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Use of Dashboards for Winter Operations Case Study: Kentucky Transportation Cabinet

Clear Roads Project 22-05: Use of Dashboards for Winter Operations

December 2024

Technical Report Documentation Page

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16. Abstract Public works agencies at state and municipal levels have invested a large amount of personnel and funding resources in dashboards to improve winter maintenance operations. This document is one of the five case studies conducted for the Clear Roads project entitled *Use of Dashboards for Winter Operations*. This case study report summarizes the Kentucky Transportation Cabinet's experiences and lessons learned in using dashboards to support winter maintenance. The case study identifies the purpose of each Kentucky Transportation Cabinet dashboard, the performance measures tracked, the data sources, how the dashboards are maintained, difficulties encountered, and key lessons learned.			
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1. Overview of Kentucky Transportation Cabinet Dashboards for Winter Operations

This section provides an overview of this Case Study report detailing how the Kentucky Transportation Cabinet (KYTC) has used dashboards for winter operations.

1.1 Case Study Background

This research project is being funded through the Clear Roads pooled fund program to develop Case Study Reports documenting how multiple State DOTs and public works agencies use dashboards for winter operations.

1.2 Agency Characteristics

As shown in Figure 1 KYTC is divided into 12 Department of Highway Districts that help keep the routes safe and passable during the snow and ice season.

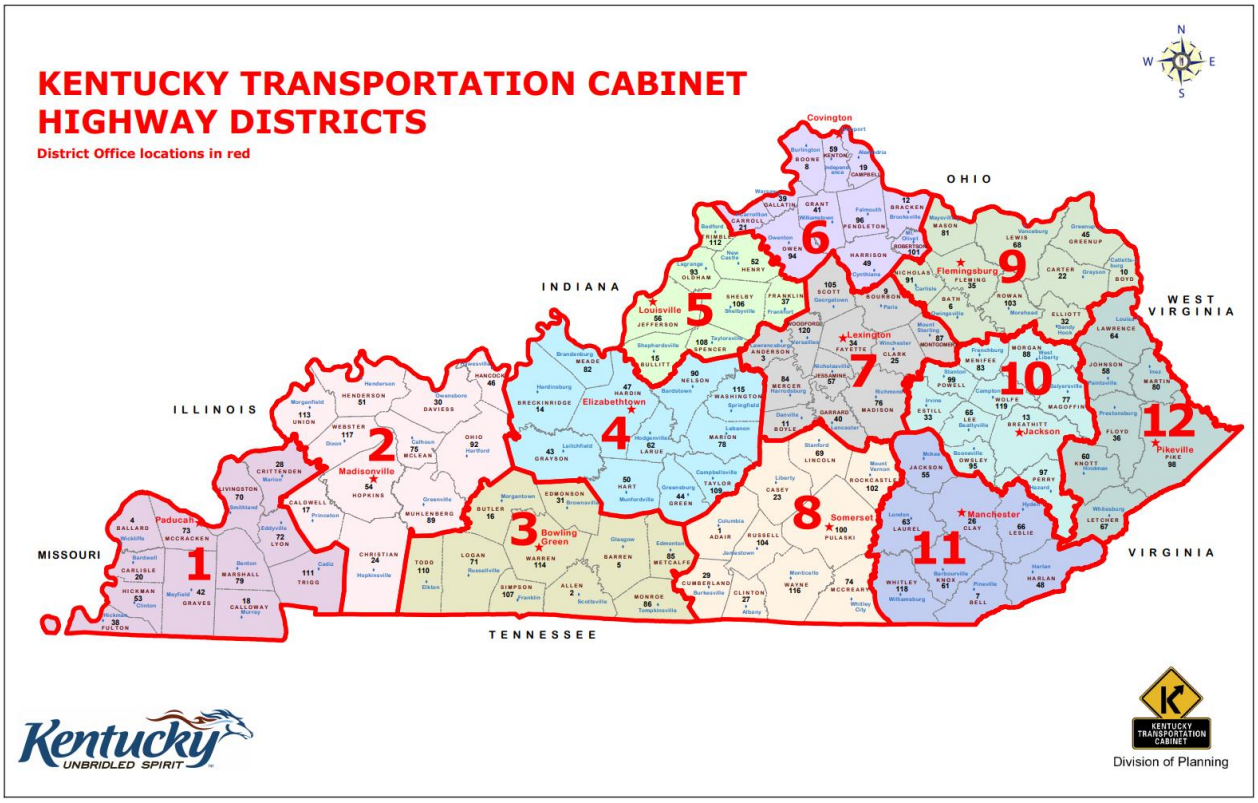


Figure 1 KYTC Districts

KYTC manages 27,600 total lane miles with 1,000 state-owned plow trucks with over 1,800 state employees and 400 contracted plow trucks. KYTC maintains 93% of the state-owned roadways. In the 2022-2023 winter season, KYTC applied approximately 136,000 tons of sodium chloride and 1,405,000

gallons of liquids (sodium chloride brine and calcium chloride brine). The cost of salt last season was $98.72 per ton resulting in $20.3 million dollars for material costs. The average accumulated winter season index was 119[1]. These data were reported to Clear Roads Winter Data Survey.

1.3 Agency Interviews

An interview was conducted virtually with KYTC staff on Thursday December 21st, 2023, at 9 AM CST. Table 1 contains a listing of the staff interviewed and the subjects discussed in those meetings. Appendix B to this report contains meeting minutes from the interview.

Table 1 Staff Interview Details

Staff Interviewed	Date / Time	Subjects Discussed
Chris Lambert, Kentucky Transportation Cabinet, Systems Consultant IT **Randi Feltner,** Kentucky Transportation Cabinet, Transportation Engineering Supervisor	Dec 21st, 2023 / 9:00 AM	Dashboard objectives Description of each dashboard Limitations of each dashboard Process for developing a new dashboard Data accuracy Data storage and management Dashboard maintenance Costs Benefits of dashboards Recommendations and lessons learned Future enhancements

2. General Overview of Winter Dashboards

Development for winter dashboards started in 2012 due to a shortage of salt during winter maintenance. The KYTC sought a more effective way to track material usage to avoid similar issues in the future. Utilizing Geographic Information System (GIS) data, historical analyses were conducted to understand the causes of the salt shortage. Additionally, in 2014, KYTC established a partnership with Waze to access real-time traffic data. After this, KYTC aimed to integrate weather information from the National Weather Service (NWS), Waze, and alerts in their practices. To achieve this, the department began collaborating with developers in 2015 to create winter dashboards.

2.1 GoKY Dashboard General Overview

The GoKY Dashboard in Figure 2 is utilized for accessing real-time traffic information, including congestion areas, accidents, road hazards, weather conditions, traffic camera feeds, and other relevant data. An general overview of the dashboard is provided in Table 2. This dashboard serves as the main

[1] https://mrcc.purdue.edu/research/awssi/indexAwssi.jsp

source of real-time roadway information for both the public and agency use. The purpose of the dashboard is to allow users to make more informed decisions when traveling in the state. By leveraging data from reliable sources KYTC is able to provide up-to-date information related to roadways on a scalable platform like google maps. This dashboard transitioned from ESRI to Google Maps not just for a fresh look, but for critical performance improvements. The original platform struggled with user surges, leading to inaccurate information and frustrating delays. Google Maps, with its robust scalability and faster refresh rates, ensured reliable access and real-time data even during peak periods. Additionally, Google Cloud offered cost-effectiveness and access to advanced features like traffic layer integration and data streaming, significantly enhancing the dashboard's functionality. This may clarify the difference between traffic layer viewing and data availability from Google.

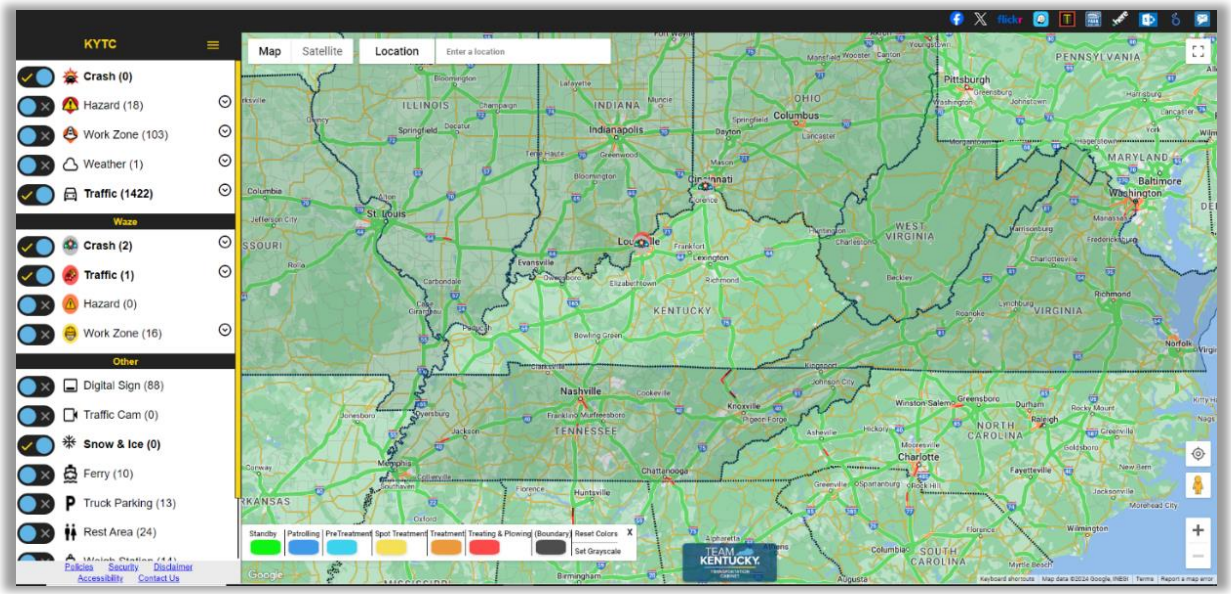


Figure 2 GoKY Dashboard

Table 2 GoKY Dashboard Overview

Purpose	Used to view live traffic data and contains information such as locations of congestion, crashes, hazards, weather conditions, traffic cameras, and more.
Performance Measures	Availability, scalability, and can support one million concurrent users
Data Sources	HERE traffic speeds, Waze reports, Traffic Management Center (TMC) reports, maintenance weather reports, traffic cameras, Dynamic Message Sign (DMS) messages
Refresh Rate	Every 2 minutes

Users/Access	The public
Platform/Software	Google Cloud
Source	https://goky.ky.gov/

2.1.1 Real-Time Data

The dashboard leverages a multitude of data sources, including HERE traffic speeds, verified by other Waze users (not necessarily by KYTC), TMC updates, maintenance weather responses, traffic cameras, and DMS messages. This comprehensive data pool refreshes every two minutes, ensuring users have the most current picture of Kentucky's roadways. Additionally, traffic cameras and DMS message displays provide visual aids for enhanced situational awareness.

