

Optimizing Data Collection, Storage, and Visualization: A Modernization of Business Processes

Submission Category: Business Process Innovations

State: North Carolina

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Executive Summary

The thirst for fast, accurate information has always existed and further accelerated through technologies like high-speed Internet, Global Positioning Systems (GPS), and mobile phones. With the tap of a finger, click of a button, or a simple voice request, information flows instantly. The North Carolina Department of Information Technology (DIT) has embraced these technologies to serve the citizens of North Carolina with more accurate data, in real time, and across multiple platforms.

Historically, the Department of Environmental Quality's (DEQ) regulatory departments have employed a multi-stage solution to geospatial data collection and entry, map creation, and public outreach. Inherent drawbacks of this approach include the high cost of staff time and equipment, data entry errors, delayed results, prolonged decision making, static/stale maps, and final products that are not easy to use.

The Geographic Information Systems (GIS) staff within DIT created multifaceted applications for multiple programs that have improved the historic methodologies and provided the user-friendly applications the public expects. These applications allow DEQ staff to collect data in the field using GPS-enabled mobile devices. The data are entered directly into the cloud-based database and eliminates post-processing time and duplicative data entry. These data feed internal and public-facing web applications, allowing users to view information in real time from anywhere in the world.

This technology has been widely incorporated at the Division of Marine Fisheries (DMF) within DEQ. The DMF collects a wide range of data relating to environmental conditions, habitat, species, fishing violations, and endangered species. The program incorporates multiple applications and DMF has realized significant cost and time savings and increased public awareness. The write-up will describe how DMF;

- Saved approximately \$100,000 since implementation
- Anticipates savings approximately \$30,000 annually by reducing printed material
- Reduced staff time to complete monthly Shellfish Sanitation Shoreline Survey database tasks from 4 days to 2 days; saving 4 – 5 days of work every month across the various teams
- Reduced the time needed to complete recurring habitat mapping tasks by 7 – 10 days per mapping event; saving 4 people 5 – 7 weeks of field work per year
- Improved fisherman's ability to target fish in reefs
- Increased Public awareness and interaction; 64K public interactions with online reef guides

Approximately 25 applications have been created but this submission will focus on 3 of our successful applications, the Shellfish Sanitation Program's Shoreline Survey Application, the Artificial Reef Program's Interactive Reef Guide, and the Estuarine Benthic Habitat Mapping (EBHM) Application.

The implementation of these applications has achieved the initial goal of modernizing the practices of data storage, collection, editing, and viewing. However, perhaps the greatest outcome of these projects has been the drastic reduction in staff time, program cost, and product delivery time. Costs were reduced by eliminating the need for expensive GPS systems, which included hardware maintenance, staff training, and software maintenance.

Technology Concepts

Technologies central to producing these applications include GPS, cloud-based storage, and mobile devices. These, coupled with Environmental Systems Research Institute's (ESRI) mapping platform, came together to create a customizable, all-encompassing approach to manage, collect, edit, and view data.

Shellfish Sanitation Program's Shoreline Survey Application

The application allows field staff to collect geospatial data, attributes, and pictures using automatically populated fields. Data are displayed in real time. Locations are inspected along the coast to identify any pollution sources that could impact the shellfish resources, including animal locations, docks (with over 10 slips), golf courses, storm water sites, subdivisions, wastewater sites, and potential areas of concern. Management can access the data in real-time, without the delay to process the data. This allows management to respond quickly to pollution issues, thus decreasing the shellfish health risks to the public. The application was created by taking the legacy database and recreating it as a geodatabase. In the past, pictures associated with the pollution source points were stored separately. In the process of creating the geodatabase, all pictures were linked in the geodatabase as attachments to the point data. The completed geodatabase was then published to the cloud and directed to a web map and application for viewing and interacting. Additional layers were also incorporated into these maps to aid biologists collecting data in the field. For example, parcel layers were added to enable field biologists (referred to as shoreliners) to have more information about properties they visit. Shoreliners can access the database in the field or at their desk through any device.

The Shellfish Sanitation Program choose to use iPad Mini 4 devices for data collection. It was determined that the active cell phone contracts were not needed for this application. Therefore, cell phone enabled (needed for GPS chip) iPads were purchased without cell phone activation. ESRI's Collector application was placed onto the iPads to interact with the web maps.

This system allows shoreliners to download predetermined study areas via WiFi. Once the study area is downloaded, the shoreliners can collect data, which is stored locally on the iPad, and sync the information when back at the office. Shoreliners take a picture for every data point they collect using the iPad. These pictures are automatically linked to the data point as an attachment (related table in the database). Shoreliners are able to perform their field work and have it automatically uploaded back at the office, significantly streamlining their process while reducing post-processing and data handling. This has saved time and reduced errors introduced during post-processing steps.

