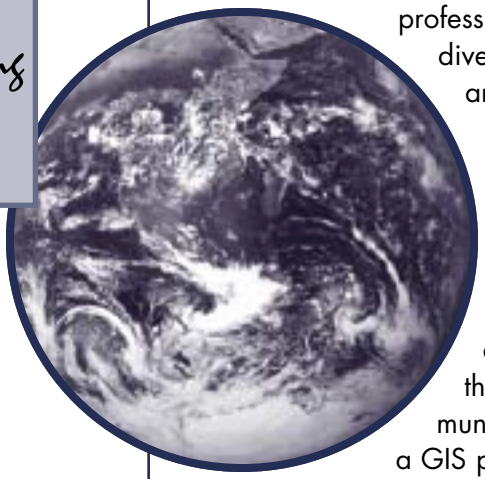
imagi NEWS

what's inside

Automating GIS: Managing Mundane Data Processes in Less Time

By Brian Cooper



The GIS career field is filled with professionals who have diverse skills: technical and non-technical. Both of these groups use GIS in a variety of interesting ways, creating projects that require high-quality, up-to-date data. Maintaining this data is often a mundane task that drains a GIS professional's time or is pushed on the shoulders of an entry-level technician. However, there are several techniques that reduce the amount of time and money invested in data maintenance procedures.

Automation is the umbrella covering these techniques. It can accomplish for GIS what the robot arm did for the assembly line. It can save time, increase accuracy, and standardize data. Not all data maintenance processes can be automated though. An easy way to determine what can be automated and what cannot is to remember a computer's strengths. Computers excel at doing quantitative processes while individuals are better at qualitative analysis. Webpage verification is an example of this. Sometimes, when working with a webpage, it will require a user to copy what appears inside a box. This is a form of prevention based on qualitative analysis. A person can easily determine what is inside the box while a computer cannot. On the other hand, a computer can find thousands of records and update them in a matter of seconds, which a person cannot. That is how automation can lead to saving a substantial amount of time. If a person were to attempt the same procedure, they could not finish nearly as quickly and the final results would be subject to human error and inconsistencies. Computers are not subject to either human error or inconsistencies. This is why automation can provide improved data quality though accuracy. Automation also brings the added benefit of standardization. Each record is updated using the identical methodology as the previous record, guaranteeing consistency. By utilizing automation, higher accuracy and standards can be brought to data processing; all while saving time.

There are numerous ways of automating the maintenance of various datasets. Here are some techniques for accomplishing that:

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Who's Doing What in GIS and Spatial Technology

TRAVERSE CITY AREA PUBLIC SCHOOLS TRANSPORTATION DEPARTMENT

PROGRAM SUMMARY

Population: 12,087 Students.

Geographic Coverage: 300 square miles (776.996 km^2) within Grand Traverse, Leelanau, and Benzie counties including 15 Elementary Schools, 2 Junior High Schools, 3 Senior High Schools, 9 Non-Public Schools, and 12 Special Education Sites

Number of Staff: 8 Office Staff & Managers, 125 Bus Drivers, 26 Aides, and 7 Mechanics

Annual Budget: 6.5 million

PROGRAM STATUS

Traverse City Area Public Schools' (TCAPS) Transportation Department has been using GIS software for the past 10 years. TCAPS is currently using a program called "SmartrTM" from Trapeze Software (www.smartr.com); based on ESRI's ArcGIS platform. As with any mapping program, success depends on the quality of data used. Thanks to the cooperative efforts and high standards of Grand Traverse and Leelanau County's Equalization Departments, the accuracy of TCAPS' base map has vastly improved from the early days when the base map consisted of TIGER files. TCAPS primarily uses GIS for transportation routing functions but has found it valuable in other areas.

TCAPS' buses service areas in Grand Traverse, Leelanau, and Benzie counties. The school district encompasses a 300 square mile (776.996 km^2) geography with rural and urban areas, interspersed with nearly 140 lakes. TCAPS' buses travel approximately 1,830,000 miles (2 945 100 km) per year. Did you know that the distance to the moon is merely 238,856 miles (384 401 km)? That means TCAPS' buses could make it there and back almost four times in a single year!