2.1.2 Scalability and Reliability

Built on Google Cloud's robust platform, GoKY boasts exceptional scalability, seamlessly managing even peak user volumes. This ensures consistent and reliable access to critical information, even during unforeseen circumstances like emergencies or natural disasters.

2.1.3 Data-Driven Decision Making

Beyond public information, GoKY empowers KYTC staff and partner agencies with valuable data-driven insights. This intelligence informs crucial decisions regarding resource allocation, response strategies, and overall transportation management. Notably, GoKY played a significant role in coordinating road closures and recovery efforts during past natural disasters.

2.1.4 Continuous Improvement

While the current user interface is undergoing mobile optimization, the GoKY dashboard remains committed to ongoing development. Future iterations promise exciting new features, potentially including static data layers like rest areas, truck parking locations, and weather radar integration. Additionally, the exploration of Road Weather Information System (RWIS) data and outward-facing dashcam views hold promise for further enhancements.

2.2 KYTC Roadway Weather Decision Support Systems (DSS) Dashboard General Overview

KYTC Roadway Weather Decision Support Systems (DSS) Dashboard as shown in Figure 3 is a support tool designed mainly for staff use in the agency. It provides real time automatic vehicle location (AVL) data from salt trucks, camera feeds, and a storm severity index, that update at each half mile interval. While its main use case is for agencies to make more informed decisions based on real time data, this dashboard

has been proven to be useful for Public Information Officers (POIs) when responding to public inquiries related to traffic.

As shown in Table 3 the GoKY Dashboard's purpose is to provide real-time traffic information, including congestion locations, crash reports, hazards, weather conditions, traffic camera feeds, and more. By combining all these data outputs, the GoKY Dashboard is able to provide a comprehensive overview of current roadway conditions. The dashboard provides various filters to easily find the data sources that are needed based on use case. This includes things like location of crashes, traffic, hazards, work zones, rest areas, digital sign, and many others. Roads are also color coded with a legend at the bottom to display specific roadway conditions.

The dashboard is built on the Google Cloud platform, ensuring availability and scalability, so that any influx of users can be adjusted to. Data sources for the dashboard include HERE traffic speeds, Waze reports, TMC reports, maintenance weather reports, traffic cameras, and Dynamic Message Sign (DMS) messages. The system overwrites the data every two minutes, and updates for passes and salt are pulled from a Google Sheet until an end date is added. It is important to note that the system does not store historical data; it is purely a real-time tool. According to DOT personal, this process is currently under review to become more automated.

The system has more detailed information than its public version. Although the link is public, it is not widely publicized and is mostly shared with partner agencies. This approach eliminates the need for password sharing. Additionally, this was effective in eliminating any issues related to authentication that may come up during off-hours.

Looking ahead, the next iteration of this tool enhancement will include a trend-tracking feature. it is worth noting that the current system may become obsolete and could be retired in a year or so once the updated version is developed. One of the limitations of the current system is that none of the real-time speed data providers they have worked with can provide volume data, which could help determine the reasons for slowdowns. Currently there exists a confusion on which platform needs to be used for the next generation of the system. It was noted that since ESRI is limited on historical view of data and Looker Studio is limited on layering (visualizations), both of these are currently used.

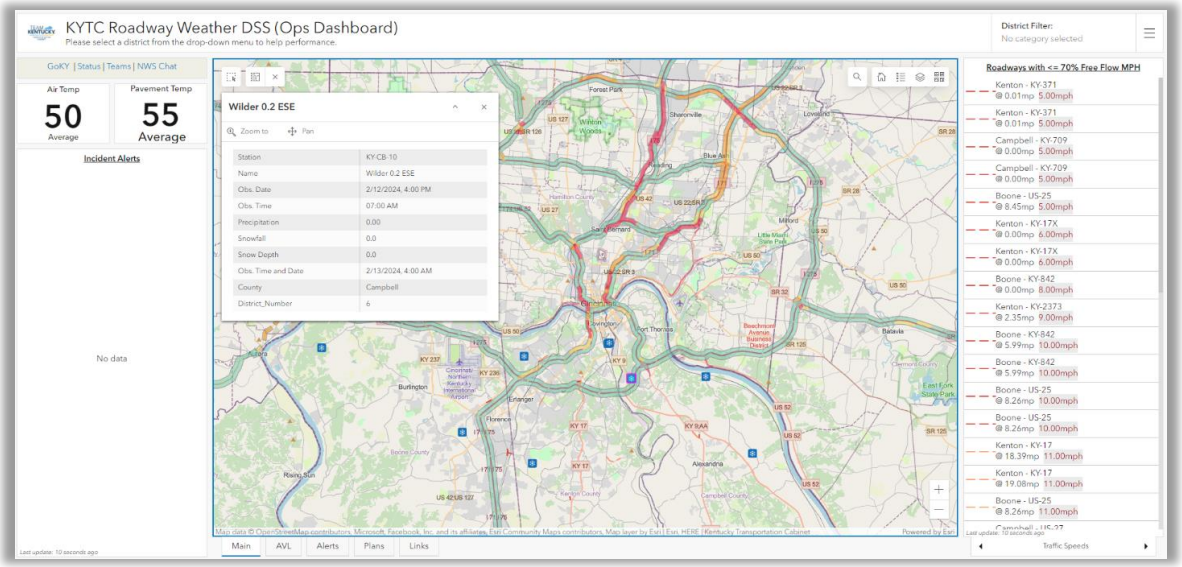


Figure 3 KYTC Roadway Weather Decision Support Systems (DSS) Dashboard

Table 3 KYTC Roadway Weather Decision Support System (DSS) Dashboard Overview

Purpose	Provides real-time decision-making data that includes salt, AVL data, cameras, and storm severity index
Performance Measures	Salt usage, vehicle location, camera access for visualization, and storm severity index. All in one spot joined to roadway segment.
Data Sources	AVL, cameras
Refresh Rate	Every 2 minutes
Users/Access	District and central office staff, Public
Platform/Software	Google Cloud, ESRI
Source	https://kytc.maps.arcgis.com/apps/dashboards/7e6fad274c5c4ae58c152e475dfe11f1

2.3 GoKY: ITS Real-Time Information Dashboard / Real Time ITS Data Studio Dashboard

GoKY: ITS Real-Time Information Dashboard /ITS Data Studio Dashboard, also known as ITS Data Studio, is a tool designed to help decision making related to short term trends related to weather and traffic as displayed in Figures 4 and 5. The tool is available to the public but is mainly used by KYTC internally. By utilizing data from a diverse range of platforms, average speeds, minimum speeds, mile points, and routes can be monitored. From these recovery movements and downward progressions can be tracked as well. This dashboard also contains a storm severity Index, which is a comprehensive scored system that inputs air temperature, wind, and radar values, to output granular weather impact

insights at 1/10th mile segments. This dashboard also contains a unique scoring system developed by KYTC known as the storm severity Index.

Table 4 shows that the purpose of the KYTC Roadway Weather DSS Dashboard is to provide real-time decision-making data for salt usage, AVL data, cameras, and storm severity index. It is a comprehensive tool that combines these various data sources into a single platform, allowing district and central office staff to access and visualize information easily.

The dashboard is built on the Google Cloud platform and utilizes ESRI software for mapping and geospatial analysis. The dashboard is accessible to the public and is hosted on the Looker Studio platform and Google Cloud. Most feeds refresh every 2 minutes, with AVL data refreshing every 2-3 minutes to ensure the most up-to-date information is available for users. However, this system does not store historical data and is purely used for real time information. By breaking down the network into half mile segments, users can click on different parts of the road to view data points such as pavement temperature and air temperature. Each piece of segment is also provided their own storm severity index. The GoKY ITS Real-Time Information Dashboard serves the purpose of displaying short-term trends and aiding in decision support. It is designed to provide the public with real-time information on traffic conditions and other relevant data. The dashboard's performance is measured by its uptime and scalability, allowing it to handle millions of records.

Data sources for the dashboard include TMC data, Waze reports, HERE traffic data, AVL data, RWIS data, KYMesonet weather data, and CoCoRahs precipitation data. With the tool being available on Looker Studio, the platform offers a very familiar and user-friendly interface for those who are familiar with google products and divides different data sources into tabs such as RWIS Weather, Waze Traffic, and Roadway Weather. A map featuring different incident types is also available with color codes for each.

In summary, this dashboard is a comprehensive tool that combines weather, speed, and severity data to provide real-time or trending insights. It should be noted that the uniqueness of this view is the time-depth. Despite some limitations, it is an example of data visualization for facilitating informed decision-making. The KYTC plans to continue improving the dashboard and addressing its limitations in future iterations.

