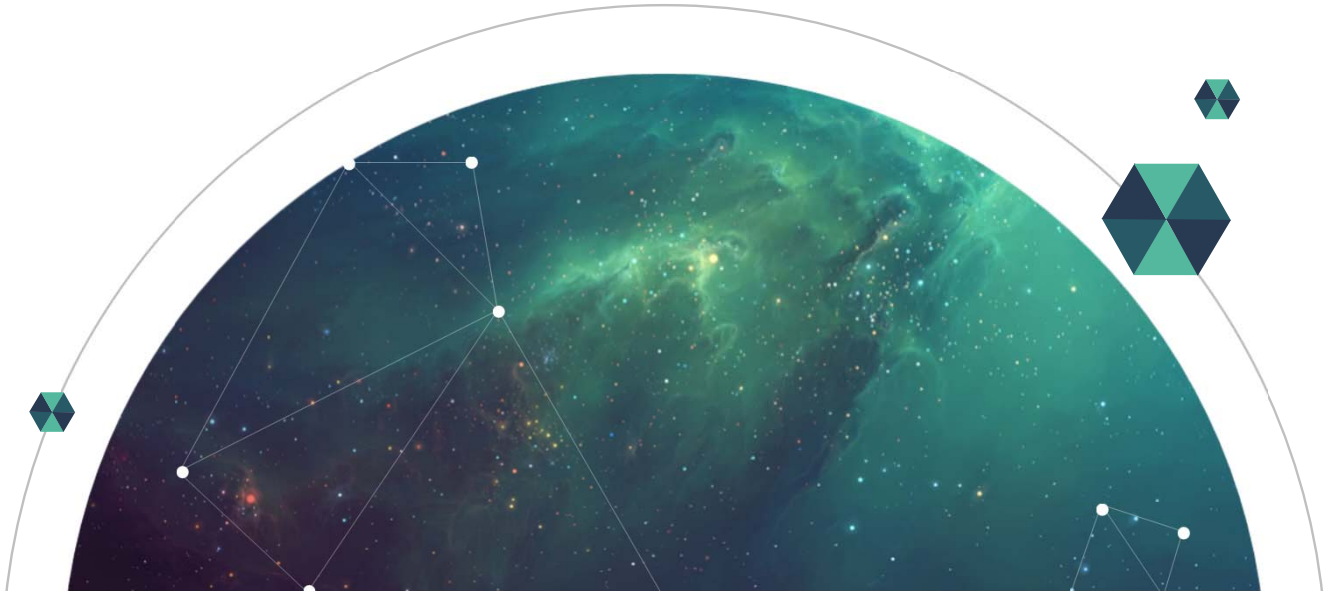
Tsinghua Community
Seismic Resilience Evaluation

Group 3 Yikun Liu; Jian Tang; Jingqiu Liao; Weixuan Chen; Yinan Hu

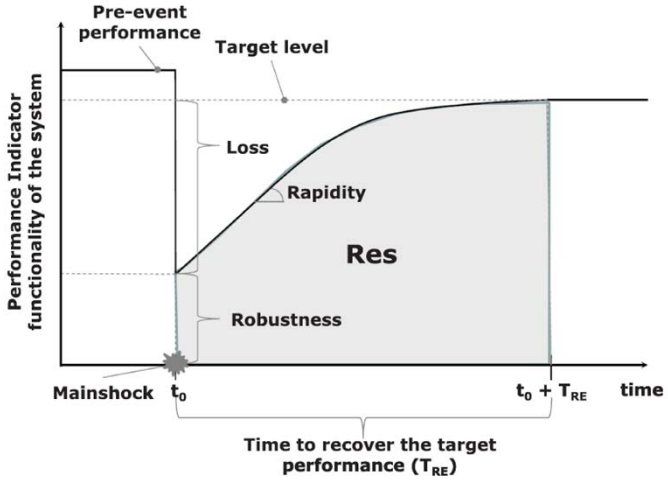


—CONTENTS—

PART 01

Theoretical Work

Resilience concepts Framework Index system



Seismic Resilience

The ability of social units to mitigate disasters, absorb the impacts of disasters and take measures to recover in time, so as to reduce social disturbances and mitigate the effects of future earthquakes.

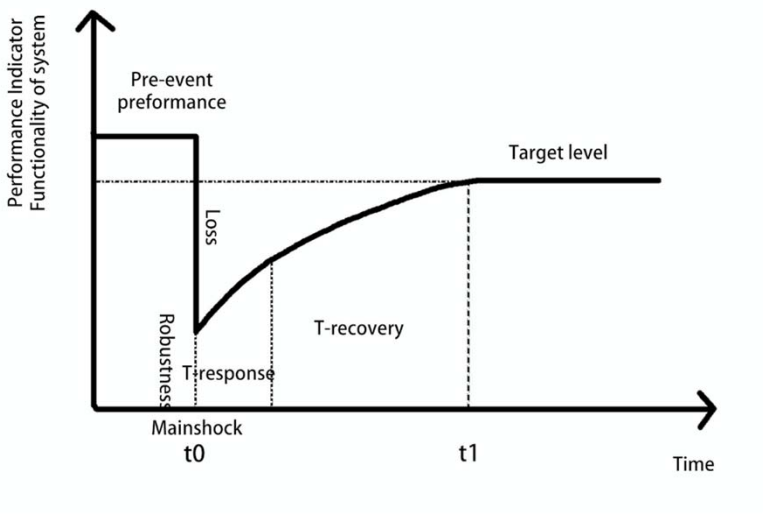
——Michel Bruneau et al

Framework from Mayunga (5×4)

