# Advance in the most "established" assessment tools

The process for identifying parameters to assess physical vulnerability: the seismic case









Parameters to assess buildings vulnerability to earthquakes							
	Classes						
Parameters	А	В	С	D	weight		
1. Type and quality of structural components	0	5	20	45	1.0		
4. Building	0	5	25	45	0.75		
6. Plan layout	0	5	25	45	0.50		
7. Front layout	0	5	25	45	variable		
8. Distance of walls	0	5	25	45	0.25		
9. Roof	0	15	25	45	variable		
10. Non structural components	0	0	25	45	0.25		
11. State of maintenance	0	5	25	45	1.00		

Data comes from surveys conducted by instructed personnel



### Advance in the most "established" assessment tools

#### Extending the process to "all" hazards



toxic chemicals building conditions very poor/ good 1 1 1 1 1 1 1 soil on which the building amplification soils 1 0,5

	Second Matrix: F	hysical vulnerability: Vulnera	bility to stress (hazard	1)		
	System	Aspect	Parameters	Criteria for assessment	Descriptors	Scoring
		Outy needle or leaf litter on the ground Staface fuels (A1) Space low regetation				
				, í	Sparse low vegetation	
				P	Tall dense phrygana or shrubs	
t				Existence and cover of tail	No tree crowns	
onme	Natural ecosystems	Do natural environments itneract significanlty with the hazard?	land cover inflammability	tree crowns (P(2)	There is a tree crown cover of >40%	
÷.				Distance from the surface fuel	No tree crowns	
Ú,				layer to the base of the tree	Distance >5m	
<del>.</del>				crown (A3)	Distance <5m	
- in				Type of trees (A4)	Conifers	
lat					Broadleaved trees	
2		Are natural ecosystems vulnerable to mitigation measures taken particularly during the eemrgency phase?	yes/no; how natural ecosystems may be impacted by mitgiation measures	hazard specific		

#### Distance d < 2m Post-fire case studies revealed that ~90% of home survival Minimum distance between 2m <= d < 8m depended on two factors: a nonthe forest fuel and the house 8m <= d < 20m flammable roof and vegetation Distance >= 20m cleared within 10 m of home Non flammable roof/flammable (Foote, 2006) Heat tolerance of the roof roof What are the factors that make Vulnerability assessment of Slope i 55% buildings and public facilities residential buildings and Influence of the slope of the 5% <= i < 20 vulnerable to the stress? public facilities surrounding area Slope >= 20% Non burnable walls/ flammable walls Heat tolerance of the walls Heat tolerance of the shutters Metal shutters/wood or plastic shutters Built Only ground floor/2 floors/ > Number of floors(C4) Exposure ani 2floors All residential/residential upper vulnerability of built Types of dangerous uses environment within or in proximity to the building unit of reference (either in the horizontal or floors, stock of inflammable material Vulnerability of the urban first floors fabric vertical sense) Close/far to/from warehouse or other place storing dangerous material What are the factors that make the urban fabric and public facilities Presence of flammable installations vulnerable to the stress? or storage/non existent Close/far to/from medium or high voltage wires and electricity installations Additional exposure due to Continuous building the pattern of building development pattern/semidevelopment detached/totally isolated

ı sites			Vulnerability assessment of critical infrastructure	water system pressure	too low pressure for hydrants/normal	
oduction	Critical infrastructures	What are the factors that make critical infrastructures vulenrable (mainly lifelines)	Accessibility factors	redundancy and width of roads	narrower than 12 m/larger; only one access/> 1 access	
e and pi				interaction with fuel	large road sections in open zones/in the middle of fuel areas	
tructur	V Production sites p	What are the factors that make	Vulnerability assessment of production sites	as for buildings, but including attention to storage of hazmat	structurally vulnerable/low vulenrability; large storage/no storage self eater tank available/not available	
Infrasi		production sites vulnerable (including na-tech potential)	Vulnerability due to dependency on lifelines	depending on the degree of dependance upon external vulnerable lifelines	self eater tank available/not available	
				and the second second second		
	People/ individuals		Sparse population	living in isolated buildings and remote settlements and total population	r <5%; r > 20%	
gents		What are the factors that may lead to injuries and fatalities?	Preparedness	self protection means	hydrants at home/lack of hydrants	
m (a)			Age; mobility impairment, other impairment	self protection against smoke	vailability of masks/lack of (makes sense?)	
syste			Age; mobility impairment, other impairment	difficulties to comply with evacuation orders; difficulties in escaping	> 65; number of handicapped	
ocia	Community and Instituions	What are the factors that may lead to large number of victims?	Distance from firefighting resources	time of arrival	within 30 min; > 1 hour	
ŏ			Availability of trained personnel	professional training in the community	firefighters (professional+volunteers)/only professional	