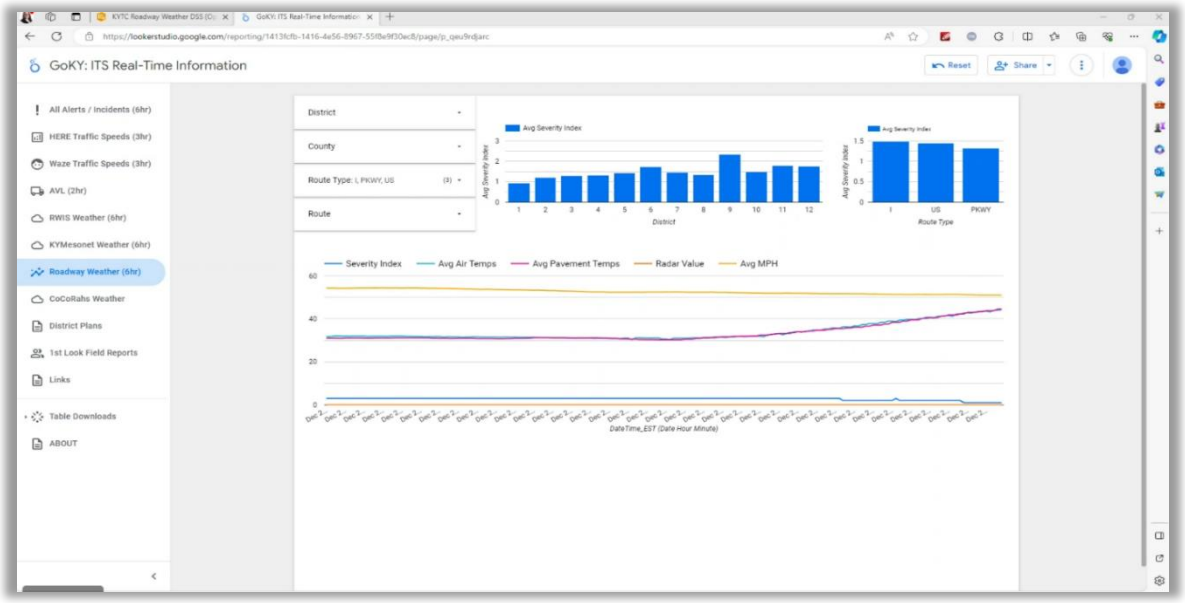


Figure 4 GoKY: ITS Real-Time Information Dashboard / Real Time ITS Data Studio Dashboard

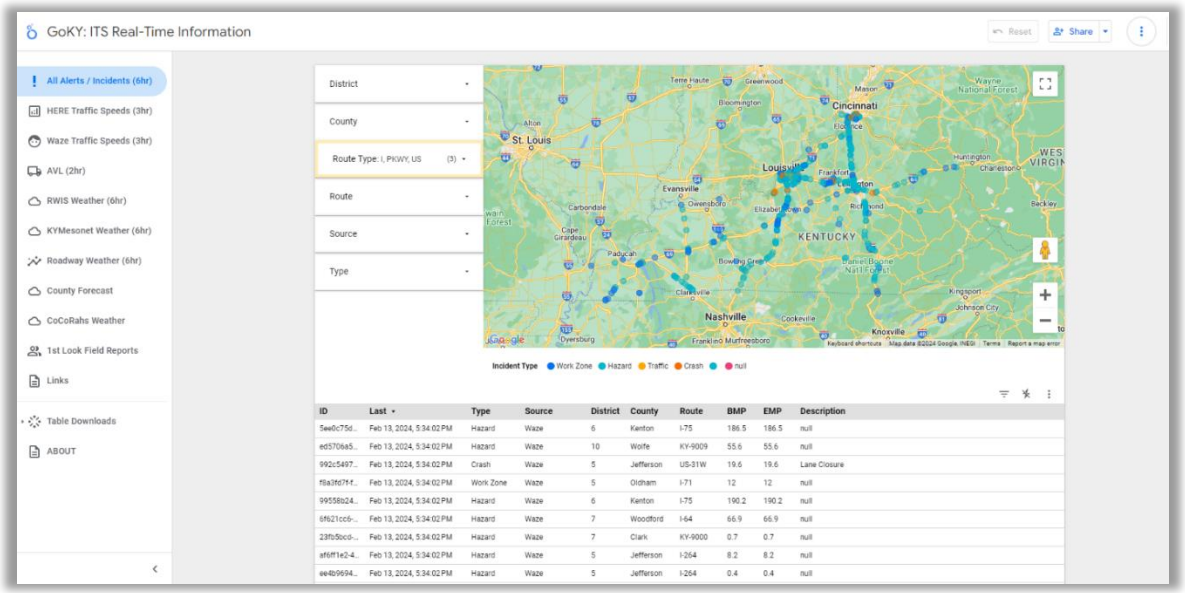


Figure 5 GoKY: ITS Real-Time Information Dashboard / Real Time ITS Data Studio Dashboard

Table 4 GoKY: ITS Real-Time Information Dashboard / ITS Data Studio Dashboard Overview

Purpose	To show short-term trends and help facilitate decision support
Performance Measures	Uptime and scalable to report on millions of records
Data Sources	TMC, Waze, HERE, AVL, RWIS, KYMesonet, CoCoRahs
Refresh Rate	Every 2 minutes on most feeds and every 2-3 for AVL
Users/Access	The public
Platform/Software	Looker Studio + Google Cloud
Source	https://lookerstudio.google.com/u/0/reporting/1413fcfb-1416-4e56-8967-55f8e9f30ec8/page/p_pbm4eo88qc

2.4 Material Usage Dashboard

Material Usage Dashboard as shown in Figure 6 is a tool to track material usage and summarize inventory information. A general overview of the dashboard is provided in Table 5. By utilizing Geotab assets which contain both inventory and AVL data, manually entered inventory data can be analyzed. Safety metrics are also able to be tracked an analyzed such as seatbelt usage, speeding, and harsh braking. This tool is purely meant for internal use and while the focus on the tool at first was salt usage, it now encompasses overall asset management with the goal to enhance resource efficiency, specifically in contract heavy areas.

Material Usage Dashboard leverages GeoTab assets to analyze manually entered inventory data. This dashboard is not open to the public and remains as an internal tool during development. While GPS coverage reaches 100%, AVL data currently sits at 85-90%, with daily card integration in development.

Beyond tracking material use, the dashboard expands into the realm of safety, pulling metrics like seatbelt usage, speeding, and harsh braking from GeoTab's onboard systems. GeoTab's diverse functionalities also offer potential for camera integration, temporary work zone identification, and more. On the other hand, the Geotab Safety Scorecard feature is a separate product, only available within the Geotab platform.

Initially focused on salt usage, the dashboard's scope has broadened to encompass overall asset management, aiming to enhance resource efficiency, particularly in contract-heavy areas. Its adaptability allows for future enhancements and creation of additional dashboards. Although the team do not yet have the AVL automated integration complete, they actively explore utilizing GeoTab's AVL data more effectively. While material usage currently relies on manual updates, integration with Trimble's AVL enhancements promises automation.

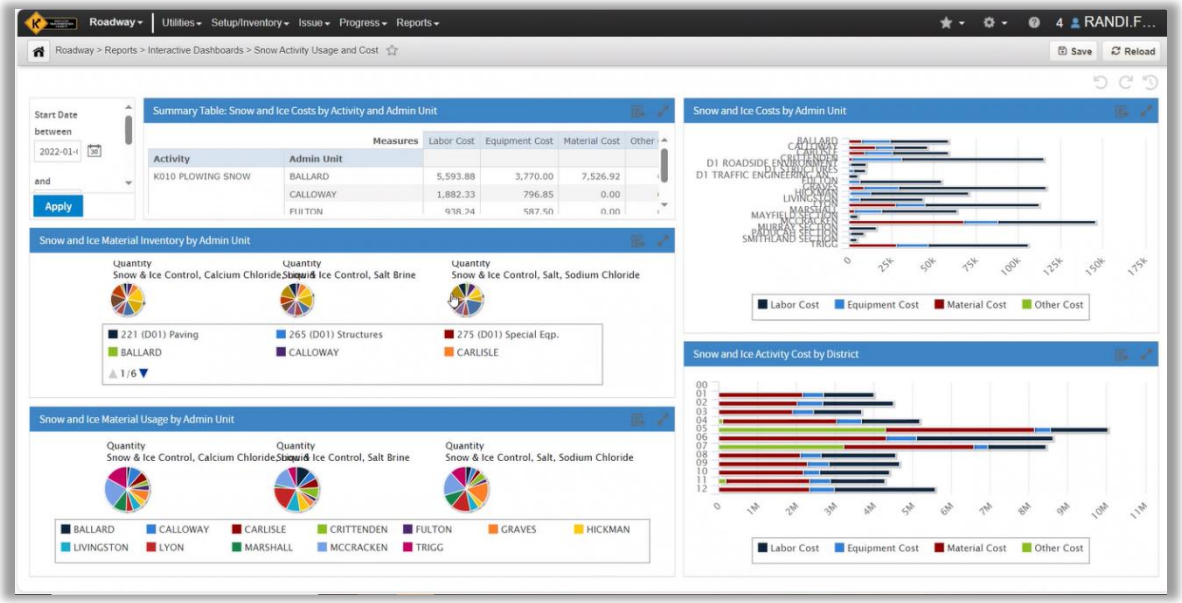


Figure 6 Material Usage Dashboard

Table 5 Material Usage Dashboard Overview

Purpose	Serves as a material usage dashboard that summarizes inventory information
Performance Measures	Material usage, safety, labor cost, equipment cost
Data Sources	OS Information (Manual Entry via Trimble)
Refresh Rate	Daily
Users/Access	Internal
Platform/Software	OMS by Trimble (formerly Agile Assets)

2.5 Previous Dashboards

A migration from the former Elastic Search platform to Google Cloud/Data Studio caused changes in dashboard layouts, making previous user interfaces inaccessible. One lesson learned from the development of this dashboard is that switching vendors may result in the loss of some dashboard views, requiring manual recreation. Figures 7 through 9 represent some of the previous dashboards that KYTC are working to recreate in the future.