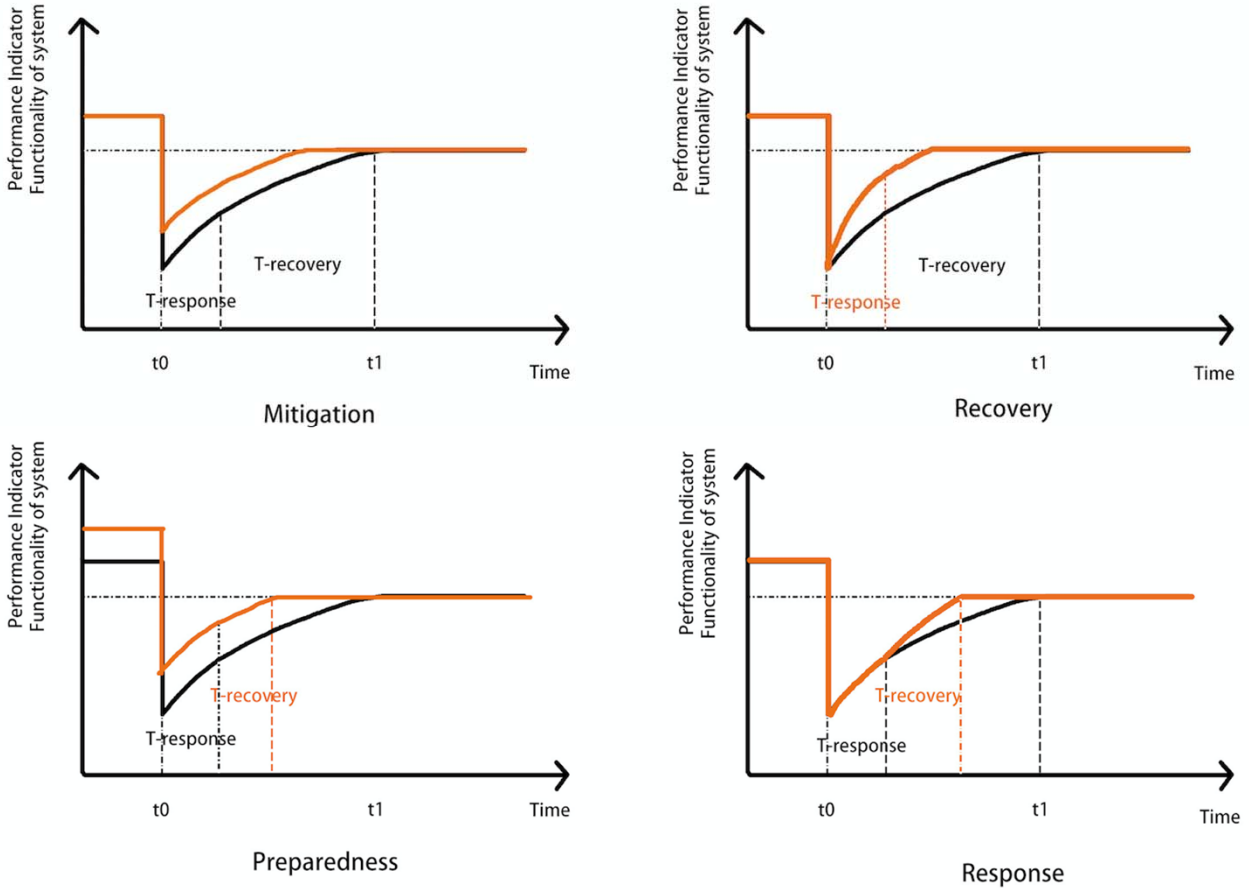
	Mitigation	Preparedness	Response	Recovery
Infrastructural	…			
Environmental		…		
Economic			…	
Social				…
Institutional				…

- Mayunga J S. Measuring the Measure: A Multi-dimensional Scale Model to Measure Community Disaster Resilience in the U.S. Gulf Coast Region[J]. Dissertations & Theses - Gradworks, 2010.
- To assess resilience from 5 dimensions of capital and 4 disaster phases
- Index selected based on various literature
- Index adjustment based on Chinese literature

Explanation for the four phases



Normal Resilience Model



Improved Resilience Model

Infrastructural

	Level 1	Level 2	Level 3	Quantitative index	Mitigation	Preparedness	Response	Recovery
Infrastructural	Building system	Stability	Building structure status	Structure type	1	1	0	0
				Degradation of building function	1	1	0	0
		Flexibility	Access restriction	Wall around the entrance and exit	1	1	0	0
	Water supply and drainage system	Stability	Water pipe parameters	Water pipe	1	1	1	0
				Water pipe diameter	1	1	1	0
				Water pipe joint stiffness	1	1	1	0
				Water pipe life	1	1	1	0
		Flexibility	Emergency shut-down	Emergency shut-off valve	0	0	1	1
		Functional degree	Supply function level	Water supply method	1	1	1	1
				Reserve drinking water	0	0	1	1
				Temporary sewage tank capacity	0	0	1	1
	Supply and distribution system	Stability	Component stability level	Power supply equipment resistance	1	1	1	0
				Wiring resistance	1	1	1	0
		Flexibility	Intelligent control ability	Intelligent measurement system	1	1	1	1
				Remote action switch	1	1	1	1
		Functional degree	Supply function level	Distributed power generation equipment	1	1	1	1
				Feeder contact switch control	1	1	1	1
	Communication system	Stability	Component stability level	Telecommunications equipment seismic fortification level	1	1	0	0
				Telecom power equipment seismic fortification level	1	1	0	0
				Seismic fortification level of the antenna feeder	1	1	0	0
		Functional degree	Supply function level	Emergency broadcast coverage	0	0	1	1
		Flexibility	Emergency preparedness	Is there an emergency backup system	0	0	1	1
				Is the communication line multipath	0	0	1	1
	Gas system	Stability	Component stability level	Gas system seismic rating	1	1	1	0
		Flexibility	Emergency preparedness	Gas earthquake emergency disposal system	0	0	1	1
		Functional degree	Supply function level	Energy reserve such as liquefied gas tank	0	0	1	1

Environmental

	Level 1	Level 2	Level 3	Quantitative index	Mitigation	Preparedness	Response	Recovery
Environmental	Community internal environment	layout	Building density	Volume rate	0	0	1	1
				Building spacing	0	0	1	1
			Emergency evacuation site	Per capita evacuation site area in the community	0	1	1	0
				Per capita road area	0	0	1	1
			Internal traffic	Unoccupied evacuation channel ratio	0	0	1	1
				Out-of-building evacuation mark coverage	0	1	1	1
		Public welfare facility	Medical service facility	does it exist	0	1	1	1
			Child care facility	does it exist	0	1	1	1
			Elderly welfare facility	does it exist	0	1	1	1
	Community surroundings	Community-to-city connectivity	Traffic accessibility	Distance from major city roads	0	0	1	1
				Number of community entrances and exits	0	0	1	1
			Rescue power accessibility	Distance from the nearest subway station	0	0	1	1
				Distance from the nearest fire station	0	0	1	1
				Distance from the nearest police station	0	0	1	1
			Medical personnel accessibility	Distance from the nearest hospital	0	0	1	1
		Standby emergency shelter	Urban emergency shelter	Distance from recent urban emergency shelters	0	0	1	1
			Hotel/hospital capacity	Per capita hotel/hospitality room within 1 km radius	0	0	1	1
		Environmental health and safety	Harmful chemical	Is there a radius of 1 km?	1	0	1	1
			Security situation	Crime rate	0	0	1	1
			Hospital capacity	Number of beds per capita within 1 km radius	0	1	1	1