Rising fuel prices, wages, and the cost of bus replacement and maintenance of the fleet requires the District to constantly search for ways to improve efficiency and cost effectiveness. An electronic version of the District's bus routes has improved the overall efficiency of the Department. Gone are the days when wall maps were covered with pushpins designating school bus stops! Routing Specialists are able to easily locate the correct bus route for new students and reduce overlapping travel paths (see the map in Figure A). The map illustrates three bus routes that cover a lot of territory. It's an area in the District fondly known as the "Arbutus Triangle" to bus drivers. Using ArcMap, TCAPS can provide detailed route maps to assist substitute bus drivers navigate unfamiliar terrain.

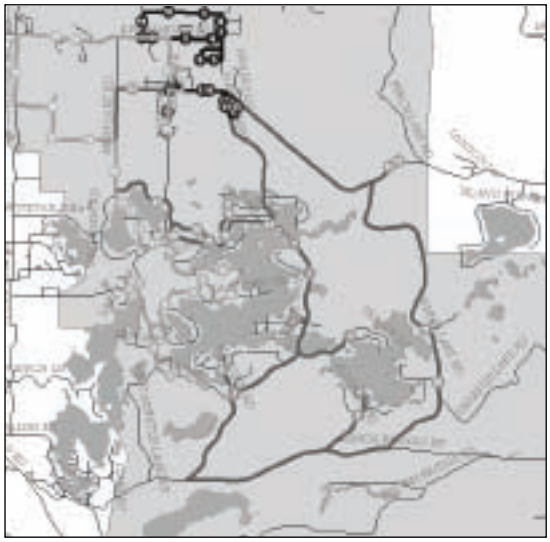

Figure A.

The GIS enables the District to evaluate different scenarios of start times throughout the District. School start times are tiered to fully utilize the fleet. Staggered start times enables one bus to serve multiple schools. Before GIS, bus drivers could expect a substantial amount of down time between bus runs. This time translates quickly into dollars as more down time means having more buses on the road – more buses consume more fuel, require more maintenance, and need paid drivers to operate them. Using GIS has greatly reduced down time by allowing the fleet to be used more efficiently.

TCAPS has also worked with the local Intermediate School

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BASIC AUTOMATION

Not all automation has to be complex. In fact, many technicians use simple forms of automation already. One useful type of automation for newcomers to utilize is saving the maps they create. By saving maps, the time required to recreate them is eliminated. There can be a lot involved in creating maps from aligning data, to labeling data, and updating reference material. Creating an intricate layout can consume a person's time. Numerous operations can also increase the likelihood of mistakes. These mistakes are usually found later and likely by another person. Since the maps are saved, it is a simple task to retrieve them, fix the error, and save again. The time to recreate the map has been reduced through this simple type of automation.

Another type of basic automation used often is joining data. When updating or adding additional information, it is common that the data already exists in another database. Moving this data by hand can lead to inconsistencies and errors, so automating the process of migration can be beneficial. For a join to work, there must be a relationship between the datasets, which can be either an attribute relation or a spatial relation. That relationship is used to link the datasets together, allowing data to be moved from one set to the other. To automate the actual process of migrating data, another method should be utilized; field calculations. Field calculations are powerful tools that do exactly what the name implies; they calculate values for an entire field. By using these, data from one source can be calculated into the other. Calculating data accomplishes three aspect of automation: saving time, increasing accuracy, and standardization. This method maintains the accuracy and standards that were originally present and is much faster then completing the project entirely by hand.

Saving maps and using joins are two types of basic automated procedures that anyone can utilize with ease. In fact they are some of the core elements and skills needed to perform any of the advanced automations techniques. This is because automation techniques, in general, build on each other. Saving maps and using field calculations are just the beginning…

FIELD CALCULATIONS AND BEYOND

Many projects can benefit from basic automation techniques, many others can benefit from more advanced automation procedures. For example, heads-up digitizing of vector data atop an aerial photo or other raster background can be a highly interpretive activity. While automated raster-to-vector tools do exists, the act of interpretation ultimately falls to the analyst, not the software. This is not to say automation cannot be an asset in this type of activity, it can be, particularly when populating and verifying the attribute side of data. Just like before, field calculations can be used to update entire fields with similar data. With a basic knowledge of the Structured Query Language (SQL) and the Visual Basic (VB) scripting language, field calculations can accomplish many things. SQL field calculations can be limited, allowing for updates to specific records or not and effect entire datasets. Field calculations themselves are not restricted to the movement of data either. By using VB scripting a field calculation can format data as well as concatenate it. Using both SQL and VB scripting can lead to excellent automation processes that ensure accuracy, standardization, and decrease production time by performing numerous updates at once in a standard and accurate fashion. Once knowledge of SQL and general scripting is established, users of automation may want to build on those new skills and construct more advanced automation techniques with a scripting language like Visual Basic for Applications.

