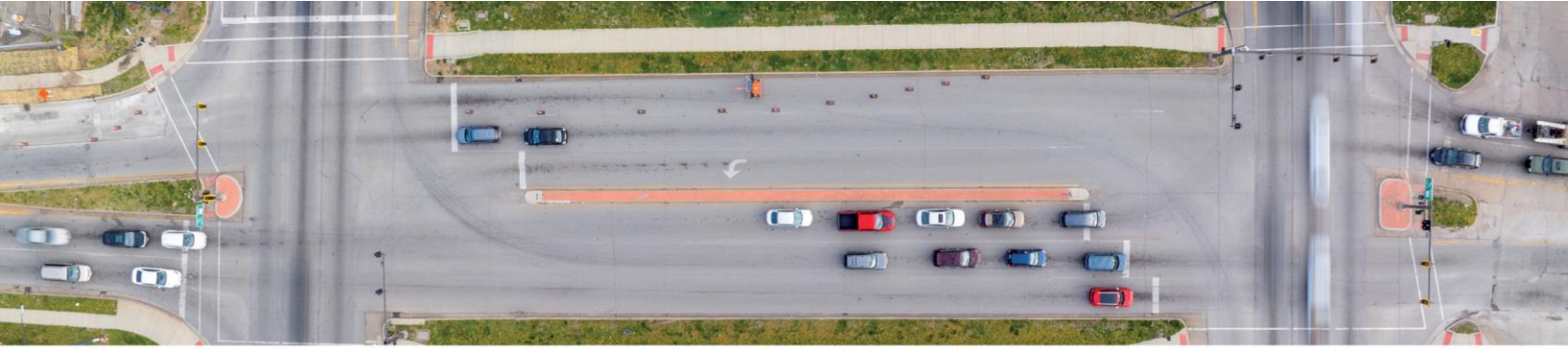

OPERATION GREENLIGHT
TURNING STOP LIGHTS INTO GO LIGHTS

2022 SMART Grants Program

AUGUST 1, 2023 - MARCH 1, 2025

Regional Traffic Signal Performance Measures

FINAL IMPLEMENTATION REPORT

FEBRUARY 1, 2025

ACRONYMS AND ABBREVIATIONS

MARC ..... Mid-America Regional Council
OGL ..... Operation Green Light
ATSPM(s) ..... Automated Traffic Signal Performance Measure(s)
SMART.....Strengthening Mobility and Revolutionizing Transportation
IT.....Information Technology
RFP.....Request for Proposal
VRU.....Vulnerable Road Users

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1 PROJECT OVERVIEW

The Mid-America Regional Council (MARC) and its program area, Operation Green Light (OGL), manage more than 750 signalized intersections across a nine-county region, as shown in Figure 1. Kansas City Regional Signal System OGL staff members analyze and retime corridors when they notice the need for potential improvements, but this awareness is often delayed because of incomplete or untimely data, lack of skills or resources to analyze available data, or inadequate resources to collect new data. Ideally, each agency and traffic signal would be equipped with advanced equipment and functioning detection to support automated traffic signal performance measures (ATSPMs) however, this infrastructure is too costly for all agencies to install and maintain. Some agencies have installed such infrastructure, but disadvantaged communities face noteworthy challenges in terms of staffing and infrastructure, leading to distinct differences in signal management across the Kansas City metro area. A lack of data and resources in any agency leads to inefficiencies in task prioritization, stretching staff time and negatively affecting roadway operations. **The two primary needs for OGL and its partners are to *better understand and communicate the status of the Kansas City Regional Transportation System.***

Stage 1 of the Regional Traffic Signals Performance Measures project is part of the SMART program's smart technology traffic signals category. This stage evaluates the capability of four vendor systems to provide data and analytics platforms for understanding and communicating corridor performance along six major routes. These routes were chosen to be representative of the region because of their diversity in location, driving population, resident population, agencies managing the signals, and signal system capabilities. Stage 1 outcomes and performance measures focus on data, platforms, and vendor support to achieve OGL's two most basic needs, bringing the following benefits:

- Reduction staff time needed to meet the basic needs,
- Improvement in the amount and quality of data and information available,
- Improvement in the ability to share information with community leaders and residents.