Social

Examining population attribute, the participation and involvement in social groups and civic engagement

	Level 1	Level 2	Level 3	Quantitative index	Mitigation	Preparedness	Response	Recovery
Social	Population level	Age	Age pyramid	Population share of all ages	1	1	1	1
		Gender	Male to female ratio	Female share	1	1	1	1
		Marital status	Proportion of all types of marriage	Married population	1	1	1	1
		Health status	Per capita health level	Average lifetime	1	1	1	1
				Incidence of diseases such as tuberculosis	1	1	1	1
		Education level	Senior talent level	Ratio of college students	1	1	1	1
		Mobility	Fixed housing	Percentage of permanent housing	1	1	1	1
			Migration	Resident population	1	1	1	1
	Social connection	Volunteer activities	Accommodation charity	Number of student apartment volunteers (Zijing volunteers)	1	1	1	1
			Traffic charity	Number of campus buses	1	1	1	1
			Community charity	Neighborhood committee, community medical				
		Community entertainment	Scale of community activities	Number of club participants	1	1	1	1
			Community activity	Number of participants	1	1	1	1
			Community activity influence	Push reading	1	1	1	1
	Community unity	Social worker activity	Social worker cadre election participation	Number of votes per thousand	1	1	1	1
			Social worker group participation	Number of associations per thousand people	1	1	1	1
		Resource reserve	Staff reserve	Number of volunteers per 1,000 people trained	1	1	1	1
				Special strengths (medical, engineering)	1	1	1	1
			Publicity and education	(for the whole community) frequency of safety disaster reduction education and training	1	1	1	1
	Disaster response potential	Professional Training	Value	Number of professional training participants per thousand	1	1	1	1
			Training results	Number of relevant certifications per thousand people	1	1	1	1
		General training	Value	Safety education and training frequency	1	1	1	1
			Training results	General public safety awareness and method mastery	1	1	1	1

Economic

Financial resources that people use to support their livelihoods

	Level 1	Level 2	Level 3	Quantitative index	Mitigation	Preparedness	Response	Recovery
Economic	Household economic situation	Income situation	Income level	Average community income / average urban income	0	0	1	1
			Income difference	Income variance	0	0	1	1
		employment status	Participation in the proportion of social production	Employment ratio	0	0	1	1
			Career development	Class of occupation	0	0	1	1
		Property situation	Land and housing ownership	Average family home value	0	0	0	1
				Per capita housing	0	0	1	1
			Vehicle ownership	Number of vehicles per capita	0	0	1	0
		Insurance situation	medical insurance	Medical insurance insurance ratio	0	0	0	1
			property insurance	Property insurance insurance ratio	0	0	0	1
	Community finance	Community income	Community internal income	Property costs	1	1	1	1
				rent	1	1	1	1
			Community external income	Financial allocation	1	1	1	1
		Community disaster prevention and mitigation related expenditure	Service expenditure	Security personnel, community doctors and other emergency personnel input	0	1	0	0
				Safety education training investment	0	1	0	0
				Emergency fund reserve	0	1	0	0
			Infrastructure construction expenditure	Emergency facility construction investment	0	1	1	0
				Infrastructure maintenance investment	1	0	0	0

Institutional

Performance of community leaders and administration before earthquake strikes

	Level 1	Level 2	Level 3	Quantitative index	Mitigation	Preparedness	Response	Recovery
Institutional	Daily maintenance	Inspection behavior	Inspection attention	Infrastructure inspection frequency	1	1	0	0
			Inspection input	Number of infrastructure inspection personnel	1	1	0	0
		Maintenance behavior	Maintenance attention	Infrastructure maintenance frequency	1	1	0	0
			Maintenance input	Number of infrastructure maintenance personnel	1	1	1	1
				Maintenance equipment	1	1	1	1
	Disaster response capability	Staff professional competence	Disaster management training experience	Proportion of personnel who have received disaster management education	0	0	1	1
				Annual number of staff disaster emergency training (drills)	1	1	1	1
			Professional emergency skill level	Proportion of staff with professional competence (first aid, repair)	1	1	1	1
			Reflection and research consciousness	Is there any reflection and discussion on regular disaster emergency work?	1	1	0	1
		Emergency plan level	Emergency plan rationality	Emergency plan detail level	0	1	1	1
		Material reserve	Emergency supplies reserve	Relief material reserve	0	1	1	1
	Earthquake prevention and disaster reduction policy	Policy development	Policy level	Number of policy documents	0	1	1	1
			Policy professional level	Anti-seismic new technology application regulations	1	0	0	0
				Graded earthquake emergency plan	0	1	1	1
		Implementation status	Supervision mechanism	Policy review	0	1	1	1
			Implementation mechanism	Annual inspection regulations	0	1	1	1
			Security mechanism	Progress in the promotion of earthquake insurance	0	1	1	1

PART 02

Questionnaire Results

Earthquake Disaster Cognition

Earthquake Response Ability

Seismic Resilience Understanding

Research Objectives

· respondents' awareness of earthquake disasters

· respondents' earthquake response capacity

· factors influencing the mental state after earthquake

· understanding of the earthquake resilience and the earthquake resilience of Tsinghua university

Questionnaire Process

· A total of 14 questions were designed, including basic information such as age and gender, the awareness of the concept of earthquake resilience and the awareness of the earthquake resilience of Tsinghua. It also covers the selection of emergency shelter locations for disaster situations, as well as whether the respondent knows about the nearest hospitals and police stations of Tsinghua University. Finally, it also includes the per capita residential area, the knowledge and skills which are related to emergency situation, and the psychological state, etc., used to measure the earthquake response capability.

