Earth Science Information Exchange

James W. Morentz, Ph.D.
Executive Director
XchangeCore Community

www.XchangeCore.org
Goal of Decision Support from Earth Science Information

- Collect
  - Static GIS data
  - Sensor
- Analyze
  - Modeling results
  - Empirical Observations
- Distribute
  - Decision-Support Information
  - Data for Further Analysis
    - Static
    - Model Results
    - Observations
  - Empirical Observations
  - Model Results
  - Sensors
  - Static GIS Data
The Clearinghouse builds on geospatial information: Sensors and predictive models

Sensor Input and Modeling Results

- There is an earthquake in this area
- Sensors identify seismic activity and models anticipate impact
Geospatial views from prior studies show where an earthquake might cause damage.

Sensor Input and Modeling Results

Overlay Hazard Zones

- Our research has shown the propensity of the earth to react in certain ways:
  - Liquefaction
  - Landslides
  - Fault Ruptures
Analysts assess physical evidence of likely locations of losses

Sensor Input and Modeling Results
Overlay Hazard Zones
Add Instructions to damage locations

- We do this by comparing predicted hazards with aerial and satellite imagery
Reports of damages come from media, 911, dispatchers

Sensor Input and Modeling Results
Overlay Hazard Zones
Add Assessment
Add Field Observations
• Then we add in reports from responders, dispatch, WebEOC, and observers
Combine that geospatial with incident information shared through XchangeCore

1. Geospatial Data Is Accumulated Through XchangeCore from Many Sources
Until skilled people observe what geospatial information depicts, there is no ground truth.

1. Geospatial Data Is Accumulated Through XchangeCore from Many Sources

2. XchangeCore Provides All the Data to Responders and Field Observers

Red Alert to Possible, Nearby Damage Locations from XchangeCore

www.XchangeCore.org
SpotOnResponse Mobile App Creates Field Observations and Shares through XchangeCore

1. Geospatial Data Is Accumulated Through XchangeCore from Many Sources

2. XchangeCore Provides All the Data to Responders and Field Observers

3. Field Observations Enrich the XchangeCore Common Operational Data that is Shared to Operations Managers and Executives

App Provides Directions for Scientist, Engineer, and Responders

Red Alert to Possible, Nearby Damage Locations from XchangeCore

Record Observations with Photographs, Text, Voice-to-Text, Video

Integrate Clearinghouse Field Notes for scientific, engineering, and damage assessment forms of emergency response and recovery

www.XchangeCore.org
The composite of all data is then shared to collaboration partners to improve decisions.

1. Geospatial Data Is Accumulated Through XchangeCore from Many Sources

2. XchangeCore Provides All the Data to Responders and Field Observers

3. Field Observations Enrich the XchangeCore Common Operational Data that is Shared to Operations Managers and Executives

4. All Data on XchangeCore is Then Available for any Organization to Use and Improve, and Share Back with Clearinghouse Partners Through XchangeCore

App Provides Directions for Scientist, Engineer, and Responders

Record Observations with Photographs, Text, Voice-to-Text, Video

Integrate Clearinghouse Field Notes for scientific, engineering, and damage assessment forms of emergency response and recovery

Red Alert to Possible, Nearby Damage Locations from XchangeCore

www.XchangeCore.org
XchangeCore Works for the “Whole Community”

• One view of incident content can’t be all things to all people and should not include information unrelated to the incident
One view of incident content can’t be all things to all people and should not include information unrelated to the incident.

If you want to give different decision-makers the view of the incident that is valuable for them, you have to ...
- Create a common set of exactly the right standardized data
- Manage the content to compose that data into the right view in their chosen application.

The goal being multiple different decision-makers, anywhere, in any organization exchanging common data that gets seamlessly composed into the exact view each one needs to make their own decisions.

