Scientific Decision Supports for Emergency Preparedness of Natural Hazards

Haruo Hayashi
Kyoto University

Old Disaster Management Paradigm

Disaster Mitigation
by
vulnerability Reduction

Disaster Mitigation Framework

$$D = f(H,E,V)$$

↓
Disaster Mitigation

Where D: Damage
H: Hazard
E: Exposure
V: Vulnerability

➡ Vulnerability Reduction

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1995.1.17 Kobe Earthquake

1995.1.17 Kobe earthquake Mw=6.9

2001.9.11 Terroist Attack

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2005.8.29 Hurricane Katrina

2011.3.11 Tohoku Earthquake

Tohoku Earthquake and Tsunami Disaster(Mw=9.0)

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2012.10.29 Superstorm Sandy

Rising water, caused by Hurricane Sandy, rushes into a subterranean parking garage on October 29, 2012, in New York's Financial District.(Andrew Burton/Getty Images)

http://www.theatlantic.com/infocus/2012/10/hurricane-sandy-after-landfall/100396/

What is suggested from these examples

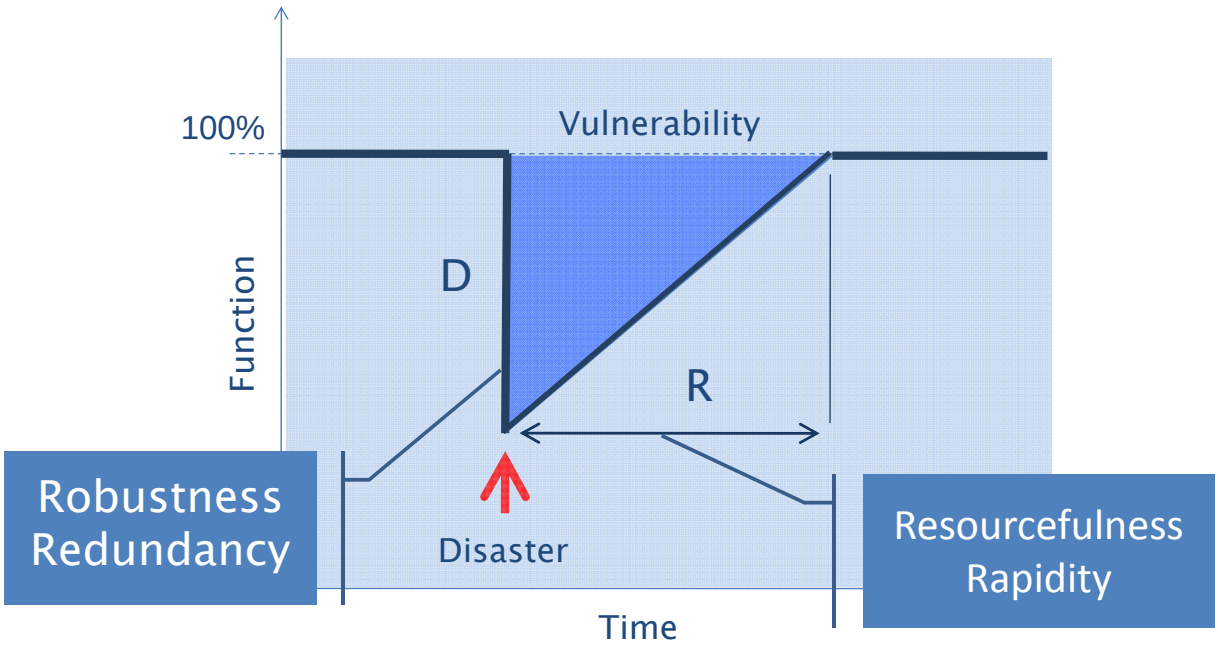
Need for New Paradigm

New Research Framework
"Disaster Resilience Model"

$$R = f(D,A,T)$$

Where
R: Resilience
D: Damage $= f$(H,E,V)
A: Human Activities
T: Time

Defining Disaster Resilience



Adapted from MCEER model on Lifeline

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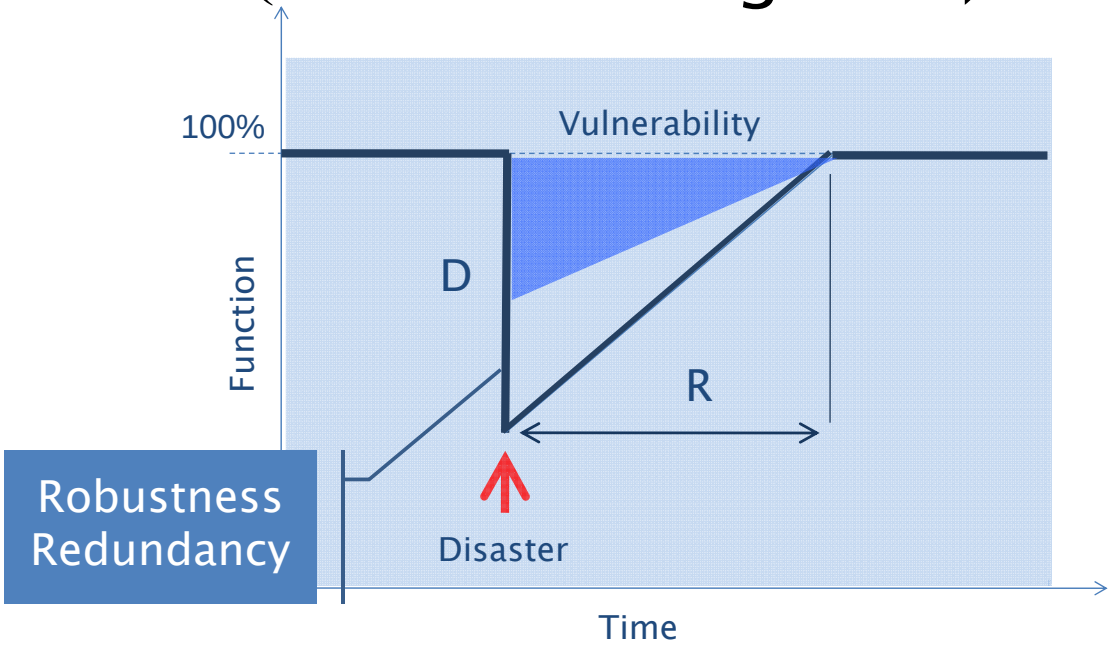
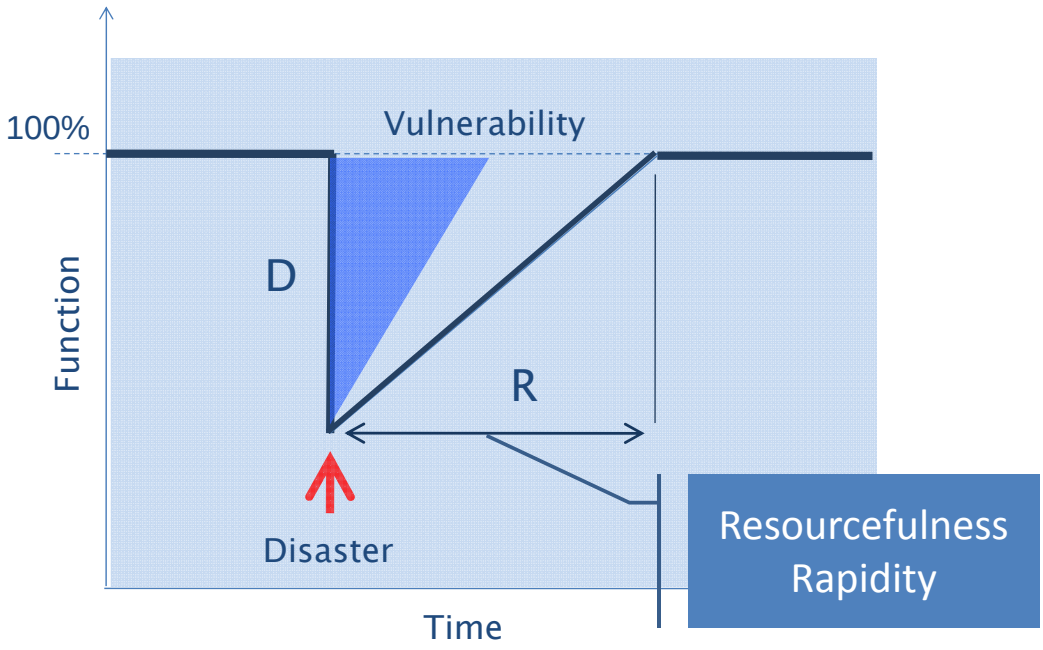
Preventing Damage & Losses (Disaster Mitigation)



Adapted from MCEER model on Lifeline

Recovering from Damage & Losses (Emeregency Preparedness)