Successful implementation at scale would benefit all MARC region partners, especially those in disadvantaged areas. While MARC and OGL manage more than 750 signalized intersections, at-scale implementation could benefit an additional 1,550 signalized intersections across 31 managing agencies and nine counties.

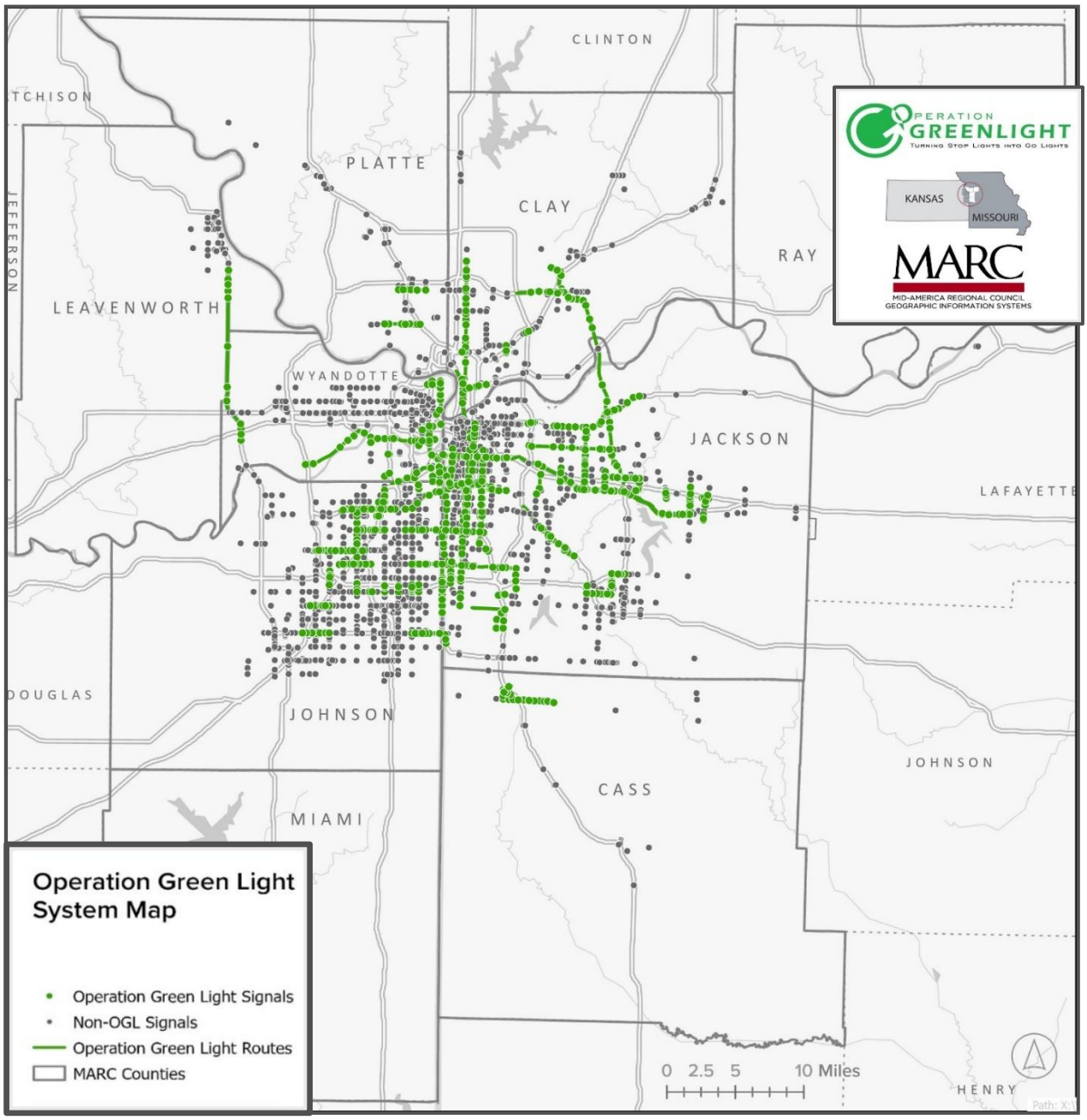
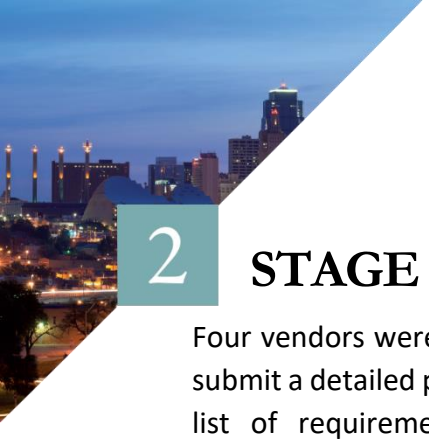


