GIS IN TRANSPORTATION

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Data Portals for Emergency Management

Interview with John Farley, GIS Manager, and Marc Clifford, Deputy Chief Information Officer, of the North Carolina Department of Information Technology—Transportation.

In collaboration with the North Carolina Department of Transportation, John and Marc led a team that created storm portals for three major hurricanes in 2018 and 2019.

Who was involved in creating the storm portal?

The portal was a collaborative effort between the North Carolina Department of Transportation (NCDOT) and the North Carolina Department of Information Technology (NCDIT). NCDIT provides direct technical support to all of the State's agencies. NCDIT's Transportation (NCDITT) team directly supports NCDOT's GIS efforts. NCDITT's web team also supported the effort. During a major event such as Hurricane Dorian, everyone on the GIS and web teams works on maintaining the storm portal full-time.

What problem was the portal intended to solve?

In 2018, North Carolina experienced back-to-back major hurricanes, Florence and Michael. Then in 2019, we experienced another major hurricane, Dorian. Before Hurricanes Florence and Michael, NCDOT did not use a lot of technology to respond to hurricanes: the agency used paper maps and phone trees to distribute information. During Florence and Michael, several executives of State agencies wanted to see situational reports in one place for more effective emergency management. During Hurricane Florence, our team used ArcGIS Online maps and other resources to distribute information. We also used unmanned aerial systems (UASs) to gather data on damaged assets for the first time. At the time, these resources were not available in a central place. Then, during Hurricane Michael, NCDOT improved on these practices by combining resources into a single portal.

What data does the portal include?

We incorporated current weather conditions from the National Weather Service. We also incorporated storm surge models from the North Carolina Department of Emergency Management and linked to our travel information management system to see what roads were closed. We used our enterprise GIS database for administrative boundaries and the road network. We also had 24 field crews that were capturing aerial imagery of storm damage with UAS and boots-on-the-ground crews that were assessing the damage with photos that we uploaded onto the site. We received and processed the imagery daily. This was the first time we used UAS during an emergency. We also gained access to National Guard, Navy, National Oceanic and Atmospheric Administration (NOAA), Coast Guard, civil air patrol, and other military imagery that we did not previously have access to.

How did you design and implement the storm portal during Hurricane Michael and Hurricane Dorian?

The team wanted a place to post interactive maps and images across the agency with drag-and-drop functionality, so we assembled a SharePoint site and improved on it throughout the event. The initial setup was very fast—just a couple of days. There was a lot of back and forth with different users. The portal was not perfect at first, but it allowed us to start collecting information quickly, and we adjusted rapidly after that.

What drove the development during the event is what the customers wanted to see and what we were able to do out of the box. ArcGIS Online and SharePoint provide a lot of flexibility, but we also had to be realistic with our customer about turnaround times for each request. For example, we received a request to automate inspection of imagery instead of having people look at images one at a time. That work was more resource intensive and would take longer than a few days to complete. With most requests for changes to the portal, our approach was to provide a few options for the customer to choose from and the timeframe we would realistically need to implement it. This approach allowed NCDOT to determine which requests were most critical. NCDITT was then able to focus our work on meeting the customer's most immediate needs.

How did you engage with key stakeholders and incorporate their input?

We realized we needed to think through who needs to see what information before using the dashboard in the field. For example, we would post data and FHWA could not see it because it was in the NCDOT domain, so we had to either open the dashboard to the public or create accounts for FHWA staff that needed access.

We learned that we could be especially helpful in connecting senior management with people on the ground. Sometimes that presented challenges: senior management might have regular and immediate needs for status reports, while the people in the field were still doing the work. Balancing the needs of both can get complicated very quickly. We had requests from management for ground conditions, while business units such as State Maintenance Operations and the Hydraulics Unit were requesting help to facilitate and support their response activities. In these cases, ad-hoc leaders on our team stepped up to give direction and focused the attention to the various needs of the Department.

Chris Werner, NCDOT's Director of Technical Services and Michelle Long of the Chief Engineer's office championed the project. They had a deep understanding of the technology and how it could help during an event. They interfaced directly with senior management, so when we were prototyping they suggested features that they would want to see and that would catch their attention. At their suggestion, we built a prototype app for the Secretary of Transportation and the Chief Operating Officer the night before they toured storm damage. They used it extensively to document what they saw.

We did not have a formal process for prioritizing user input. It depended on who the request was from, their role, and what we could get done the fastest. If there was an operational outage—for example, if field crews were unable to input data—that went to the top of our list. Similarly, when we got a request from Chris Werner, we pushed that through. After that, we identified where users were performing repetitive tasks and made fixes to save them time.

Finally, with Hurricane Michael more so than with Hurricane Dorian, we made sure that Virginia and South Carolina also had access to our data.

What feedback have you received on the storm portal?

Overall, users found the portal very useful. The feedback that we have received is extremely positive. Many have reacted with "Now can you do this other thing….?" The portal is constantly evolving. We moved, added, and removed things on the fly to respond to what users wanted and how they thought about the event. We received many kudos from Chris and executive management as well.

