TROUBLESHOOTING YOUR CAMA DATA WITH GIS

Abstract: Computer Assisted Mass Appraisal (CAMA) databases are used by practically every government entity that collects property taxes. CAMA databases typically contain an enormous amount of data, and for this reason alone they often contain incorrect information in one form or another that can result in lost tax revenue to one or more entities. By merging a CAMA database with a Geographic Information System (GIS) parcel coverage, a tax appraiser or GIS technician can visualize the CAMA data in a way that was never before possible. Visualizing the CAMA data in the form of maps makes many of the mistakes contained within that database blatantly obvious.

Keywords: Geographic Information Systems, GIS, Computer Assisted Mass Appraisal, CAMA, Thematic Mapping, Aerial Photography Masking, Data Troubleshooting

INTRODUCTION

Most county and city governments throughout the United States collect property taxes to support their operations and services. To assist in the process of appraising real property to determine market value and thus taxes due, most tax assessor offices use a computer-based appraising application / program and a CAMA database. While CAMA database designs vary dramatically, the contents are basically the same since the final objective, determining property value, is shared by all.
To accomplish the task of appraising property, a wealth of information must be collected and entered into a CAMA database, thereby presenting many opportunities for mistakes to be made. By merging a CAMA database with a GIS parcel coverage, a tax appraiser or GIS technician can visualize the CAMA data in a way that was never before possible. Inherent to the process of visualizing the CAMA database is the ability to reveal many of the mistakes concealed within it. In many cases the mistakes found can result in significant tax revenue gains, thereby helping to justify the initial GIS development costs and ongoing maintenance.

PROCEDURES AND TERMINOLOGY

Though the practice of using GIS to identify potential errors within a CAMA database are not exclusive to any particular GIS software product, this paper is being written via the use of some ESRI specific terms. Some GIS terms are universal while others may have slightly different meanings depending on the context of the software being used. All of the troubleshooting and analysis work described in the remainder of this paper was done with ArcView 3.2 software, while the data was actually created using ArcInfo. All of the procedures described will work with either ArcInfo coverages or ESRI shapefiles and therefore the term “GIS parcel coverage” will be used to describe both. However, when the term “GIS parcel table” is used, one must understand that, for shapefiles, this refers to a table named covername.dbf, and if an ArcInfo coverage is being used it refers to covername.pat (polygons) or covername.rat (regions).

ERRORS OF OMISSION

The most costly error that can be made in a CAMA database is an error of omission of an entire parcel. In some instances a parcel subdivision will be recorded on the tax maps, but for whatever reason, will be accidentally excluded from entry into the CAMA database and therefore a tax bill will never be generated. Since most CAMA databases should contain at least one record for each parcel shown on their tax maps, and each parcel has a unique identifier, errors of omission can be quickly found by joining the appropriate CAMA database table (source table) to the GIS parcel table (destination table). The join is established via the unique identifier (parcel-id or pid for short). After the join is established parcels without a matching record in the CAMA database become blatantly obvious (see illustration 1).
ILLUSTRATION 1
JOINING A CAMA TABLE TO A GIS PARCEL TABLE

GIS PARCEL TABLE
covername.dbf (shapefiles)
or covername.pat (poly coverage)
or covername.rat (region coverage)

CAMA TABLE (containing all unique pids)

<table>
<thead>
<tr>
<th>cover-id</th>
<th>area</th>
<th>pid</th>
<th>owner</th>
<th>address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>983,456</td>
<td>001-123-1</td>
<td>Smith, J.</td>
<td>123 Jim St</td>
</tr>
<tr>
<td>2</td>
<td>68,438</td>
<td>001-123-2</td>
<td>Jones, A.</td>
<td>456 Joe Av</td>
</tr>
<tr>
<td>3</td>
<td>123,698</td>
<td>001-123-4</td>
<td>Adams, K</td>
<td>357 Mag St</td>
</tr>
</tbody>
</table>

Notice: pid 001-123-3 (destination table) does not have a corresponding record in the CAMA table (source table) and therefore does not list an owner after the tables are joined.