# Extending the process to "all" hazards

# **Example of application on wildfire**

					Distance <sup>&lt;</sup> 2m
				Minimum distance between the forest fuel and the house	Distance between 2-4m Distance between 4-6m Distance between 6-8m Distance between 8-12m Distance between 12-20m
ment		What are the factors that make buildings and public facilities vulnerable	Vulnerability assessment of residential buildings and public facilities	Influence of the slope of the surrounding area (B)	Distance <sup>2</sup> 20m Slope <sup>5</sup> % Slope between 6-20% Slope <sup>2</sup> 20%
2		to the stress?		Heat tolerance of the walls(C1)	Non burnable walls Flammable walls
env				Heat tolerance of the roof(C2)	Non flammable roof Flammable roof
Duilt				Heat tolerance of the shutters(C3)	Metal shutters Shutters made of wood or plastic
	Exposure and vulnerability of built			Number of floors(C4)	Only ground floor Two-floor building Three-floor or higher building
	environment		Vulnerability of the urban fabric	Types of dangerous uses within or in proximity to the building unit of reference (either in the horizontal or vertical sense)	Residential use on a higher floor while there is another use at the ground floor storing flammable materials or entailing a risk of explosion (e.g. warehouse, workshop, small industry
		What are the factors that make the			Proximity with a site hosting a use entailing presence of flammable materials (e.g. warehouse) Presence of flammable installations or constructions in the non-built part of
		urban fabric and public facilities vulnerable to the stress?			the building plot A building adjacent to a vacant site (i.e. lacking fuels altogether) Medium or high voltage wires and electricity installations close to the building
				Additional exposure due to the	continuous building development
				pattern of building development	t pattern
					Semi-detached buildings
					rree from all sites system



## Advance in the most "established" assessment tools

#### Establishing a process for systemic vulnerability





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sy stemic vulnerabil	ity:vulnerability to lo	is es		
systems	parameters	depending on:		
natural environment	* vulnerability to na-tech	losses and	Loss	
		the consequence	L055	
built environment		losses may	Of	
		have on	<b>U</b> I	
urban fabric	* external and internal		6	
	accessibility		Tunction	
critical infrastructures	* dependency	individual		
and facilities	* robustenss	sectors,		
	* rapidity	activity		
	* resourcefulness			
production sites	* transferability	service		
	*			
agents (examples)		key criteria:		
		* ability to function		
opulation living in	* preparedness			
hazardous areas	* access to information	* information		
governmental organ.	* plans, preparation			
	* sharing of information			
	* access to crucial			
	knowledge			
				nhysical damag
economic stakeholders	* husiness continuity			physical uamag

...............................





Research institute of Lifeline Engineering, Inc., prof. Shiro Takada, Junichi Ueno

Organisation: -Able to develop cognition - Sensemaking -Preparedness -Flexibility

Social system

#### **Temporary multiorganisations**:

-Generally do not meet everyday;
-Some are used to face emergencies other not
-Each organisation has its own culture, language, tools and skills,

- Tasks and responsibilities overlap...

- Sometimes (particularly for surprises) nobody is responsible...

## Community: -Class, gender aspect -Access to services and resources





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Shigeru Ban is planning partitions evacuation centers in Japan.

Our paper partition system is very simple and also flexible. There is no need for any wooden joints or braces. It is fast, easy to assemble and disassemble. It will be delivered directly to each facility in a week after order.



#### -----

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- Evolution of scenarios (event scenario)

- Damage and loss assessment
- Ways to reduce vulnerabilities

Rapid needs and damage assessment: the urgent and fundamental need of a methodology. Drawing on an experience of ASEAN in Birmania/Myanmar 2008

> Comment by Richard Blowitt (Microdis meeting 2009): "not enough experience and training in such needs/damage assessments"

Rapid needs and damage assessment: the urgent and fundamental need of a methodology. Drawing on an experience of ASEAN in Birmania/Myanmar 2008



-Needs assessment
-Losses assessment
-V.Y. GIS use (GPS if needed)
- Double check on entries
-Multidisciplinary approach
- Structured methodology

