

Advanced Collaboration Technology Best-Use Study: REKOR ONE PILOT EVALUATION REPORT



Table of Contents

Contents

Table of Contents
Executive Summary
Introduction and Purpose
Evaluation Overview
Methodology4
STIC Grant Criteria4
Planning Phase4
Implementation Phase:
Utilization Phase:6
Operational Criteria8
Predictive Traffic Capabilities
Number of Incidents Detected8
Incident Detection Time9
Key Findings10
Overall Budget10
Lessons Learned
Conclusion12



Executive Summary

In 2019, the North Carolina Department of Transportation (NCDOT) received State Transportation Innovation Council (STIC) Incentive Program funding to pilot software to improve collaboration and communication. Rekor One (formerly known as Waycare), a non-traditional advanced traffic management system (ATMS), was among the technologies investigated as part of this grant. The department also completed pilots for the Dynac and Activu software platforms.

The pilot involved testing the Rekor One platform in North Carolina's Triangle region. This 6-month pilot evaluated the platform's communication, dispatching, and predicative analytics capabilities. Rekor One is intended to improve collaboration and incident detection of the Statewide Transportation Operations Center (STOC), Traffic Management Centers (TMCs), Incident Management Assistance Patrol (IMAP) Responders, and other partner agencies. By performing a best-use study, NCDOT gained greater insight of this technology. Key takeaways included:

- System Benefits:
 - Rekor One successfully integrated Waze, NCDOT's Traveler Information Management System (TIMS) data, and Raleigh PD CAD feeds into its software. This supported incident awareness within the pilot locations.
 - Rekor One demonstrated a well-designed user interface and provided a useful workflow process within the platform for control room staff.
- Challenges:
 - 7% of the data received from Rekor One resulted in actionable steps. Duplication of data and inability to reduce "noise" of information received increased the workload on operational staff.
 - Limitations in the predictive analytics capability led to limited use throughout the deployment.
 - Although it was anticipated, automated and dynamic dispatching of IMAP personnel was ultimately not used in the pilot because of current NCDOT procedures, driver distraction and safety concerns, and unidentified benefits of the Rekor dispatching platform.
- Lessons Learned:
 - NCDOT's communication network and structure impacted the departments' ability to evaluate the full functionality of the Rekor One system. For instance: The platform could not access the CCTV streaming video or connect to the DMS information.
 - Through this pilot, the department gained greater insight within their ITS infrastructure and the system capability needed to support a future ATMS deployment.

The information below captures the details of the evaluation of this pilot.

Introduction and Purpose

The purpose of the pilot was to understand how Rekor One could enhance NCDOT's operational capabilities, improve collaboration, and implement predictive analytics to support incident awareness and potentially dynamic dispatching. Efforts to set up and integrate the system started in June 2021 and



the pilot went live on February 7, 2022 and ended on August 7, 2022. This report provides information regarding NCDOT's experiences with the platform and captures lessons learned, limitations, and technical challenges. This investigation provides information and recommendations on how it best helps NCDOT achieve their long-term goals, whether as individual platforms or used in concert.

The evaluation of Rekor One also aligns with NCDOT's Traffic Systems Operations group (TSO) goal to procure an Advanced Traffic Management System (ATMS). The TSO group, as part of this STIC grant, evaluated (3) advanced collaboration technologies. NCDOT piloted Activu[®], Dynac[®], and Rekor One to support the departments movement towards securing an ATMS. The STIC grant funds of \$50,000 were directly used to purchase the Waycare / Rekor One 6-month pilot.

Activu[®], operational at all NCDOT TMCs since August 2019, allowed for pushing of CCTV camera feeds and TMC operator screens to anyone with the appropriate application and access. DYNAC[®] is a traditional ATMS that has been operational for the North Carolina Toll Authority (NCTA) since December 2019 and was piloted in the Triangle area by NCDOT in 2020, offering opportunities for efficiencies in resource-sharing, interoperability, and technology transfer. Evaluation reports for these pilots are available.