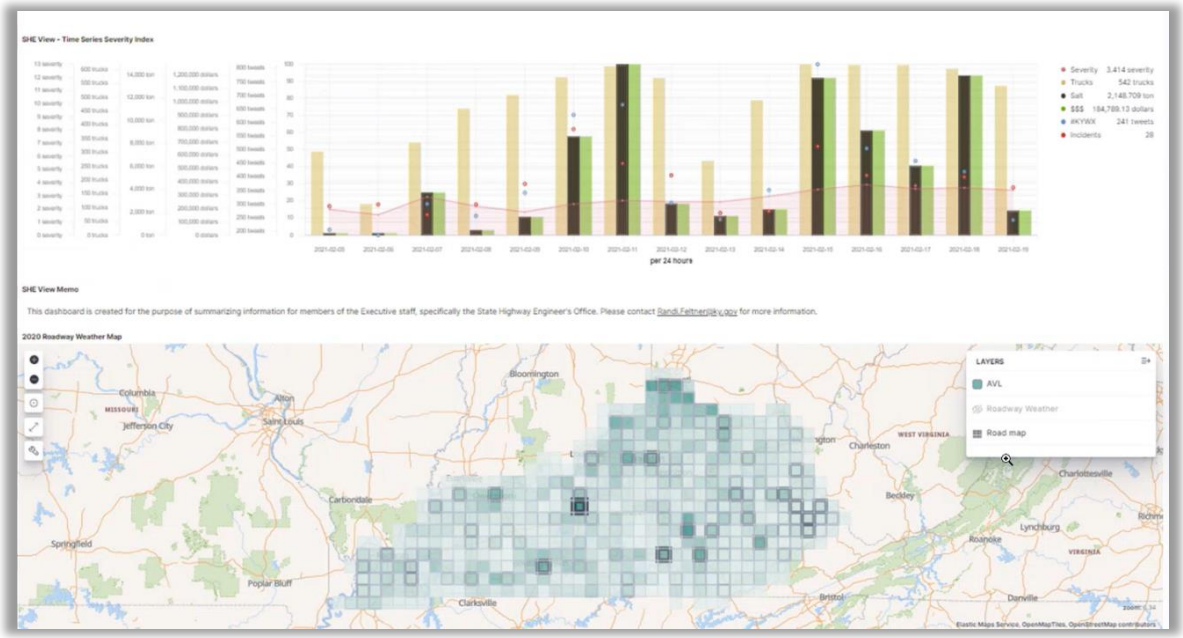


Figure 7 Time Series Severity Index and Roadway Weather Map

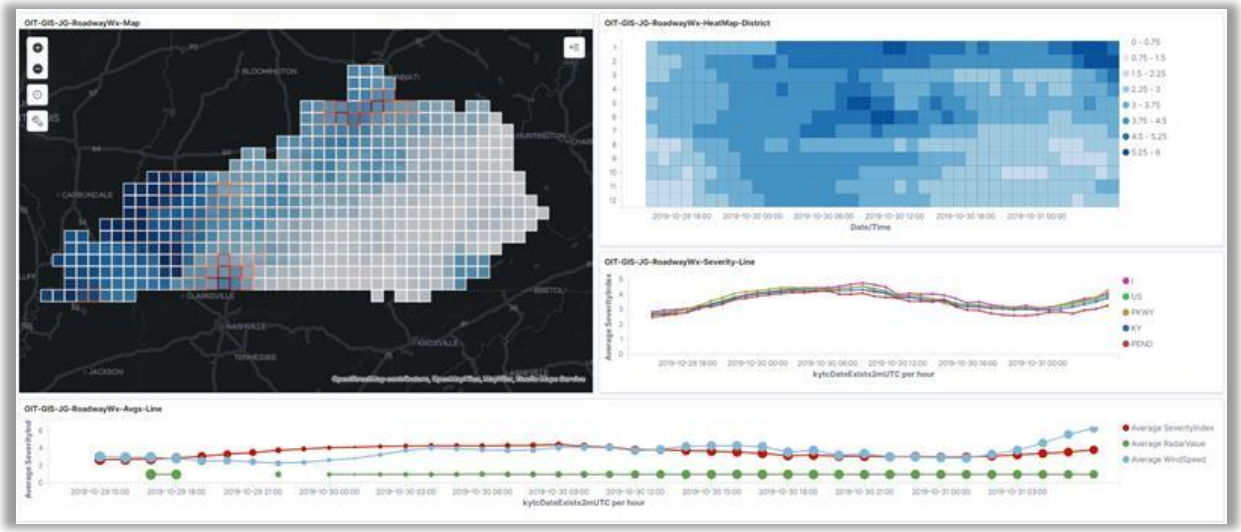


Figure 8 Weather Severity Heatmap

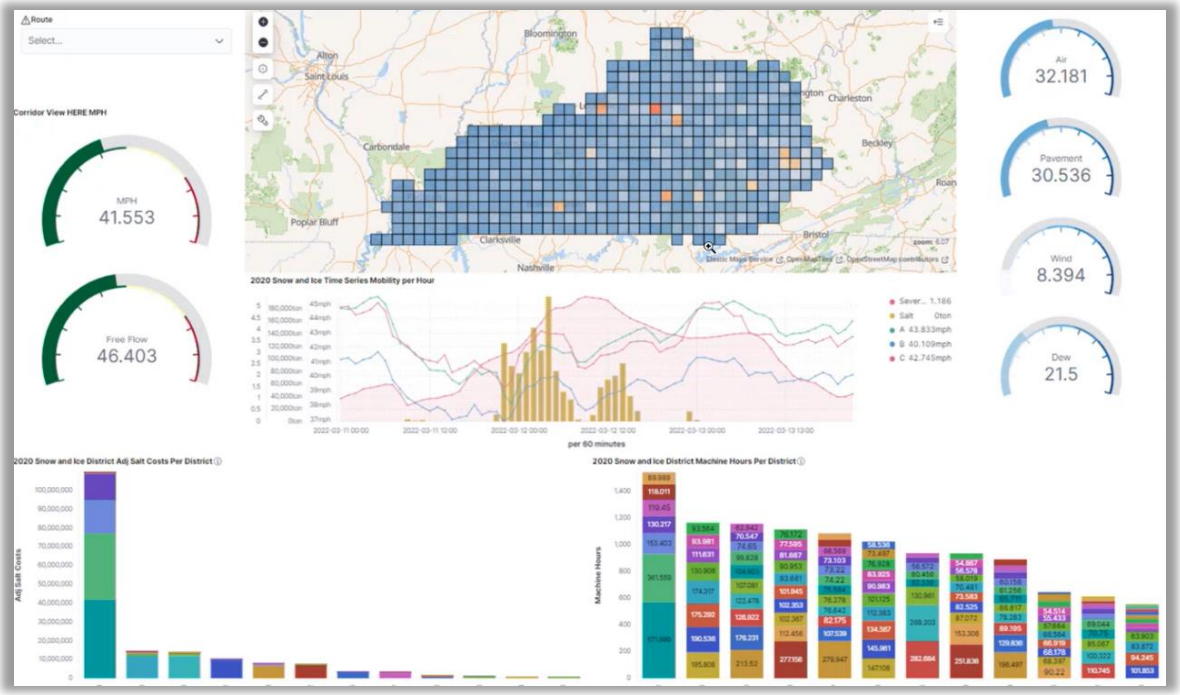


Figure 9 Operational Resource Data

3. Development of Dashboards

This section details the process in which winter dashboards are created. Winter Dashboards were developed due to the requests that KYTC was receiving and when it was recognized the value that could be provided by dashboards when developing strategic plans moving forward. As the dashboards became implemented and the processes became more formalized, additional request were then being made due to their effectiveness, leading to the need to create more dashboards to accommodate various needs. When a request is made the development team decides what data inputs will be needed for this dashboard and the steps it would take to create it.

An internal team of developers and stakeholders are the ones who primarily assisted in the development of dashboards and while there are no formal processes currently made to verify the accuracy of the performance measures, errors are notified to the appropriate people if they were to occur. Due to the nature of weather during the winter season, what types of issue that can occur with equipment is still being explored as well as how the data is being affected. The data gathered for these dashboards is stored in Looker Studio and Google Cloud and be queried back up to 6 hours, with further queries for data further back currently in the works. No major issues or challenges were noted by KYTC during the development of the dashboards.

4. System Operations and Maintenance

This section describes system operations and maintenance procedures for the winter dashboards. The dashboards are all being hosted for viewing on either Looker Studio or Google Cloud. These two platforms have the advantage of being easily scalable to deal with increased number of users and having easy integration with other google services such as google maps.

The dashboards are all maintained by a team of systems IT consultants and the platforms Looker Studio and Google Cloud are responsible for maintaining, storing, and updating the data. The costs and resources that are used to maintain these dashboards are not directly tracked.

5. Benefits and Lessons Learned

This section goes over the benefits and lessons learned from developing the winter dashboards. In terms of data quality some key lessons that were learned were that AVL data can be inaccurate due to the weather conditions during the winter season. The severity of snowstorms and other weather variables can cause errors in the equipment used to track data. Therefore, it is very important to understand where the data is coming from and the reliability of the data quality before implementing it into dashboards.

When switching data vendors, it's important to recognize that the data previously being used in dashboards may be affected which can lead to different outputs on the dashboards. Before switching vendors, its best to always have a plan for testing and updating dashboards after the switch. Furthermore, vendors do not always provide an update when changes are made to the data, they provide which could potentially affect the dashboards. This is why its key to consistently test dashboards and stay up to date with vendor changes.

The data being utilized in each of the dashboards is key to what will be displayed so it is important to use only relevant data by applying the proper filters. This could involve removing potential outliers or removing unnecessary variables.

Relating to project management for the dashboards, keeping the team relatively small and selecting those who are knowledgeable of the operations and technology proved to be beneficial. Being specific with the scope of the project was also key to focus on creating the primary functionalities the dashboard should provide. Additionally, the right data platform needs to be selected for real-time and historical data.

6. Plans for the Future and Potential Enhancements

This section goes over future plans for the winter dashboards and possible enhancements that could be made. KYTC has five areas that they feel could undergo potential future enhancements involving their dashboards.