清华地震韧性认知调查

您好，我们是来自土木建管系的学生，目前在完成基于校园的地震韧性指标构建的工作，现希望统计您对于清华园地震韧性的认知程度，感谢您抽出2分钟的时间参与我们的调查

[第1页/共1页]

基本信息

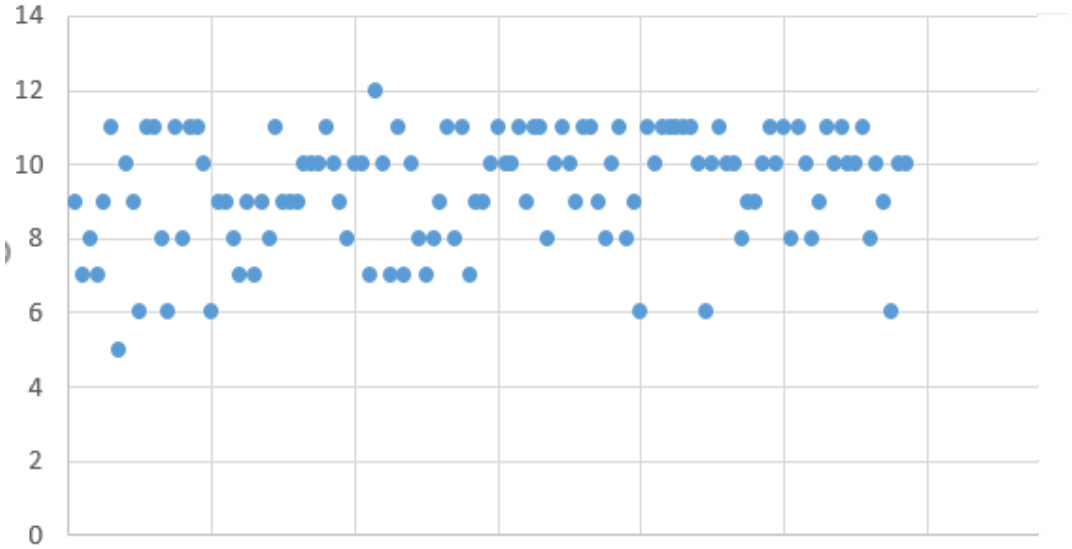
*1. 您的年龄?

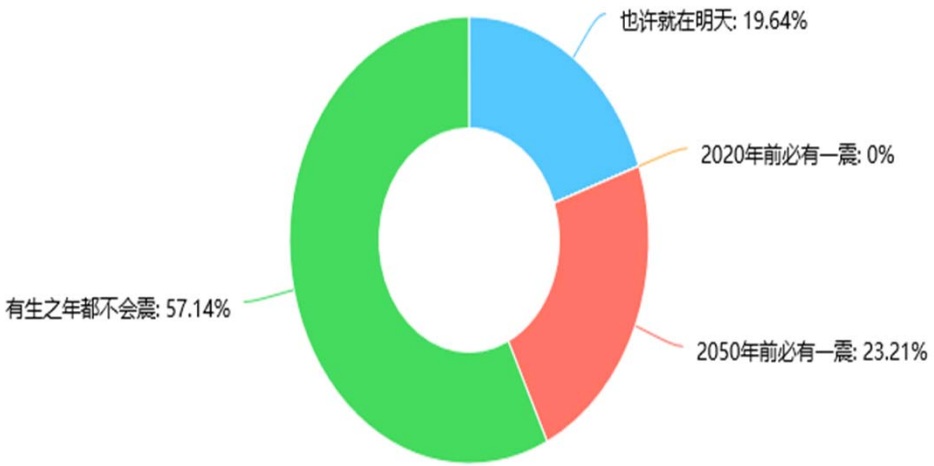
*2. 您的性别:

男 女

· A total of **217** questionnaires were collected, with the main interviewees aged 20-25 years, mainly students from tsinghua university. The ratio of male to female is close to 1:1.

Earthquake Disaster Cognition





Earthquake disaster cognition =

whether you are familiar with the location of the school hospital +

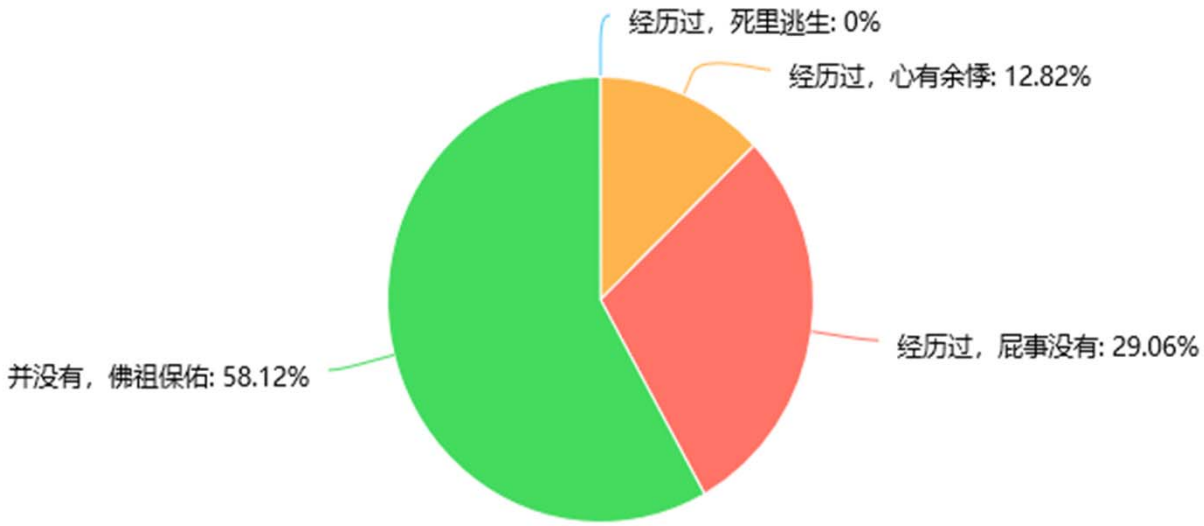
whether you are familiar with the location of the police station +

earthquake probability judgment +

whether you have experienced an earthquake

57.14% of the permanent residents in Beijing believe that they will not experience an earthquake in their lifetime. Only **19.64%**thought the quake was nearby.

Earthquake Disaster Cognition



- among the students who filled in the questionnaire, **97.44%** were familiar with the location of the school hospital, but only 30.77% were familiar with the location of the school's nearest police station.
- only **12.82%** of the students said they had experienced an earthquake, and they are still afraid of it. 60% of them had never experienced an earthquake before.