Evaluation Overview

The research team completed the Rekor One evaluation using two sets of criteria:

- 1. STIC Grant Criteria: This followed the prescribed process of reviewing planning, implementation, and utilization phases of this deployment.
- 2. Operational Criteria: The evaluation focused on key outcomes that were anticipated as part of this deployment. Our assumptions regarding predictive capabilities, increased incident detection, and the research team evaluated the reduction of incident detection time as part of this process.

Methodology

STIC Grant Criteria

Planning Phase

The Rekor One pilot kicked off in June 2021 with a demonstration and overview of the platform's capabilities, which involved multiple agencies. Based on their knowledge of the platform, NCDOT's TSO group identified the following operational goals that could potentially be met with the deployment of the Rekor One Platform:

- Support predictive incident detection by identifying locations and times of where incidents may occur
- Increase the overall number of impactful incidents detected
- Improve incident detection time
- Decrease dispatch times



The planning process consisted of numerous coordination meetings with the TSO group, NCDOT IT department, and Rekor One to determine the system implementation needs. The research team identified the NCDOT's ITS/IT infrastructure limitation and the Rekor One platform connection capability during this process. The research team discussed the following items as part of this implementation:

- Integration with NCDOT ITS devices (CCTV and DMS)
- Two-way TIMS (Traveler Information Management System) integration
- Automatic Vehicle Location (AVL) data integration with NCDOT Emergency Vehicle Alerting (EVA) Devices
- Smart Work Zone data from providers such as iCone
- Historical crash data
- HERE probe data
- Waze data
- Connected vehicle data
- National Weather Service data

Implementation Phase:

This phase includes data integration, device installation, setup, and training for use of this platform. Schedule management was a key focus area during this period.

Data Integration: The Rekor One Platform successfully integrated with the EVA and Smart Work Zone AVL data and 4 years of NCDOT's historical crash data. Achieving two-way integration of incident logging and data exchange with NCDOT's existing TIMS system required hundreds of hours of NCDOT's staff time to develop. This effort began in August 2021 and completed in February 2022 with a TIMS update release.

Initially included in the scope, the Rekor One platform was going to use HERE probe speed data to supplement the incident detection capabilities. However, the Rekor data scientists determined that the data was too noisy and decided not to use it. Rekor One did use traffic speed and congestion data that they sourced on their own for the traffic congestion layer shown on the Rekor platform. Even without the probe speed data, the platform's incident detection system consumed source data from Waze and connected vehicle data.

Device Integration: The Rekor One Platform was not able to fully integrate the CCTV and DMS devices. NCDOT and Rekor One attempted to ingrate the devices by:

- NCDOT provided Rekor with h.264 compression camera streams over an RTSP protocol through its current video distribution system. This format was not ingestible for the Rekor One platform and NCDOT did not have the capability to convert the streams into a consumable format without upgrading their video distribution system.
- Rekor attempted to convert the video streams themselves but was not successful.
- Rekor attempted to utilize thumbnails of camera streams; however, this was not successful due to delayed responses of video. Inability to capture video streams and thumbnails impacted mobile platform expectations.



- The Rekor One platform was intended to display the current messages playing on NCDOT's DMS. NCDOT's DMS software does not supply an API feed so communication between the platform and NCDOT's DMS was not achieved.
- NCDOT provided Rekor with the DMS system's Software Developer Kit (SDK) to see if they could reverse engineer the communication, however, this was not successful and therefore the Rekor One platform was unable to display messages.

Setup: The Rekor integration team was able to easily set up the accounts and workspaces. This included customization of user accounts by TMC, functional class, and geography. The software for the platform delivered a browser-based user interface, so there was no installation required for the users.

The original intent of the pilot was to only focus on the Triangle region, however Rekor offered to increase the geographic limits of the evaluation area to include all regions of the state. After the pilot started, NCDOT and Rekor decided to reduce the geographical scope back to only including freeway and arterials in the Triangle region due to the challenges seen with integration and the risk of introducing too many incidents to manage on a larger scale.

Training: The Rekor team provided multiple onsite training sessions for super users who then provided training to the remainder of the control room operators. Rekor also provided remote observation and training sessions during live operations to improve the operators' use of the system.