What were your lessons learned from this project?

Data governance is critical. Make sure you are using accurate and timely information from an authoritative source. Also, make sure you have a plan for all of your information streams. For example, how will you incorporate crowdsourced images that have geographic coordinates? In an emergency event, different people report different things all over the board. Plan in advance. Who needs access to what information, who needs accounts to access your system, and how will they access it? Finally, set yourself up to be flexible. Use platforms that are compatible with mobile devices and allow for changes on the fly.

How will you apply this solution in the future?

Going forward, we will create a new event portal for every event. We expect that it will evolve with each event, but we have a solid starting point. For example, this winter we prepared for a potential snow event by creating a new portal from the existing template. Each portal that we build is storm-specific. When the event is over, the portal continues to display information on ongoing recovery activities related to that storm. The portal also serves as an archive for important data that someone might want to see about a storm, such as water levels, flooded area, and storm damage.

The Future of GIS in Transportation Is Data

Editorial by Robert O. Vos, Assistant Professor (Teaching) of Spatial Sciences and Director of Graduate Studies with the University of Southern California Spatial Sciences Institute

Robert O. Vos, Ph.D., is an Assistant Professor (Teaching) of Spatial Sciences and Director of Graduate Studies with the University of Southern California Spatial Sciences Institute. He teaches technology project management courses for USC's GIS graduate programs, and his award-winning research focuses on industrial ecology, including projects on regional materials flow analysis, eco-industrial park planning, lifecycle assessment, and sustainability indicators.

As a professor at the University of Southern California, I'm honored to work with talented people who apply GIS to a broad range of industries. One of the things I am most excited to see for the future of GIS in transportation is the availability of spatial data on an unprecedented scale.

One overarching goal for sustainable transportation systems is reducing total vehicle miles traveled (VMTs), which reduces congestion, pollution, and accidents. Instead of restricting

people's access to goods and services, reducing VMTs will entail substituting car trips with walking, biking, and mass transit and reducing trip distances to key destinations.

With new geospatial data on land use and transit, walking, and biking networks, we can create parcel-level indices representing travel time to destinations such as healthcare, entertainment, education, shopping, and work. A true picture of how accessible a city is via walking, biking, and transit emerges.

Such an index is useful for land use and transportation planning in its own right, and it's also an input for machine learning models that can predict VMTs by neighborhood under different land use patterns and transit networks. Such models have recently grown in importance and hold great promise for designing transit-oriented development that can reduce VMTs.

With advancements in technology like smartphones, autonomous vehicles, sensors, and drones, we'll have access to spatial data that accounts for a far greater number of factors, giving more depth and accuracy to our modeling. There is great untapped potential in this area, as it will have implications for transportation system design, transportation technologies, sustainability, public health, safety, and countless other areas.

My own work focuses on the intersection of ecological and human systems. With plentiful transportation data, it's easier to design pedestrian and road networks that reduce congestion and our overall environmental impact. At the same time, planners, policymakers, engineers, and researchers will need to build professional bridges. While new data presents new opportunities, professionals will be challenged to align both the design of more sustainable systems and the policies that influence how these systems operate.

Other News

Newly Available

FHWA Webinar on Using GIS for Local Agency Data Collection

In March, FHWA hosted a webinar focused on Massachusetts DOT's efforts to collect data from local agencies using GIS. MassDOT shared their efforts to improve data collection across multiple programs through implementing the Local Aid Grant Workflow. The webinar also reviewed the MassDOT Road Inventory Submission Application (RISA). RISA provides a web-based mapping interface for the municipal authorities to interactively add, update, and review its roadways in the Roads and Highways Database in a multi-user collaborative environment. A summary and recording of the webinar are now available on this page: https://www.gis.fhwa.dot.gov/Webinars.aspx.

FHWA Webinar on MIRE Data: A GIS Perspective

In January, FHWA hosted a webinar on State DOT efforts to implement new Model Inventory of Roadway Elements (MIRE) requirements. Arizona DOT discussed their implementation process, including the guiding principles of route dominance, one source of truth, and training and knowledge management. Arkansas DOT shared lessons learned from using Intersection Manager and ArcGIS Online to manage and visualize their MIRE data. A summary and recording of the webinar are now available on this page: https://www.gis.fhwa.dot.gov/Webinars.aspx.

Coming Soon

FHWA Webinar on Using GIS to Create a State of the System Map

In May, FHWA hosted a webinar on State DOT efforts to implement new MIRE requirements. Minnesota DOT (MnDOT) discussed their efforts to create an online, interactive map of their highway and transit system. MnDOT used ArcGIS Online and Story Maps to share infrastructure condition, safety recommendations, and other data with local governments. In this webinar, MnDOT shared the benefits, challenges, and lessons learned for other agencies interested in creating a dynamic State of the System Map. A summary and recording of the webinar will be available on this page: https://www.gis.fhwa.dot.gov/Webinars.aspx.

For more information about this newsletter, please contact Mark Sarmiento, FHWA Office of Planning, at Mark.Sarmiento@dot.gov.