SCRIPTING; LET THE COMPUTER DO IT!

Many applications used to create and manage GIS data, come with a built-in scripting or macro language. In ArcMap for example, Microsoft Visual Basic for Applications (VBA) is included. Scripting allows automation to move to the next level. Sometimes scripting will not have any bearing on the actual data, but may still simplify the process. When working with data, a process is sometimes done repeatedly, and might consist of several steps. Going through each step takes time and leaves room for human error, but automation can reduce errors and decrease time. For example, it is sometimes impossible to create a join, and data has to be moved manually, which is no small task. These procedures, by their nature, can end up highly erroneous. However, a process can be created through scripting that would automatically take data from one record and enter it exactly into the destination record, eliminating the majority of human errors. In the end, the only component the user has to manage is matching the two records. Scripting can also directly create data. An example here would be a line segment that requires a field populated by the closest point. This would be a tedious and time consuming process if done manually. Thanks to scripting, this process can be automated to create precise and accurate data in a relatively short period of time.

Not all scripting has to be code-based. Being familiar with

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From the President: Have You Stepped Outside Your Comfort Zone Lately?

As a community of geographic applications producers, users, and consumers, we might want to take a moment to critically examine how we protect, promote, and advance the resource programs we support. Geospatial technology professionals represent many disciplines and possess great ability to discern spatial relationships – it's what uniquely distinguishes us from other disciplines. However, how often has your geographic analysis and/or products received poor organizational acceptance? Does it seem like the effort you expend is not fully understood or valued by those in leadership positions or was viewed as peripheral to the core mission of the organization? Outside the geospatial services industry, using industry catch phrases like "geo-enablement" or "geo-intelligence" may have little meaning to those in leadership aside from the cost implications. Here are a few thoughts on ways you might be able to advance your geographic initiatives which increase the value associated with your role and geographic resource output (applications, map products, analysis, reports, and many others). Some of these suggestions may not be easy for us and may require us to step beyond the proverbial comfort zone:

- **Affiliate Yourself With Credible Stakeholders:** Internal organization partnerships are not always easy and require constant nurturing and check-up. Consider understanding the roles of those who either currently use or would greatly benefit from the geographic resources you manage. Become an advocate for others even when geographic resources are indirectly involved. In turn, your advocacy may be reciprocated when you seek support for your initiatives.
- **Link Your Geographic Applications to Core Mission Objectives:** Self-initiative is necessary to learn what matters most to decision makers and leaders. Objectives are commonly detailed in budget documents, annual reports,and internal/external organization communications. You have to learn what vocabulary and issues matter to win the attention of leadership and actually promote ideas which add recognized, organizational value. Your geographic support role needs to be aligned with core objectives to be deemed essential by leaders.
- **Improve Perceived IT Resource Value Within Your Organization:** Regardless of whether you work in an IT department, remember that if IT resources are regarded as ineffective, the geographic resources that depend upon these IT systems will eventually be perceived ineffective. You cannot dissociate yourself from IT regardless of the personality conflicts, past history, control issues, tensions, and other real or perceived impediments. Instead, work to champion or become a member of the IT service delivery group/department to make your geospatial resource successes, shared successes spanning the entire organization.

Most of us would agree that geographic information support resources are growing exponentially in both the public and private sectors. The challenge for you is to make this exponential growth a reality within your own organization. Commit yourself to stepping outside your comfort zone. In all likelihood, remaining inside the "zone" will prevent you from attaining your professional goals which include geo-enabling your organization. Great ideas present themselves by discovering new ways to identify and deliver the resources your stakeholders require. I value my membership within IMAGIN because of the continuing opportunities to learn new strategies and proven applications used by talented IMAGIN members to advance the organizations they serve. Your active participation within IMAGIN allows these strategies and lessons to be introduced and/or adapted into your organization's business practices. The benefits of your IMAGIN membership are realized as your awareness of existing and future geospatial technology application grows translating to productivity improvements, efficiency gains, and greater value placed on the geographic resources you manage within your organization.

IMAGIN President Christopher Blough can be reached at (248) 347-3279 or cblough@cityofnovi.org

THE CALL IS OUT!