Adapted from MCEER model on Lifeline

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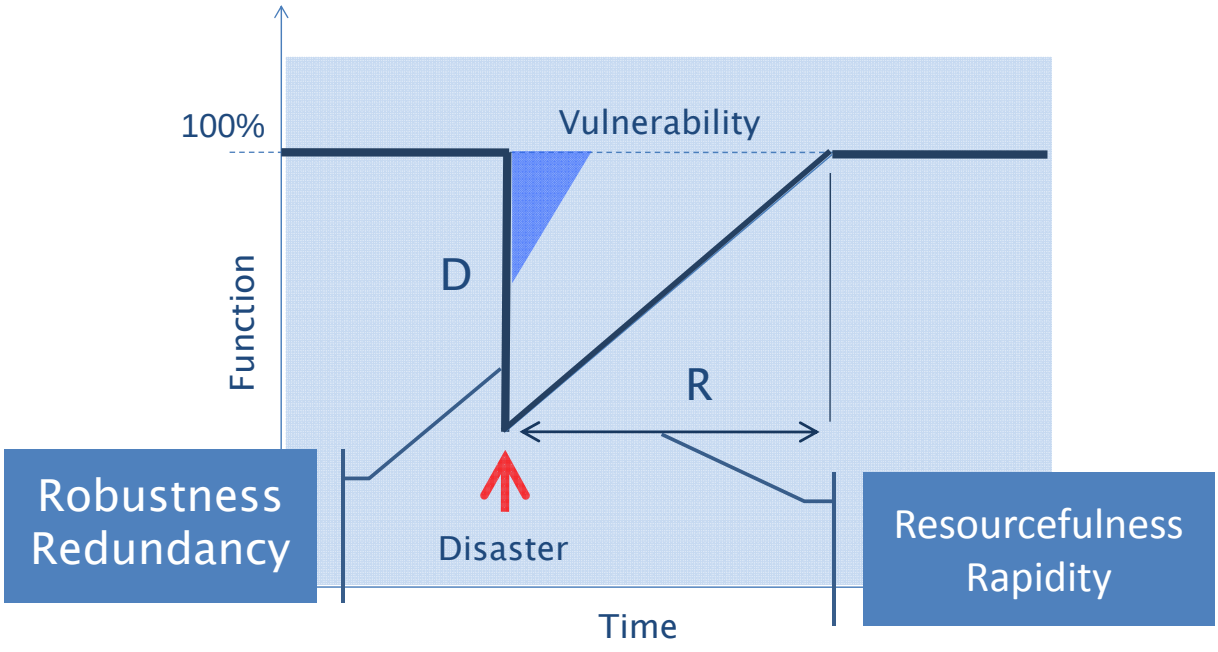
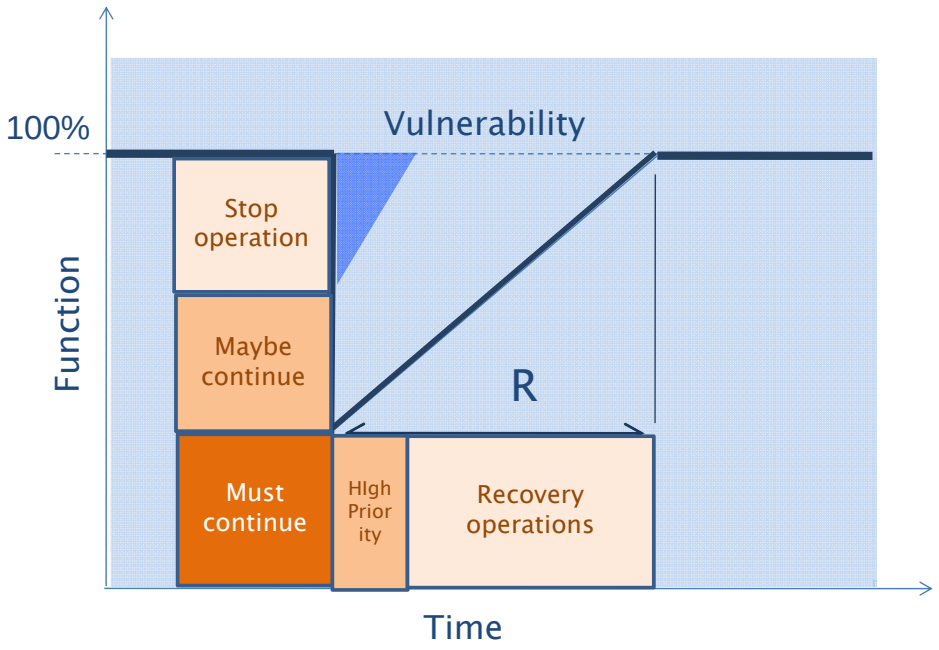
An Integrated Approach：Priortization



Adapted from MCEER model on Lifeline

An Integrated Approach: Priortization



Adapted from MCEER model on Lifeline

Disaster resilience Model is an integrated approach

$$R = f(D,A,T)$$

$$R = f(H,E,V,A,T)$$

where $D = f(H,E,V)$

Disaster can not be prevented completely

→ Improve Emergency Preparedness to "build back better"

By Understanding Disaster Response and Recovery Process Better

- To do so
  - By Focusing of Human Activities and Time Factors (Who does What at When)
  - Only on those recurrent disaster problems

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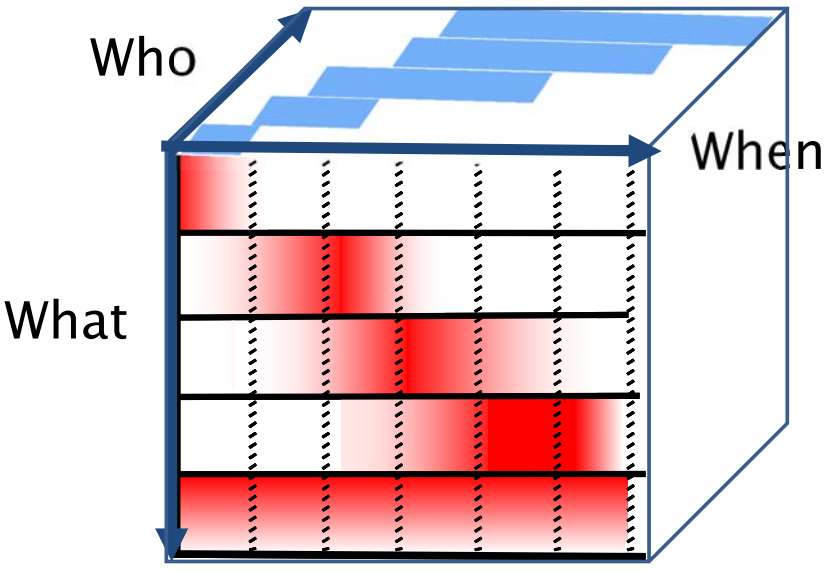
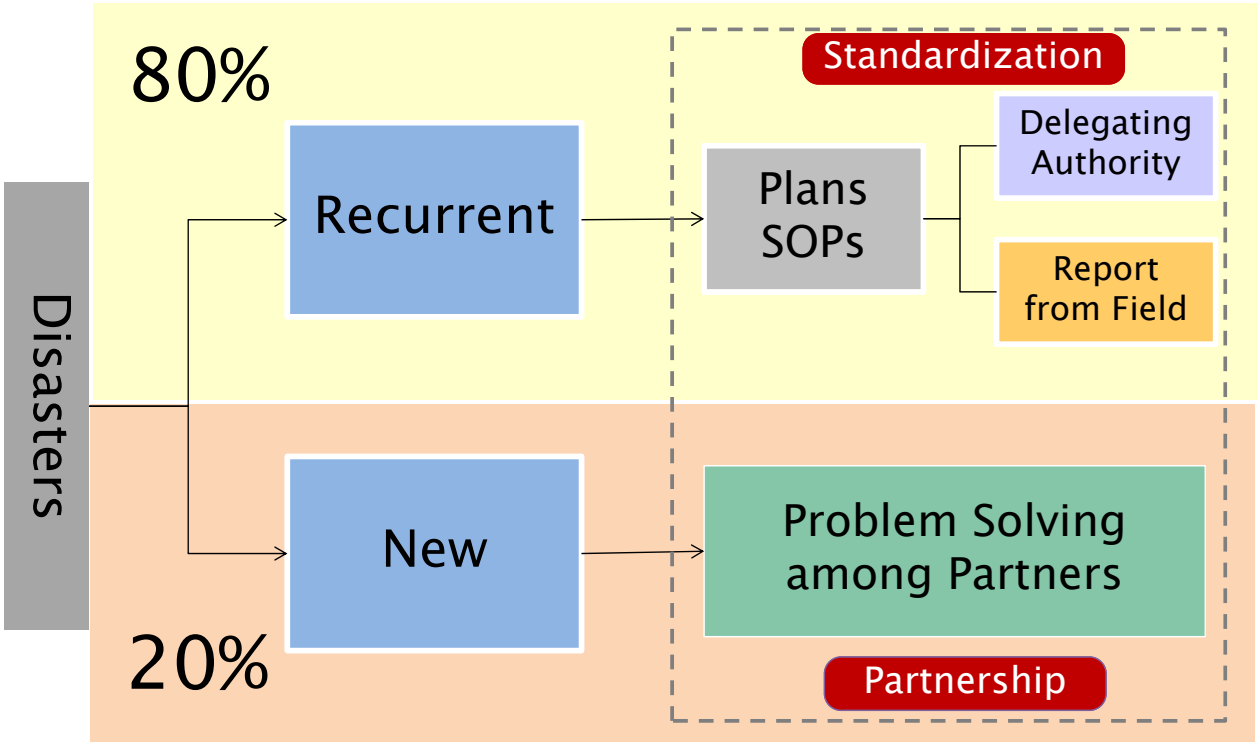
By Focusing of Human Activities and Time Factors (Who does What at When)

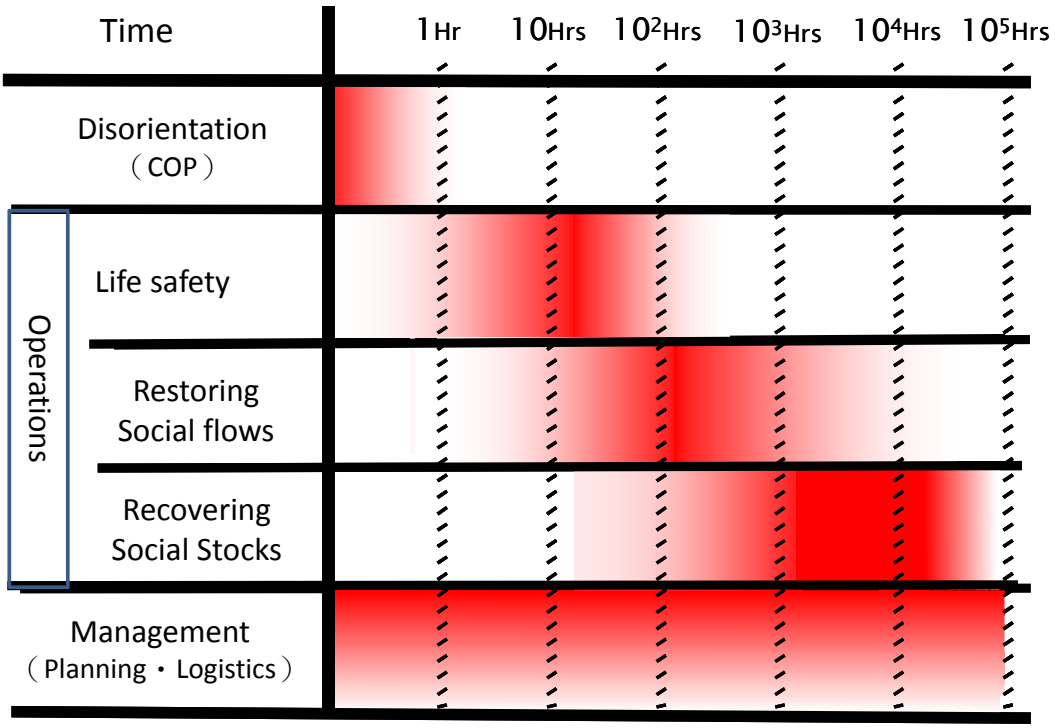


Only on those recurrent disaster problems



Based on our reconnaissance report on Hurricane sandy

Disaster Response & Recovery Process (What/When)