- The first is in the mobile optimization. The user interface that is currently being used on mobile devices for their dashboards is undergoing optimization and is improving its user interface.
- The second area is in static data layers. This would involve adding rest areas and truck parking locations, which would provide additional value to users who are traveling and utilize these dashboards.
- The third area involves weather radar integration. By integrating weather radar information into dashboards, travelers could receive crucial information to make more informed decisions.
- The fourth area for potential improvement would be to implement RWIS data. This would allow users to have access to weather information that can provide more detailed weather information for specific areas. This could allow travelers to prepare for icy roads or avoid unsafe driving conditions.
- Lastly, outward-facing dashcam view could provide real-time visual information on the roads, which could lead to both the public and KYTC staff to be more aware of the condition of roads.

Overall, these enhancements are all capable of making drastic improvements to the dashboards that are currently being used by the public and agency in the areas of functionality, user experience, and the types of information that is currently being provided.

7. Key Point

- KYTC started the development of dashboards due to the need to track material usage such as salt during the winter maintenance season in an efficient way.
- GoKY Dashboard is used for accessing real time traffic data and is the main source of real-time roadway information.
- KYTC DSS Dashboard is a tool for agency staff that provides real-time AVL data along with other data sets linked to roadways. GoKY ITS Real-Time Information Dashboard/Real Time ITS Data Studio helps make decisions based on short term trends related to weather and traffic.
- All platforms are hosted for viewing on either Looker Sudio or Google Cloud. This is key for scaling up for more users during weather events. It is setup similar to TV streamers to prevent buffering issues.
- A lesson that the KYTC learned from developing the winter dashboards was that due to the nature and unpredictability of the winter season, AVL data can be inaccurate.
- When switching data vendors, it’s important to recognize that the data previously being used in dashboards may be affected which can lead to different outputs on the dashboards. Before switching vendors, its best to always have a plan for testing and updating dashboards after the switch.

- Future enhancements will allow KYTC to implement more of their dashboards to mobile devices making data more accessible on the go and bringing in additional data sources.

Appendix A Survey Response

Contact Information

Name	Randi Feltner
Title	Assistant Director
Agency	Kentucky Transportation Cabinet
Email	randi.feltner@ky.gov
Phone	859-227-9956

Survey Information

1. Do you have any dashboards (with interactive performance measures) using data of winter maintenance operations?	Yes
If yes, how many?	4
1A. If you answered yes to the previous question (you do have dashboards) please briefly describe how each on is used.	GoKY - public facing dashboard (511 type of setup); used by public and leadership; real time DSS - used by district and central office staff; more of an in-depth look; real time ITS Data Studio - visualization of short term trends and summarze 6 hours worth of data; more of a 'near time' Trimble OMS - material usage dashboard
2. Do you find these dashboards useful during an event in real-time?	Yes
3. Do you find these dashboards useful after an event, such as after-action reports?	Yes
4. Do you use the dashboards to inform beneficial / best practices?	Yes
5. What data are you using in your dashboard(s)? (Select all that apply)	6
Automatic Vehicle Location/Global Positioning System (AVL/GPS)	X
Material Usage total	X
Material Usage Rates	X
Weather Data (For example: Road Weather Information System (RWIS))	X
Cycle Time	
Plow Position	
Traffic Data (Speed and/or Volumes)	X
Connected Vehicle (CV) data	
Incident Data	X
Finance data	
Other (please specify)	
6. What are the sources of the data in the dashboards? (Select all that apply)	9
Automatic Vehicle Location/Global Positioning System (AVL/GPS)	X
Spreader/Sprayer Controller	X

Plow Position Sensor	X
Mobile Weather Sensors, etc.	
Maintenance Decision Support Systems (MDSS)	X
RWIS Stations	X
Advance Traffic Management System (ATMS)	X
Maintenance Management System	X
Probe Traffic Data	X
Connected Vehicles (CVs)	
Crowd Sourced data (e.g. Waze)	X
Other (please specify)	
7. How are the data ingested into the dashboard? (Select all that apply)	
Application Programming Interface (API) from data source	X
SQL database updated	X
Excel spreadsheets	
CSV/Text File	
Access Database	
Other (please specify)	
8. What is the frequency of the data refresh? (Select all that apply)	5
Minutes / Close to real-time (5)	X
Hourly (4)	
Daily (3)	X
Weekly (2)	
Monthly (1)	
Other (please specify)	
9. How are data stored? (Select all that apply)	
Cloud-based	X
Client-Owned Server	
Third-Party Server	
Enterprise Content Management System (For example: SharePoint)	
Other (please specify)	
10. What dashboarding platforms are used? (Select all that apply)	
PowerBi	
Tableau	
ArcGIS	X
Internally custom created or other platform (please describe)	Looker Studio; Google Maps (GoKY); Trimble OMS

11. What metrics/performance measures presented on the dashboard(s) do you find most helpful for operations? And describe why they are the most helpful.	Performance Metrics are currently being developed using some of the same data/sources used for dashboards. KYTC does have a SSI developed.
12. Are you able to generate static reports / outputs from the dashboard?	Yes
13. Who has access to view the dashboards? (Select all that apply)	4
Internal agency	X
Partner Agencies	X
Contractors	X
Public	X
Other (please specify)	
14. Who developed the dashboard(s)? (Select all that apply)	
Internal agency	X
Consultant	X
AVL / GPS Vendor	
Other Third-Party vendor	
Unversity	
Other (please specify)	
15. If an external entity developed any of your dashboards, were you a part of the design process?	Yes
15A. Is your dashboard customizable to fit your needs?	Yes
16. Who maintains the dashboard and data used?	Internal for 3 out of 4; Trimble maintains material dashboard. All data is maintained internally.
17. How are the data checked for accuracy and who is responsible for checking?	It is not readily checked for accuracy. Errors are noticed after the fact. There has been some data quality issues noticed by KYTC staff.
18. What data do you wish you had within a dashboard? And why?	More data of the same sources. For example, more weather information (RWIS); more cameras.
19. What are the limitations of your current dashboard(s)?	Limited scale of views/queries on ArcGIS online and Looker concurrently. Dependency on data source/providers maintenance or changes to the feed, API, fields, etc.
20. Do you have any enhancements to current dashboards, or new dashboards, you want to develop or are in the process of developing?	Yes
If yes, please describe:	Mobile version of GoKY; development of performance management dashboards
21. Has your agency deployed or planned to deploy connected vehicle technology that may assist with winter operations?	No
22. Has your agency used or planned to use connected vehicle data for winter maintenance dashboards?	No

23. What issues has your agency experienced with developing the dashboard(s)?	Staffing; changes in staffing which then leads to changes in opinions of views.
24. What issues has your agency experienced with using the dashboard(s)?	Reaching technical limits (concurrent views); data quality issues with a vendor source.
25. What practical advice and/or lessons learned can be offered to others interested in developing and implementing dashboards to support winter maintenance operations?	Be specific with scoping; keep team small; need members on team to be knowledgeable of both operations and technology and use of data
26. May we contact you with follow-up questions?	Yes

Appendix B Virtual Interview Meeting Minutes

PROJECT 22-05: USE OF DASHBOARDS FOR WINTER OPERATIONS

SUMMARY OF KENTUCKY TRANSPORTATION CABINET VIRTUAL INTERVIEW

Overview

Virtual interviews were conducted by Ming-Shiun Lee and Mallory Crow of AECOM and coordinated with the assistance of Chris Lambert and Randi Feltner with the Kentucky Transportation Cabinet (KYTC) on Thursday December 21st, 2023, at 9 AM CST.

KYTC Staff Interviews

Meeting attendees on Thursday, December 21st included the following individuals:

- Chris Lambert
- Randi Feltner

Introduction

Development began for winter dashboards in 2012 when salt began to run out during winter maintenance and so the KYTC wanted a better way to track material usage to prevent issues like this from occurring again. Geographic information system (GIS) data was used to understand historical analyses to figure out why this happened. In 2014, the KYTC formed a deal with Waze to obtain real time traffic data. Eventually, KYTC wanted to blend weather information from the National Weather Service (NWS), Waze, and alerts, so the department began collaborating with developers in 2015 to create winter dashboards.

GoKY Dashboard

GoKY Dashboard Overview

Purpose	Used to view live traffic data and contains information such as locations of congestion, crashes, hazards, weather conditions, traffic cameras, and more.
Performance Measures	Availability, scalability, and can support one million concurrent users
Data Sources	HERE traffic speeds, Waze reports, Traffic Management Center (TMC) reports, maintenance weather reports, traffic cameras, Dynamic Message Sign (DMS) messages

Refresh Rate	Every 2 minutes
Users/Access	The public
Platform/Software	Google Cloud

The KYTC GoKY Dashboard serves as a central hub for real-time roadway information, catering to both public and agency needs. Functioning as an advanced 511 system, it empowers travelers with up-to-date road conditions while aiding KYTC and partner agencies in making informed decisions.

Kentucky's GoKY dashboard transitioned from ESRI to Google Maps not just for a fresh look, but for critical performance improvements. The original platform struggled with user surges, leading to inaccurate information and frustrating delays. Google Maps, with its robust scalability and faster refresh rates, ensured reliable access and real-time data even during peak periods. Additionally, Google Cloud offered cost-effectiveness and access to advanced features like traffic layer integration and data streaming, significantly enhancing the dashboard's functionality. This may clarify the difference between traffic layer viewing and data availability from Google.

Real-Time Data:

The dashboard leverages a multitude of data sources, including HERE traffic speeds, verified by other Waze users (not necessarily by KYTC), TMC updates, maintenance weather responses, traffic cameras, and DMS messages. This comprehensive data pool refreshes every two minutes, ensuring users have the most current picture of Kentucky's roadways. Additionally, traffic cameras and DMS message displays provide visual aids for enhanced situational awareness.

Scalability and Reliability:

Built on Google Cloud's robust platform, GoKY boasts exceptional scalability, seamlessly managing even peak user volumes. This ensures consistent and reliable access to critical information, even during unforeseen circumstances like emergencies or natural disasters.

