Climate and Disaster Resilient Transport System and Infrastructure Development

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Resilience as a pre-requisite to Sustainability
Damages by
The Great East Japan earthquake

**Time & Date**

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| **Magnitude**        | 9.0    |
|                      |        |
| **Earthquake type**  | Undersea mega-thrust |
|                      |        |
| **Dead**             | 14,907 (19/05/11) |
|                      |        |
| **Missing**          | 9,041  |
|                      |        |
| **Injuries**         | 4,799  |
|                      |        |
| **evacuees**         | 160,672 |
|                      |        |
| **Tsunami area (km2)** | 561   |
|                      |        |
| **Completely destroyed residential buildings** | 91,150 |

(source: Ministry of Internal Affairs and Communications, Statistics department, Japan)
Damage in Local Roads

(Coast areas lost road access)

(source: Tohoku Regional Bureau, Ministry of Land, Infrastructure, Transport and Tourism)
Damage in Motorways
(Higher Spec. to recover keeping redundancy)

Closure just after the earthquake (15:50 11 March)

Crack
Bump
Subsidence
Debris

290km

(source: NEXCO East Japan)
Recovery in Transport

Process of recovery

As of 6 May, 3 months after 11 March

(source: Ministry of Land, Infrastructure, Transport and Tourism)
Recovery in Local Roads ("Operation Comb")

Clear debris from roads to secure access from inlands to seaports
12 March: 11 east-west routes open
15 March: 15 east-west routes open
16 March: Access open to public
18 March: Most coast roads open

Parallel routes M4 and N4 made Operation Comb possible!
Damage in Airports

Serious damage only at Sendai Airport (Flooded by TSUNAMI)

Protecting huge site is difficult.

(source: Ministry of Land, Infrastructure, Transport and Tourism, Miyagi Prefectural Government)
Damage in Seaports

Most seaports closed just after the earthquake

Ishinomaki-port

Kamaishi-port (Broken seawalls)

Sendai-Shiogama-port

- Untied Containers floated to hit houses
- Oil Tanks floated to fire

(source: Ministry of Land, Infrastructure, Transport and Tourism, Miyagi Prefectural Government)
**Resilience: QOL Transition after Earthquake**

- QOL indices are recovered from coast towards inner areas, after roads and facilities were re-open
- Areas of QOL stage 2 are bigger than flooding areas from tsunami at 3/31 and 4/11
Lessons learned:
Infrastructure Supply is not enough → Demand-side Management

 Mobility as a Service (MaaS)

○ Emerging transport solution serving a package of mobility to people to enhance travel experience.

○ Promote the shift of mode from private to public transport
Thailand Flood
Jan-Oct 2011

By Courtesy of Dr Varameth
Central Region Inundated for Months

By Courtesy of Dr Varameth
Industries gone...

By Courtesy of Dr Varameth
On the Public Road ...

By Courtesy of Dr Varameth
Central Bangkok Protected

By Courtesy of Dr Varameth

14th Regional EST Forum, Hayashi
Rail+Bus: Public Transport the Only Way
Lessons: Infrastructure Supply is not enough → Demand-side Management

- **Mobility as a Service (MaaS)**
  - Emerging transport solution serving a package of mobility to people to enhance travel experience.
  - Promote the *shift* of mode from *private* to *public* transport
Sukhumvit Model – QOL - MaaS: Daily Life-Travel Design

Create a Daily Plan to Work and Travel with higher QOL

TODAY

Max QOL

ENERGY & ENVIRONMENT

QoL

Working

Picking up kids

Shopping

SCHEDULE

Health

Timing

Burden

- Timing

- Burden

Private car

Leaves at 6:00 a.m.

Rest @home

Co-Work Space

Work @office

Kids

Shop

Rest @home

Leaves at 7:30 a.m.

SSV

walk + sky train

SSV

SSV

Sky train

Arrives at home earlier

= Sufficiency

JIAC/JST SATREPS Project “Smart Transport Strategy for Thailand 4.0”

14th Regional EST Forum, Hayashi

2021/10/19

19
QOL-MaaS recommends
Most Sufficient Sequence of Activities and Travels

Daily quality of life (DQOL)
Social Cost (SC)

- Lower stress from congestion
- Reduce Travel time
- Lower emission
- Reduce infrastructure load

θ Degree of sufficiency

3rd
2nd
1st

Limit for sustainability
Simulation results

Option 1
- Home
- Office
- Home

FP=100, Ncws=500, alpha= 3.0

Option 1: 55.2%
Option 2: 14.0%
Option 3: 30.8%
Lessons learned: land use & transport perspectives  
by Varameth Vichiensan

- The poor land use regulation caused urbanization into very large area, which used to be flood plain. These urbanized area were obstructing the surface water. The flooding water needed to be drained into canals and rivers having limited capacity. This caused the flooding more rapid and severe. So, the regional and urban land use plan and enforcement must be revisited.

- In the past, the canals were large and could drain the flood water. But now most of the canals were filled with houses and factories. Canal drainage were then replaced by pipe drainage system. However, since land subsidence is large in Bangkok and other cities. The pipes were not functioning well. More effective urban drainage system must be redeveloped. The future urban land use forecast will be very important information.
The transport network in Thailand was not planned to handle such situation. Most of the roads were cut, leaving many municipalities isolated. Production and logistic were enormously affected, causing shortage of food and daily life supplies. Therefore, a strategic transport network plan is needed, particularly highway, such that certain routes must be protected for logistics during emergency, not only flooding but also other kinds of disaster.

During the flooding, cooperation of the road and public transport operators will have important roles to lessen the impact. For example, exemption of toll collection might help to divert the inundated road on to the elevated expressway and relieve the congestion. These operations might need proper support or subsidy from the local or central government.
Changes in **Nature and Social Acceptability**

- Climate Change / Earth’s Crust Movement
- Increasing Natural Disaster Risk

- Nuclear Family / Ageing / Urban Sprawl
- Community without Cooperations

**Vulnerability** increasing in future generation

- Resilient Society & Social System
- Compact-Connected
- Redundancy

Maintain and improve the level of QOL

- Land Use
- Infrastructure

**Miss-match!**

Nuclear Family / Ageing / Urban Sprawl

Community without Cooperations

Increasing Natural Disaster Risk

Climate Change / Earth’s Crust Movement

higher

weaker
Resilient Cities and Community

Societal Objective

Characteristics of Society

Strategy and methodology

Social consensus

Platform

Security of QOL

Resilience
Redundancy
Compact-Connected

Reversible Infrastructure, City

Society's choice

People's judgement

Balance of Self-help, Public-Assistance, Co-Assistance

wisdom / consensus

Awareness

Preppedness

Infrastructure, Land use, Information

External force of disaster
(e.g. Tsunami)

Aging and financial difficulties
(Social Tsunami)
Evaluation and Planning for Resilient Cities

▷ Access from living place to service facilities
  ○ QOL Accessibility method

▷ Hierarchical centers and transport networks
  ○ 15 City (Japan, Paris), Central Place Theory(Germany)

▷ Demand-side Management is essential
  ○ Down-sized/time-space flat Equilibrium → QOL-MaaS
  ○ Human-Planet centered Sufficient Solution = QOL/CO2

▷ Hayashi, Suzuki (2016) Disaster Resilient Cities
Resilience as a pre-requisite to Sustainability

Thank you for your attention!