Schedule: The initial platform go-live date was planned for September 2021. However, due to the time required for implementing a number of integration items (TIMS data integration, CCTV and DMS connectivity, data feeds, etc.) and the time required to determine the operator workflow and configuration of the platform, the launch was delayed until February 7th, 2022.

Utilization Phase:

This phase assesses and reviews the capabilities of the technologies, usability and reliability, and user experience.

Dispatching: Initially NCDOT planned for its IMAP Safety Service Patrol and NC State Highway Patrol to use the platform from in-vehicle tablets for dispatching functions. The scope included Rekor providing automated notification and dispatching of personnel to an incident scene, as well as the possibly of predicting potential event risk areas. NCDOT purchased tablets as part of this grant for Division 5 IMAP drivers to utilize the Rekor application. NCDOT's TSO and Rekor met with Division 5 IMAP personnel to understand application and the needs of IMAP. Division 5 IMAP Safety Service Patrol did not utilize the dispatching function of the Rekor platform due to the following reasons:

- The platform only allowed for IMAP to self-dispatch, however, this does not follow NCDOT's protocol. The current dispatch practice is for the TMC to dispatch the IMAP drivers to confirmed incident locations.
- IMAP managers raised concerns regarding drivers spending additional time and mileage driving to unconfirmed incident notifications.
- Rekor One was unable to provide IMAP with the ability to view live video from nearby CCTV cameras.



- IMAP managers also raised safety concerns about driver distraction in use of the platform on tablets. NCDOT's IMAP training program does not currently include using electronic devices in their vehicle so there was additional safety training needed to emphasize the dangers of interacting with a mobile device and driving. IMAP drivers are constantly patrolling so there is a risk of drivers using the platform while in motion.
- SHP was in the process of implementing new CAD systems, which hindered the participation with the Rekor platform.

IMAP used Rekor to view incident details but did not use Rekor to its fullest potential to include viewing live video stream from cameras and dispatching. As a result, IMAP's participation in the pilot was significantly limited.

Control Room Experience: The STOC was responsible for monitoring and responding to incidents identified in software. The following items were captured as part of the evaluation:

- Utilizing the data:
 - Rekor platform reported too many incidents that could not be verified or should not result in further operator action.
 - Rekor platform provided insufficient data to support further operator action (e.g., incident types listed as "Other"; no cross street provided or cross street and impacted route were the same, etc.).
 - Rekor platform did not suppress crash duplicates to ensure that the operators did not miss a potential secondary incident.
 - Rekor platform reported incidents earlier than SHP for 50% of the cases examined. See the details of the analysis in the section "Incident Detection Time" below.
- Surveyed operators: As part of the utilization phase a mid-pilot survey was prepared and sent to the TMC Operators using Survey Monkey on June 13th. Results from the survey included:
 - Users reported that the platform was well laid-out and easy to use.
 - 80% of the users reported that the platform did <u>not</u> help to optimize workflow efficiencies. Operational staff was required to maintain the existing systems (TIMS, etc.), while managing Rekor One.
 - Operators faced challenges with confirming a majority of the incidents that were reported by the software's detection algorithms. This reduced the operator's confidence in the platform.

Rekor One provided constant and consistent customer support throughout the entirety of the pilot through recurring meetings and a customer support email address. Rekor One worked to resolve the following issues identified during the pilot:

- Data hub reported "missed" incidents by the control room floor operators, however, these incidents were outside of the designated workspace, meaning there was a major discrepancy between what analysts were seeing and what Operators were experiencing.
- The Rekor One platform reported numerous incidents on roads considered as "Minor Arterials" (locations where verification unlikely and meaningful DOT action not available).
- The Rekor One platform presented common road names on the map platform instead of the road numbers.



During the pilot, the TIMS product team at NCDOT developed an add-in screen in TIMS and enhanced the TIMS incidents API to automate transfer of incident data and eliminate duplicate incidents feeding between the two systems.

Connectivity of the Rekor One system was maintained during the pilot. When outages occurred, the Rekor One team quickly resolved the issues.

The Rekor One Platform utilized connected vehicle data as one of its sources for incident detection. In many cases, this data was helpful in identifying incidents earlier than existing sources, however it often introduced false positives and duplicates.

