To understand how geographic information systems (GIS) can add to auditing capabilities, we must first understand what they are. Simply stated, GIS is a collection of computer hardware, software, and geographic data for capturing, managing, analyzing, and displaying geographically referenced information. GIS allows us to visualize, question, and interpret data to understand relationships, patterns, and trends across space and time.

To use GIS in an auditing context, you need geographic reference data — such as addresses, latitude, or longitude — or an administrative boundary, such as a county line. Geocoding, for example, is one common analysis in which GIS attributes latitude and longitude to a location based on information such as an address or postal code. After the data is geocoded, GIS can analyze and visually display it in a map, making the information both more understandable and memorable. If prepared correctly and with forethought, a well-designed map can be a useful tool to reach your target audience, whether it be clients, policy makers, or the general public.

So how can you use GIS analysis in your audit work? How does it add value? Auditors can use GIS analysis to enhance the value of all phases of an audit: planning, fieldwork, and reporting. The Office of the New York State Comptroller (Comptroller) has issued several audit reports and studies in which GIS played a key role in planning and executing the audit work and communicating results. For example, on a recent audit of the New York State Department of Motor Vehicles’ (DMV) oversight of automotive repair, sales, and salvage facilities, the Comptroller’s audit team used GIS software in the planning phase to analyze publicly available New York property parcel records. The auditors compared the property records, which include location and zoning information, with addresses of currently-registered repair and sales facilities and facilities whose registrations had recently expired. Based on the GIS-derived conclusions, auditors identified 266 locations that were potentially operating as repair or sales facilities without being registered with DMV. After visiting a sample of these facilities, auditors identified 18 percent that appeared to be operating without a valid registration or license. Ultimately, using GIS during planning allowed the team to quickly identify areas of risk, execute a well-designed approach to fieldwork, and address consumer protection and public safety.

During fieldwork, GIS can help make the best use of travel costs, available personnel, and time when conducting site visits. In a statewide study of homelessness in New York (excluding New York City) issued by the Comptroller, audit personnel piloted using GIS analysis to help teams execute field visits to homeless shelters and homeless hotels/motels in Suffolk and Nassau counties. To make this work, auditors began with a list of shelter street addresses and then used GIS analysis to identify the most efficient routes. This allowed them to develop detailed itineraries, including the order in which each shelter should be visited. Without this analysis, determining the routes and organizing the visits would have been an onerous task that would have delayed the study’s progress. The resulting observations confirmed findings from a prior Comptroller audit: while many homeless facilities provide “adequate” living conditions (i.e., a basic level of habitability), there continued to be deficient — and sometimes squalid — properties that posed...
persistent dangers to the health and safety of this vulnerable population. Finally, GIS can create compelling visual images that help make reported audit results more meaningful. The Comptroller’s audits have used several types, described below.

• **POINT MAPS**, which represent addresses or coordinates, can display location characteristics by adjusting the points’ color and/or shape. For example (Figure 1), a green point is used to represent homeless shelters that auditors found to be in adequate condition, whereas a red point represents shelters found to be in very poor condition. The map also distinguishes shelter types by using shapes, with adult shelters shown as circles and family shelters as squares.

• **CHOROPLETH, OR THEMATIC, MAPS**, which use color to display relative differences across a geographical area. In one example (Figure 2), a Comptroller’s audit used choropleth maps to visually present information about differences among counties in the number of incidents of cyberbullying reported by county schools in a given period.

• **GRADUATED SYMBOL MAPS**, which combine concepts of choropleth and point maps to show differences in the magnitude of events (e.g., counts of people or events) at specific locations — a useful tool when boundaries wouldn’t make sense in the context of the map or if you want to distinguish between multiple different points. For example, the Comptroller’s auditors in New York City used GIS to visually present concentrations of nightlife noise complaints for a particularly noisy district, using proportional symbols to represent the relative number of complaints reported. This information generated audits that addressed the issue of noise, which can have significant adverse effects on both public health and quality of life. The City of New York subsequently amended its Noise Code to address issues identified in the audits.

• **STORY MAPS**, which combine maps with narrative text, images, and multimedia content, allowing you to tell your findings (or story) in an interactive format. The Comptroller is exploring online, interactive mapping formats that have potential to both assist auditors with fieldwork and provide options for more visually engaging results to customers.

Costs for GIS software and systems vary greatly, from open source solutions that are publicly available at no cost to purchased software solutions. Purchased solutions range from those with minimal monthly charges to others with significant up-front and annual maintenance fees. It’s important to assess the potential benefits to your organization and the associated costs of each GIS option. If leveraged properly, the benefits can outweigh the costs. The Comptroller’s auditors continue to explore and expand the GIS capabilities in planning and conducting audits and in communicating results visually to enhance their impact, understandability, and potential to inspire change.

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