In the example above a CAMA database table was joined to the GIS parcel table to find errors of omission in the CAMA database. To find errors of omission in the GIS parcel coverage, simply perform the join in the opposite direction by making the CAMA table the destination table and the parcel GIS table the source table. By joining the GIS parcel table to the appropriate CAMA database table you can quickly find CAMA records that do not have a matching record in the GIS parcel coverage.

THEMATIC MAPPING

Thematic mapping is the process whereby features (parcels) can be grouped and displayed based on a common attribute(s). Many data items within a CAMA database lend themselves to being mapped thematically after they are joined to a GIS parcel coverage.

In most CAMA databases found in Georgia, a taxdistrict column will contain a code, which dictates the millage rate that is applied to an assessment. Different parts of a county will have different taxation rates depending upon whether it is a special assessment area, unincorporated, or incorporated portion of the county. In most cases a thematic map created upon the taxdistrict attribute of parcels will result in a single color for the majority of the county (unincorporated) and different colors for each municipality (incorporated) or special assessment area within the county. Anomalies in the pattern usually result from a parcel within one of the incorporated or special districts being mistakenly assigned the general county (unincorporated) taxdistrict code. The
mistake is extremely difficult to find without the use of GIS and results in lost tax revenue for one or more levying authorities.

**ILLUSTRATION 2**  
**THEMATIC MAPPING BY TAX DISTRICT (UNIQUE VALUE)**

In the illustration above one parcel was incorrectly assigned to tax district 1, resulting in lost tax revenue for the City of Watkinsville.

**HOUSE GRADE**

In Georgia, house grade is a factor which greatly affects appraised value. A grade of 1.0 is average with values of 0.50 to 1.50 being common. Thematic mapping allows you to group parcels based on a range of values and control their display. By creating groups such as those shown below, patterns become visible.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 &lt; Grade &lt; 0.5</td>
<td>Green</td>
</tr>
<tr>
<td>0.5 ? Grade &lt; 0.7</td>
<td>Blue</td>
</tr>
<tr>
<td>0.7 ? Grade &lt; 0.9</td>
<td>Red</td>
</tr>
<tr>
<td>0.9 ? Grade &lt; 1.1</td>
<td>Cyan</td>
</tr>
<tr>
<td>1.1 ? Grade &lt; 1.3</td>
<td>Tan</td>
</tr>
<tr>
<td>1.3 ? Grade &lt; 1.5</td>
<td>Purple</td>
</tr>
<tr>
<td>Grade ? 1.5</td>
<td>Gray</td>
</tr>
</tbody>
</table>

Because of building covenants, and building trends, houses in most subdivisions will be of similar quality and therefore will be of similar grade. If a typing error occurs it is possible for a house in an above average subdivision to be given a grade of 1.03
when it was supposed to have been given a grade of 1.30. This type of error will be vividly visualized with thematic mapping, but once again it is difficult to find in a tabular database alone.

ILLUSTRATION 3
THEMATIC MAPPING BY HOUSE GRADE (GRADUATED COLOR)

In the illustration above, the house grade should probably be 1.30 instead of 1.03.

Other examples of where thematic mapping may be useful to troubleshoot CAMA databases are location factors, subdivision lot value, taxmap, zoning, physical and economic depreciation, land classification, land use, neighborhood, location (street name), and qualified sale price.
ILLUSTRATION 4
THEMATIC MAPPING BY ZONING (UNIQUE VALUE)

One parcel completely surrounded by R-1 zoning is designated as R-2 zoning. This is probably a data entry error.

AERIAL PHOTOGRAPHY MASKING

The most common type of error found in CAMA databases is under accounting of assets. This type of error occurs on a routine basis and until recently was not corrected until a property appraiser in the field spotted a new asset and recognized it as being not previously recorded. Obviously many assets, especially those not visible from roads, could remain unrecorded for many years and may never be recognized.

