New evaluation model to improve the decision-making process of municipal governments for disaster management

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Disaster management organization in Japanese municipal governments

Existing organizational structure is used maximally.

- Collection of existing sections with new tasks and communication routes among them
- Ordinary task jurisdictions are maintained and expanded.

Typical organizational structure for disaster management
c.f. Incident command system

Major communication channel is by phone.
- Email and ICT tools are in limited use.

Records of organized activities in actual disasters are very limited.
Objectives

- Create a new exercise and its support tool that help effective coordination among sections in local governments and relevant organizations

- Quantitatively evaluate coordinated disaster management capacity through functional exercises

Task distribution problem in disaster management

We are too busy.

Who is responsible for Task 3?
Creation of simplified decision making network for every emergency support function (ESF)

ESFs

Command and control, Back-up request, Volunteer coordination, Communication
Evacuation warning, Shelter preparation, Shelter operation, Logistics
Rescue, Recovery, Public facility safety
National relief law application, Livelihood support, Health support, Body recovery
Epidemic prevention, Garbage treatment, Sanitation, Water supply

Simple task processing network

Information gathering, Decision making, Execution

ESF 1

ESF 19

Three stage structure in Japanese local governments (Hayashi et al. 2014)
Our focus: Functional exercises

Controller

Simulator

Player

Disaster narrative

<table>
<thead>
<tr>
<th>Earthquake characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>9:00</td>
</tr>
<tr>
<td>Epicenter</td>
<td>Chikuho</td>
</tr>
<tr>
<td>Depth</td>
<td>30 km</td>
</tr>
<tr>
<td>Magnitude</td>
<td>6.8</td>
</tr>
<tr>
<td>Tremor</td>
<td>7</td>
</tr>
<tr>
<td>6 plus</td>
<td>Tobata</td>
</tr>
<tr>
<td></td>
<td>Yahata-nishi, Yahata-higashi</td>
</tr>
<tr>
<td></td>
<td>6 plus</td>
</tr>
<tr>
<td></td>
<td>Kokura-kita, Kokura-minami, Wakamatsu</td>
</tr>
<tr>
<td></td>
<td>5 plus</td>
</tr>
<tr>
<td></td>
<td>Moji</td>
</tr>
<tr>
<td>Lifeline</td>
<td>In-house power generation working, Water supply stopped</td>
</tr>
<tr>
<td>Communication</td>
<td>Telephone network heavily congested</td>
</tr>
<tr>
<td></td>
<td>Email and satellite phones work</td>
</tr>
<tr>
<td>9:05</td>
<td>Call from a citizen in Yahata-nishi</td>
</tr>
<tr>
<td></td>
<td>Three houses collapsed. It seems some people trapped inside.</td>
</tr>
<tr>
<td>9:10</td>
<td>Call from a factory in Tobata</td>
</tr>
<tr>
<td></td>
<td>Inflammable gas leakage. Needs evacuation of nearby houses.</td>
</tr>
</tbody>
</table>

Inject Harmful gas leakage from a factory

Info gathering
| e.g. Fire Department |

Decision
| e.g. Emergency Management Section |

Execution
| e.g. Environmental Monitoring Section |

Evaluator

Recording Players’ responses

Coordinated responses are expected
Problems in functional exercises

1. Objectives are often ill-defined
   What are we checking?

2. Weakness in evaluation
   - Cannot find problems in task processing networks
   - Results are descriptive and not quantitative

3. Lots of work for preparation
   Disaster narrative, documents, analysis

Based upon our interviews to local government officials and literature review (Zujyo Ensyu Kenkyukai (2011) and Fire and Disaster Management Agency (2009) among others)
Our functional exercise

1. Clear objectives
   - Examine coordination capacity
   - Resource allocation for prioritized tasks

2. Quantitative evaluation
   - Weakness and strength by disaster management functions
   - Bottlenecks of prioritized task processing
   - Standard reporting formats facilitating comparisons

3. Preparation support library
   - Disaster narratives
   - Task processing networks
Prioritized injects, task processing network, and check points

Prioritized Inject: Life safety, incident stabilization, and property/environmental preservation

Land slide occurred in Wakamatsu Ward and 20 plus residents are apparently berried. Need immediate help.

Players

<table>
<thead>
<tr>
<th>Players</th>
<th>Info gathering</th>
<th>Decision</th>
<th>Execution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Department (FD)</td>
<td></td>
<td>Emergency Management Section (EMS)</td>
<td>Ward Office</td>
</tr>
<tr>
<td>Task</td>
<td>Share info with EMS</td>
<td>Issue evacuation warning</td>
<td>Task Shelter preparation</td>
</tr>
<tr>
<td></td>
<td>Operate field units</td>
<td>Share info with Ward Office and Architecture Section</td>
<td>Housing damage inspection</td>
</tr>
</tbody>
</table>

Check point 1  
Check point 2  
Check point 3
Summary of prioritized task processing

Green number: number of prioritized tasks

- 10 times or more
- 5-9 times
- 1-4 times

Communication

1st section
- Ward 57
- FD 20
- EMS
- Environment 3
- Construction 7
- Welfare 5
- Education 12
- Logistics
- Backup