Three Research Questions

- To shorten Disorientation phase
  - By creating **Common Operational Picture** (COP)
- To implement **Operationa**l Excellence
  - Response: Life saving
  - Relief: Restoring Social Flows
  - Recovery: Reconstructing Social Stocks
- To realize Effective Emergency **Management**
  - Planning
  - Logistics

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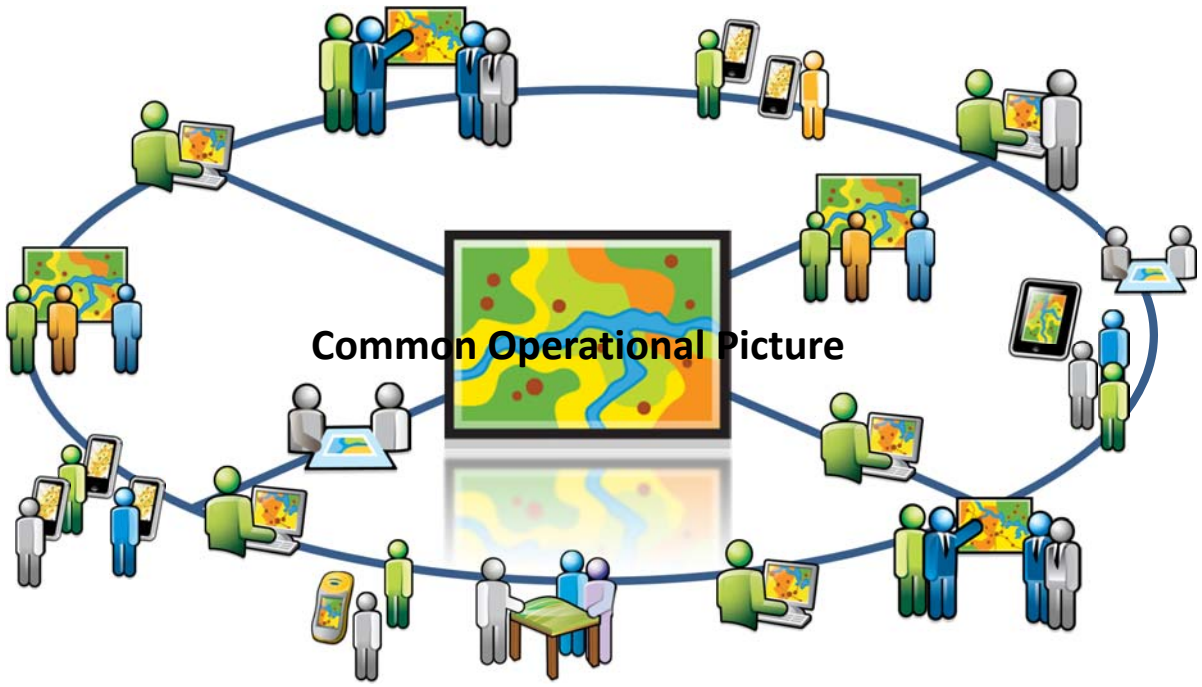
状況認識の統一
(Common Operational Picture)



Common Operational Picture (COP)

- At all phases of disaster management
- For better situational awareness
  - What is happening?
  - How are we doing?
  - What should we do next?
- Visualization by GIS: Power of Maps

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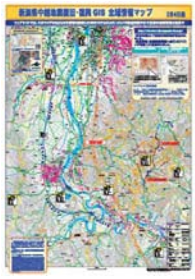
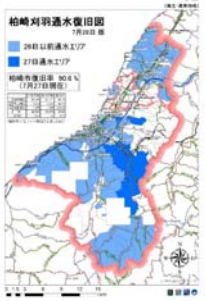
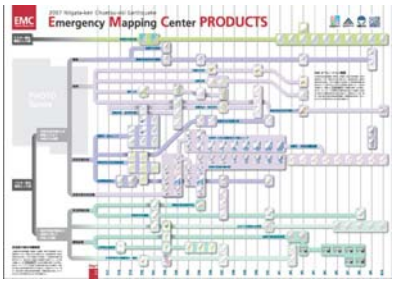
2004
Niigata Chuetsu
GIS Project

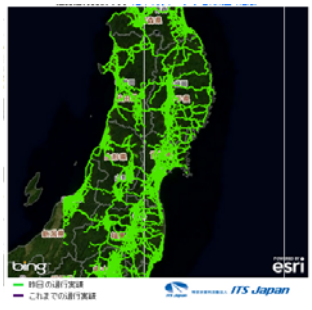


2007
Niigata Chuetsu-oki
EMC Project





2011
Tohoku EQ & Tsunami
EMT Project



A Great Innovation：Power of Internet

- Everyone can disseminate information now
  - Emergency Service is “one” of info sources
  - Social Media
  - EMT Project
- Cloud Service
  - From Information system to information service
  - From “Open Source” to “Open Access”
- GPS＋GIS
  - WebGIS
  - Mash Up

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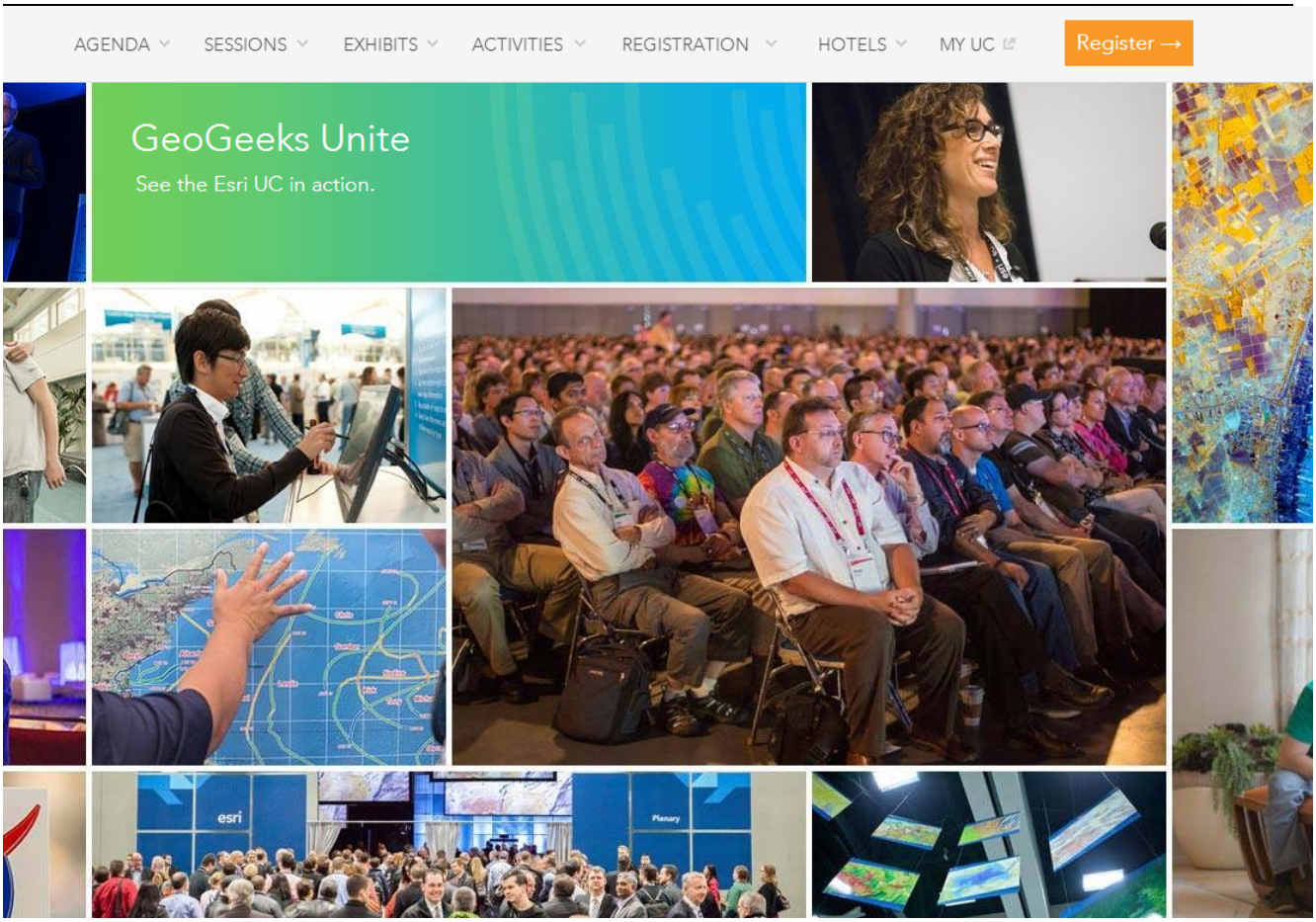

At 2014 ESRI UC, All Presentations were made by using ArcGIS Online Service

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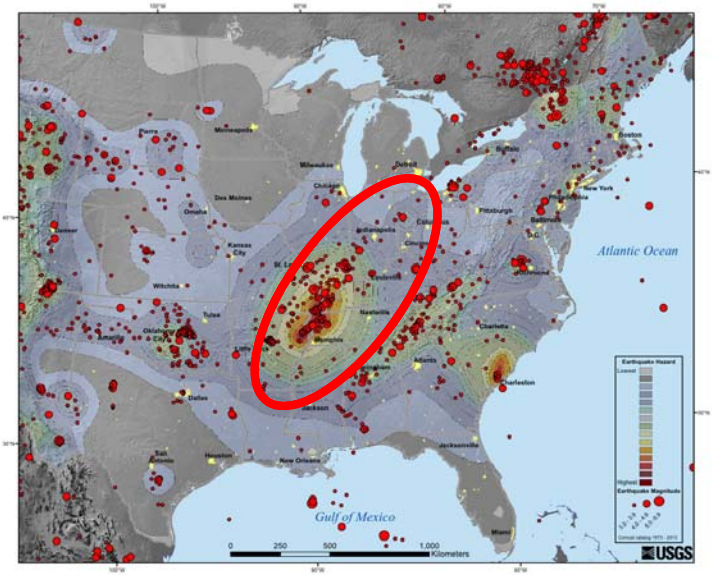
At 2014 ESRI UC