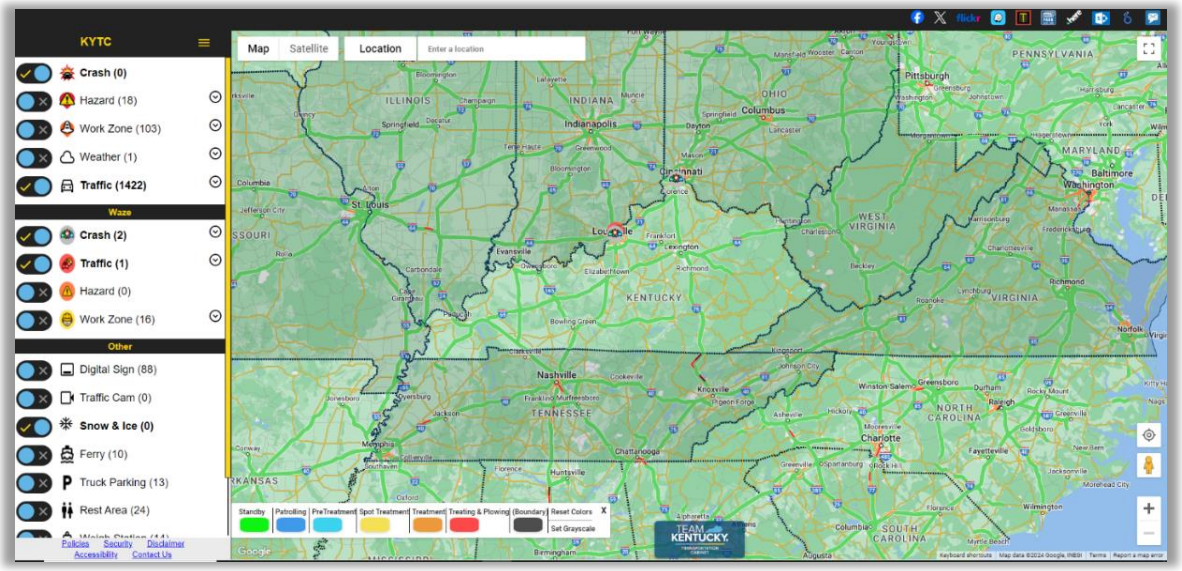
Data-Driven Decision Making:

Beyond public information, GoKY empowers KYTC staff and partner agencies with valuable data-driven insights. This intelligence informs crucial decisions regarding resource allocation, response strategies, and overall transportation management. Notably, GoKY played a significant role in coordinating road closures and recovery efforts during past natural disasters.

Continuous Improvement:

While the current user interface is undergoing mobile optimization, the GoKY dashboard remains committed to ongoing development. Future iterations promise exciting new features, potentially including

static data layers like rest areas, truck parking locations, and weather radar integration. Additionally, the exploration of Road Weather Information System (RWIS) data and outward-facing dashcam views hold promise for further enhancements.



The GoKY dashboard stands as a dynamic and valuable resource, continuously evolving to meet the diverse needs of Kentucky's transportation landscape. By providing real-time, comprehensive information to both the public and transportation agencies, GoKY fosters informed decision-making, promotes safety, and contributes to a more efficient and well-managed transportation system.

However, limitations exist. Snow and ice data currently rely on manual entry, which can be less accurate and timely compared to real-time information. Additionally, not all winter operations vehicles have global positioning system (GPS) integration, hindering real-time tracking. Recognizing these limitations, KYTC is actively working on mobile optimization and exploring advancements like static data layers for rest areas and truck parking, and weather radar integration.

KYTC Roadway Weather Decision Support System (DSS) Dashboard

KYTC Roadway Weather Decision Support System (DSS) Dashboard Overview

Purpose	Provides real-time decision-making data that includes salt, automatic vehicle location (AVL) data, cameras, and storm severity index
Performance Measures	Salt usage, vehicle location, camera access for visualization, and storm severity index. All in one spot joined to roadway segment.

Data Sources	AVL, cameras
Refresh Rate	Every 2 minutes
Users/Access	District and central office staff
Platform/Software	Google Cloud, ESRI

The KYTC Roadway Weather DSS Dashboard is a real-time decision support tool designed primarily for internal staff use. It provides a wealth of data, including AVL, and is updated every two minutes. The data is pulled together from various sources, including a roadway weather table, and is stored on Google Cloud. The system tracks a variety of metrics, including salt passes, line segments, camera feeds, and a storm severity index, all of which are updated at half-mile intervals.

While the system is available to the public, it is not actively promoted. Despite this, it has proven to be a valuable resource for Public Information Officers (PIOs), who use it to respond to public inquiries about traffic conditions. For example, if a member of the public calls to complain about traffic, the PIO can pull up the relevant section of roadway and provide real-time information about the situation.

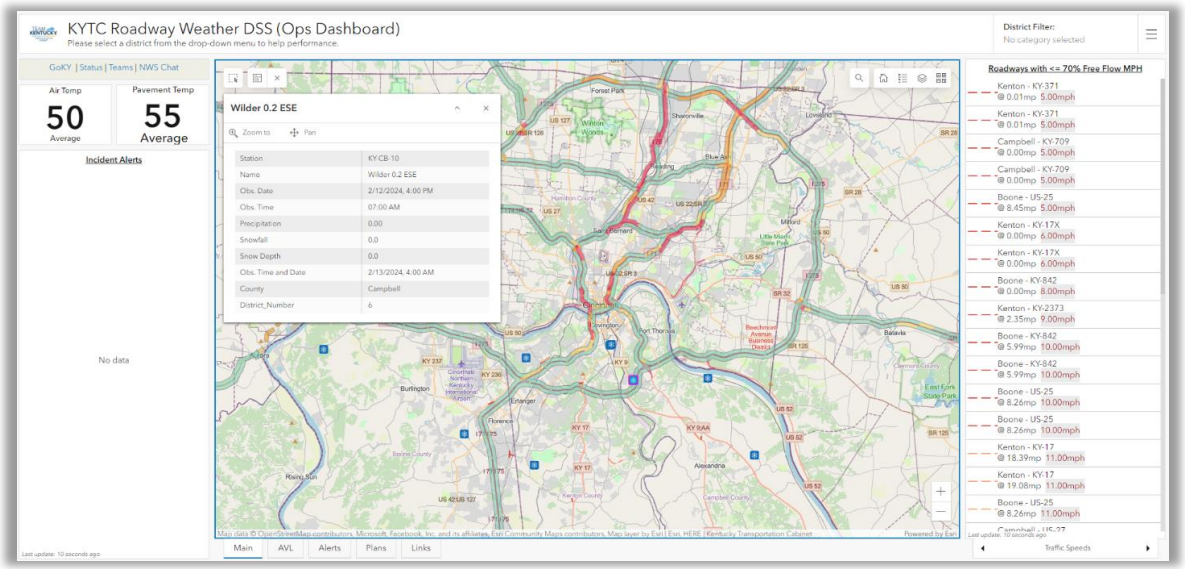
The system overwrites the data every two minutes, and updates for passes and salt are pulled from a Google Sheet until an end date is added. However, it is important to note that the system does not store historical data; it is purely a real-time tool. But according to DOT personal, this process is currently under review to become more automated.

The system has more detailed information than its public version. Although the link is public, it is not widely publicized and is mostly shared with partner agencies. This approach eliminates the need for password sharing. Additionally, this was effective in eliminating any issues related to authentication that may come up during off-hours.

The network is broken down into half-mile segments, which are updated every two minutes. Users can click on these segments to view important data points, such as pavement and air temperature. The storm severity index is also available for each segment.

Looking ahead, the next iteration of this tool will include a trend-tracking feature. However, it is worth noting that the current system may become obsolete and could be retired in a year or so once the updated version is developed. One of the limitations of the current system is that none of the real-time speed data providers they have worked with can provide volume data, which could help determine the reasons for slowdowns. Currently there exists a confusion on which platform needs to be used for the

next generation of the system. It was noted that since ESRI is limited on historical view of data and Looker Studio is limited on layering (visualizations), both of these are currently used.



GoKY: ITS Real-Time Information Dashboard / Real Time ITS Data Studio Dashboard

GoKY: ITS Real-Time Information Dashboard / ITS Data Studio Dashboard Overview

Purpose	To show short-term trends and help facilitate decision support
Performance Measures	Uptime and scalable to report on millions of records
Data Sources	TMC, Waze, HERE, AVL, RWIS, KYMesonet, CoCoRahs, First Look
Refresh Rate	Every 2 minutes on most feeds and every 2-3 for AVL
Users/Access	The public
Platform/Software	Looker Studio + Google Cloud

The GoKY: ITS Real-Time Information Dashboard, also known as ITS Data Studio, is an innovative solution developed by the KYTC. The primary function is to facilitate decision-making by visualizing short-

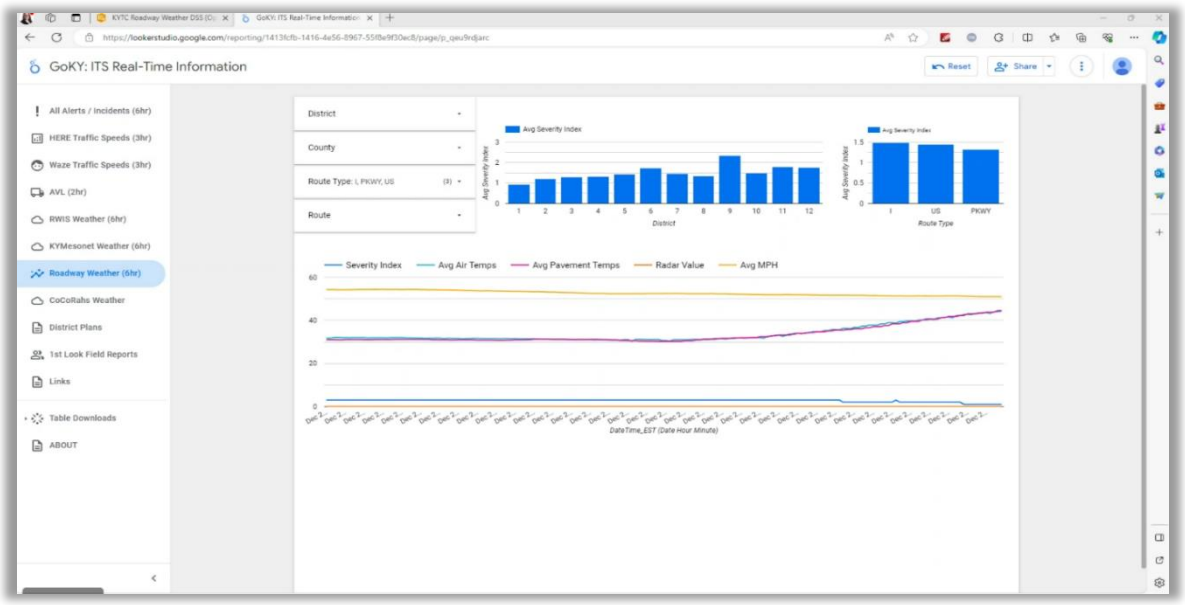
term trends. The dashboard is designed to be robust, with performance measures focusing on uptime and scalability, capable of reporting on millions of records.

