

# WIGINS

*Wearable Inspection Grading  
Information Network System*

Information Communications Technology Initiatives



NC Department of Transportation  
Engineering Applications Development

North Carolina

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### **Executive Summary:**

In accordance with a federal mandate, the North Carolina Department of Transportation (NCDOT) Bridge Management Unit must inspect more than 21,000 bridges, culverts, pipes, and overhead signs every two years. Historically, the inspections were handled via a paper-based process, which proved to be inefficient and inaccurate. The process also created the possibility that bridges in disrepair or potentially hazardous to motorists might not be repaired in a timely manner.

To increase the efficiency, accuracy and consistency of the process, and to make bridge reports available more quickly, NCDOT implemented a tablet PC-based mobile inspection system.

The application was developed under the leadership of Lin Wiggins, the Transportation Engineering Director for the Central Bridge Maintenance Unit, in collaboration with NCDOT senior managers and bridge inspectors. The system was originally called VIPER, but following the untimely death of Wiggins, his co-workers renamed the application WIGINS, (Wearable Inspection Grading Information Network System).

To build the system, senior management first itemized the numerous data points that had to be captured during inspections. Application developers then spent time with bridge inspectors to understand how they conducted inspections and what that process meant in terms of designing the screens for the application. In turn, the bridge inspectors helped design the screens.

On the tablet PCs, inspectors are able to enter measurements and observations, upload digital photos, and draw sketches. Based on inspector input, the application interface was designed to make it easy to capture the required data points with minimal scrolling and flipping from screen-to-screen.

From the end-user perspective, all of the technology is invisible, which means inspectors can focus on inspections rather than technology. And the success of the project has allowed NCDOT to remain in compliance with federal regulations that require the state's 21,000 bridges, culverts, pipes, and overhead signs to be inspected every two years. With approximately 150 new bridges being added each year and the aging of the current infrastructure, the automation provided by the WIGINS application will become even more critical in years to come.

**Description of the business problem and solution:**

There are an estimated 21,000 structures (bridges and culverts) statewide, which are inspected by 18 topside teams, 4 underwater teams and 3 special inspection teams.

Before the implementation of WIGINS, the process of bridge inspection/reporting was very time consuming. Inspectors took notes and photos in the field, and then returned to the office to type their reports, using written notes and digital photos, which they imported and placed one by one in an Excel spreadsheet. They also drew freehand sketches using the Excel drawing tools, which contained no set scale or common elements. After reports were completed, they were printed, signed, and then mailed to the Bridge Maintenance Unit for approval. After this, they were sent through Analysis for another approval and sign-off, and then through three more stages of approval. When a report has to pass manually through the hands of at least five different people, the approval process can be painfully slow, and there is an increased possibility of reports getting lost in the paperwork shuffle.

Each inspection team had different ways of documenting data, which led to inconsistent data collection. This made it difficult to confirm whether inspections were done accurately, on time and in a way that would enable the Bridge Management Unit to make a correct analysis of each bridge's condition. The complex analysis process includes as many as 23 different types of inspections that might be performed, depending on the type of structure. And with no two bridges built the same way, the process was even more complex. The numerous measurements and observations recorded during a typical inspection include bridge width, bridge height, pile spacing, water depth, pile exposure, asphalt thickness, rail thickness, gap thickness and streambed erosion.

In 2004, WIGINS automated the inspection process, providing a single point of data entry that could be taken anywhere. This significantly reduced the time spent on bridge inspection reporting both in the field and in the office. WIGINS utilizes an Oracle database for the storage of statewide data. Smaller, portable ASA Mobilink server (Sybase) databases reside on the HP Tablet PCs, which enable data to be sent and received in multiple locations around North Carolina.

Because bridge inspection involves a lot of legwork, Inspectors were given the HP Tablet PCs loaded with the WIGINS application and the synchronizable ASA Mobilink server (Sybase) databases. When in the field, they are able to synchronize information with each other when they are working on the same structure. In the office, all information can be sent to the main Oracle server through synchronization. During this process the main Oracle server sends back any new inspection assignments, rejected reports, software updates, or any other necessary information sent by other NCDOT departments. Not only can the Tablet PCs go anywhere the inspectors go, they also provide a central base of operations.