Capstone-14 Exercise June 15 2014



http://earthquake.usgs.gov/regional/ceus/images/CEUSseis_lg.jpg

New Madrid Seismic Zone Scenario Earthquake

Information Management Drill by Eight States

(450 Counties)

Illinois, Missouri, Arkansas, Mississippi, Alabama, Tennessee, Kentucky, Indiana

18 Essential Element of Information（EEI)

1. Electricity Grid Status
2. National Gas Grid Status
3. Public Water Grid Status
4. Road Status (including Bridges)
5. Rail Network Status (including Bridges)
6. Navigable Waterways Status
7. Air Transportation Infrastructure Status
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9. Staging Area Status
10. Points of Distribution Status
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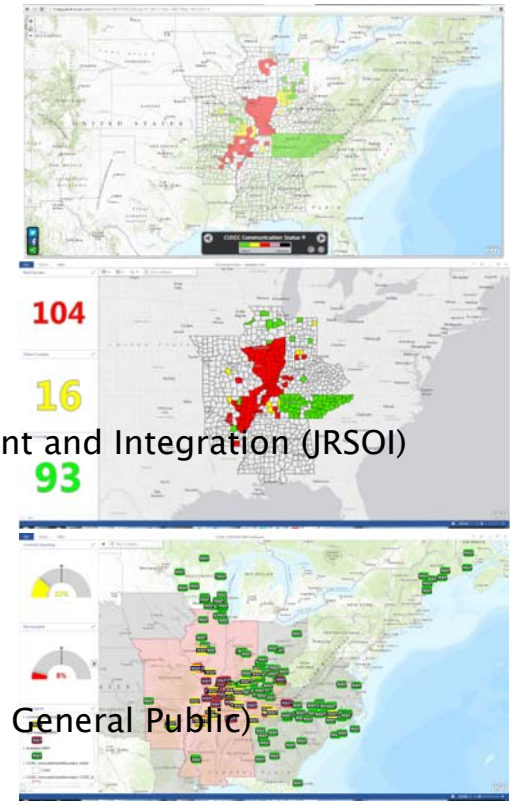
12. Evacuation Orders Status
13. Injuries and Fatalities Status
14. Shelters Status
15. Private Sector Infrastructure Status
16. U.S. Geological Survey Status (e.g. PAGER)
17. Communications Status (Public Safety and General Public)
18. Hospital Status



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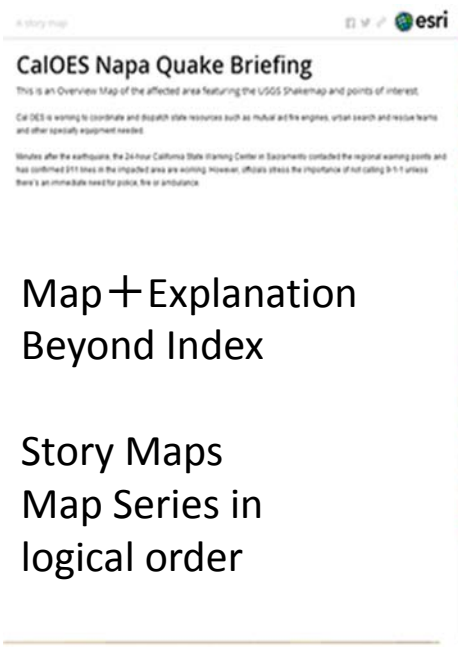
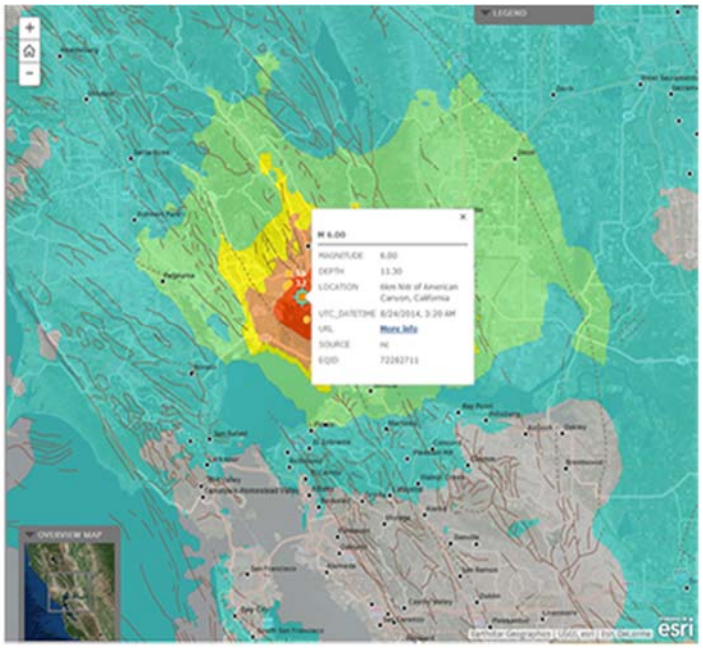
Briefing Book