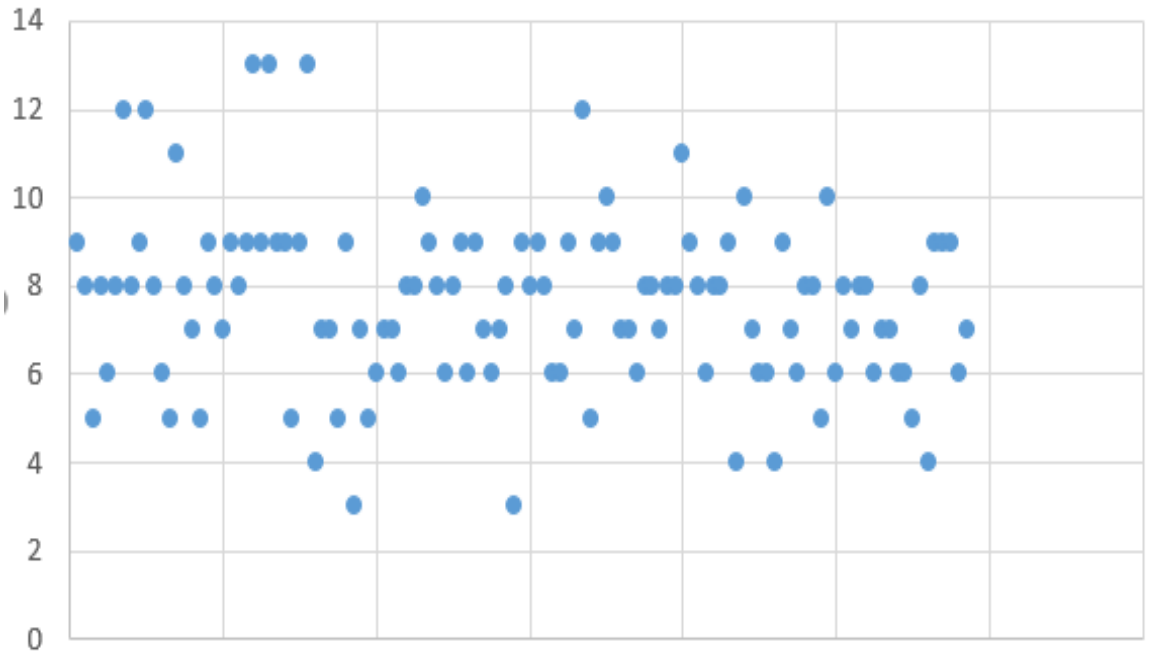
Earthquake Response Ability

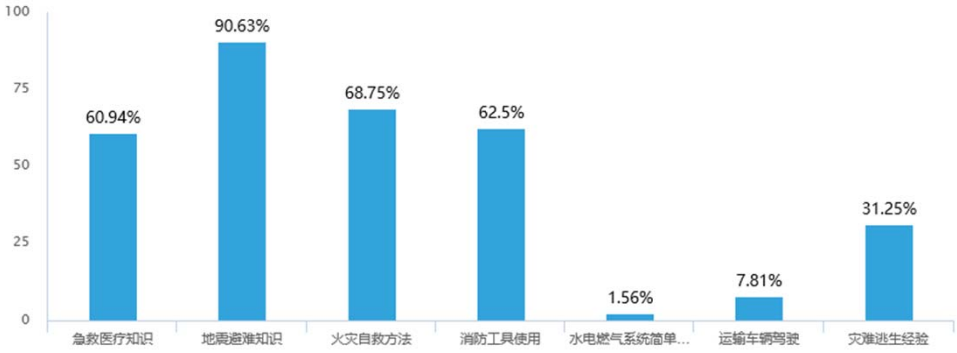
earthquake response ability =

mental state after earthquake +

knowledge and skills useful in emergency +

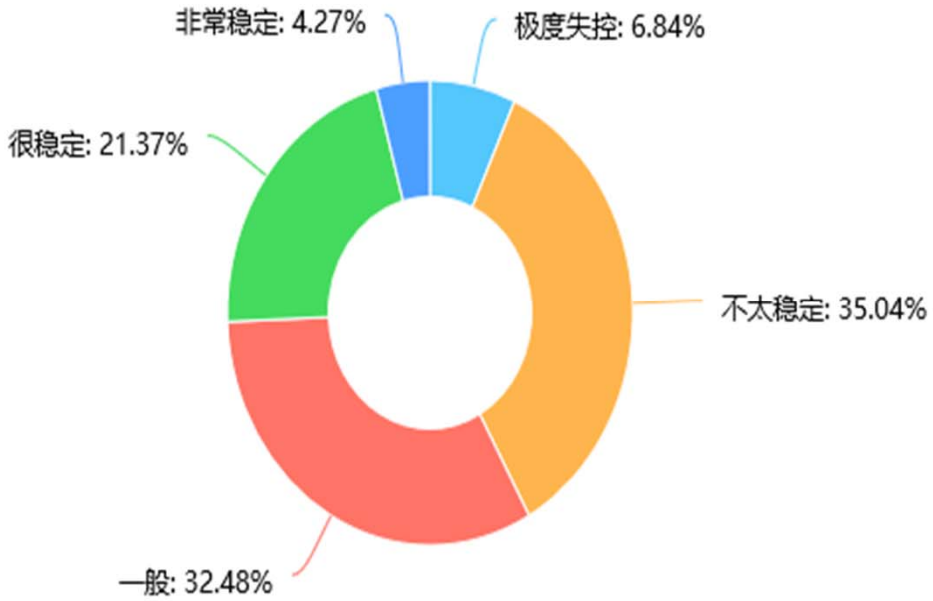
per capita living area





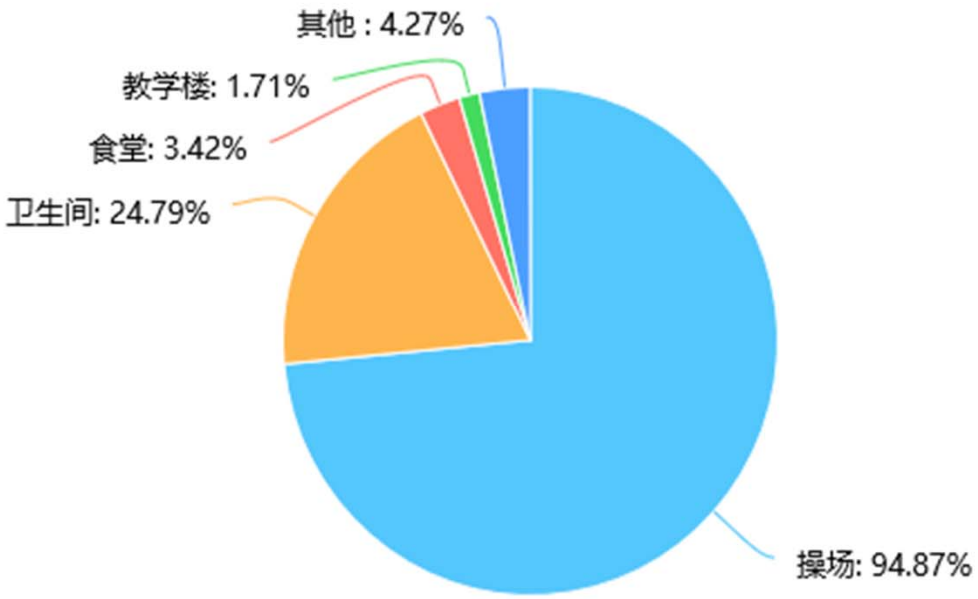
· relatively speaking, men have a more comprehensive range of skills. However, the one with the most skills is knowledge of earthquake refuge, followed by fire self-rescue method, first-aid medical knowledge and use of fire fighting tools.

Earthquake Response Ability



· mental state after earthquake : a majority of people indicated that there would be unstable situation, only 4.27% indicated that it would be very stable

Earthquake Response Ability