Operational Criteria were evaluated in the following described subsections.

Predictive Traffic Capabilities: The six-month Rekor One pilot with NCDOT ran from February 7 through August 7, 2022. One of the metrics evaluated is the ability of the platform to predictive crash analysis. The platform provides an upcoming time window, usually 3 hours, over a highlighted road segment, which it predicts the **likelihood of a crash occurring.**

The evaluation team examined the accuracy of the crash risk predictions, comparing a sample of the logged prediction notification windows to the actual crashes listed in TIMS. Among the sample evaluated, the team found at least one crash in TIMS which was inside the Rekor crash risk predicted locations and times. Outside of the predicted locations and times, no TIMS incidents were found in our sample.

The information from the crash risk predictions was found to not be useful for traffic management because the predictions were given over long segments and over long periods of time.

Number of Incidents Detected: This metric evaluates the number of incidents detected on the Rekor One Platform within the six-month pilot data set. Rekor developed monthly summary metrics and each KPI was reviewed monthly throughout the pilot. The Rekor platform increased the number of incidents detected by the Traffic Management Center (TMC) operators by 7%. Conversely, 93% of crashes listed on Rekor One platform were not usable, for example:

- incidents reported on small residential streets,
- incidents that were unable to be verified, and
- incidents with insufficient details

The Rekor support team continued to work to reduce the incidents on small residential streets during the pilot. The metrics related to crash incident detection during pilot are summarized in the table below.



Table 1: Rekor One Crash KPI Summary for the 6-month pilot

Crash Metric	Monthly Average
Total number of crash only incidents identified in Rekor	2,485
Total number of confirmed crashes in Rekor (traffic impacting only)	195
Percentage Confirmed Crashes (over all Crashes Reviewed)	4%
Percent of crashes rejected	93%
Percent of crashes expired	3%
Top 3 Completion Reasons for Rejected Incidents (non-expired)	Could not be verified, Duplicate, False
Total number of crash only incidents identified in TIMS	1,397
Total number of crash only incidents identified in TIMS sourced from Rekor	242
Total percent of crash only incidents identified in TIMS sourced from Rekor	17%

To check the Rekor incident awareness, the research team evaluated the TIMS incidents using crash type incidents for Division 5, between February – August 2022. A total of 1,397 crash type incidents were recorded over a 6-month period and 242 of those incidents were first found in the Rekor One platform. Although the TMC operators may have found some of the incidents without the Rekor One platform, incident awareness increased by 17% for the six-month period.

Incident Detection Time: This metric evaluates the ability of the platform to enable **earlier incident detection**. By collecting and bundling incident information from a variety of sources, such as the Raleigh 911 CAD Feed, Waze, and the Rekor One platform itself, the TMC operators may be made aware of some of the incidents earlier than they otherwise would, had the platform not been used. This investigation is an attempt to assess the contribution of the Rekor One platform to achieving earlier incident detection.

As with many studies, the analysts can never directly compare the action taken, i.e., using the Rekor One platform vs not using it, during the same calendar period and geography. Instead, the approach suggested for this evaluation is to compare the entry times of incidents from State Highway Patrol (SHP)



via the SHP CAD Feed in TIMS, to matching incidents which appeared in the Rekor One platform. SHP CAD Feed incidents are a major source of incidents in TIMS, especially on the interstate roads.

During the six-month pilot period, the archived incidents along interstates in NCDOT Division 5 were downloaded from SHP CAD Feed in TIMS, and Rekor One incidents were obtained from Rekor staff as direct download from the Rekor One database. The evaluation team wrote an automated evaluation script to check each SHP incident and find the earliest matching incident in the Rekor One Platform, based on similar road, direction, date, time, and mile marker. A research team analyzed a total of 1,933 SHP incidents, after removing the blanks for location, direction, and mile marker. Of those, the research team found a total of 847 SHP incidents with a matching Rekor One incident.

When comparing incident detection timelines between Rekor and SHP, the research team found that of the incidents analyzed, Rekor had an earlier detection time in 422 (50%) cases, while the SHP incidents had an earlier detection time in 391 (46%) of the cases, and 34 cases (4%) had equal detection times. Among the incidents found first by the Rekor One platform, they were found 12.0 minutes earlier on average than the same incidents in the SHP CAD feeds.