GIS and digital aerial photography make many unrecorded assets easy to identify. By “masking” parcels with known assets a person can visually inspect those unmasked parcels for unrecorded assets. For example, to find unrecorded swimming pools, overlay your parcels coverage onto digital aerial photography and block out the parcels which are known to have swimming pools by querying the linked or joined CAMA database tables. After making the selected parcels non-transparent, inspect the remaining visible portion of the aerial photography for any swimming pools. If a swimming pool is visible, it implies that some type of error exists in the CAMA database tables for that parcel. This same technique works for many other types of assets such as houses, barns, sheds, farm irrigation systems, mobile homes, poultry houses, and even porches, decks and other improvements that might be attached to a primary structure.
In the illustration above, parcels known to have swimming pools are masked. Where the underlying photography can be seen it should be inspected. If pools are seen, they are not accounted for in the CAMA database.

It is important to note that there will be occasions where features will be seen on aerial photography, and upon inspection it will be determined that the structure actually has no value. It is also important to note that this technique is simply a tool that is used to find missed improvements and in no way a substitute for an onsite inspection in regard to the valuation process.

ACREAGE DISCREPANCIES

In order to properly identify acreage discrepancies, the GIS parcel coverage used should contain regions (as opposed to only lines and polygons). Regions are critically important since they allow for the summation of area calculations for multi-polygon parcels, as in the case of a parcel split by a right-of-way. In addition to the combined area attribute, parcel regions should contain the unique parcel identifier that will allow them to be linked or joined to the CAMA database.
Depending upon local practices, it may not be possible to do a meaningful acreage comparison on all parcels. In most cases where parcel size is considered to be a major factor in determining value, the CAMA database will contain a parcel’s legally surveyed and platted size in units of acres (1 acre = 43,560 ft) and thus a comparison is possible. However, if legal acreage is not entered into the CAMA database, for whatever reason, an acreage comparison between drawn acreage and legal acreage is obviously not possible. This is likely to occur in most small lot subdivisions or commercial properties where parcel frontage is of greater importance than total acreage.

After parcel regions are joined or linked to the CAMA database and area units are standardized (acres), a meaningful comparison can proceed. During the comparison process, you may be just as likely to identify drawing / drafting errors as you are CAMA database errors. The likelihood is more dependent upon how your GIS parcel coverage was created than on any other factor, but none the less, the discrepancies should be resolved. Where the GIS parcel coverage is found to be in error, the appropriate changes should be made to the polygons. Where the CAMA database is found to be in error, a simple database entry or revision is required.

Since there is seldom an exact match between the surveyed acreage and the drawn acreage of a parcel, you should decide what you would consider to be an acceptable margin of error before making a comparison of this type. This decision will be based on your opinion of exactly how accurate your data is and how accurate it should be. Most Chief Appraisers in Georgia agree that the calculated acreage should never vary more than 15% (de-facto standard) from the deeded acreage without exhausting all sources of inquiry. To calculate the acreage ratio, simply divide the drawn area (acres) by the legal area (acres). A ratio of 1 means the parcel’s drawn acreage is identical to the parcel’s legal acreage (this will be rare). If you have established an inspection threshold of 15%, every parcel with an acreage ratio greater than 1.15 or less than 0.85 should be inspected and reconciled where possible.
ILLUSTRATION 6
ACREAGE RATIO LABELS, 15% THRESHOLD (SELECTED)

In the illustration above, the two selected parcels (yellow) are beyond the 15% threshold. Notice how one is drawn too small (0.80) and the other is drawn too large 1.20.

CAVEATS

The more familiar a person is with their CAMA database and its design, the more effective they will be at troubleshooting it. For comparisons between a CAMA database and an aerial photograph or GIS parcel coverage to be meaningful one must be conscious of the currency of the data they are using. Typically a CAMA database needs to be current to the same date as the parcel GIS data. Otherwise many “false positives” will be result from an error checking process and the process will not be confidence-worthy. Aerial photography should be current as of the same date of the GIS and CAMA data or it should be from an earlier date. If, for example, a pool is visible on older photography, that pool should be accounted for in a more recent CAMA database, whereas a swimming pool on new photography may not be considered to be “missing” from the CAMA database until the beginning of the next calendar year.

CONCLUSIONS

GIS can be a valuable tool for finding many different types of costly errors in a CAMA database such as typing errors, errors of omission, and under-accounting. Thematic mapping and aerial photography masking are two of the more powerful techniques that can be used in the process. In many cases the mistakes found can result
in significant tax revenue gains, thereby helping to justify the initial GIS development costs and ongoing maintenance.