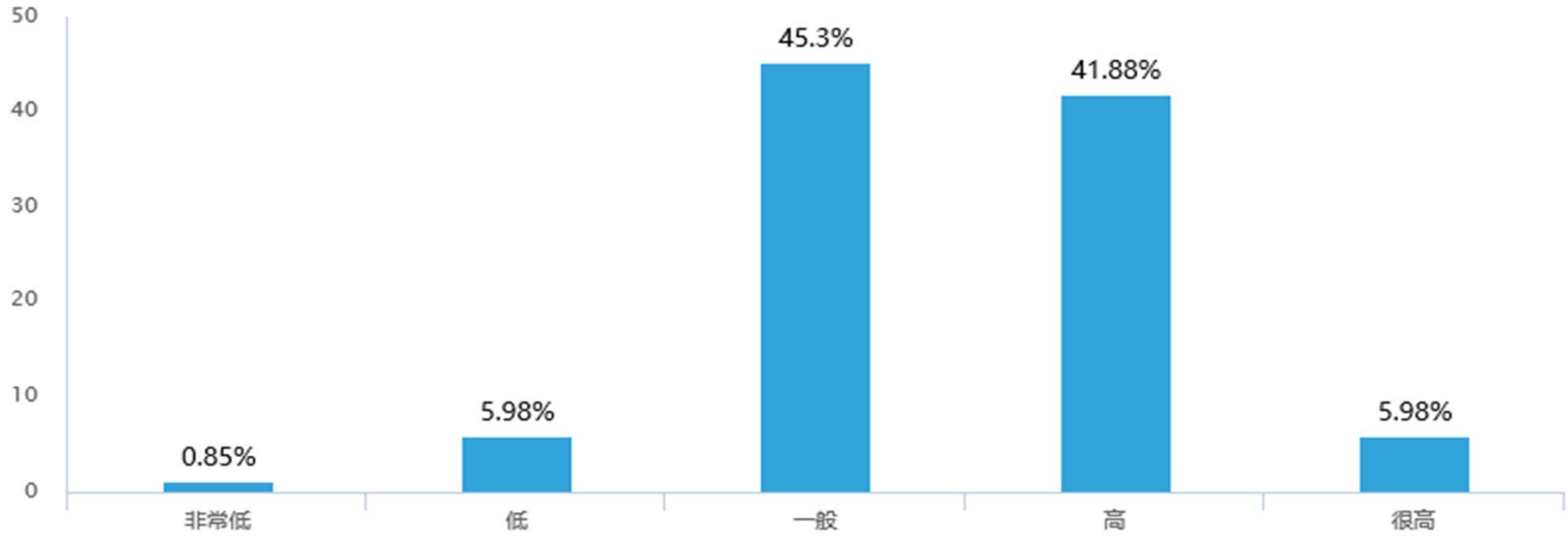
Which shelter will you choose?

· The statistical results showed that 95% of respondents chose the playground as the shelter for the earthquake, 25% chose the bathroom, 3.42% chose the canteen and 1.71% chose the teaching building.

Earthquake Response Ability

Pearson correlation test showed that the correlation coefficient between earthquake and psychological state variables was **-2.44**, showing a significant negative correlation, indicating that people who had no experience/feeling of earthquake were more likely to have severe anxiety.

Seismic Resilience Understanding



· only 24 percent of respondents who had heard of earthquake resilience

· 80% of the people believed that Tsinghua's earthquake resilience level was relatively high.