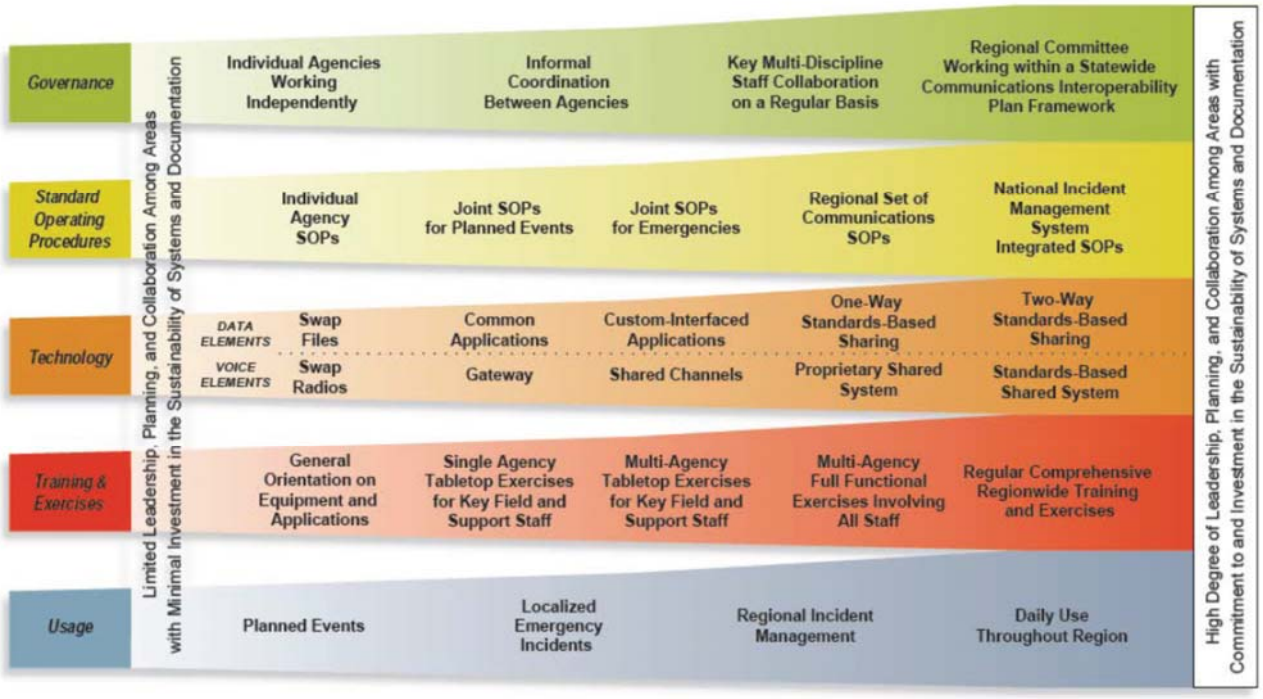


Map＋Explanation
Beyond Index

Story Maps
Map Series in
logical order

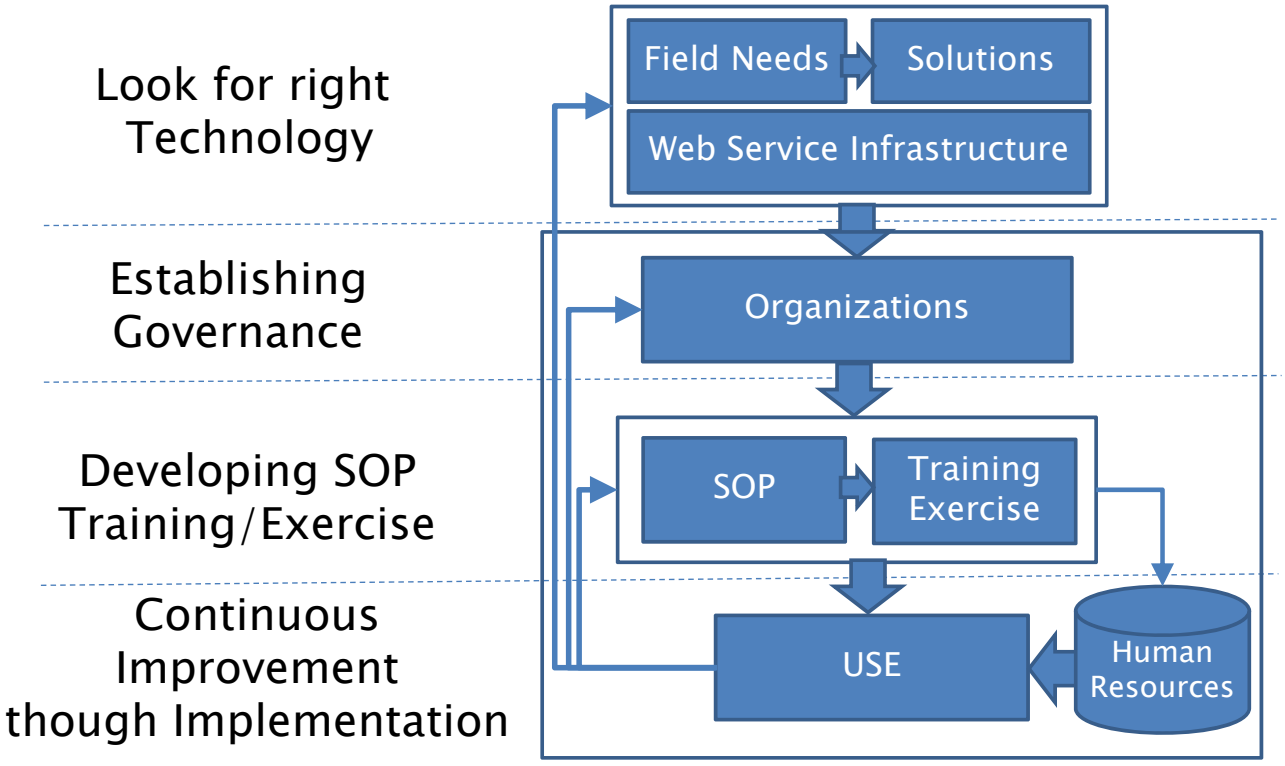


Interoperability Continuum



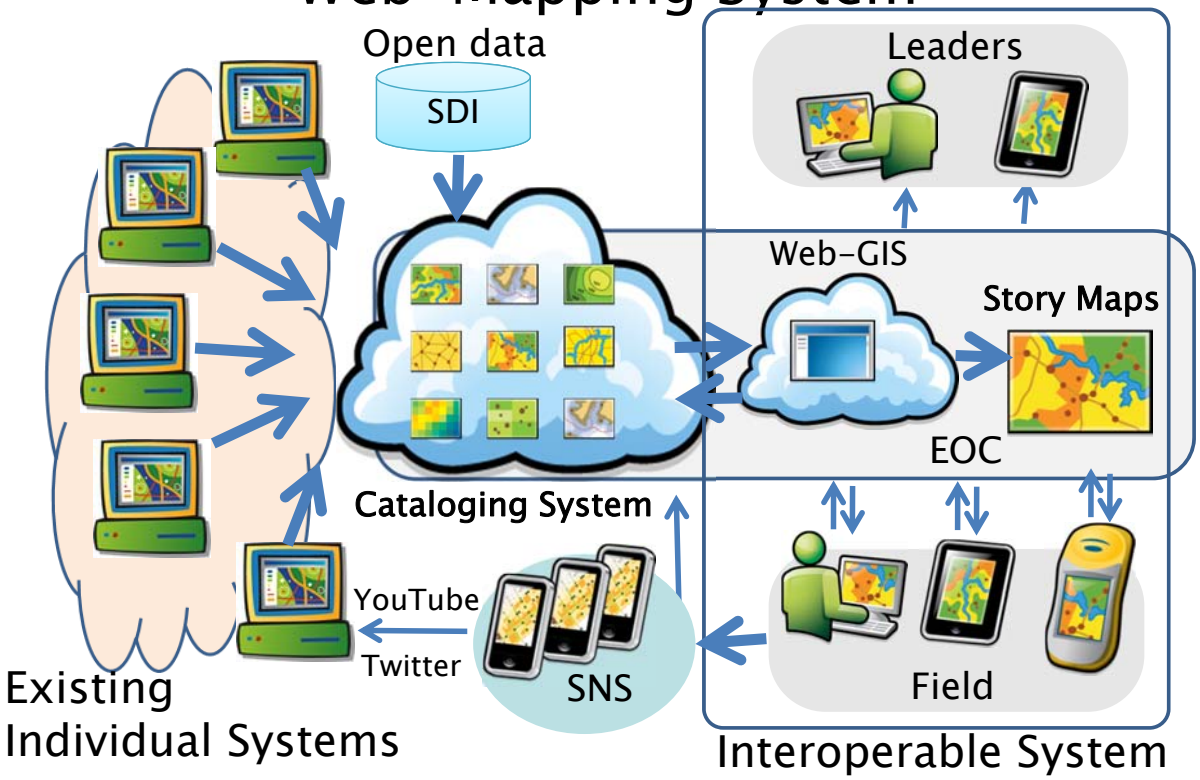
DHS

Roadmap for realizing Interoperability

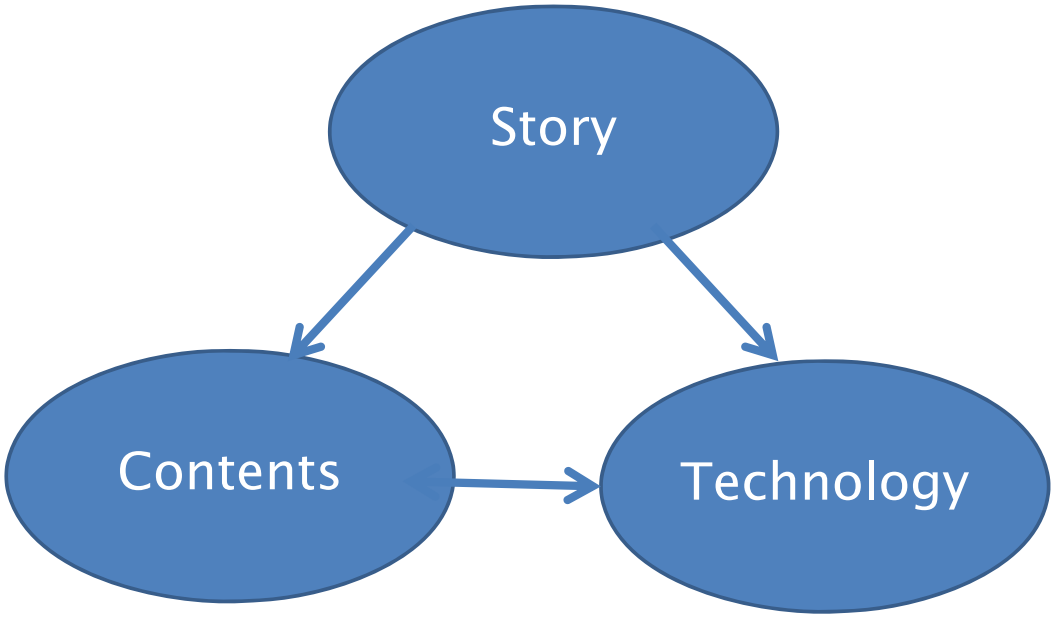


Technology : ArcGIS Online

Disaster Response Support Web-Mapping System



Three Kinds of Experts for New System



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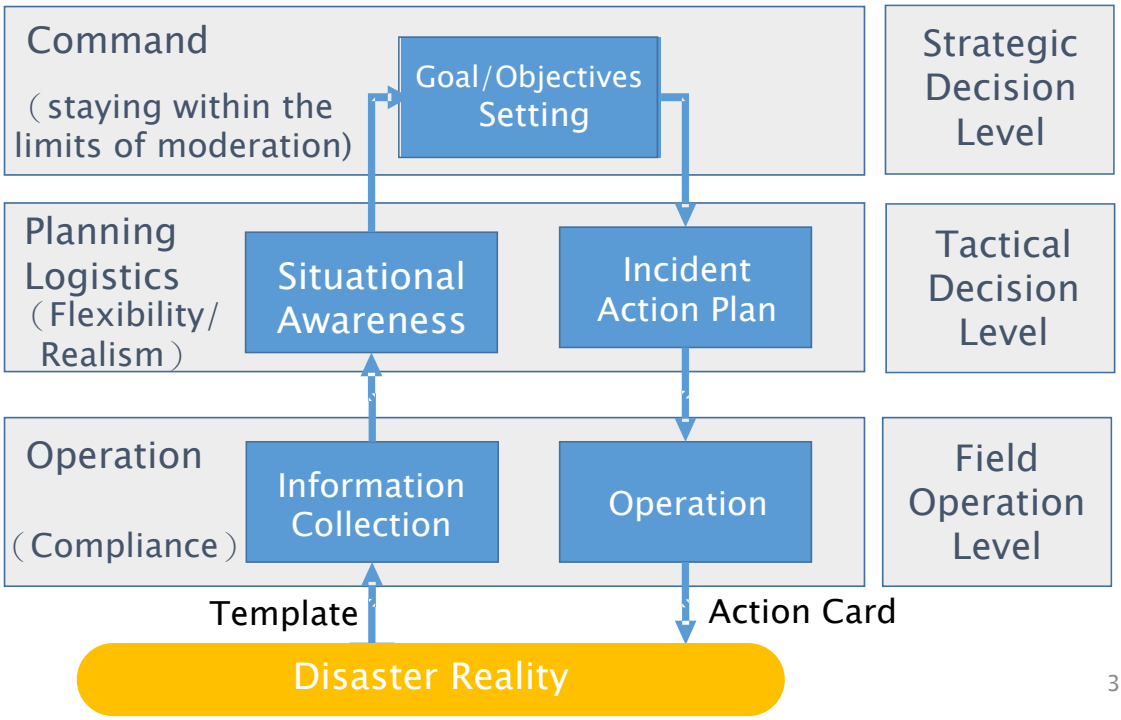
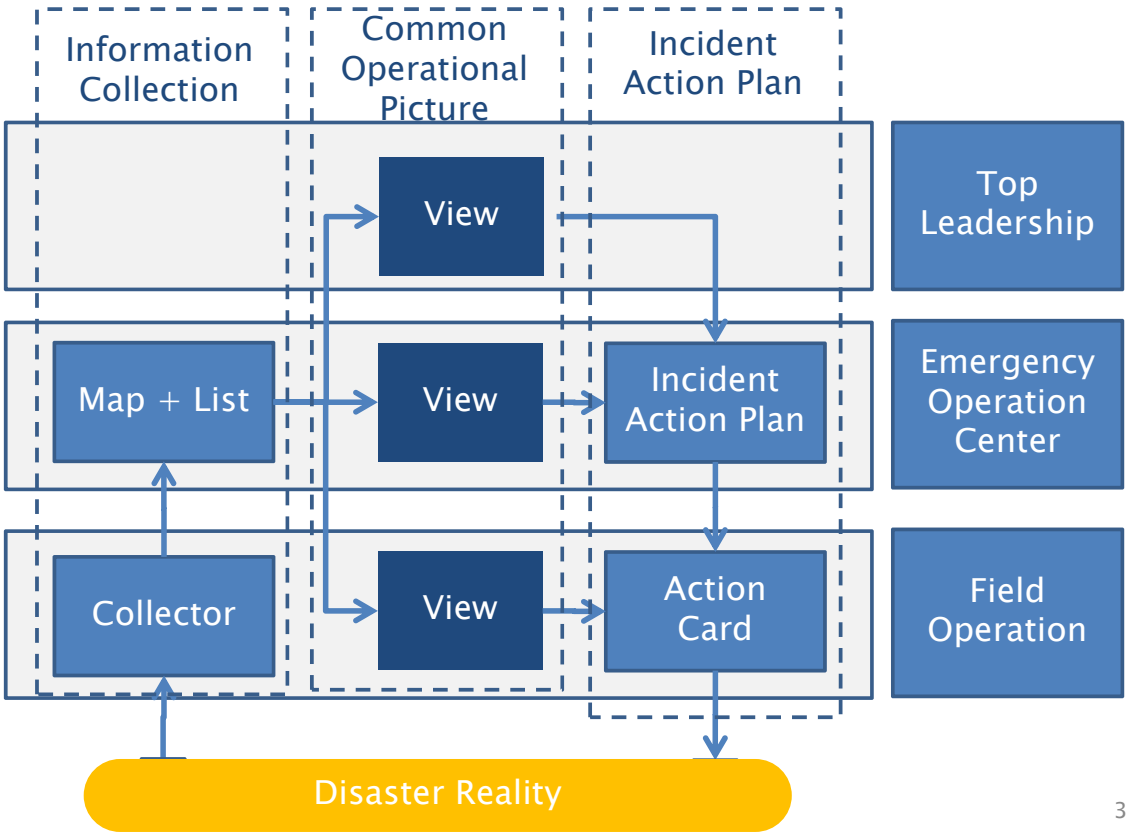
Governance:
Organizational Observation

