Geospatial Information System (GIS) Research at EPRI 2011-2015

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Technical Executive

ICT Informational Webcast
May 28, 2015
Agenda

2011
- Monetizing the GIS

2012
- GIS Data Dependencies
  - Field Force Data Visualization
  - GIS as a Wide Area Situational Awareness Platform
  - DER Integration
  - Conflation

2013
- Social Media in Support of Outage Management
- Automated AG Asset Identification

2014
- GIS Data Guidebook
- “Red Button”
- Automated AG Asset Identification

2015
- Accelerating AR
- DMD – GIS Data Correction
- “Red Button”
- Automated AG Asset Identification
## EPRI Jargon

<table>
<thead>
<tr>
<th>“What you heard”</th>
<th>“What we meant”</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Program 161” or “161”</td>
<td>Information and Communication Technology Program</td>
</tr>
<tr>
<td>“161C”</td>
<td>Information and Communication Technology for Distribution</td>
</tr>
<tr>
<td>“174”</td>
<td>Renewable Integration Program</td>
</tr>
<tr>
<td>“Base” or “Base Project”</td>
<td>Part of the ARP or regularly scheduled research</td>
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<tr>
<td>“ARP”</td>
<td>Annual Research Portfolio – Catalog of future base projects</td>
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<tr>
<td>“Supplemental” or “Supplemental Project”</td>
<td>Ad hoc, utility directed project.</td>
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<td>“Product ID”</td>
<td>Basically, a part number for a report you can order.</td>
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<tr>
<td>“TI”</td>
<td>Technology Innovation Program – long term, risky research</td>
</tr>
<tr>
<td>“AR”</td>
<td>Augmented Reality</td>
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<tr>
<td>“DMD”</td>
<td>Distribution Modernization Demonstration Project – a large supplemental</td>
</tr>
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2010 - Distribution Research Area Strategic Plan
  – John Tripolitis
  – Matt Olearczyk

Reviewed the document section by section

Looked for ways to fill gaps via standards or data management

“Hey, I can help that!”
## 2011- Past GIS Research & Coordination

<table>
<thead>
<tr>
<th>Gap</th>
<th>Description</th>
<th>Distribution Research Area Strategic Plan Reference</th>
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</table>
| Incomplete IEC 61968 Data Model, Profiles and Messages | Missing parts of the CIM model  
- CIM for DER integration  
- CIM to EV infrastructure  
- Distribution Contingency Analysis (DCA)  
- Multi-level Feeder Reconfiguration (MFR)  
- Relay Protection Re-coordination (RPRC)  
- Pre-arming of Remedial Action Schemes (PRAS)  
- Coordination of Emergency Actions (CEmA)  
- Coordination of Restorative Actions (CRA)  
- Intelligent Alarm Processing (IAP)  
- Weather data  
- Plenty of unknown parts that will only become apparent with time. | 5 b-e.  
7 d.  
8 c.  
11 c.  
13 a.  
16 i.  
17 b.  
18 c.  
18 e. |
| Incomplete and Inaccurate GIS Data | Incomplete and inaccurate data make DER integration impossible.  
Incomplete and inaccurate data make DMS less useful.  
Incomplete and inaccurate data make OMS less useful.  
Incomplete and inaccurate data make power flow calculations incorrect.  
Business processes need to be modernized to take advantage of new technology. | 3 f.  
7 a-c.  
7 e-j.  
11 k.  
13 d.  
14 a.  
14 h-i.  
16 a.  
16 c.  
16 i.  
17 b.  
19 a.  
19 e. |
| Poor visualization of distribution system data in the control center | Reliance on institutional knowledge instead of technology has created a looming personnel crisis.  
DSO will have access to more information than before. They need to be able to process it.  
Depending on the utility, DSOs will have access to different information and have varying abilities to act on it. | 11 a-k.  
12 a-c.  
12 g.  
13 b-c.  
16 a-b.  
16 i.  
17 b. |
| Poor visualization of distribution system data in the field | Technical barrier to field personnel having access to all the back office data need to be removed.  
Interactive applications to increase efficiency and decrease dependence on institutional knowledge need to be developed.  
Tools need to be developed to determine GIS data accuracy and storm assessment.  
Staking and GIS red-lining tools need improvement.  
Maintenance crews would benefit from the ability to identify assets, access 3-D renditions of equipment and have SOPs at their fingertips.  
GIS, asset management, inventory management and work management need to be integrated in the field.  
Business process and workflows to take advantage of the advances in technology need to be developed. | 11 a-k.  
12 a-c.  
12 f.  
13 c.  
16 a-b.  
16 i.  
17 b. |
GIS Research Goals

- How good does data need to be?
- What are the impacts of bad data across the enterprise?
- How can a utility assess a financial cost due to bad GIS data?
- How can a utility complete/correct data cheaply and regularly?
- What options exist for reconciliation and maintenance of data?
Monetizing the GIS

GIS Data Dependencies

Field Force Data Visualization

GIS as a Wide Area Situational Awareness Platform

Field Force Data Visualization

DER Integration

GIS Data Guidebook

“Red Button”