PART 03

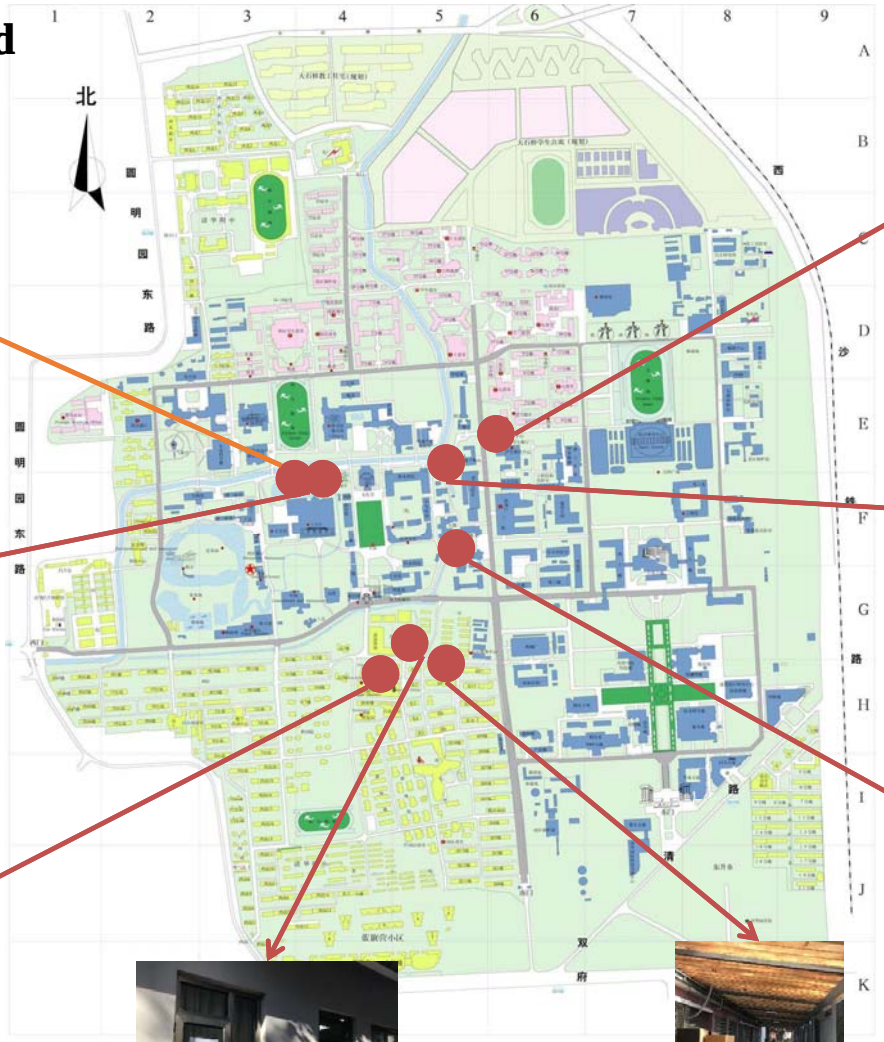
Interview& Investigation

Emergency-related departments

Earthquake Emergency plan

Normal Insurance Measures

Visited emergency-related departments in Tsinghua



General Affairs Office

Tsinghua Property Office

School Office

Tsinghua Asset Office

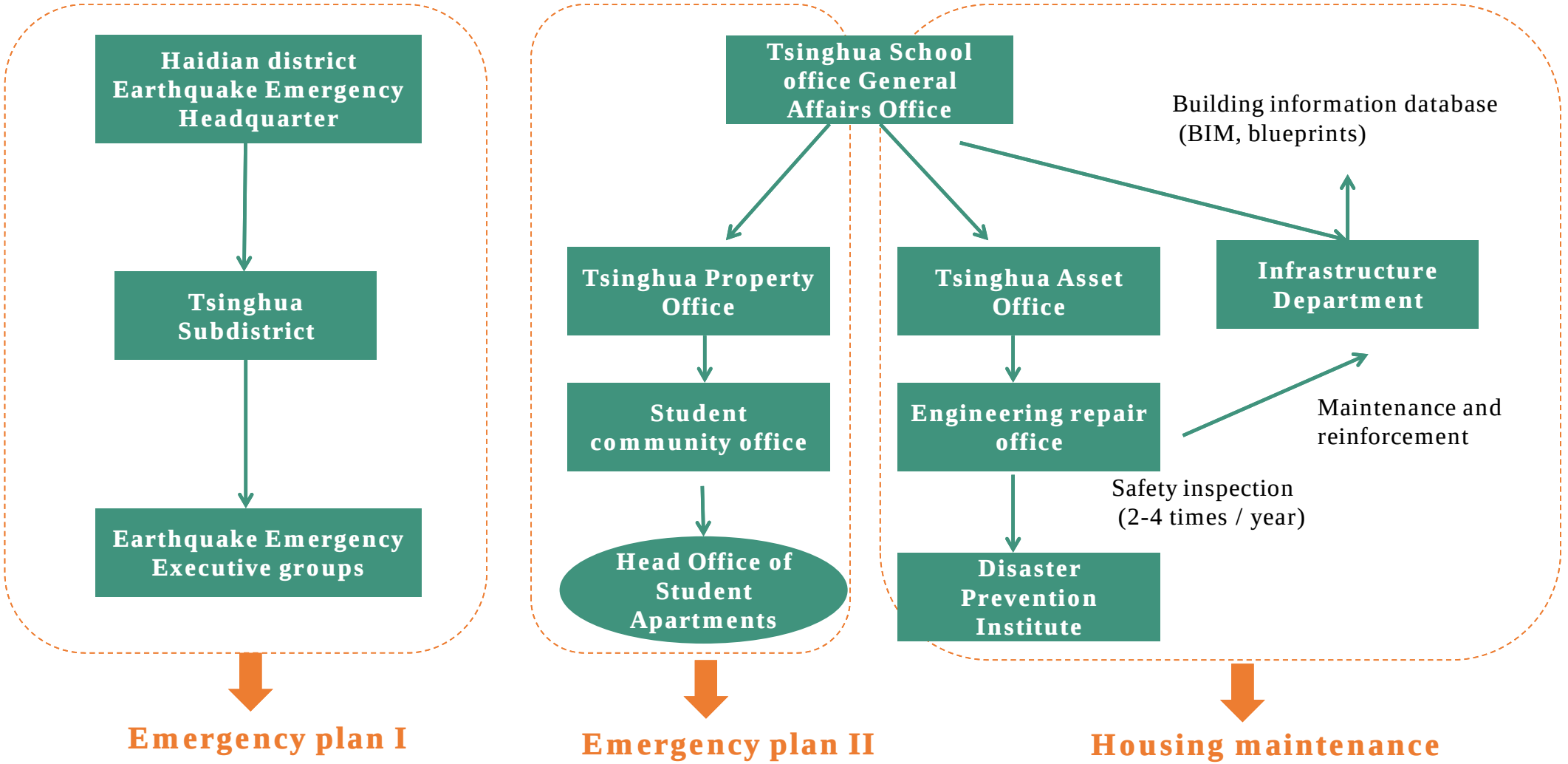
Tsinghua Subdistrict Office

Aiwei Association

Urban Management Department

Security Office

Earthquake Emergency plan



Jurisdiction

01 **Tsinghua University**
(teaching area, student dorm area, faculty residential area)