XchangeCore Works for the “Whole Community”
XchangeCore Works for the “Whole Community”

• One view of incident content can’t be all things to all people and should not include information unrelated to the incident

• If you want to give different decision-makers the view of the incident that is valuable for them, you have to ...
  – Create a common set of exactly the right standardized data
  – Manage the content to compose that data into the right view in their chosen application

• And if you want to allow decisions to be made based on collaboration, then you must allow two-way communication
  – Which means one decision-maker with their special view ...
  – Shares information with another decision-maker in their own view ...
XchangeCore Works for the “Whole Community”

• One view of **incident content** can’t be all things to all people and should not include information unrelated to the incident

• If you want to give different decision-makers the **view of the incident** that is valuable for them, you have to ...
  – Create a common set of exactly the right **standardized data**
  – **Manage the content** to compose that data into the right view in their chosen application

• And if you want to allow decisions to be made based on **collaboration**, then you must allow **two-way communication**
  – Which means one decision-maker with their special view ...
  – Shares information with another decision-maker in their own view ...

• The goal being **multiple different decision-makers**, anywhere, in any organization **exchanging common data** that gets seamlessly **composed into the exact view** each one needs to make their own decisions
Getting started: Pick your tool

ArcGIS Online

SpotOnResponse App

Google Earth

Single Automated Business Exchange for Reporting

WebEOC

vBEOC

NASA JPL Models

20+ Data Sources

Aloha Plume Model

Field Notes
XchangeCore Orchestration Life Cycle

Data Sources
- Geospatial Web Service
- Non-Geospatial Web Service
- Non-Web Service Operational
- API-Based Operational

Translate Transform

Common Operational Data

Arrayed on the Tree of Knowledge

www.XchangeCore.org
XchangeCore Orchestration Life Cycle

Data Sources

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Common Operational Data

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Composed into Content Packages

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Translate Transform

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Agreements Determine Approved Consumer Applications

Notifications to Approved Applications
Synchronize Content

www.XchangeCore.org
XchangeCore Orchestration Life Cycle

Data Sources
- Geospatial Web Service
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Data is Exposed for Exchange in its Native Format, Becoming a Data Source

Enable Applications to Process, Visualize, and Improve Data

Notifications to Approved Applications

Synchronize Content

Agreements Determine Approved Consumer Applications

Composed into Content Packages

Arrayed on the Tree of Knowledge

Common Operational Data

Translate Transform

www.XchangeCore.org
A Very Focused Value Illustrated by the Geospatial Concept of Operations
Item-by-Item Look at Geospatial Association with Incident Information

### Table 2-5: Authoritative Data - Damage Assessment Mission - Ground Truth

<table>
<thead>
<tr>
<th>Sub Category</th>
<th>Theme</th>
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<td>Damage - Infrastructure</td>
<td>Commercial Building Damage</td>
<td>Point</td>
<td>5 day</td>
<td>FEMA (State/Local EOC)</td>
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<td></td>
<td>Government Building Damage</td>
<td>Point</td>
<td>5 day</td>
<td>FEMA (State/Local EOC)</td>
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<td>Residential Building Damage</td>
<td>Point</td>
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<td>Road Damage</td>
<td>Polyline</td>
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<td>Damaged Areas (Report Derived)</td>
<td>Polyline</td>
<td>3 day</td>
<td>FEMA, IOC, State</td>
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<tr>
<td></td>
<td>Earthquake Damage-Field Reported Liquefaction</td>
<td>Polyline</td>
<td>48 hour</td>
<td>USGS</td>
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<tr>
<td></td>
<td>Earthquake Damage-Field Reports</td>
<td>Polyline</td>
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<td>USGS</td>
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<td>Earthquake Damage-Reported (Did you feel it)</td>
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<td>Earthquake Impact-Measured (MMI)</td>
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<td>FEMA IMAT Reports</td>
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<td>High Water Depth</td>
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<td>Red Cross Inspections</td>
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<td>ARC</td>
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<td>Red/Yellow Tag Reports</td>
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<td>Wildfire Damage-Field Reports</td>
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### Table 3-24: Authoritative Data - Response Mission - SAR