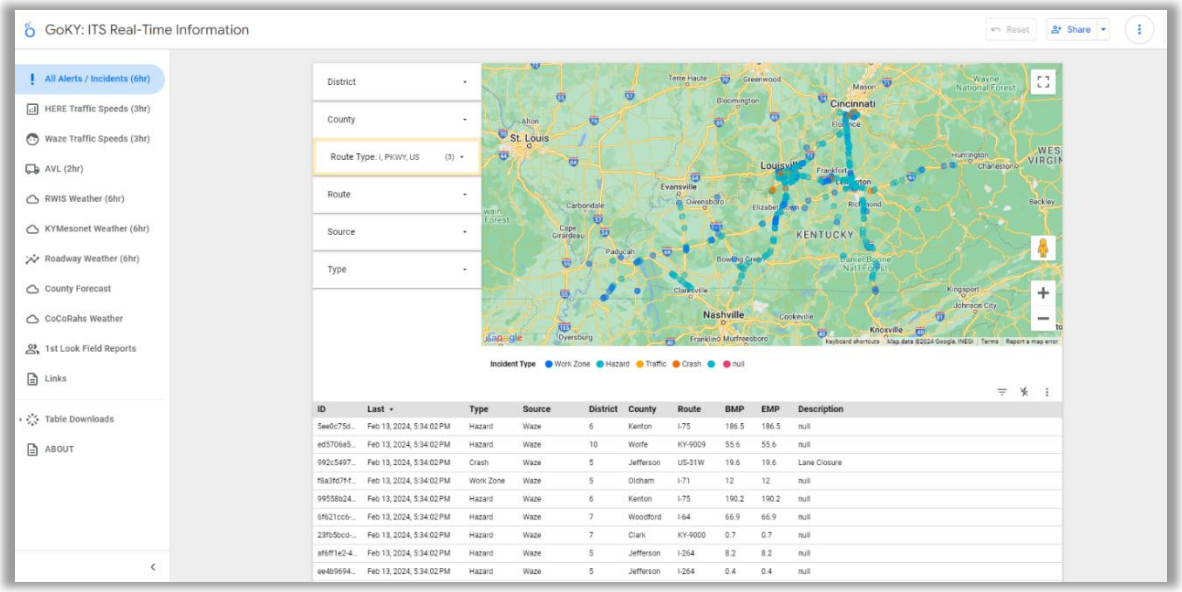
The data for the dashboard is sourced from a diverse range of platforms including TMC, Waze, HERE, AVL, RWIS, KYMesonet, CoCoRahs, an in-house mobile application developed by the KYTC. The refresh rate is optimized for real-time updates, connecting directly to the data warehouse every 2 minutes for most feeds and every 2-3 seconds for AVL data.

Despite being accessible to the public, the dashboard is primarily used for internal purposes. It is built on the Looker Studio and Google Cloud platforms. The dashboard is utilized to monitor short-term traffic and weather trends. However, due to the volume of data it processes, some users have reported performance issues. The dashboard aggregates nearly 41.5 million records of real-time data within a six-hour timeframe, processing a total of 166 million records every 24 hours.

The dashboard was developed as a response to frequent queries from leadership, providing valuable decision support. It allows users to monitor average and minimum speeds, mile points, and routes. It also tracks recovery movements and downward progressions.

One of the unique features of the dashboard is the Severity Index, a scoring system developed by KYTC (similar to the Purdue method). This index scores air temperature, wind, and radar values per segment, with color values indicating intensity. A leading GIS Developer developed a python script to analyze radar data at 1/10th mile segments, offering granular weather impact insights.





In summary, this dashboard is a comprehensive tool that combines weather, speed, and severity data to provide real-time or trending insights. It should be noted that the uniqueness of this view is the time-depth. Despite some limitations, it is an example of data visualization for facilitating informed decision-making. The KYTC plans to continue improving the dashboard and addressing its limitations in future iterations.

Material Usage Dashboard

Material Usage Dashboard Overview

Purpose	Serves as a material usage dashboard that summarizes inventory information
Performance Measures	Material usage, safety, labor cost, equipment cost
Data Sources	OS Information (Manual Entry via Trimble)
Refresh Rate	Daily
Users/Access	Internal
Platform/Software	OMS by Trimble (formerly Agile Assets)

Material Usage Dashboard leverages GeoTab assets to analyze manually entered inventory data. This dashboard is not open to the public and remains as an internal tool during development. While GPS coverage reaches 100%, AVL data currently sits at 85-90%, with daily card integration in development.

Beyond tracking material use, the dashboard expands into the realm of safety, pulling metrics like seatbelt usage, speeding, and harsh braking from GeoTab's onboard systems. GeoTab's diverse functionalities also offer potential for camera integration, temporary work zone identification, and more. On the other hand, the Geotab Safety Scorecard feature is a separate product, only available within the Geotab platform.

Initially focused on salt usage, the dashboard's scope has broadened to encompass overall asset management, aiming to enhance resource efficiency, particularly in contract-heavy areas. Its adaptability allows for future enhancements and creation of additional dashboards. Although the team do not yet have the AVL automated integration complete, they actively explore utilizing GeoTab's AVL data more effectively. While material usage currently relies on manual updates, integration with Trimble's AVL enhancements promises automation.

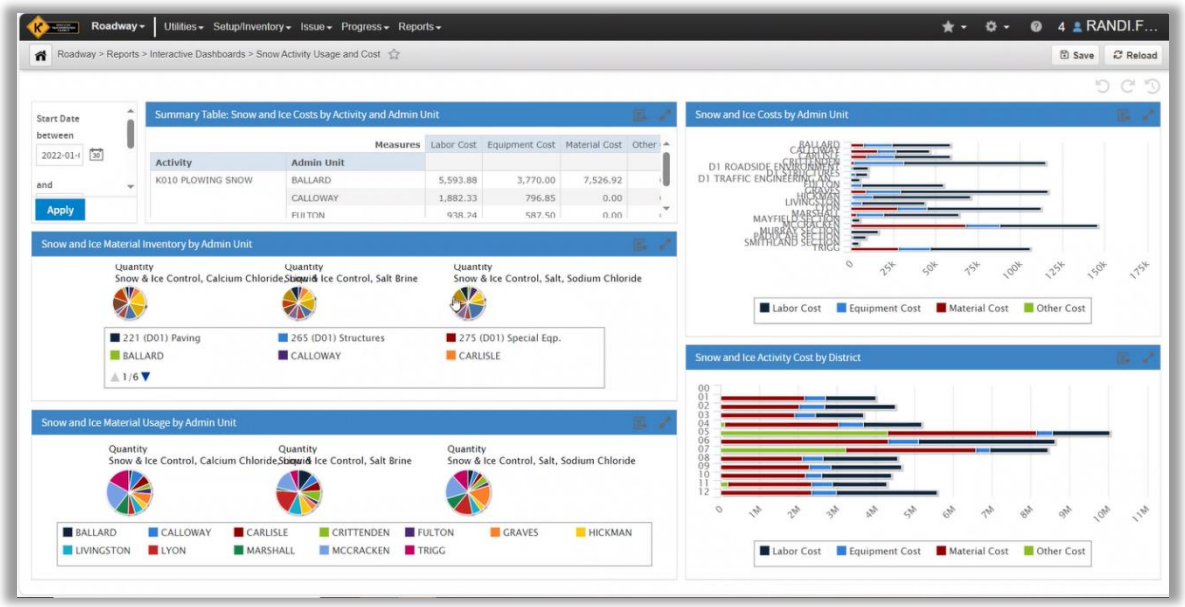
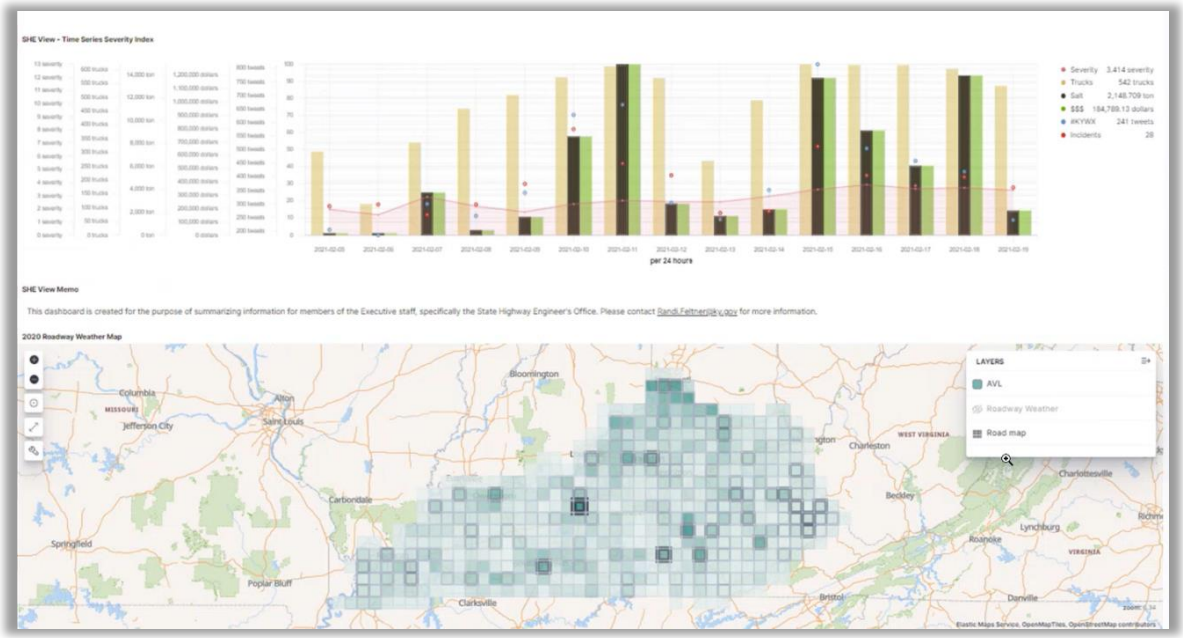
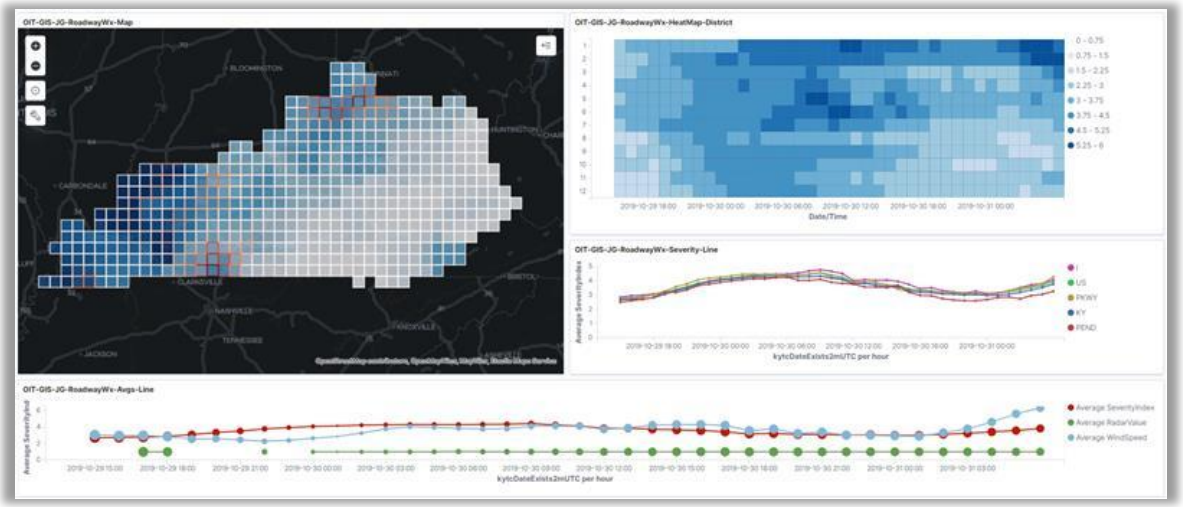