Rapid needs and damage assessment: the urgent and fundamental need of a methodology. Drawing on an experience of ASEAN in Birmania/Myanmar 2008



-At the beginning for being rapid and according to the extent of damage area, use of sampling techniques; scale matters -Infrastructures have to be assessed first for rapid repair (even temporary)

Rapid needs and damage assessment: the urgent and fundamental need of a

methodology. Drawing on an experience of ASEAN in Birmania/Myanmar 2008



-Social aspects: needs in terms of ill persons; workers; services (including information about how to get back to homes/ compensations)

-Social aspects: need to check what has been accomplished; gaps between done and perceived;

-Monitoring of recovery phase

Another example of interdisciplinary approach to be applied in crisis times: the Stop handbook developed by the Italian Firemen Department for shoring damaged buildings applied at an urban scale after the l'Aquila earthquale









	Risk: seismic		Third Matrix: Systemic vulnerability: Vulnerability to losses			
	System	Aspect	Parameters	Criteria for assessment	Descriptors	Scoring
Natural environment	Natural ecosystems	Are natural ecosystems fragile to the potential secondary effects of hazard(s)?	areas affected by landslides	number and extent	few/many; in remote areas/in crucial-central zones	
uilt environment	Exposure and vulnerability of built environment	What are the factors that make buildings, the urban fabric and public facilities vulnerable to losses?	Availability of rapid post seismic buildings usability assessment Quality of temporary shelters (first emergency) Quality of more permenent temporary shelters Accessibility to potentially	forms pre-prepared and shared among all teams information computerized rapid damage assessment map obtained in few weeks with heating or conditioning, sanitation; density dimension; availability of services	yes/no yes/no yes/no 1/50 people; d < 1tent per family/d > 20 persons/tent d > 14 mq/4 persons/ d < 10 mq/4 persons; yes/no d < 500 m/ d > 500 m.	The TAquila case showed that the existenc of various forms reduces the efficiency of usability arveys, as well as the lack of comuterized systems for their fast recovery and particularly georeferencing. The availability of human conditions in temporary camps is essential for peple's recovery, particularly when the earthquake strikes in winter As temporary shelters in seismic hit zones are expected lo last some years, they must
Bu			damaged areas from temporary shelters Accessibility to work sites from temporary shelters Accessibility to public facilities	on foot; transportation on foot; transportation on foot; transportation	available/not available; frequent/not frequent d < 500 m/ d> 500 m; available/not available; frequent/not frequent d < 500 m; available/not available; frequent/not frequent	be provided with a minimal level of commodities. In the meantime accessibility to working places and homes is essential for victims
nd production sites	Critical infrastructures	What are the factors that make critical infrastructures stop functioning?	Redundancy in lifelines systems Degree of interdependance among lifelines Availability of emergency devices Continuity plan for lifelines, individually and in a coordinated fashion Degree of dependance of critical public facilities from lifelinen	degree degree binary (generators; tanks, etc) binary and quality degree	low/high low/medium/high yes/no: considers also induced hazards/ does not low/medium/high	The capacity to isolate priority modes for fast recovery of lifelines, the evaluabity of tanks, generators and any other means to make lifelines and critical facilities work at least partially after the event is clearly crucial also for curving out emergency operations. The Löcke and the Northrungs cathgankes showed clearly that such evaluabitity is much less evaluable than thought and than what would be required and possible thanks to
Infrastructure a	Production sites	What are the factors that may lead to halting production?	Degree of dependance of production sites from lifelines Accessibility to the plant and to markets Contingency plan for na- tech Business continuity plan	degree redundancy; quality of roads; usability; expected increase in travel time binary binary	low/medium/high redundant/not redundant; open/close roads; tinc < 30 min/ tinc > 30 min yes/no; considers all potential threats/does not yes/no	ninderin technologies
(s	People/ individuals	What are the factors that may reduce coping capacity during crisis?	Access to understandable information Trust in information provisers Preparedness to evacuation Presence of impaired groups (elderly, sick persons, etc.)	binary degree individual plan binary and quality of caring	yes/no; centralized /at each group level (for example in each temporary camp) low/medium/high yes/no (like going to relatives) yes/no; capacity to provide treatment in temporary camps/or not	In the l'Aquila case an accurate survey of people needing care for cronic deseases whas conducted and patients were given ther treatment since the
Social system (agents	Community and Institutions	What are the factors that may hamper effective crisis management?	Existance of contingency plan for threats at stake availability of quick post event scenarios to be checked and used as a guidance in crisis management Training using the contingency plan	binary: date of last production or update binary and quality binary; frequency of training	yes/no; recent/old yes/no; considering also enchained effects and systemic damage/estricted to physical damage yes/no; every two years/only occasionally	tirst days Comfort (1999) refers to the Northridge earthquake when repsonders could count on available pre-set scenarios for rapid damage estimation Overlapping responsibilities between the fizemen and other technicians of the cyll potection, in usability surveys
	monutions		Uverlapping responsibilities among agencies Established protocols for information sharing Established protocols for use of resources to manage the crisic	degree binary degree	Low/medium/high yes/no yes/only partially/high	and first shoring have sometimes delayed surveys and return of people to undamaged houses in the l'Aquila case