<table>
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<tr>
<th>Sub Category</th>
<th>Theme</th>
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<td>Emergency Management</td>
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<td>Emergency Resources</td>
<td>Mobile Food - Mobile Commissary</td>
<td>Point</td>
<td>48 hour</td>
<td>DOI/NIFC</td>
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<td>Mobile Food Unit - Mobileized Locations</td>
<td>Point</td>
<td>24 hour</td>
<td>DOI/NIFC</td>
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<tr>
<td></td>
<td>FEMA US&amp;R Search Targets</td>
<td>Point</td>
<td>24 hour</td>
<td>FEMA</td>
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<td></td>
<td>FEMA US&amp;R Unsafe Areas</td>
<td>Point</td>
<td>24 hour</td>
<td>FEMA</td>
</tr>
<tr>
<td></td>
<td>FEMA US&amp;R Equipment Cache Locations</td>
<td>Point</td>
<td>Immediate</td>
<td>FEMA</td>
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<tr>
<td></td>
<td>Mobile Shower Facilities</td>
<td>Point</td>
<td>24 hour</td>
<td>DOI/NIFC</td>
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### Table 3-22: Authoritative Data - Recovery Mission - Individual Assistance

<table>
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<th>Sub Category</th>
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<td>FEMA IA</td>
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<td>FEMA IA Expedited Assistance Areas</td>
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### Table 3-23: Field Operating Locations

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<td>Area Command/Unified Area Command Post</td>
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<tr>
<td></td>
<td>Incident Command Post (ICP)</td>
<td>Point</td>
<td>24 hour</td>
<td>FEMA</td>
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<tr>
<td></td>
<td>Disaster Medical Assistance Team (DMAT)</td>
<td>Point</td>
<td>48 hour</td>
<td>FEMA</td>
</tr>
<tr>
<td></td>
<td>FEMA Incident Management Assistance Team (IMAT)</td>
<td>Point</td>
<td>24 hour</td>
<td>FEMA</td>
</tr>
<tr>
<td></td>
<td>FEMA US&amp;R Canine Teams</td>
<td>Point</td>
<td>3 day</td>
<td>FEMA</td>
</tr>
<tr>
<td></td>
<td>FEMA US&amp;R Incident Support Teams</td>
<td>Point</td>
<td>24 hour</td>
<td>FEMA</td>
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<tr>
<td></td>
<td>FEMA US&amp;R Teams (Deployed)</td>
<td>Point</td>
<td>24 hour</td>
<td>FEMA</td>
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<tr>
<td></td>
<td>Incident Management Teams (MTs)</td>
<td>Point</td>
<td>24 hour</td>
<td>FEMA</td>
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<tr>
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<td>USCG Strike Teams</td>
<td>Point</td>
<td>24 hour</td>
<td>USCG</td>
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<td>DoD WMD-Civil Support Team Deployed Location</td>
<td>Point</td>
<td>48 hour</td>
<td>DoD/USACE</td>
</tr>
<tr>
<td></td>
<td>USAEC Planning &amp; Response Teams (PRTS)</td>
<td>Point</td>
<td>48 hour</td>
<td>DoD/USACE</td>
</tr>
<tr>
<td></td>
<td>Other Federal EPA Environmental Response Team (ERT)</td>
<td>Point</td>
<td>24 hour</td>
<td>EPA</td>
</tr>
</tbody>
</table>

**Incident Information Requirement**

**Geospatial Information Representation**
One Specific Information Requirement
Supported by the Clearinghouse

Table 2-5: Authoritative Data - Damage Assessment Mission - Ground Truth

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<td>Damage - Infrastructure</td>
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<td>Road Damage</td>
<td>Polyline</td>
<td>24 hour</td>
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<tr>
<td></td>
<td>Damaged Areas (Report Derived)</td>
<td>Polygon</td>
<td>3 day</td>
<td>FEMA, JOC, State</td>
</tr>
<tr>
<td></td>
<td>Earthquake Damage-Fiel d Reported Liquefaction</td>
<td>Polygon</td>
<td>48 hour</td>
<td>USGS</td>
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Table 3-24: Authoritative Data - Response Mission - SAR