Three Kinds of People and Five jobs to do in case of Disaster Response



Situational Awareness



Three kinds of people needs different ICTs

- Top Leadership：
  - Setting goals and objectives based on clear situational awareness
  - “What is going on, What should be done”
- Field：
  - Reporting from field and Implementing operations
  - Simple and Flexible Interface
- EOC：
  - Creating situational awareness based on field information
  - Creating incident action plan based on goals/ objectives set by top leadership

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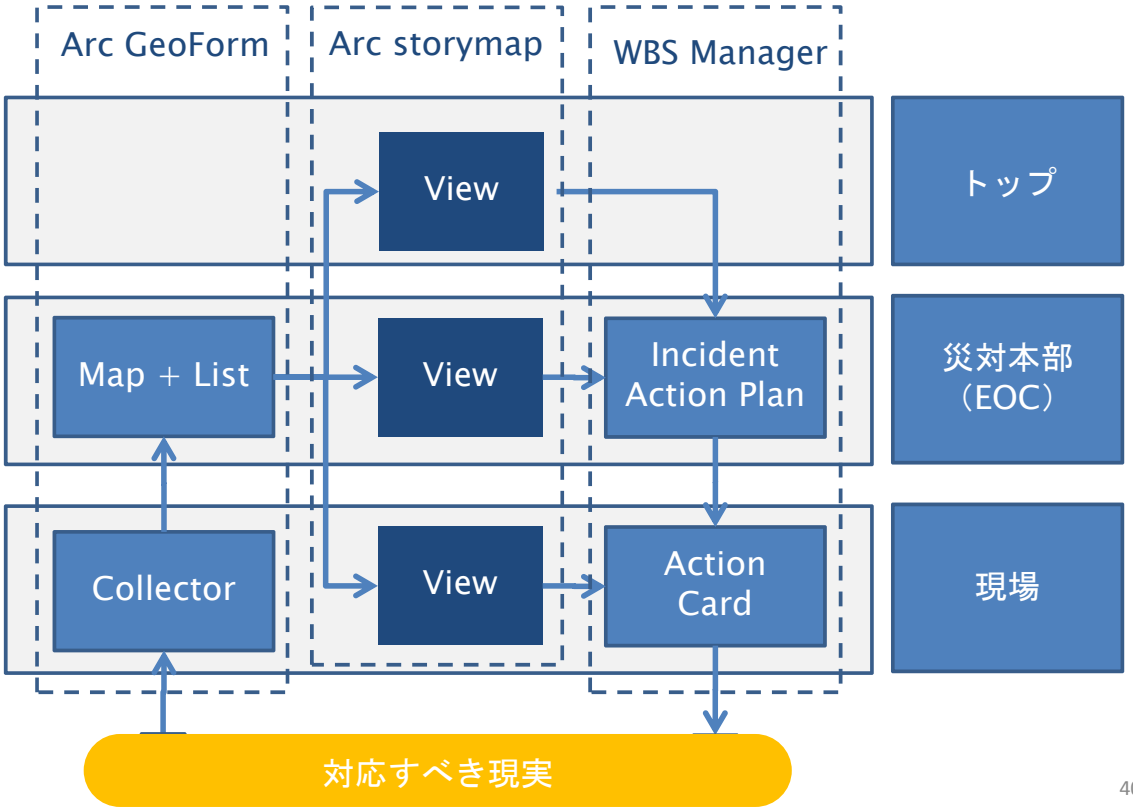
災害対応組織におけるGISの使い方



Standard Operation Procedure/ training & Exercise

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ICT for Top Leadership: COP by Storymap

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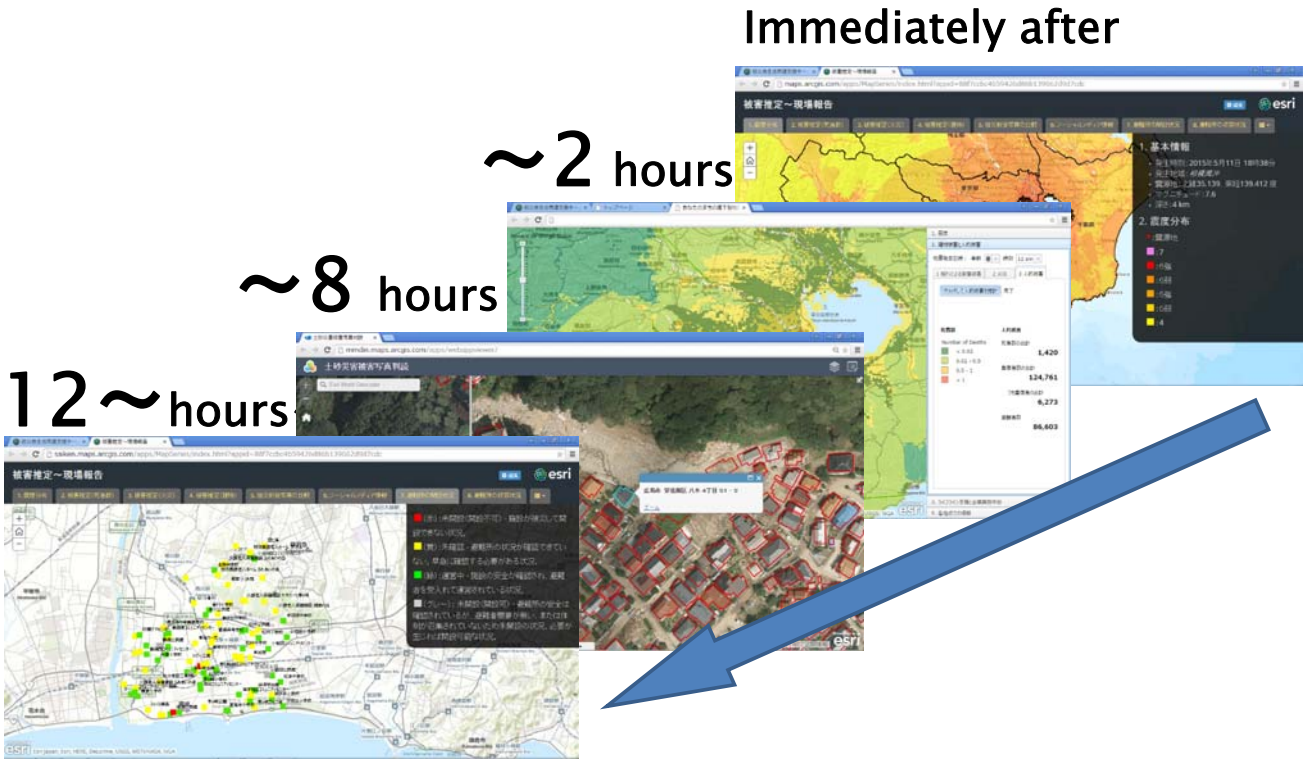
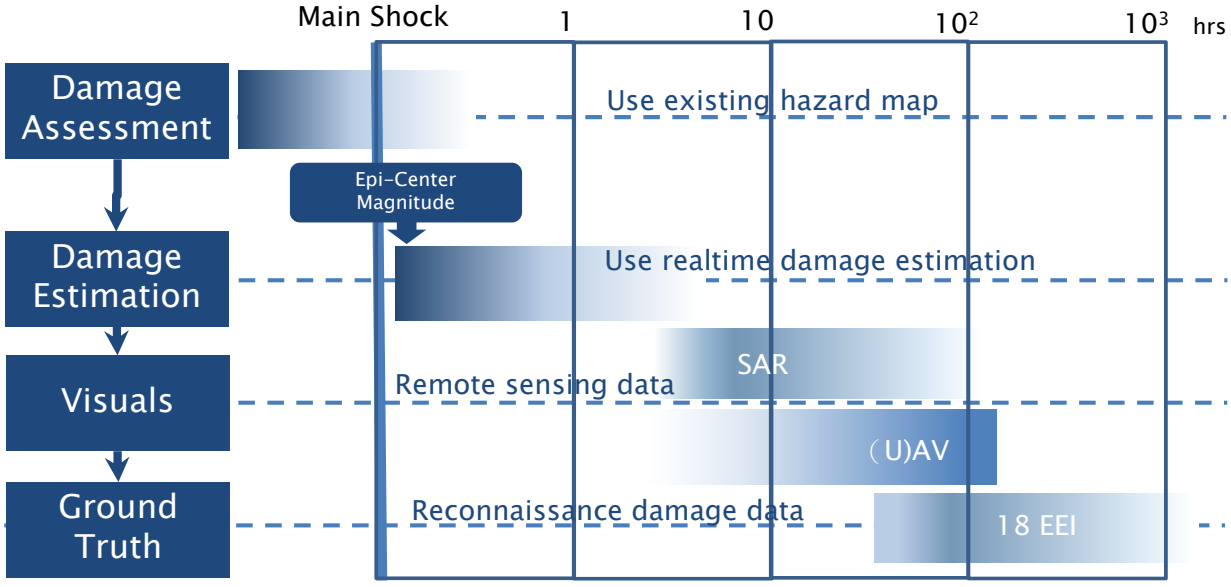
ICT for Top Leadership

- Setting goals and objectives based on clear situational awareness
- "What is going on"
  - Storymap
- "What should be done"
  - Goal Setting
  - Allocation of resources

