Conventional wisdom be damned

A data manager explains why experience trumps cheap labor during asset inventories.

Conventional wisdom has promoted the myth that high-quality asset inventories can be completed using entry-level personnel. This is categorically incorrect. Experience is the more cost-effective option — people that know their data can do the work more accurately, much faster, and (in terms of quality and productivity) way cheaper.

Recently, I took over an asset inventory project that had been implemented using summer interns. I applaud efforts to pinch pennies in these tight economic times, but I would never want to manage a project like this without the involvement of experienced land surveyors.

In April 2008, three college interns and one brand-new city employee were tasked to locate, identify, and evaluate the condition of all surface utility structures within the more than 400 miles of dedicated bike lanes and major arterials of Seattle. None were familiar with the features they were inventorying, the bicycle network and city neighborhoods in which they worked, or the GPS equipment they used.

Although GPS gear is easy to use, getting location coordinates is only one of the attributes collected for an asset inventory. Finding, identifying, and characterizing surface utility features — manholes, inlets, gate valves, etc. — in a complete, correct, and consistent fashion takes training and experience. Several months and $25,000 later, only a fraction of the city's utilities within the bike lanes and arterials were inventoried, and the resulting data was in shambles.

It was at this point that the project came to me, with only seven weeks left to complete it. I was assigned two inexperienced engineering technicians who would work as one full-time equivalent, and two experienced in-house surveyors. I also hired two private-sector surveyors — though it took three weeks to navigate the paperwork to get them contracted and on the job.

A code for everything

Guided by a data dictionary, field crews assigned the following attributes to utility features located along Seattle's streets and bike lanes:

- Bike lane type (using five two-letter codes)
- Utility feature type (standard city land surveying descriptor codes)
- Grate style (17 styles; each identified by a one-letter code)
- Grate dimension (radius or width x length)
- Grate condition (seven two-letter codes, default G for good)
- Comments (sparingly used)

Additionally, the GeoXH GIS handheld data collection units automatically assigned:

- Point number I.D.
- Northing & easting coordinates
- Date and time

After the information was downloaded from the GeoXH units, the data manager assigned:

- Unique point number I.D.
- Picture number to coincide with point number I.D.
- Suffixes to the bike lane type attribute that identify points within a crosswalk, wheelchair ramp, or in the curb return: -X, -W, -C, respectively.

To collect and log location, size, condition, and other data on this manhole, Field Technician Leo Asuan uses a Trimble GeoXH unit, which is equipped with a Zephyr antenna and 6-foot antenna for improved spatial accuracy. Photo: Karen Zollman

DATA CHALLENGES

To properly identify and describe the state of utility structures I first needed to create a data schema — or data dictionary — which defines the features to be located, the attributes used to describe each feature, and the valid values (a range of characters or numbers indicating type, condition, etc.) allowed for each attribute. Once

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completed, the schema was loaded into a Trimble handheld GeoXH GIS data collection unit.

I also supplied each field person with a users manual explaining the operation of the unit, the five attributes to be captured, and the valid values associated with each attribute. None of the staff were familiar with data schemas; however, the land surveyors were accustomed to using descriptor codes to describe features.

After mobilizing the equipment and crews, the next challenge was to review the interns' data to figure out what areas had been completed.

I was given a file that was supposed to contain all data collected in the 2008 inventory. After more than 60 hours of trying to normalize the data into a coherent schema I realized that a lot of data was missing. I combed through all of the files I could find, scattered on three servers, and came up with nearly twice the data I had been given originally. After formatting the new data to match my schema, I found that several data sets had been saved under different names and therefore had been entered twice. Sometimes the duplicate data sets represented the same data, and sometimes the information was different. I had to make a lot of assumptions to decide which data to keep.

BOTTOM LINE

I used the two engineering technicians as my control group to evaluate how their work compared to the 2008 interns' work, as well as the 2009 land surveyors' work. The following elements were reviewed:

- Productivity
- Accuracy
- Completeness
- Correctness.

Of the three teams, the land surveyors decisively led in each of these categories.

Interns: To be fair, the students didn't receive the same level of management as the other groups. To be realistic, even if they had, they probably would have needed substantially more direction. They didn't understand the functions or typical locations of features they were collecting — since they've never even opened manholes, catch basins, or inlets before — nor were they able to clearly distinguish a maintenance hole from a water or gas valve. Their data was erratic, and because they didn't take pictures, we couldn't evaluate the correctness of attributes.

Engineering technicians: This group improved slowly but surely in all categories. However, their productivity rarely exceeded one-third the output of the land surveyors, and their data typically took three times longer to process because of missing data or mismatched pictures. One of the drawbacks of the GeoXH unit is that when downloading to shape file format, it changes the file name to the generic "DESCRIP.shp," which opens up risks of writing over previous downloads. I couldn't trust the technicians to download the data without overriding files, as they routinely forgot to

download their cameras and file the pictures using the proper date format — a constant source of frustration, since the data could not be checked in a timely manner without the pictures.

Land surveyors: Each surveyor raced up the learning curve and achieved a thorough understanding of the project — and each contributed improvements to in-the-field data-collection processes. Mind-numbingly systematic, even their errors tended to be methodical, making inaccuracies easier to catch and correct. More importantly, they maintained safety, high productivity, and high data quality even when working in rights of way, adverse weather conditions, and heavy traffic areas.

Category	2008 Intern data	2009 Surveyor/engineering technician data
Features located	1,610	9,929
Features attributed	80%	100%
Attribute correctness	Unknown	99%
Spatial accuracy	66%	99%
Features photographed	0	99.5%
Field days	190+	84
Features captured/day	8.5	118
Cost-effectiveness	8.5/day/person	118/day/person

The surveyor and engineering technician teams correctly located, attributed, and photographed nearly 10,000 utility structures in 25 working days. The interns only located roughly 1,600 in four months. Although the cost of the four full-time and two part-time staff members in 2009 had been slightly more than twice the cost of the four less-qualified full-time staff members in 2008, the productivity was nearly 14 times better. And the quality of the data was exponentially better. Source: Karen Zollman

In my experience, surveyors' linear natures produce the highest-quality data results. In addition to this project, I have managed environmental assessment inventories that paired surveyors with biologists. Again, the biologist/surveyor assessment teams were more productive and their data was more complete and consistent than the biologist teams without surveyors. This was also the case when I managed an electrical equipment inventory that paired surveyors with electrical linemen to identify equipment on utility poles.

I hope decision-makers will appreciate the real advantages of using land surveyors, along with a skilled data manager, to plan and implement their asset inventory projects. Listening only to the conventional wisdom about asset inventories can create a lot of expensive, bad data. **PW**

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