<table>
<thead>
<tr>
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<th>Theme</th>
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<td>Mobile Food Commissary - Mobilized Locations</td>
<td>Point</td>
<td>48 hour</td>
<td>DOI/NIFC</td>
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<td></td>
<td>Mobile Food Unit - Mobilized Locations</td>
<td>Point</td>
<td>24 hour</td>
<td>DOI/NIFC</td>
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<td>Emergency Services</td>
<td>FEMA SAR Metrics</td>
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<td>3 day</td>
<td>FEMA</td>
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<td>FEMA SAR Recovery</td>
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<td>FEMA</td>
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<td>FEMA SAR Rescues</td>
<td>Point</td>
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<td>FEMA SAR Temporary Landing Zones</td>
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<td>48 hour</td>
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<td>Earthquake Damage-Fiel d Reported Liquefaction</td>
<td>Polygon</td>
<td>48 hour</td>
<td>USGS</td>
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Table 3-22: Authoritative Data - Recovery Mission - Individual Assistance

<table>
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<tr>
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<tr>
<td>Emergency Management</td>
<td>FEMA IA Applicants</td>
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<td>48 hour</td>
<td>FEMA IA</td>
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<td>FEMA IA Expedited Assistance Areas</td>
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<td>FEMA IA</td>
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<tr>
<td>Specialized Response Teams</td>
<td>DHS</td>
<td>FEMA Damage Assessment Teams</td>
<td>Point</td>
<td>48 hour</td>
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Table 3-23: Authoritative Data - Specialized Response Teams

<table>
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<tr>
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<td>Point</td>
<td>48 hour</td>
<td>NGB (DFHQSTATE)</td>
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<td>Other Federal Agency</td>
<td>EPA Environmental Response Team (ERT)</td>
<td>Point</td>
<td>24 hour</td>
<td>EPA</td>
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<td></td>
<td>Mine Rescue Teams</td>
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<td>MSHA/MEO</td>
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<td>Specialized Response Teams</td>
<td>USACE Planning &amp; Response Teams (PRTS)</td>
<td>Point</td>
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<td>USACE</td>
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<td></td>
<td>Disaster Medical Assistance Team (DMAT) Locations</td>
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<td>FEMA</td>
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<td></td>
<td>FEMA Incident Management Assistance Team (IMAT)</td>
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<td>24 hour</td>
<td>FEMA</td>
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<td>FEMA US&amp;R Canine Teams</td>
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<td>FEMA</td>
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<td>FEMA US&amp;R Incident Support Teams</td>
<td>Point</td>
<td>24 hour</td>
<td>FEMA</td>
</tr>
<tr>
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<td>FEMA US&amp;R Teams (Deployed)</td>
<td>Point</td>
<td>24 hour</td>
<td>FEMA</td>
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<td>Incident Management Teams (BMTs) Federal Type 1 and Type 2</td>
<td>Point</td>
<td>48 hour</td>
<td>FEMA</td>
</tr>
<tr>
<td></td>
<td>USCG Strike Teams</td>
<td>Point</td>
<td>24 hour</td>
<td>DHS/USCG</td>
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</table>
Clearinghouse People and Technologies Make a BIG Difference

Real-time initial and continuing ground truth in

MINUTES not hours through the Virtual Clearinghouse built on XchangeCore

Available to all XchangeCore-connected applications – for both geospatial and incident information
Field Observations with Science, Photos, Text, Video, all in Five Minutes or Less

XchangeCore and SpotOnResponse Mobile App Team with Many Other Applications

Products of Static GIS, Sensors, Models appear in the California Earthquake Clearinghouse Mobile App as INSTRUCTIONS for Self-Directed Observations

A Huge Team of Scientists, Engineers, and Responders Trained by the California Earthquake Clearinghouse Use the Earth Science Information to Provide Field Observations to Produce Real-Time, Location-Based Empirical Measures and Damage Assessment

www.XchangeCore.org
Take-Away Message: XchangeCore Information Exchange for the Whole Community

- **Enables Exchange**: Transforms data into national standards
- **Assures Currency**: Notifies all applications of new or updated data
- **Provides Security**: Authenticates application to the XchangeCore Core
- **Delivers Collaboration**: Two-way exchange among Whole Community diverse applications
- **Manages Content**: Coordinates all Common Operational Data around a relevant incident so there is just one place to look for everything
- **No New End-User Software**: No training, existing applications, DHS paid
- **Available Now**
Contact

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