Key Findings

After the evaluation of the Rekor One Platform the following key findings were identified:

- Rekor increased incident awareness (for traffic impacting incidents) by 17%
- 7% of the crashes listed on Rekor Platform were used. This represents an increase in the number of incidents for which the TMC had awareness, compared to not using the platform. Regarding the remaining 93% that were not used, the TMC already had awareness of many of these incidents through existing sources of incident detection.
- Rekor detected 50% of incidents faster than SHP CAD feeds.
- Among the incidents found first by the Rekor One platform, they were found 12.0 minutes earlier on average than the same incidents in the SHP CAD feeds.

Overall Budget

The overall budget for this project, not including internal NCDOT labor costs, was \$62,500. A complete breakdown of estimated and actual project costs is provided below:



Table 2: Project Budget Performance

Task	Estimated	STIC	NCDOT	Internal	Total
	Cost	Funding	Funding	Labor	Costs
				Costs	
 Purchase Rekor Pilot: The NCDOT STOC has negotiated a fee with Rekor for a 6-month pilot of their platform in Wake County. Prior to the beginning of the 6-month pilot, Rekor will spend approximately 3 months gathering data and training STOC 	\$50,000	\$48,000	\$0	\$66,631	\$114,631
operators and dispatchers use of the software.					
2. Inter- and Intra-Agency Coordination:	\$12,500	\$2,000	\$18,663	\$8,517	\$25,180
 The STOC will purchase tablets for use in IMAP and SHP vehicles, to trial the in-car technology component of Rekor The SHP has agreed for two Troopers and two Sergeants to participate in the pilot by using the software and tablets and providing feedback to be used in the overall evaluation. 	440 200				
Total Estimated Cost	\$62,500				
Total Actual Cost		\$50,000	\$18,663	\$75,148	\$143,811

Lessons Learned

Key lessons learned include:

- 1. The pilot involved concurrent usage of the Rekor platform along with the existing traffic management monitoring and logging tools and did not replace these in the operator workflow. The additional workload and duplication of effort resulting from use of an additional tool may have reduced the effectiveness of the Platform, compared to switching to it exclusively.
- 2. Reducing the geographical scope of the area could have reduced the noise in the platform and improved the operator response.
- 3. Reducing the requirements for confirming incidents could have led to an increase in the number of incidents managed by the TMC. NCDOT's situational awareness did improve with the utilization of the Rekor One Platform.
- 4. NCDOT has historically been reluctant to use cloud-based software, like the Rekor One platform. With the implementation of the system:
 - IT requirements and restrictions within NCDOT were brought to light, such as difficulties connecting the platform to CCTV video feeds



- The department recognized the advantages of the cloud-based software (logging into website without IT installing software on multiple machines, etc.).
- 5. With the Rekor platform, NCDOT was also able to test and demonstrate the value of AVL.
- 6. The pilot also served as a precursor for operator workflow for using an ATMS software and shaped interactions with the ATMS procurement based on the Rekor One platform.

Conclusion

Overall, the Rekor pilot was a good exercise to recognize NCDOT's limitations, demonstrate the need for a platform that combines multiple incident detection tools, and show the value in a cloud-based software. The platform's user interface was well laid out and combined multiple data sources and incident detection tools into one platform. Rekor's customer service and training representatives were professional, knowledgeable, and attentive to issues or suggestions. Although the Rekor One platform provided some additional benefits, there were significant challenges and limitations that were found throughout the 6-month pilot. These challenges included technical shortfalls, Rekor's dynamic dispatching process, Rekor reporting too many incidents that could not be verified or did not result in further operator action, and the quantity of incidents reported by Rekor presented a workload increase based on our current operational processes that was not sustainable during the pilot. The Rekor pilot provided several benefits to enhancing NCDOT's traffic management process, however, because multiple challenges were left unresolved, the full intent of the pilot was not received. NCDOT offered Rekor to continue using the system, so the machine learning system continues to learn while the department helps them optimize and study results.