Mobile Data Collection Solutions for AEC

Implementations of ArcGIS Collector and other mobile tools in support of AEC workflows

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Introduction/Background

Ian Sleeper

- Geospatial Engineer at Terracon
- Past experience at NHDOT Bureau of Planning and Community Assistance (GIS Department)
- B.S. Civil Engineering, University of New Hampshire 2015

Terracon

- Based in Olathe, KS
- Over 3500 employees in over 130 offices nationwide
- Geotechnical, Environmental, Facilities, and Construction Materials and Testing Services
- Ranked 32nd in ENR 2016 Top 500 Design Firms in USA
- Geodataworks (GIS Department) based in Portsmouth, NH
  - Full-time GIS staff: five
Additional Challenges

- **Workflow**
  - Most field staff aren’t GIS users
  - Many offices don’t have ArcMap or someone to run it

- **Accuracy Requirements**

- **Scheduling**

- **Buy In**
Life Before Collector/AGO

- Paper forms, field notes, scanned sketches
- Rented Trimble units
- Recreational GPS
- Ad-hoc Google Earth photologs

Users were alone in the wasteland, without support, left to their disconnected devices…

What do you mean “unable to load custom data dictionary…”?

Mad Max: Fury Road
Problems with the Good Old Fashioned Way

- Data Management
  - Different data architecture for each job
  - Data kept in silos
  - Disparate file formats for similar datasets

- Workflow/Efficiency
  - Repetitive efforts
  - Underutilized expertise across organization
  - Reference data difficult to implement
  - Timeliness of data delivery

- Data Quality
  - Human Error
  - Accuracy
Solution: ArcGIS Collector

- Use any iOS or Android mobile device (or Windows Mobile...)
- Easy implementation anywhere in the world
- Collaborative/versioned
- Easy to incorporate reference layers (including thousands available on ArcGIS Online)
- Synced to cloud (no lost efforts from wet field notes)
- Simple workflow
Starting Simple

- Most common field data collection task: geotechnical soil borings

- MVP: minimum viable product
  - Basic attributes only
  - Domain for boring types to provide drop-down
There's more where that came from…

1. Create a simple feature service that accomplishes a common task
2. Publish it with the word "TEMPLATE" in the title
3. Use the *create from existing layer* function in ArcGIS Online to make a clean copy for each project that needs the service

Esri also has many templates available in ArcGIS Online to suit a myriad of workflows.
Case Studies
Case Study 1: Industrial Retention
Lagoon Inspections

- Original request was for assistance in making a map of geotagged photos from a single inspection event
- Field staff was using a paper form and a GPS-enabled point-and-shoot
- Mentioned needing assistance on same task for more facilities as part of the same job
- Extracted locations from photos, created point feature class, attached photos in FGDB, added a couple attributes for field notes, served to ArcGIS Online

- Implemented Collector for remaining seven facilities across the US

- Delivered project via Story Map (tabbed layout), allowing parallel presentation of narrative and photo log
Case Study 2: Pipeline Geohazard Aerial Survey

- Pipeline corridor through active landslide terrain (Appalachia)
- Helicopter survey to identify three types of geohazard:
  1. Landslide Hazards
  2. Subsidence (Settlement/Sinkhole) Hazards
  3. Water Hazards (Erosion/Inundation)
- Several subtypes for each class
Case Study 2: Pipeline Geohazard Aerial Survey

- Field staff was experienced GIS user
- Assisted in setting up domains and reference layers
- Used Collector offline on iPad
Back in the office, aerial observations and photos used to identify areas of special concern

Developed scan lines for field investigation by comparing aerial observations to Terracon’s landslide hazard raster model
Aerial feature service used as template for scan line collection

(Photo from scan line observation, showing tumbled rock and bent and fallen trees due to slope movement)
Case Study 3: School District Infrastructure Asset Inventory and Assessment

