



Risk Management against External Events

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Outline of Lecture





1. Emerging need for current society against external natural events
2. Significance of Risk Concept
3. Fundamentals of Risk Management
4. Examples of Risk Assessment of Natural Hazards
5. Risk concept and further concept
6. Conclusions



Shift of Technological Needs



Past	Present
Single function	Multiple function
Simple system	Complex system
Independence	Mutual dependency
	
Frequent disaster with low tech. -> more careful consideration & treatment	Rare disaster due to Tech. innovation -> Once disaster occurs, Conseq. quite large
Traditional discipline is sufficient	Multi-disciplinary approach needed -> Risk management needed

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Definition of Risk



Risk = Product of probability of having loss and magnitude of loss

$$R = P C$$

R: risk (\$)

P: probability of event

C: consequence or loss of event (loss (\$), fatality, etc.)

e.g., Risk of building collapse due to earthquake (\$)

=loss due to collapse x collapse probability

Risk of fatality due to a single flight

=number of fatality x aviation accident probability

Risk of down time due to moderate earthquake (days)

=number of days x down time probability

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How to Reduce Risk



$$R = P C$$

To Reduce P leads to → Precautious measures

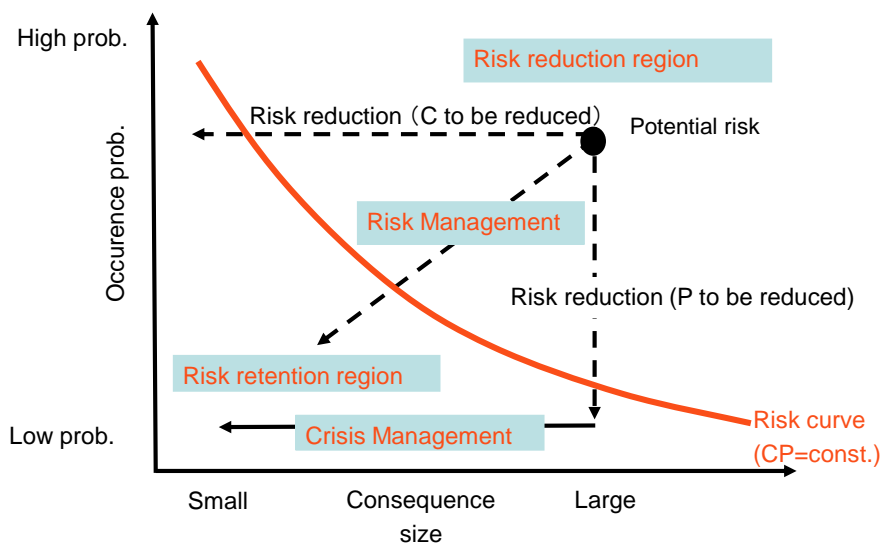
- to design and construct safer buildings

To Reduce C leads to → Post-event measures

- to strengthen rescue power to save human lives, to let people not live in less safe houses, buy earthquake insurance