The WIGINS application uses ActiveReports technology to produce real-time previews of the reports so that inspectors can view them while they are still at an inspection site. This eliminates the need for site revisits due to incorrect data entry. WIGINS is written in C# specifically for mobile devices and has the ability to run on wearable PCs such as the XYBERNAUT as well as the HP Tablet PCs. For ease of use in remote locations, voice recognition and a heads-up display feature were also built in.

WIGINS includes the following features and utilities:

- Automatic Import of digital photos directly from memory card
- VectorDraw CAD drawing tools for structure sketches
- Sketch Wizards to standardize common sketches
- General bridge information, including maps and GPS information from MS Maps
- Individual bridge components of each bridge
- Measurement conversion tool, Calculator and Ruler
- Handwriting Recognition
- Shorthand database (customizable per user)
- Scheduling tool for Inspections
- Prompt Action Generator

WIGINS began as a simple data collector and report generator for NCDOT Bridge Inspectors and evolved into a business solution connecting all aspects of the inspection process, including emergency prompt action items. The processes were always connected, but were handled by different departments within NCDOT. Each department had its own methods, and communication between them was slow and limited at best. With WIGINS, all departments are kept informed about everything affecting them, even if it is being handled by another department.

**Significance:**

With WIGINS, NCDOT has developed the first, completely inclusive bridge inspection system in the U.S. But most importantly, the WIGINS application has helped NCDOT address bridges that need repairs more promptly. The ability to repair a bridge before a major problem occurs is invaluable. Keeping motorists safe on North Carolina roads and bridges is NCDOT's first priority, and this innovative use of technology allows it to do just that—more efficiently and effectively than ever before.

**Benefit of the Project:**

The most important benefit that the WIGINS application provides is that it helps NCDOT make sure the bridges in North Carolina are as safe as possible. This benefits not only the citizens of North Carolina, but also those traveling through North Carolina. As both a vacation destination and a major thoroughfare state with I-95, I-85, I-77 and I-40, North Carolina is also concerned about our out of state visitors and their safety. Since deploying the WIGINS application, NCDOT has been able to address bridge problems more promptly. The potential tragedy and loss of lives is great, so it is important to know that the state is doing all that it can to ensure motorist safety.

From an administrative perspective, the WIGINS application makes it easier for all departments in NCDOT to analyze bridge conditions because all of the data is documented using the same data format within the data fields. Therefore, any user can parse the information collected and deliver, with certainty, the current state of efforts. With more than 1,000 data points, the WIGINS application also makes it much easier to analyze reports and compare specific data points among multiple bridges. Under the previous bridge inspection system, reports were saved and formatted differently by each inspector, especially in cases where reports were submitted by outside contractors. In addition, the new system has shortened the time-span for information to flow from the inspectors to the analysis team down to days instead of weeks.

Historically, the inspection process was paper based. Inspectors, working in two-person teams consisting of a team leader and a team member, were assigned bridges to inspect. They were given paper copies of the previous inspection reports as a reference and would make written notes on their observations and measurements as they conducted inspections. This process was not particularly efficient and was prone to inaccuracies, as information had to be transferred from the handwritten notes into the department's consolidated database. In addition, each inspection team collected data differently, leading to inconsistent data collection. Following the deployment of the WIGINS application, NCDOT has generated four significant process benefits:

- Increased inspection efficiency, accuracy and consistency of the bridge inspection process
- Elimination of paperwork, allowing inspectors to spend more time on inspections
- Immediate availability of inspection reports, which allows analysts to view reports faster and react faster to bridges that need repairs
- Digital storage of reports allows multiple people to view reports at the same time, improving quality control

The Department of Transportation estimates that they spent approximately \$1.0 M developing and implementing the system. The annual cost savings are approximately \$400,000. The savings number includes the process savings mentioned above as well as the DOT's ability to handle an increased work load with the same number of inspectors.

From an application development perspective, NCDOT found it easy to integrate WIGINS with the Sybase technology, and the Sybase technology integrated easily with the third-party operating system and backend database. This easy integration along with the Sybase synchronization capability pays off when it comes to upgrading the application. Instead of needing to have the devices physically in house, IT can deploy upgrades automatically through the main server when end-users synchronize by logging on to the state network. NCDOT has also found the system to be virtually maintenance-free and cost-effective since no expensive hardware is required to run the synchronization server.

Ultimately, the travelers and all citizens of North Carolina benefit from the WIGINS solution, by having an infrastructure that is well maintained. With the nation's only all-inclusive bridge maintenance management system, NCDOT is paving the way for the safety of its citizens and the efficiency of its operations.