Figure 1. Kansas City Regional Signal System

Over time, these benefits will lead to better management of the transportation system with tangible improvements in key goal areas of efficiency, safety, reliability, resiliency, equity, and access. Implementation will also bring other significant benefits in climate, system integration, partnerships, workforce development, and community development.



2 STAGE 1 PROOF OF CONCEPT

Four vendors were selected for evaluation in the Stage 1 project. The vendors had a chance to submit a detailed proposal showcasing their data, systems, and support against a comprehensive list of requirements. After selection and contracting, the systems were activated and implemented, with all the vendors providing training on their platforms and support services.

The evaluation used both quantitative and qualitative performance criteria to assess the capabilities of each system. The performance metrics for the project included a range of factors covering data and functionality as well as system usability, system cost, and vendor performance. The systems were evaluated based on their ability to provide available, timely, and accurate real-time and historical performance data for individual intersections, corridors, and the region from local and third-party data sources. Data types included traffic, multimodal, and safety. Systems were qualitatively evaluated based on their usability and the vendor support resources and service. An estimated cost for at-scale deployment was also considered.

Despite some limitations during data collection, sufficient data was available for the evaluation. The primary limitation encountered was access to ATSPM data. The network and controller architecture allowed only one vendor to access this data. The team worked with the central software provider to develop a module for distributing ATSPM data to multiple destinations, but the team encountered multiple challenges. By the end of the evaluation, ATSPM data for a few intersections was available, allowing vendors to demonstrate limited ATSPM functionality.

A summary of the qualitative and quantitative evaluation findings is shown in Table 1. Notably, some of the license agreements require that system performance comparisons be held confidential, therefore no specific vendor names are included.

Table 1. Summary of Scores

Scoring Category	Weight	Vendor A	Vendor B	Vendor C	Vendor D
Contracting	0.1	4.0	4.0	2.0	5.0
Initial Set up	0.2	3.0	4.0	4.0	5.0
Customer service	0.2	4.0	5.0	5.0	2.0
Training	0.2	5.0	5.0	5.0	5.0
Local Agency Score	0.6	3.5	4.5	4.0	1.0
Ease of Use	1.0	4.3	3.8	3.8	3.1
Reporting	0.9	4.1	3.8	4.3	2.8
Compliance with Requirements	0.2	4.3	4.8	3.6	4.5
Effectiveness of Meeting Requirements	1.0	4.0	3.3	3.6	3.2
Data Accuracy & Reliability	1.0	3.5	3.0	5.0	3.7
Potential Cost	1.0	3.0	3.5	4.3	5.0
Total Score		**24.3**	**23.9**	**26.7**	**21.8**

As with any complex project, the systems evaluated under this proof-of-concept met and exceeded many expectations while some anticipated functionality was not available. The primary goal of the project was to allow system operators to better assess system performance and to provide tools to effectively communicate that performance. In these two primary goals, all four systems provided good reporting tools and excellent access to good data, analytics, and visualization tools. This was especially effective in areas with little or no local detection infrastructure. Operations staff from multiple agencies now make daily use of the available systems. Areas where systems were lacking partly related to hoped-for data or functionality, such as data on near crashes (the availability of which is quickly evolving, but not in place yet), as well as multi-modal data, which is only available in conjunction with additional field detection.