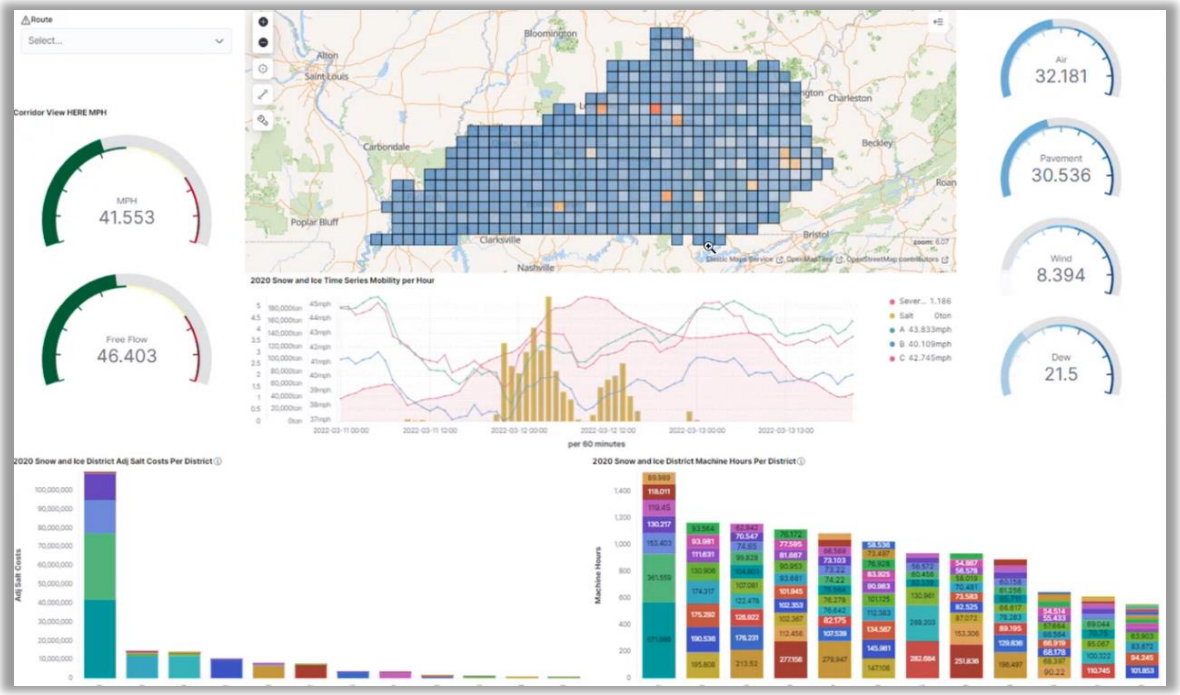
Figure 10 Current Trimble Material Dashboard

Previous Dashboards

A migration from the former Elastic Search platform to Google Cloud/Data Studio caused changes in dashboard layouts, making previous user – interfaces inaccessible. One lesson learned from the development of this dashboard is that switching vendors may result in the loss of some dashboard views, requiring manual recreation.


SHE View - Time Series Severity Index
per 24 hours
SHE View Memo
This dashboard is created for the purpose of summarizing information for members of the Executive staff, specifically the State Highway Engineer's Office. Please contact Sandi.Feltner@ky.gov for more information.
2020 Roadway Weather Map
LAYERS
AVL
Roadway Weather
Road map
Bloomington
Columbia
Jefferson City
Saint Louis
Carbondale
Springfield
Poplar Bluff
Clarksville
Charleston
Bedley
Charlottesville
Lynchburg
Roanoke
Bristol
Danville


OIT-GIS-JG-RoadwayWx-Map
OIT-GIS-JG-RoadwayWx-HeatMap-District
Date/Time
OIT-GIS-JG-RoadwayWx-Severity-Line
kytcDateExists2mUTC per hour
OIT-GIS-JG-RoadwayWx-Avgs-Line
kytcDateExists2mUTC per hour



Development of Dashboards

Dashboards were developed to help with requests KYTC was receiving and can be used to create strategic plans. As the dashboards became more implemented, more requests were being made that required additional dashboards to be made. A request is received and then the development team comes together to build upon it and decide what data is needed and how the dashboard should be made.

An internal team of developers and stakeholders helped develop the dashboards. There are no formal processes that have been made to verify the accuracy of performance measures, however, if an error occurs, they will be notified. They are still learning where data is coming from and what unique issues can occur with the equipment they use. The data is stored in Data Looker Studio as well as Google Cloud. The data stored can be queried back to 6 hours but a query for data from further back on previously deployed dashboards is being worked on.

System Operations and Maintenance

These dashboards are hosted for viewing on Looker Studio and Google Cloud. A team of system IT consultants maintains the dashboard system. Looker Studio and Google Cloud maintain and store the data for these dashboards and update the data. The costs and resources needed to maintain and develop these dashboards are not directly tracked.

Benefits / Lessons Learned

Benefits and lessons learned are below:

1. **Data Quality:**
    - AVL data is more prone to errors in winter conditions, so it is important to be aware of this when using it for winter dashboarding.
    - It is important to understand your data sources and data quality to create accurate and reliable dashboards.
2. **Vendor Management:**
    - Switching vendors can change dashboards and affect data, so it is important to be prepared for this and to have a plan in place for testing and updating dashboards after a vendor change.
    - Not all vendors will notify you of updates that could affect your dashboards, so it is important to stay up to date on vendor changes and test your dashboards regularly.
3. **Data Selection and Filtering:**
    - It is important to use relevant data for your dashboards and to filter out irrelevant information.
    - For example, when using speed or Waze data, it is important to test out different filters to determine what works.
4. **Project Management:**
    - Be specific with the scope of your project and keep the team small.
    - Use team members who are knowledgeable of both operations and technology.
5. **Additional Findings:**
    - It is important to find the right platform for real-time and historical data.
    - There is a need for a small, knowledgeable team to work on winter dashboards.
    - Team members should be knowledgeable of both operations and technology.

Future / Enhancements

The KYTC has identified five areas for potential future enhancements of their current dashboards:

1. **Mobile Optimization**
    - The current user interface is undergoing optimization for mobile devices to improve accessibility and user experience.
2. **Static Data Layers**

- Future versions of the dashboard may include static data layers such as rest areas, and truck parking locations, which would provide additional useful information to the users.

3. **Weather Radar Integration**
    - There is a possibility of integrating weather radar to provide real-time weather updates, which could be crucial for travelers.
4. **RWIS Data**
    - The exploration of RWIS data is being considered. This could provide more detailed and location-specific weather information.
5. **Outward-Facing Dashcam View**
    - This feature could provide real-time visual information from the roads, enhancing situational awareness for both the public and KYTC staff.

These enhancements aim to improve the functionality, user experience, and the range of information provided by the GoKY dashboard. However, please note that these are potential future enhancements and may be subject to change based on several factors.