2nd section
- Ward 19
- FD 4
- EMS 75
- Env 1
- Construction
- Welfare 1
- Education
- Logistics
- Backup

3rd section
- Ward 8
- FD
- EMS
- Env 3
- Construction 3
- Welfare 21
- Education 16
- Logistics 7
- Backup

4th section
- Ward
- FD
- EMS
- Env
- Construction
- Welfare
- Education
- Logistics
Support tool: Detailed recording of task processing

Evaluator
Task monitoring and measuring time

Simulator
Send injects according to disaster narrative

Online evaluation card

1st section
2nd section
3rd section

Players

Inject

Evaluation info

Online inject card

Not yet
Not yet
Not yet
done
done
done
Exercise example

Simulated date: January 17, 2014 (Fr)

Location: Kitakyushu City, Japan (pop 970 thousand)

Simulated earthquake
9:00 Epicentral earthquake (Seismic intensity level: 6 plus )
9:10 Inter plate earthquake in North East Pacific ocean (Seismic intensity level: 5 plus )
Tsunami approaching
Exercise example

Exercise time: Jan 18, 2015 9:00 – 12:30
Participants: 488 people
- 24 sections of Kitakyushu City Government
- 15 regional organizations

Simulation room set up
Weakness and strength of Kitakyushu City Government

Prioritized task completion by deadline

Mean task processing time

Strength

Weakness
Comparison between exercises

2007 heavy rain

Prioritized task completion: 76%
Mean processing time: 10.1 min

2014 earthquake

Prioritized task completion: 88%
Mean processing time: 5.7 min

Overall performance:
Improved: 12%
Time reduced: 88%
Bottleneck analysis
EMS overwhelmed

Exercise gives a hint to Improve EMS
Minimum number of staff
Timing of back up
Bottleneck analysis: Unexpected gap

DMS ignored some types of scheduled tasks

Gap between plan and actual operation

Unfinished tasks mounted in EMS

Tasks under processing

Earthquake

Prioritized injects
Other injects
EMS
FD
Education
Welfare
Construction
Citizen support
General affairs
Water
Hospital

Unfinished tasks mounted in EMS

Gap between plan and actual operation
Conclusions

New exercise method and its support tool developed

- Efficient expansion of coordinated disaster management capacity for municipal governments
- Quantitative evaluation
- Easy preparation

Our new targets are:

- Emergency medical activities
- Evacuation in large gatherings
Planning to improvise

Keep more resource for higher level decision making

Back-up request, etc.

Info gathering
Decision
Executing

ESF + task processing network, practice, smooth operation by command/general staff

DMS understands strength and weakness of their organization

Autonomous back-up by staff

The title of this slide is a modification of a section title in T. Wachtendorf and J. M. Kendra (2006) Improvising Disaster in the City of Jazz: Organizational Response to Hurricane Katrina http://understandingkatrina.ssrc.org/Wachtendorf_Kendra/
Survey of task processing network structure in Japanese municipal governments

Objective:
To identify the common section structure that conducts info gathering, info distribution, decision, and dissemination of evacuation warnings

Questionnaire:

<table>
<thead>
<tr>
<th>City category</th>
<th>Sent</th>
<th>Recovered</th>
<th>Response rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designated large city</td>
<td>20</td>
<td>11</td>
<td>55.0</td>
</tr>
<tr>
<td>Core city</td>
<td>47</td>
<td>24</td>
<td>51.1</td>
</tr>
<tr>
<td>Prefectural capital</td>
<td>12</td>
<td>9</td>
<td>75.0</td>
</tr>
<tr>
<td>Tokyo ward</td>
<td>23</td>
<td>12</td>
<td>52.2</td>
</tr>
<tr>
<td>100-300 thousand</td>
<td>13</td>
<td>7</td>
<td>53.8</td>
</tr>
<tr>
<td>50-100 thousand</td>
<td>16</td>
<td>6</td>
<td>37.5</td>
</tr>
<tr>
<td>Less than 50 thousand</td>
<td>15</td>
<td>4</td>
<td>26.7</td>
</tr>
<tr>
<td>Total</td>
<td>146</td>
<td>73</td>
<td>50.0</td>
</tr>
</tbody>
</table>
Task processing network

1 section structure

- Info gathering
- Decision
- Dissemination

5 cases

2 section structure

Section A
- Info gathering
- Decision
- Info distribution

Section B
- Dissemination

15 cases

3 section structure

Section A
- Info gathering
- Decision
- Info distribution

Section B
- Dissemination

Section C
- 7 cases

Most common structure among Japanese municipalities

4 section structure

Section A
- Info gathering
- Decision
- Info distribution

Section B
- Dissemination

Section C
- Decision

Section D
- 14 cases

2 section structure

Section A
- Info gathering
- Decision
- Info distribution

Section B
- Dissemination

7 cases
References

FEMA, IS-100.B: Introduction to Incident Command System, ICS-100


Hayashi, Y., et al. (2014)

Kato, T. et al. (2014)

Zujiyo Ensyu Kenkyukai (2011)
Zujiyo Ensyu Nyumon (Introduction to disaster management exercise), Naigai Syuppan, Tokyo.