This project has demonstrated benefits in many specific areas of need. Some of these benefits will only be fully realized once the system is deployed region-wide; however, the deployment along the six evaluated corridors provides an indication of the anticipated improvements. One of the primary direct benefits comes from the ability for operators to actively understand the operational status of the system in all areas without the need for system-wide comprehensive detection, which has a direct positive impact in underserved and disadvantaged areas. Understanding the system status also results in better and faster prioritization of timing and maintenance activities, and immediate access to data on the impacts of those changes.

This directly improves the safety and reliability of the system for both vehicles and vulnerable road users and reduces the system's climate impact through reduced congestion. The regional nature of this project, through the leadership of MARC and OGL, benefits the community, strengthens regional partnerships, and fosters the integration of new and existing data sources. While access to these systems and data may not generate many new jobs in the area, it will improve the capacity and qualifications of the existing workforce.

3 ANTICIPATED COSTS AND BENEFITS OF AT-SCALE IMPLEMENTATION

The benefits realized during this project were related to the timeliness and broad availability of information about the operational status of the system, which gave more complete insights into impacts and needs for all modes of travel on the six sample corridors. Improvement in the active management of the arterial network after full scale deployment of the selected system will have positive impacts in many areas of operations and will be documentable based on data and performance measures. Impacts observed during the proof-of-concept, and which are anticipated with full-scale deployment, are highlighted below:

- **Safety and reliability have significant potential for improvement.** Operators had up-to-date information on operational trends, allowing them to focus their attention where it was needed most. They were also able to more easily assess before-and-after data to ensure that changes had positive impacts on vehicle operations. Future data will allow for the assessment of multimodal and vulnerable road user (VRU) operations. Safety will be further enhanced as connected vehicle data becomes available, along with VRU data from various sources.
- **Resiliency was improved through access to real-time data and alerting capabilities**. This helped make operators aware of situations and traffic impacts that could be alleviated through operational changes, such as adapting signal operations due to or around closures from crashes or unscheduled maintenance activities.
- **Equity and access were improved by providing data about signals in underserved areas.** Intersections with little or no operational data due to limited detection or other means of assessing operational status had operational data available. Once the system is available region-wide, such data will allow impacts and needs in these areas to be better understood, allowing comparison to and prioritization with intersections having full ATSPM data.
- **Climate can be positively impacted through the overall improvement of signal operations** primarily associated with minimizing vehicle emissions from stops and accelerations, and potentially reducing congestion.
- **Partnerships were strengthened by the project**. OGL partners came together to evaluate and assess the software platforms. Although OGL is a renowned multi-agency effort, its success relies on ongoing innovation and continually strengthening inter-agency ties. This proof-of-concept system offers access to essential regional data, and regional deployment of the solution will allow all member agencies to compare and discuss projects and improvements as a group.
- **Leadership was demonstrated through this effort** as better data allowed improved communication to the public and community leaders. It reflected OGL's culture of innovation and provided evidence of efforts to enhance quality of life across the region.

- **Integration of data from local and external sources and drawing insights from that combination** was the primary function of the evaluated systems. Technical integration was achieved through integration with the signal management software, though more work on this is still needed. Operational integration was strengthened through access to insights across jurisdictional boundaries.
- **Workforce development was improved through the improvement of skills and efficiency within existing operational positions**. No additional positions are anticipated.

3.1 Anticipated Cost of At-scale Implementation

Stage 1 proof of concept costs were $400,000 for data analytics platforms covering four vendors, six OGL corridors, and 137 signalized intersections within the greater Kansas City region. In the vendor proposals, OGL requested estimated costs for at-scale deployment to allow development of a budgetary estimate. Each vendor provided functionality in various modules and products that all had a different cost model and structure. To fairly evaluate each system, the overall system benefits and costs were compared from the base products only. Budgetary cost estimates for the systems applied only to the 750 signals managed by OGL and ranged between $100,00 and $500,000 annually. The costs of full-scale deployment that would include all 1,500 connected traffic signals in the region ranged between $250,000 and $750,000 annually.