Don't miss this professional opportunity to submit your entries and nominations for IMAGIN Awards

IMAGIN AWARDS

Every year, several individuals are recognized for their contributions to the geospatial field in Michigan. Nominations are requested for the following awards to be presented at the 2008 Conference:

The ***Jim Living Geospatial Achievement Award*** is presented to an IMAGIN member in recognition of exceptional career-long dedication and commitment in the field of geospatial technologies.

The ***GIS for Everyone Award*** is given to an organization that does an outstanding job of making GIS data or analysis available to either organizations or to the public.

The ***GIS Education and Outreach Award*** is presented to an individual or group that promotes an innovative GIS activity or educational project using geospatial technologies.

Recipients will be recognized at the 2008 IMAGIN Conference awards banquet.

Criteria and submittal information is located on the IMAGIN website (www.imagin.org/awards). All nominations must be submitted to the IMAGIN office by March 21, 2008.

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SQL will allow automation to play a big part in Quality Control (QC). Creating data that is accurate and free of errors is important and the only way to accomplish this is through extensive QC. By using automation, the QC process can be effective and efficient. Sometimes fields are limited to particular pieces of information. The data inside those fields can be searched in mass for anything that is outside the expected parameters by using SQL. This is an easy way to begin a QC process. Often the applications used to manage GIS data do not support sophisticated SQL statements. If this is the case, the attribute component of GIS data can usually be exported and then imported into another program that supports more sophisticated statements. Microsoft Access is an example of one of these programs. It also contains helpful "wizards" that can build SQL statements. These allow users to find errors that could easily be missed. By using scripting and SQL, lengthy processes can be reduced to more manageable and reasonable amounts of time. Without scripting, QC could never account for the majority of exceptions, causing the quality of the data to suffer.

AUTOMATIONS APPLICATIONS; THE END PROCESS

In the same way scripting and SQL build on the knowledge gained through field calculations, the next part of automations uses scripting knowledge as its base. Automation really starts to shine in the development process, but there are still downsides. A development solution involves using a compiled programming language to create an application that uses all previous forms of automation to streamline major processes. These solutions require an individual familiar with everything covered so far, and who is knowledgeable in both GIS and Computer Science. The price for development solutions and the time required to implement them may be a deterrent; why should so many dollars be invested for these solutions when the traditional way works fine for fewer dollars? This view, however does not consider the big picture. Development solutions may have higher up-front costs, but these expenses are most often recovered over time through higher standards, accuracy, and increased efficiency.

Development solutions excel at saving time and can be applied to many different projects. Consider one of the basic forms of automation already discussed. Saving maps only saves time when a map has to be redone, but what if automation could create the map itself? Automation can be implemented to create custom standardized layouts. Many layouts consist of the same elements: north arrows, logos, titles, index maps, etc. Creating each one of these takes time, but the process of creating them can be automated. This yields several advantages: saving time and creating a standard layout that can be used for future maps. It can even be taken a bit farther. Instead of creating one layout for one map, the layouts can be driven by tabular data, to accomplish things like creating layouts for each cell in a map index grid. Tax maps are a good example of where this type of automation can save a substantial amount of time. Development solutions can also be used to create data. Record data can be influenced by many factors and there can be a complex, error prone, time consuming process involved in determining the end result.

A development solution can remove these variables from a process. An example here is the population of address centerline data. Centerline data is generally well structured. It follows local ordinances as well as national standards. These ordinances and standards may include: block-specific minimum and maximum house numbers, directionality, address parity, possible ZIP Codes, etc. A development solution could return a possible address that adheres to all these variables and standards in less then a second. This is a vast improvement over the manual method. Creating such development solutions requires knowledge of Computer Science and Cartography.

BRINGING IT TOGETHER

In summary, automation is a process that can be implemented at various levels for all kinds of projects. It is a time-saving technique that allows for improved accuracy and the standardization of data. While its initial cost and development time may be higher than a typical project, the recurring costs can be significantly lower saving time and money in the long run. Basic implementations can be used right away but the real power behind automation is found in the use of advanced methods. These advanced techniques require knowledge not only of GIS, but also of Computer Science and this is why institutions looking to take advantage of automation may consider hiring a GIS developer as well as a technician. Because GIS is being used in new and different ways every day, sufficient support systems should be implemented to complete the mundane task of keeping the associated data up-to-date and error free. Automation can accomplish this while allowing professionals to utilize their time on newer, more interesting projects.