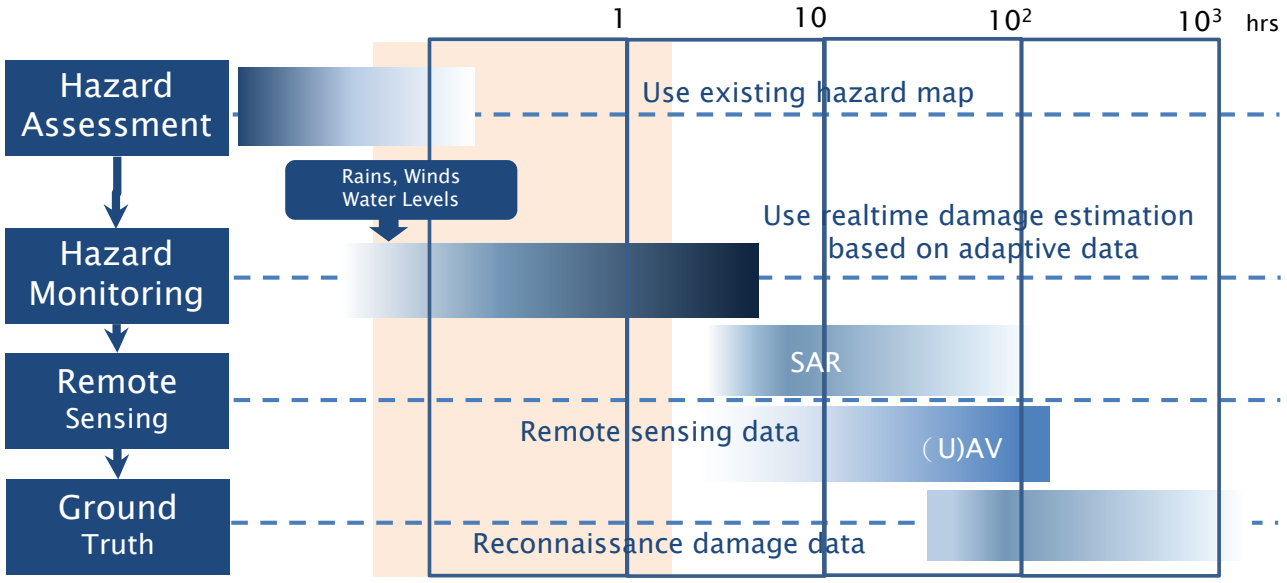
Common Operation Picture by Storymap



Successive Common Operational Picture based on available information (earthquake)



Successive Common Operational Picture based on available information (storms)



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ICT for Field Operation: Collector+Action Card : Geoform

ICT for Field Operation

- Given instruction, perform operation
- Clear, Simple, & Flexible interface
- Instruction : What to do
  - Action Card
- Situational Awareness: What is happening
  - Storymap
- Information Collection:
  - Collector

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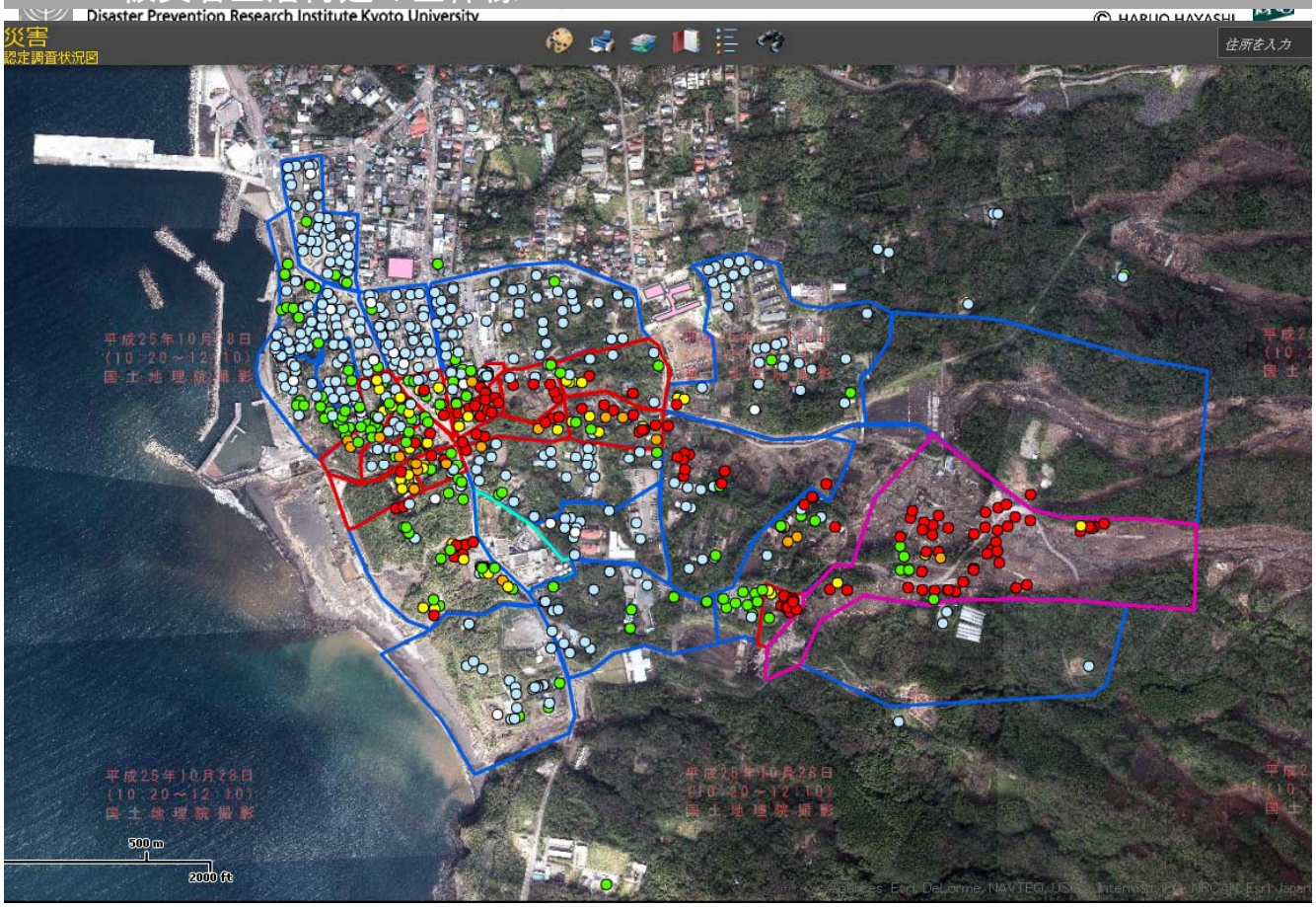
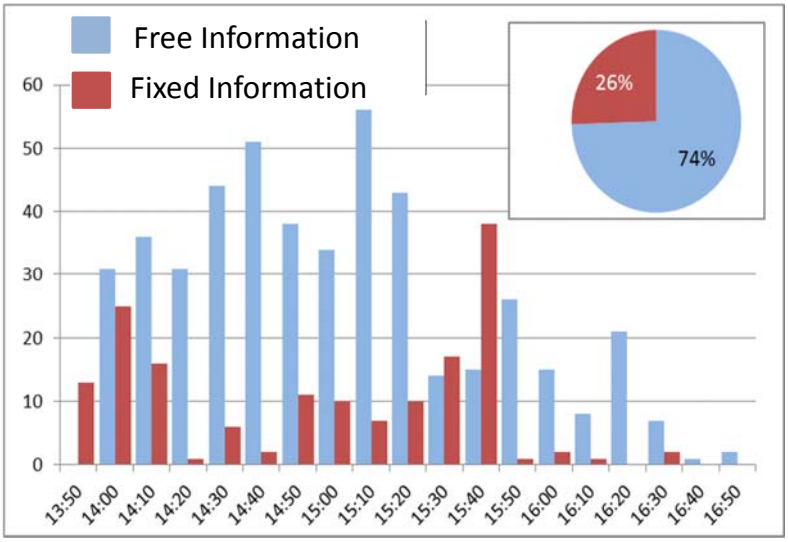
0101 被災者生活再建の全体像



collector : Processing Fixed and Free Information

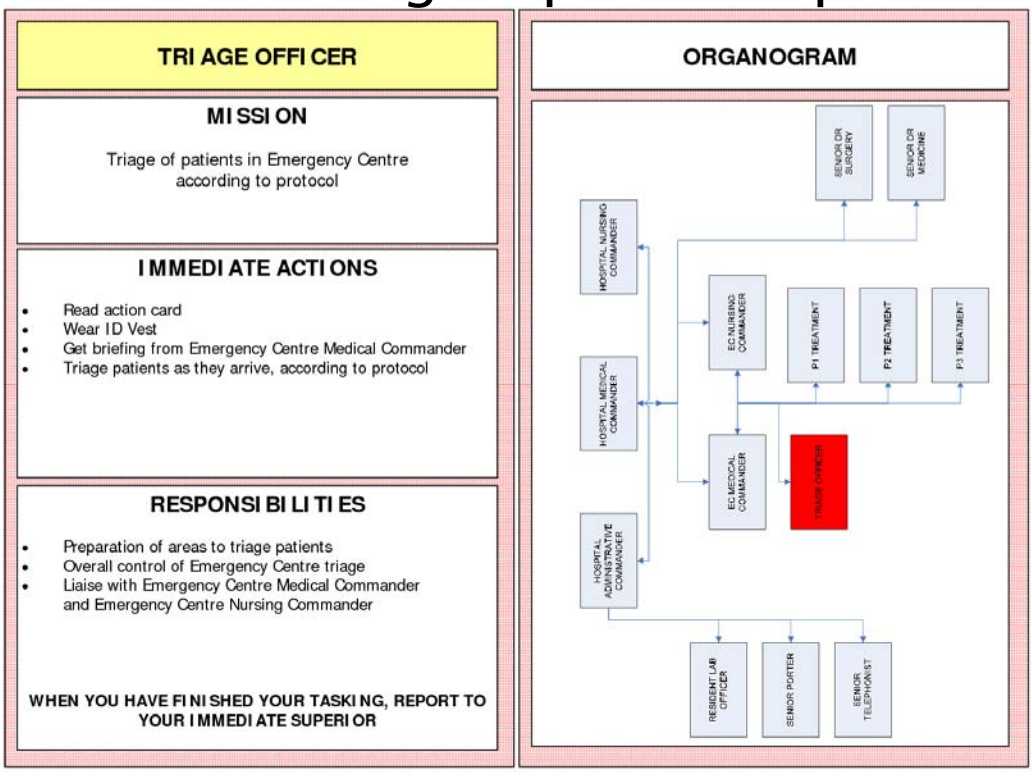


Types of Information Processes during 2014 Kashihara Exercise

Types of Information Processing needed for Disaster Response

	Free Information 75%	Fixed Information 25%
Recurrent Tasks 80%	Formatted Free Information 60%	Templates for Specific Operations 20%
New Tasks 20%	Formatted Free Information 15%	