Artificial Reef Program's Interactive Reef Guide

North Carolina has 68 artificial reef sites, which help make the state a fisherman's paradise. Over the past 20 years, efforts have been made to publicize these areas using printed artificial reef guides. North Carolina DIT created an interactive web mapping application specifically for the public. The Artificial Reef Program's Interactive Reef Guide consists of an interactive web map application allowing the public to pinpoint artificial reefs and oyster sanctuaries in North Carolina waters. The application can be accessed on personal computers or mobile devices. On the mobile platform, GPS allows fishermen to see when they are directly over reef material. This is an excellent resource allowing fishermen to identify where to target fish. The application incorporates GIS layers showing the footprint of these reefs categorized by reef type (i.e. sunken ship, concrete, or reef balls). Additionally, there is side scan sonar data for each

reef hosted in the cloud and incorporated into the web application. **Citizens can now see the locations of all artificial reefs and oyster sanctuaries online.** As the user focuses in on a reef, the reef footprint appears. Focusing closer in displays the side scan sonar data, allowing the user to see a detailed representation of the benthos (bottom habitat). The features are available to the public on personal computers or mobile devices. **Fishermen can pull up the application while fishing and determine exactly where they are in relation to the underlying reef material using their mobile device, enhancing their ability to target fish.**

The public facing Artificial Reef application can be viewed here:

<https://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=3b27e8594cb6444c88b5525bf763aa55>

Estuarine Benthic Habitat Mapping (EBHM) Application

The Estuarine Benthic Habitat Mapping (EBHM) Application incorporates the use of iPad Pro's, allowing field technicians to digitally map the bottom type of all estuarine areas in North Carolina. EBHM is essential for identifying habitat locations for various shellfish and finfish. Habitat mapping is an important element in the North Carolina decision making process for fisheries. Habitat data collected are used in Coastal Habitat Protection Plans, Fishery Management Plans, shellfish lease authorization, and rulemaking. This program provides a detailed representation of the estuarine benthos. Historically, field technicians used paper maps to map an area. GIS staff would provide the technicians with a map of the shoreline in an area, on which the technicians would then hand draw the habitats in the field. Once the technicians completed an area, the map was returned to the GIS staff for digitization. Field staff would have to wait for the digital maps and acreage calculations. This information was used to generate the number of sampling locations needed for a certain area, before the technicians could return to the area to sample the habitats.

North Carolina DIT improved this process by using cloud storage, web maps, and iPad Pros. A web map was created with feature types for all habitat strata in the program. Additionally, a sample layer was created, which allows the field crews to sample all habitats and relay the data to a common database. The iPad is paired with an Apple pencil and a mapping grade GPS. Technicians can stream GPS locations, draw on the map using the pencil, and take individual GPS points. **This system allows field crews to digitize the habitats in the field, eliminating the need for further details and time intensive work in the office.**

Significance

The systems implemented and outlined here created a fluid, interactive, scalable solution to data collection, public interaction, and data storage. These systems put an emphasis on saving resources and providing products to the public in an accurate, time efficient manner. Currently, citizens can access data associated with the projects from personal computers and mobile devices at their leisure. The results are user-friendly applications for the public and fewer data requests taking up staff time.

In addition to the public interaction, improvements to data collection and handling allows fisheries staff to focus on other priorities. The centralized nature of the database created for these applications enables collected data to go directly into the database with all associated links, creating a centralized

up-to-date database for staff to interact with and produce products. The cloud-based system also allows staff to work from anywhere with an internet connection.

These applications are significant steps in the DEQ mission to transition to modern technology, with the goals to better serve the citizens of North Carolina, while cutting the cost burden. Additionally, this project directly addresses two of the State Chief Information Officer priorities – cloud services and data management and analytics. Each of the services outlined here are cloud hosted, resulting in seamless interaction and scalability with the database. The architecture and data management policies implemented greatly reduce the potential for keying errors, use of out-of-date data, and location errors.

Impact

Replacing legacy systems and methods with these applications has drastically reduced staff time needed to perform tasks in a variety of ways.

Time savings by application:

- The Shellfish Sanitation Shoreline Survey database and application has **decreased staff requirements by 50 percent**. A geographic area which takes 4 days to complete, between office and field time, is now being completed in two days. This happens several times a month and saves 4 – 5 days of work every month. The time savings is realized in numerous areas. Shoreline surveyors have drastically reduced preparation time (to review information, print it, and organize it), as all pertinent information is now at their fingertips in the field with iPad minis. Post collection work for the surveys has been virtually eliminated. Surveyors historically had to manually link pictures from an external camera to data points, QA/QC the data before sending to GIS analyst, and QA/QC the database after the analyst has incorporated the data. GIS analysts are no longer required to transition data from collection into a database. This seamless and automatic process is now handled with cloud storage.
- The Artificial Reef Public Viewing application has enabled the state to provide spatially accurate reef information to the public without having to field numerous data requests.
- EBHM's application has enabled significant time savings by GIS analysts and field technicians. This reduced the time needed to complete a habitat mapping task by 7 – 10 days. This task is done about 5 times per year and requires 2 boats in the field with 2 field technicians in each boat; **saving 4 technicians 5 – 7 weeks of field work per year**.
- Field crews do not have to wait for GIS analysts to digitize field maps before they can return to sample the areas. Layers such as imagery, NOAA Charts, and bathymetry available to the technicians on the iPad Pro, allows technicians to substantially increase the speed in which they map habitat.

Initial cost savings estimates are based on equipment and staff savings. Phasing out dedicated GPS products with this project has saved the state thousands of dollars by eliminating new GPS purchases and maintenance. **Staff cost savings for these programs equates to approximately \$100,000 since implementation**, with the potential for that value to dramatically increase. The reliance on printed maps, documents, and reef guides has also been significantly reduced. **Reducing the number of annually printed artificial reef guides could save the state tens of thousands of dollars each year.**

Beyond efficiencies realized in time and cost, this project has been well received by the public. **The public interacted with the artificial reef guide 64,871 times since inception**, without a significant marketing push. Field crews have embraced the technology and have conveyed appreciation for the ease of use, efficiencies gained, and reliability of the data/applications.

At the onset of this project, DIT sought to create modern, efficient systems to better serve the public. This was achieved with all three applications. Each application is in production and is scalable and adaptable to growing databases and evolving technologies. The cloud-based nature of the applications has set a higher standard for mapping products delivered to the citizens of North Carolina.