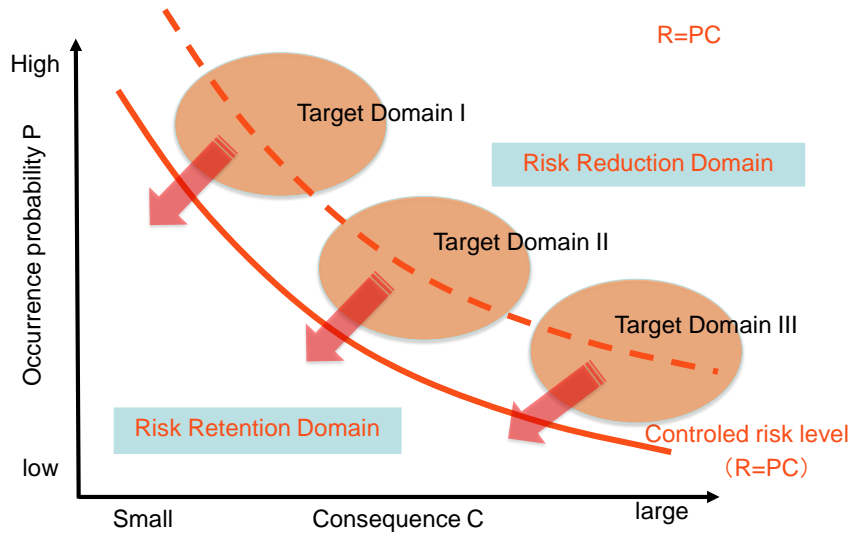


Risk Reduction





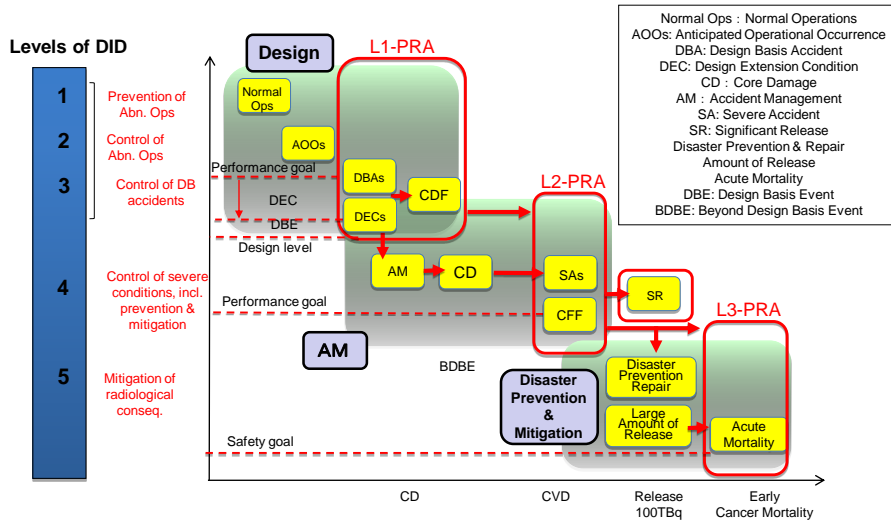
Multi-stage Risk management Scheme



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DID and Performance Requirements for NPP (JAEE, 2015) JAEE (Japan Association of Earthquake Engineering)

From recent report by JAEE Committee on Tsunami Resistant Engineering for Nuclear Safety (2015)



Domains of design, AM, Prevention & Mitigation and Areas of PRA

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Overview of Risk Management



(taken from Guide 73, 2002)

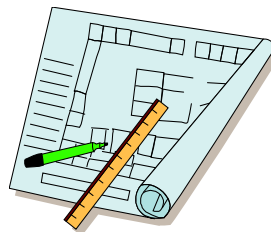
Risk Management		
Risk Assessment		
Risk Analysis		Source Identification
		Risk Estimation
Risk Evaluation		
Risk Treatment		
Risk Avoidance		
Risk Optimization		
Risk Transfer		
Risk Retention		
Risk Acceptance		
Risk Communications		



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Examples of Risk Assessment of Natural Hazards



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Hazard List (Natural hazard)