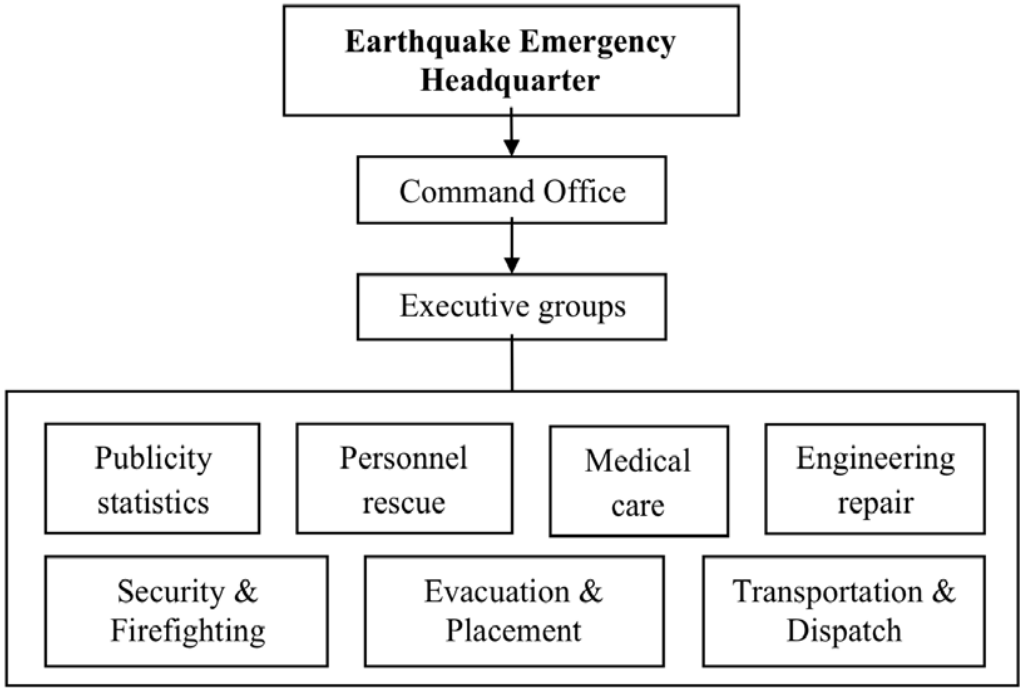
02 **Tsinghua University High School**

03 **Tsinghua University Primary School**

04 **Jiehua Kindergarten**

Earthquake Emergency plan

Organization Structure



Earthquake response procedure

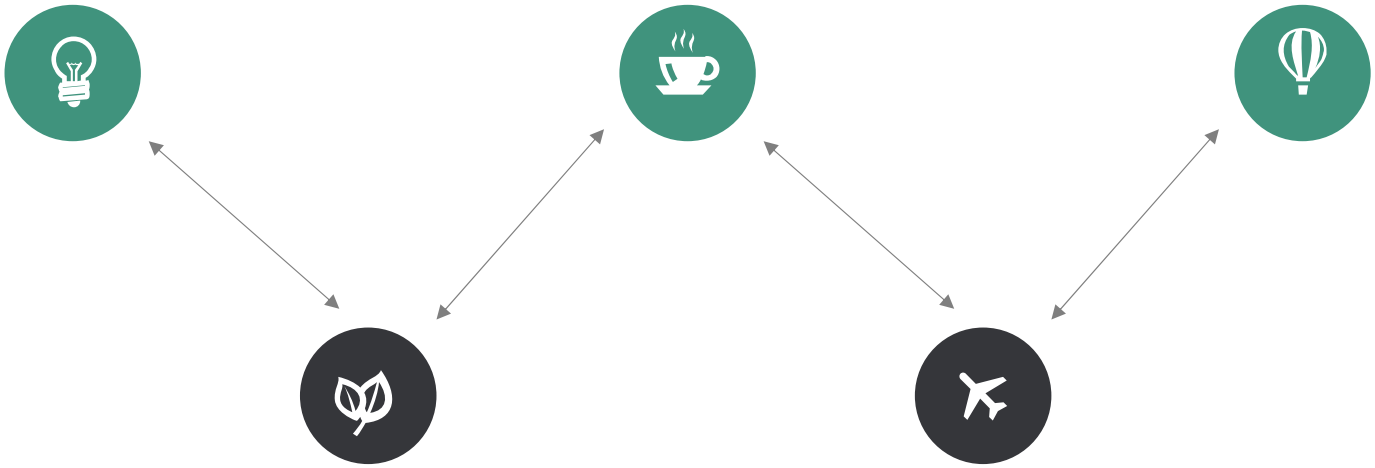
- Earthquake Emergency Headquarter
  - Hold urgent meetings to convey the command from Haidian District
  - Inform the regional army force and relevant departments
  - Command material dispatch
  - Seek outside help
- Command Office
  - Update the disaster situation to the Headquarter
  - Coordinate the executive groups
- Executive Groups
  - Follow the orders
  - Perform their duties

Normal Insurance Measures

Update the Earthquake Emergency Plan regularly

Regular trainings for the community earthquake response team

Reserve relief materials



Hold annual **emergency drills**

Maintain emergency shelters


PART
04
Presentation
Design

Burr Puzzle

We designed to customize the Burr Puzzle on Taobao APP and write the name of the level 1 index on each strip.

Nestle Wafer Crunchy Shark

the use of Nestle Wafer Crunchy Shark to create a simple lap joint and put a name strip on each crunchy shark.

Lay Up

Use the lay up mode to represent each indicator with a wooden strip. Students can participate in the game of drawing wood to deepen their impression of the indicator system.

Model

Create a sand table model and mark buildings and structures with different seismic levels in the model.

Poster

Use posters to design and display our results. The main introduction is to show the results of the research on the earthquake-resistant city of Tsinghua University.

Brochure

Completely display all of our metrics in the brochure. A detailed introduction to the four primary indicators is given, and a definition and explanation are given for each indicator in the brochure.

Burr Puzzle

1. Environmental
2. Infrastructural
3. Economic
4. Social
5. Institutional

Lay Up & Nestle Wafer Crunchy Shark

We designed the use of Nestle Wafer Crunchy Shark to create a simple lap joint and put a name strip on each crunchy shark. In this way, other students can not only participate in the game of “quickly extracting Nestle Wafer Crunchy Shark”, but also get the food.

Use the lay up mode to represent each indicator with a wooden strip. Students can participate in the game of drawing wood to deepen their impression of the indicator

Model

- ✓ Different seismic levels
- ✓ Emergency plans
- ✓ Emergency equipment
- ✓ Escape routes
- ∘ ∘ ∘

Poster & Brochure

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Thank you!

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