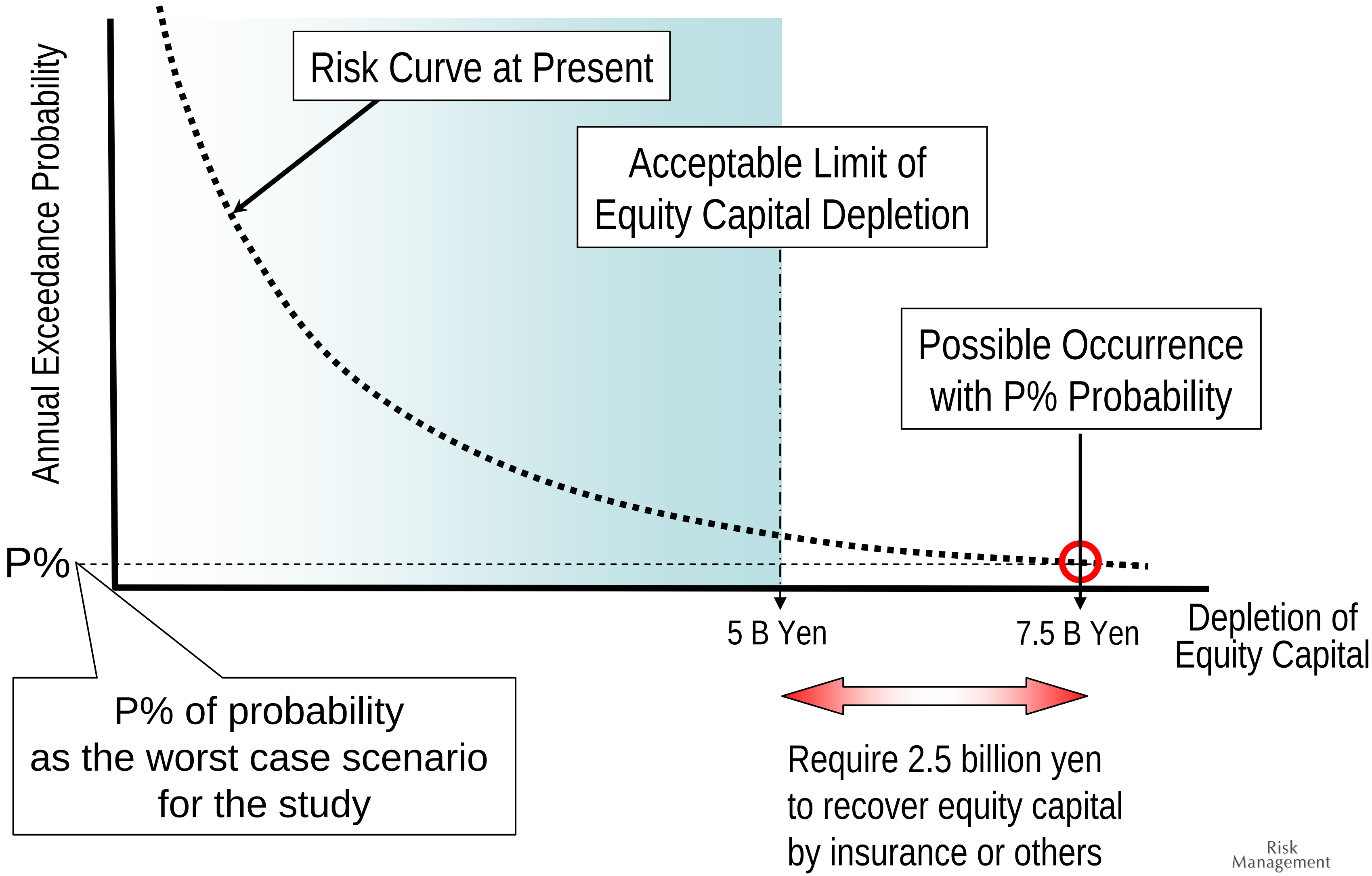
Estimated Losses and Financial Statements

Loss by Physical Damages

- Losses by facility damages

	Balance Sheet (Assets Side)	Income Statement (P/L)
✓ Repairing Cost Dismantlement Cost, etc.	Depletion of Cash	Extraordinary Loss / Non-operating Expense
✓ Restoration Cost excluding the above (Asset Capitalization)	Depletion of Cash New Asset (after recovery)	Amortization
✓ Loss of Booked Values	Depletion of Fix Assets	Extraordinary Loss
• Damages of Inventory Assets	Depletion of Liquid Asset	Extraordinary Loss
Losses by Business Interruptions	Depletion of Cash Depletion of Earnings	Drop in Sales/Profit