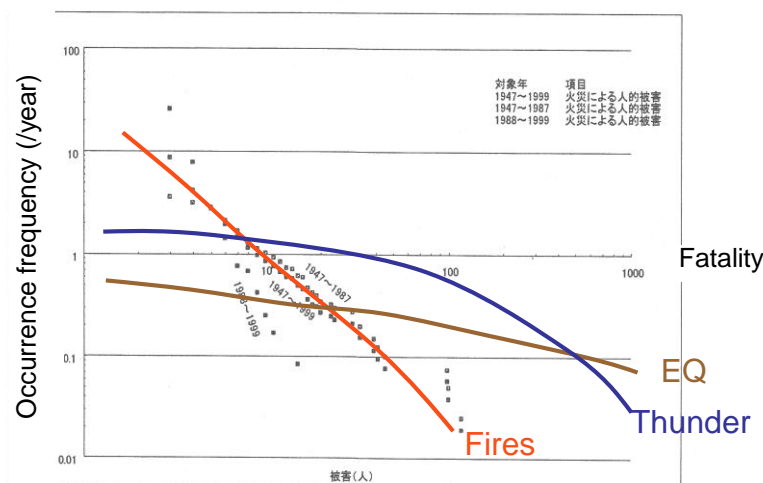


	Hazard Type	Hazard Group
Natural Hazard	Seismic	Seismic motion Subsidence Landslide Flood Fire
	Tsunami	Tsunami
	Wind/Water	Tide Strong Wind Flood Landslide Thunder/Lightning Temperature
	Volcano	Volcano Seismic Tsunami
	Snow	Snow Load Snow slide Landslide
	Others	Biological Meteorite Magnetic storm
	Combined	Seismic induced hazards Seawater/High Wind/Heavy Rain Seawater/High Wind/Heavy Snow/Lightning Seawater/High Wind/Melted Snow/Lightning

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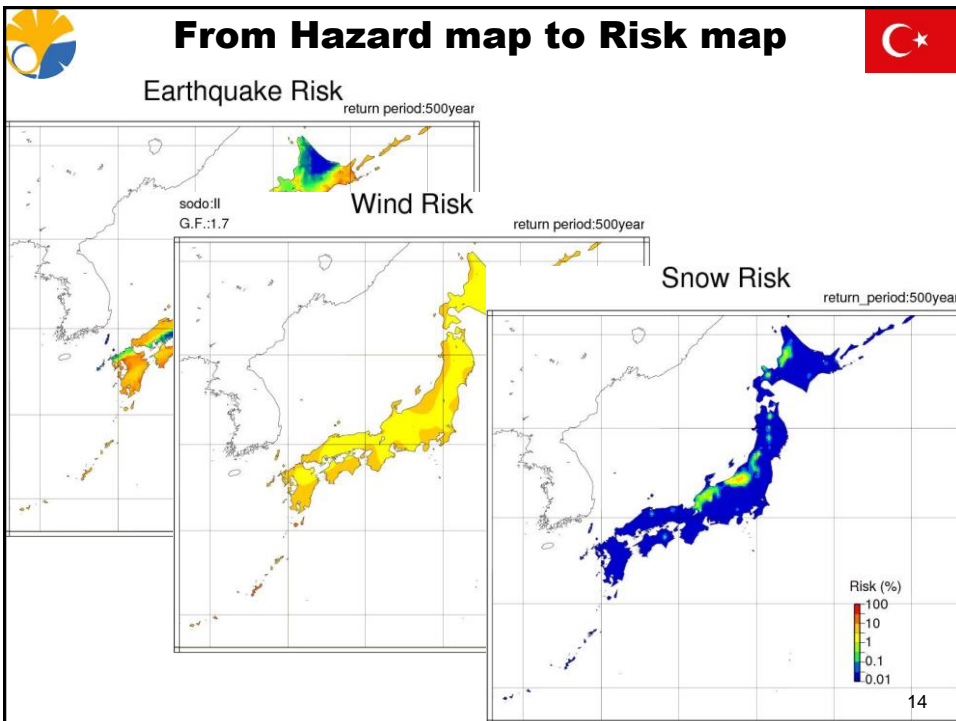
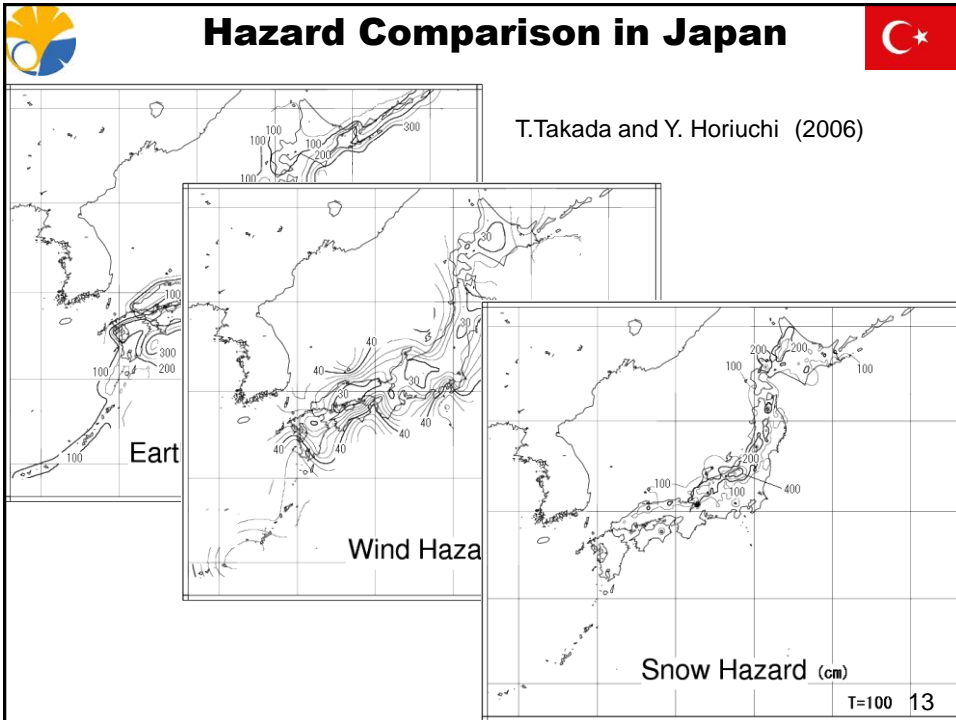