- Katy Independent School District: Katy, Texas
- 63 schools (enrollment ~70,000 K-12) in Houston metro
- Requested tabular inventory of all light poles, bleachers, and basketball hoops, with some kind of geo-location
- Preference awarded to innovative proposals
Asset Inventory and Assessment: Our Process

- Pre-inventory prep/planning
- Database setup and proof checking
- Preliminary desktop inventory of outdoor assets
- A 1-day visit to Houston for on-site training of field staff
- Field inventory of indoor asset locations and indoor/outdoor asset attributes using Collector
- QA/QC using ArcGIS Pro
- Delivery via web mapping application
Pre-Inventory Planning Prep

- Needed to create a feature class of facilities
- Georeferenced a PDF map provided by district to rough-in locations, refined using aerial imagery/Google Maps
Local facilities experts pulled from old inventory forms, client requests, and field experience to create attribute lists and drop-down options.
Database Design

Asset Attributes
- Permanent attributes of a given asset
  - E.g. Asset ID, Facility Name, General Location, Physical Dim
- Collect only once
- Stored in asset feature class attribute table
- Many coded value domains

Assessment Attributes
- Condition Attributes
  - Overall
  - Individual Component Systems
- One coded value domain
  - Good, Fair, Poor
- Standalone table, tied to asset using relationship class in FGDB
  - One-to-Many relationship for recurring inspections (time or maintenance driven)
Database Design/Setup Tips

- Plan everything out beforehand
  - Field names, aliases, types, domain types, domain codes and values
  - I used Excel

- Use ArcGIS Pro (GASP!) to design the database
  - Simpler interface
  - Streamlined domain creation

- Use ArcCatalog to setup the relationships
  - At the time, capability was not accessible in ArcGIS Pro
  - Need ArcGIS Standard or Advanced to author relationship classes
Preliminary Desktop Inventory

- Published feature service of facilities, light pole assets, bleacher assets, and basketball goal assets, along with respective assessment tables to ArcGIS Online
- Added hosted feature service to ArcGIS Pro map, edited features using Pro instead of in AGO
  - Created an editor web application in ArcGIS Online using WebApp Builder to facilitate collaboration with Houston technical staff
- Assets identified using aerial orthoimagery from Bing, Esri, and Pictometry, and oblique imagery from Pictometry
- Light pole heights measured using Pictometry ConnectExplorer web application
Editor Web Application
Collector for Field Inventory

- Update outdoor asset attributes
- Collect locations for indoor assets by drawing on map (no GPS indoors), then catalog attributes
Collector for Assessments

Bleacher Condition Assessment: LSD-FMHS-FOOTBALL-B-5 (Good - Average to above-average condition for the building system or materials assessed, with consideration of its age, design, and geographical location. Generally, other than normal maintenance, no work is recommended or required.
- 9/20/2017 2:09 PM)

Asset Identifier
LSD-FMHS-FOOTBALL-B-5

Assessment Date
9/20/2017 2:00 PM

Overall Condition of Asset
Good - Average to above-average condition for the building system or materials assessed, with consideration of its age, design, and geographical location. Generally, other than normal maintenance, no work is recommended or required.

Structure/Frame Condition

Structure/Frame Coating Condition

Seating Area Condition
Good - Average to above-average condition for the building system or materials assessed, with consideration of its age, design, and geographical location. Generally, other than normal maintenance, no work is recommended
Delivery via Web App
Hurricane Harvey Before
Hurricane Harvey After
Final Takeaways

- Empower your users: a reusable template that accomplishes a common task will make their job easier – that makes your job easier

- Collector is the most map-centric platform for mobile data collection
  - Survey123 (Esri) has more form options and is configurable via Excel, but lacks a robust map function
  - Fulcrum (Fulcrum) bridges the gap between the power of Collector’s mapping/data architecture and the flexibility and ease-of-setup of Survey123. It lacks the connectivity of Esri products and it is harder to silo data by project (silos by “form”), but is a strong candidate for municipal work or one-off tasks

- Collector can be as simple or as complex as you make it
  - Relational data structure, diverse basemap and reference layer abilities, quick deployment
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