Study on Risk Measures by Using Risk Curve of Equity Capital



Risk Management
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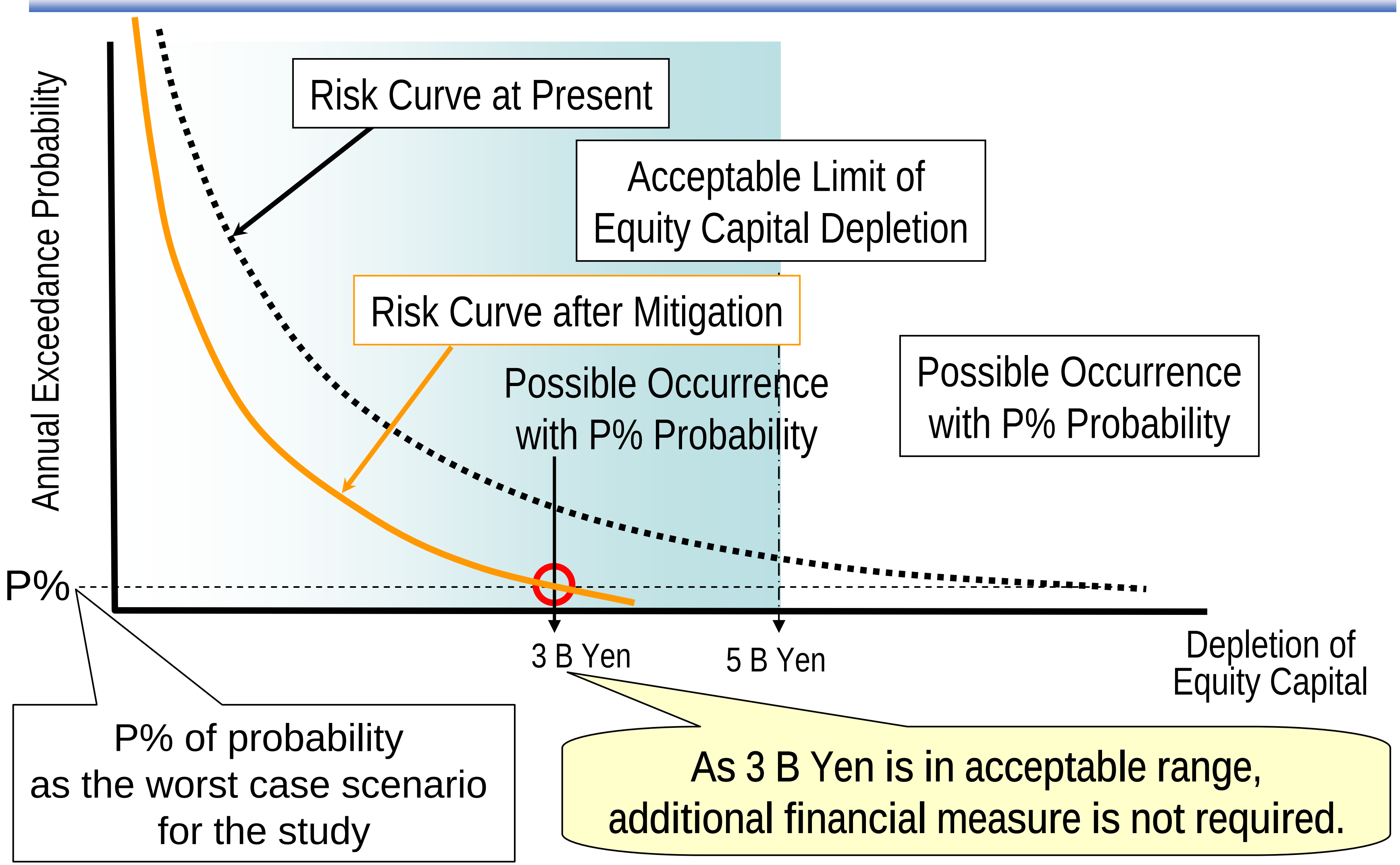
Study on Risk Measures by Using Risk Curve of Equity Capital



Conclusions

- Assessment technology on Seismic Risk has already reached at a certain level of probabilistic approach.
- Utilizing existing models is more efficient way to build specific risk models for financial institutes
  - First, a perspective model and then move to a detailed model
  - Implementing uncertainties adequately is very important for risk modeling.
- Losses by earthquake will spread geographically and temporally
  - Limiting seismic risk to operational risk is an appropriate way?