Instruction : Action Card including Maps & Templates



TRIAGE OFFICER

MISSION

Triage of patients in Emergency Centre according to protocol

IMMEDIATE ACTIONS

- Read action card
- Wear ID Vest
- Get briefing from Emergency Centre Medical Commander
- Triage patients as they arrive, according to protocol

RESPONSIBILITIES

- Preparation of areas to triage patients
- Overall control of Emergency Centre triage
- Liaise with Emergency Centre Medical Commander and Emergency Centre Nursing Commander

WHEN YOU HAVE FINISHED YOUR TASKING, REPORT TO YOUR IMMEDIATE SUPERIOR

ORGANOGRAM

ICT for EOC

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ICT for EOC

- Creating situational awareness based on field information
- Creating incident action plan based on goals/ objectives set by top leadership

Web GIS Service for EOC
Listed Information Products for Operations

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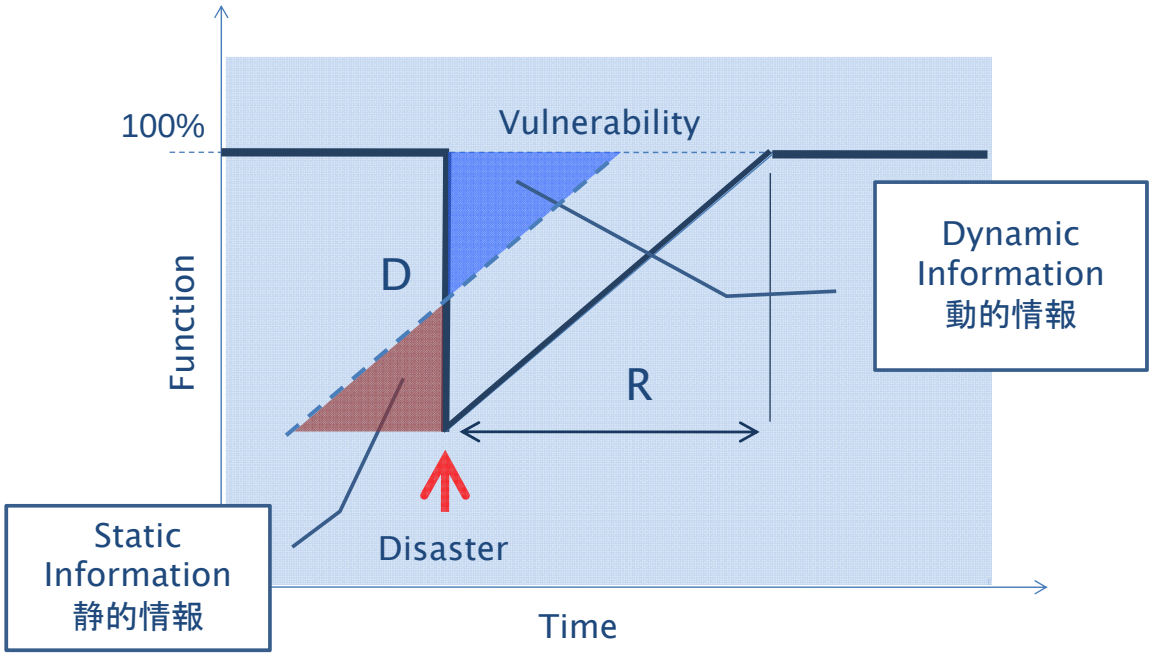
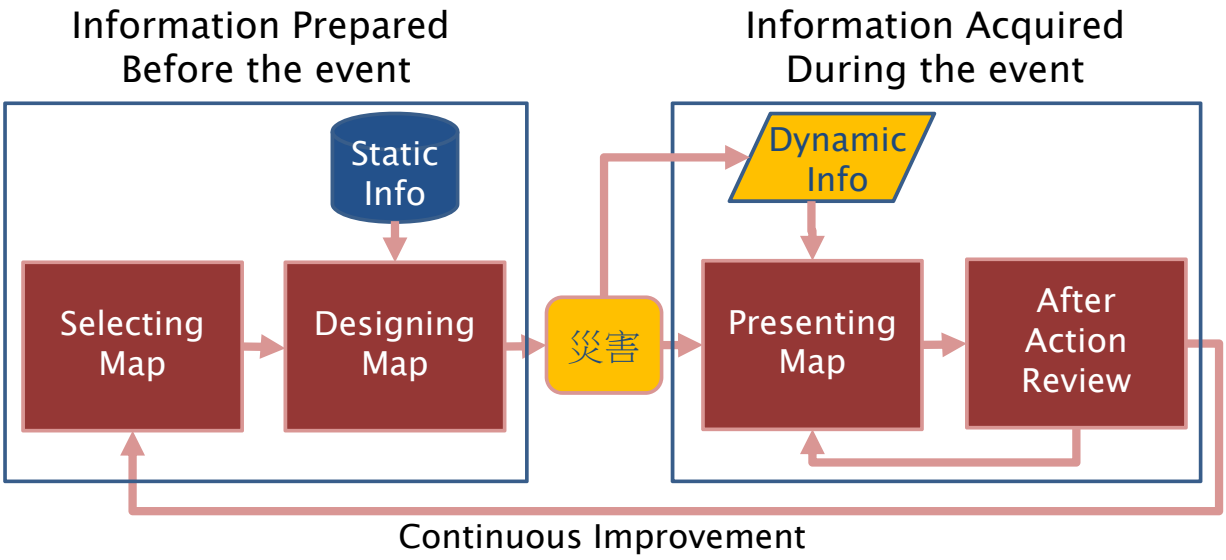
Two Types Information for Effective Operations



Adapted from MCEER model on Lifeline

Information Products Workflow



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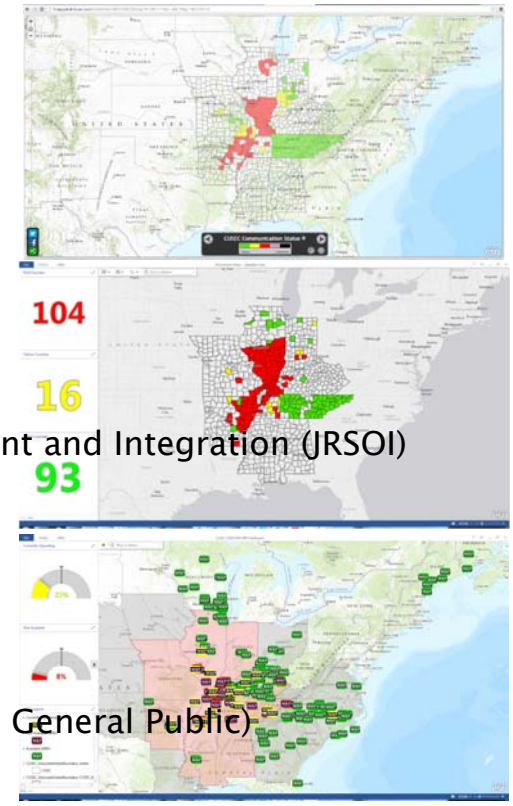

Human resource development and continuous improvement through repeated Implementations

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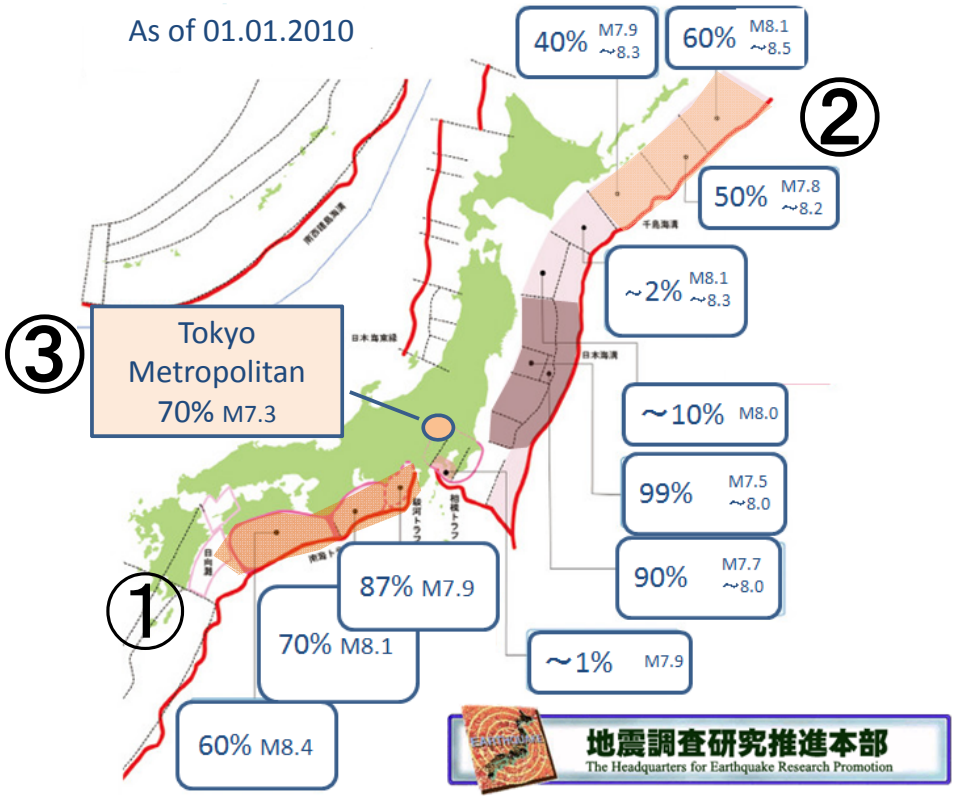
We are expecting “Big Ones” after Tohoku



Standardization of Disaster Response System is Out Goal

- Coordinated response at national level
- Starting from impacted local resources.
- Resources from other area will come to help to the impacted area.
- Resources will be mobilized from all over the nation as well as from Chinese Taipei and other countries
- This system will be applied for every incidents with all sizes and all kinds

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Roadmap for Standardization

2020 Testing Situational Awareness System at Tokyo Olympic/Paralympic games

2023 Introducing this system at 100th Anniversary of 1923 Kanto Earthquake

2030 Completing Standardization by 4th UNDRR

2035? Implementing for Nankai Trough Earthquake Disaster and/or Tokyo Metropolitan Earthquake

Thank you for your attention