Conflation

DMD – GIS Data Correction

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Accelerating AR

DER Integration

2011

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2014

2015
2012 - Base GIS Research


- Should we do this or not?
- Need a case example!
2013 - Base GIS Research

Past GIS Research & Coordination

Enterprise Integration Bus

- GIS to fault location
- GIS to network operations
- GIS to network calculations
- GIS to network control

- GIS to customer account management
- GIS to meter data management
- GIS to asset investment planning
- Customer account management to GIS
- GIS to maintenance and construction

2013 Supplemental - Field Force Data Visualization

- CIM Messages
- Augmented Reality
- GIS context awareness
2013 Supplemental - Field Force Data Visualization
Example of Functionality
2013 Supplemental - Field Force Data Visualization
Augmented Reality in Action
2013 TI - Artificial Intelligence – Image Analysis

- Using neural network technology
- University of New Mexico
- Image analysis from a variety of sources
- Used to correct or complete GIS and asset information
  - Location
  - Type
2013 TI - Artificial Intelligence – Image Analysis

- Long-term
  - Revenue recovery
  - Automatic storm damage assessment

- Short-term
  - GIS correction
  - Conflation

![Diagram showing GIS positions and conflation](image-url)
2013 - Social Media in Support of Outage Management

- Integrating Social Media with Outage Management and Customer Relationship Management
- Providing consistent status reports to stakeholders.

3002002280 – Social Media In Support of Outage Management
2014 Base - GIS as a Situational Awareness Platform

- **Historical** look at situational awareness
- Wide area situational awareness in network operations **today**
- **Challenges** reaping the full benefits of GIS
- **Importance** of GIS as a situational awareness platform
- Innovative uses of GIS (Case studies)
2014 Base - GIS as a Situational Awareness Platform

TODAY

- Sensors
- Augmented Reality
- Social Media
- Weather Prediction
- Advanced Imaging
Data Storage

• Systems Overview
• Asset Data Organization

Data Management & Integration

• QC/QA Techniques
• Statistically Calculating Quality
• Data Quality Migration
• Maintenance Processes and Performance
• Data Dependencies
Problem Statement

• Means to effectively integrate smart inverters with SCADA, DMS and other utility applications were not well defined

• The standardized smart Inverter functions were not deemed appropriate by DMS makers, who required, simpler, group-based management
2014 Collaboration with P174 - Enterprise Integration of DER

Forecast MidPoints for Maximum Capability
Forecast Uncertainty Factor for Maximum Capability

Enterprise Integration (e.g. CIM MultiSpeak)

MDMS  OMS  WMS  Others
DMS  GIS  DERMS  DRAS

Meters, Switches, Capacitors, Regulators

SOLAR  BATTERY  PEV
2014 Collaboration with P174 - Enterprise Integration of

- **November Workshop at NREL**
  - Test 1 - DER Group Creation
  - Test 2 - Querying a DER group
  - Test 3 - Adding DER to a group
  - Test 4 - Removing a DER from a group
  - Test 5 - DER Group deletion
  - Test 6 - DER Group Status Monitoring
  - Test 7 - DER Group Capabilities Discovery
  - Test 8 - DER Group Dispatch
  - Test 9 - DER Forecasting
2014 - “One Source of Truth”

- Outage Data Initiative – Red Button
- Meetings through 2014
- DistribuTECH 2015

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Social Media in Support of Outage Management

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2015 DMD - GIS Data Improvement

- **Objectives and Scope**
  - Identify potential data cleanup algorithms
    - Define the data sources and processing requirements necessary to make them fast and effective.
  - Vet the demo project(s)
    - Propose demo to DMD
    - Phone interview with utilities to understand their existing challenges and thoughts on the subject.
    - Bad legacy data cleaning vs starting new.
    - Impact of high performance computing.
  - Deliverable: One chapter in Data Practice/Technology Book.
  - Project completion: Q3 2015
2015 - Accelerating Augmented Reality for the Electricity Industry

- **Objective and Scope:**
  - Bring together technology developers and electric utilities to accelerate availability of new AR solutions for electricity sector;
  - Provide a first demonstration of vendor products; and
  - Leave participants with a clear understanding of the value of augmented reality for utility applications.

- **Why:**
  - Utilities should define the direction of technology that is being applied to their problems.
  - Realistic, monetized, benefits of AR need to be determined for technology adoption.

- **Approach:**
  - Match participants up with vendor of their choice.
  - Identify measurable use cases for testing.
  - Vendors create the software.
  - EPRI measures any productivity or accuracy gains (or losses).
Objective and Scope:
- Create a detailed CIM message for emergency services, based on the 2014 work, to keep them informed on outages.
- Message to be man-readable as well as plot-able on wide area situational awareness (WASA) platform.
- Messages to be displayed on wearable computers and personal protective equipment (PPE).

Why:
- Emergency services need more detailed information on outages – down to the neighborhood or house level.
- Messages need to be able to be used with numerous WASA platforms.
Objective and Scope:
- Use techniques developed in TI project on real, utility data.
- Can this technology be used for:
  - Street-light cataloging.
  - Dual use cataloging.
  - Conflation reconciliation.

Why:
- Low hanging fruit provides economic incentives for GIS data projects.
- Considerable revenue is being lost by not having a good catalog of pole use.
- Complete/correct bad GIS data (equipment, connectivity, etc.).
- Reduce back-log of “as built” data.
Together...Shaping the Future of Electricity