Risk Profile - Earthquake, Thunder, Fires ?



出典：消防白書、戦後の重大事件早見表（毎日新聞社）
 図-1.1.5 我が国における火災の被害（死亡者数）と累積発生頻度（発生期間別）

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Why Risk Assessment?



1. “How safe” should be demonstrated rather than “absolute safety (safe or not)”
2. Comparison of various risks (comparison with common measure)
Discussion should be made on from qualitative to quantitative difference
3. Needs of reasoning for decision-making in various process (accountability to the public)
4. As a tool for consensus-making among experts
As a communication tool between regulator and general public

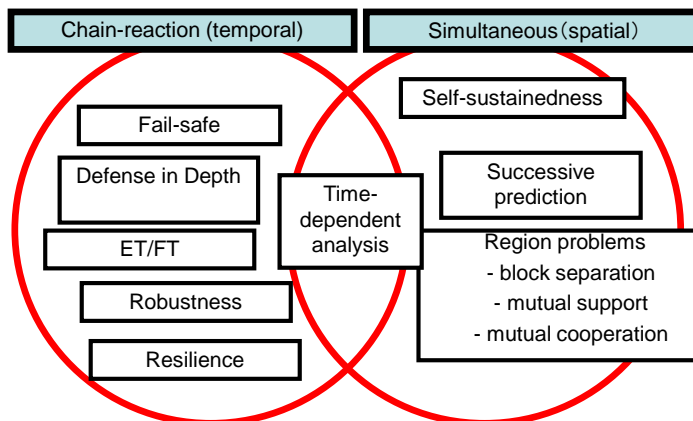
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New Concept “Safety Burst” (EAJ, 2004)



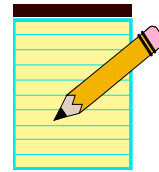
Safety burst indicates the physical state that after either a single failure of a part or simultaneous failures of portions of a huge, complex engineering system with possible large failure consequence is initiated, further damage will be propagating and expanding in time and space, and finally the expected performance of the system becomes out of control.



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Summary



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Summary



- 1 Modern Technology needs advanced approaches due to its characters; multi-function, complex system, dependability.
- 2 Risk is emphasized as essential concept for the above. Risk is defined as $R=PC$
- 3 Risk management is a key approach to treat various risks. Multi-stage risk management scheme is effective for implementation of risk management with defense-in-depth concept. It includes redundancy, independence, multiplicity, diversification.
- 4 New concept related to risk in time and space
- Fail-safe, robustness, resilience, self-sustainedness, region blocking, etc.

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