	Risk: seismic	: seismic Third Matrix: Systemic vulnerability: Vulnerability to losses				
	Svstem	Aspect	Parameters	Criteria for assessment	Descriptors	Scorina
Natural environment	Natural ecosystems	Are natural ecosystems fragile to the potential secondary effects of hazard(s)?	areas affected by landslides	number and extent	few/many; in remote areas/in crucial-central zones	
				forms pre-prepared and		
				shared among all teams	yes/no	The l'Aquila case showed that the
			Availability of rapid post	information computerized	yes/no	efficiency of usability srveys, as well
			assessment	rapid damage assessment map obtained in few weeks	yes/no	as the lack of comuterized systems for their fast recovery and particularly georeferencing.
ronment	Exposure and	What are the factors that make	Quality of temporary shelters (first emergency)	with heating or conditioning; sanitation; density	yes/no; a>1/50 people/ a < 1/50 people; d < 1tent per family/d > 20 persons/tent	<ul> <li>the intervent of contactured systems for their fast recovery and particularly georeferencing.</li> <li>The availability of human conditions in temporary camps is essential for peple's recovery, particularly when the earthquake strikes in winter</li> <li>As temporary shelters in seismic hit zones are expected m; to last some years, they must le; be provided with a minimal level of commodities. In the meantime m; accessibility to working places le; and homes is essential for your strikes.</li> </ul>
nvi	environment	it buildings, the urban fabric and public facilities vulnerable to losses?	Quality of more permenent	dimension; availability of	d > 14 mq/4 persons/ d < 10	As temporary shelters in
lte			temporary shelters	services	mq/4 persons; yes/no d < 500 m/ d> 500 m <sup>-</sup>	seismic hit zones are expected
Bui			damaged areas from temporary shelters	on foot; transportation	available/not available; frequent/not frequent	be provided with a minimal level of commodities. In the meantime
			Accessibility to work sites from temporary shelters	on foot; transportation	d < 500 m/ d> 500 m; available/not available; frequent/not frequent	accessibility to working places and homes is essential for victims
			Accessibility to public facilities	on foot; transportation	d < 500 m/ d> 500 m; available/not available; frequent/not frequent	
_			De dun den eur in lifeline e			793
		What are the factors that make critical infrastructures stop functioning?	Redundancy in lifelines systems	degree	low/high	The capacity to isolate priority nodes for fast recovery of lifelines; the availability of tanks generators and
tes			among lifelines	degree	low/medium/high	any other means to make lifelines and critical facilities work at least partially
n si	Critical		Availability of emergency devices	binary (generators; tanks, etc)	yes/no	after the event is clearly crucial also for
ductio	infrastructures		Continuity plan for lifelines, individually and in a coordinated fashion	binary and quality	yes/no; considers also induced hazards/ does not	carrying out emergency operations. The Kobe and the Northridge earthquakes showed clearly that such
and pro			Degree of dependance of critical public facilities from lifelines	degree	low/medium/high	availability is much less available than thought and than what would be required and possibile thanks to modern technologies
ucture		What are the factors that may lead to halting production?	Degree of dependance of production sites from lifelines	degree	low/medium/high	
Infrastr	Production sites		Accessibility to the plant and to markets	redundancy; quality of roads; usability; expected increase in travel time	redundant/not redundant; open/close roads; t.inc < 30 min/ t.inc > 30 min	
			Contingency plan for na- tech	binary	yes/no; considers all potential threats/does not	
			Business continuity plan	binary	yes/no	
					yes/no; centralized /at each	
			Access to understandable information	binary	group level (for example in each temporary camp)	
			Trust in information	degree	low/medium/high	