For more information, contact InfoGeographics Consultant Brian Cooper at (231) 995-8266 or bcooper@infogeographics.com

WHO'S DOING WHAT continued from page 2

District to help determine classroom placement for students with special needs. By geocoding students with special needs on the map it can be easily determined which school location would be most centrally located for those children. Centrally placing special programs reduces the amount of time the children spend on a bus and further improves efficiency.

In order to continue providing a superior learning environment for students, it's important to keep the number of students balanced throughout the schools within the District. Overcrowded classrooms or an underutilized teacher are not the best ways to utilize resources. Sometimes it is necessary to change the school boundaries. In the past, it could take weeks to come up with viable boundary scenarios using marking pens and transparencies. ArcMap illustrates possible changes in a matter of minutes. Students that could be affected by boundary changes are quickly identified.

NEW PROGRAMS AND ACTIVITIES

The ArcGIS system was originally purchased for assisting in the deployment of TCAPS' bus fleet. However, the system has been helpful in a variety of different ways including: fiber optic cable routing, walk zones, snow check areas, mailings based on geographic location, identification of students based on demographics and other variables, and ad-hoc queries that assist educators with various grants

Future GIS plans include adding a sex offender layer to the District's maps. This additional information will be beneficial when deciding placement of bus stops. The District would also like to work with Benzie County to improve geocoding results along TCAPS' western boarder. Other future plans include exploring AVL (Automatic Vehicle Location) to further reduce costs including minimizing down time between bus runs.

LESSONS LEARNED/RECOMMENDATIONS

When first implementing GIS in the Transportation Department, geocoding errors were unmanageable. Soon after, TCAPS implemented a process called "street validation" at the school level. School secretaries are required to enter student addresses into the system using guidelines that will provide the Transportation Department better matches when geocoding. Since TCAPS uses County data for the base map, addresses must match the way the County streets exist within the routing program or the secretary will receive an error message. The amount of time spent tracking down and correcting errors was virtually eliminated. If other School Districts are interested in beginning a GIS, TCAPS' Routing Technician recommends implementing some type of street validation along with GIS.

TCAPS' Transportation Routing Technician, Denise Watzel, can be reached at (231) 933-1923 or watzelde@oper.tcaps.net.

Did You Know?

Michigan's drainage system includes over 80,000 miles (128 748 km) of streams and drains, of which 36,000 miles (57 936 km) are navigable. The top county in miles of streams and drains is Ontonagon, with over 4,000 miles (6437 km). Rounding out the top five in order are Sanilac, Huron, Marquette, and Saginaw. The top counties for miles of drainage per square mile of land area are similar: Sanilac, Ontonagon, Schoolcraft, Huron, and Saginaw. For more fun with Michigan's waterways, see the Michigan Geographic Data Library at www.mcgi.state.mi.us/mgdl

MAP GALLERY APPLICATIONS DUE FRIDAY, APRIL 11, 2008

Sponsored by North Arrow Technologies, Inc.

Showcase your cartographic work over the past year at the 2008 IMAGIN Conference. Maps are judged in the following categories:

The **Best Cartographic Design** award is presented to the map that best maintains functionality and use while artistically employing cartographic elements such as color selection and label placement. Overall aesthetic appearance is a major factor in this category.

The **Best Analytical Presentation** award is presented to the map that best meets a specific analytical purpose, allowing the viewer to utilize the map as a tool for extracting information. Unbiased presentation of the data is very important in this category.

The **Best Data Integration** award is presented to the map that best incorporates data from various sources and formats, and often reflects creative data collection or extraction techniques. When evaluating this category, the panel looks for map layers that truly compliment each other within the map.

The **Best Cooperative Presentation** award is presented to the map that best demonstrates collaborative efforts between individuals in different types of companies or organizations. A key requirement in this category is that all listed individuals are involved in some aspect of the map preparation.

Winners of each category receive a framed certificate and a ribbon. Second and third place maps receive ribbons. Participants can also earn "Contributions to the Professional Component" points towards their GISP certification or recertification.

Applications are available online at www.imagin.org/awards. For further information, please contact Sarah AcMoody at (517) 432-7447 or acmoodys@msu.edu.

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IMAGIN is a non-profit 501(c)3 organization comprised of individuals and organizations interested in the use and application of geographic information system (GIS) technology in Michigan. Our members are committed to improving the quality and availability of digital data necessary to make good use of GIS. We believe that cooperation and open communication are necessary to achieve these objectives.

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