3.2 Expected Benefits of At-scale Implementation

The benefits of at-scale implementation would be realized in two parts: (1) agency benefits and (2) public benefits. Agency benefits include a more efficient use of staff time; by allowing the data analytics platform to identify priorities, operators could focus on tasks that have the highest impact and include a significant reduction in the need for expensive data that is often collected through paid services and detection infrastructure. The direct costs for one of the tested platforms was shown to be far lower than the overall cost of data collection services and infrastructure across the same number of intersections. For example, the estimate to implement a data analytics platform on OGL corridors was between $100,000 and $500,000 annually. The estimated cost to add sufficient detection infrastructure at approximately two-thirds of the OGL-managed intersections that currently lack full ATSPM-level detection was estimated at a minimum of $25,000 each or $12.5M – not including communications or maintenance. Notably, many of these agencies often install minimal or no detection because of the prohibitive costs, which can perpetuate the neglect of some underserved areas.

Public benefits were derived from the fact that the data and analytics platforms will guide agency staff to corridors and activities that will have the greatest impact on improvements in safety, efficiency, reliability, and other key goal areas. These activities include traffic signal timing and coordination and real-time adjustments in response to unplanned incidents and other events. Demonstrating improvements through before-and-after comparisons of key goal measures and extending the benefits across the region will eventually provide cost-benefit information.

3.3 Preliminary Baseline Data

The Stage 1 evaluation collected a significant amount of baseline data. This includes baseline operational data for each of the six identified corridors in the Stage 1 project. Notably, some license agreements had restrictions on retaining any raw data beyond the end of the agreement, therefore only the summary metrics were retained for those systems. This data provides a good baseline with which to measure operational changes over time, along with climate and safety measures. Additionally, the evaluation team documented the need and usefulness of many of the features and functions of each system. This will help define the functional requirements for any future procurement needs.

4 CHALLENGES & LESSONS LEARNED

As with any complicated project, this endeavor encountered its share of challenges. This included procurement and contracting, data sharing, and workforce capacity challenges. A summary of specific challenges is provided in Table 2 along with the solutions or ideas garnered to assist in resolving these challenges in the future.

Table 2. Challenges, Lessons Learned, and Recommendations

Topic	Specific Challenge	Lessons Learned / Recommendation
Legal, Policy, and Regulatory Requirements	License agreement terms constrained some project activities, lack of flexibility in contracting required additional time to resolve.	Provide a baseline contract in the request for proposals (RFP) documents, require vendors to submit proposed base contract modifications and license agreements as part of the proposal, and include a review of these proposed modifications in the proposal review process.
Procurement and Budget	Time spent on the project support RFP delayed the vendor RFP process.	Prepare evaluation support RFP immediately after award notification to streamline as much as possible.
Technology Suitability / Integration with Existing Systems	Local Automated Traffic Signal Performance Measure (ATSPM) data could not be shared from one partner agency because of delays with that agency's information technology (IT) division.	Buy-in from all needed agency groups (including IT) needed to be secured earlier in the project.
Technology Suitability / Integration with Existing Systems	Modifications to the central signal system were needed to share ATSPM data with multiple vendors via a push mechanism rather than allowing the vendors to install custom software, a security concern for some agencies.	Earlier engagement with the central signal system vendor would minimize time needed to prepare for integration with newly procured systems.
Technology Suitability / Integration with Existing Systems	Unexpected limitations, such as lack of configurability or smaller-than-anticipated data sample sizes.	Require more specific information about configurability and data sample sizes in the system requirements in the RFP and requirements.
Technology Suitability / Integration with Existing Systems	Vendors acquiring different, or additional data sources for their platforms.	Provide vendors with the flexibility to enhance the quality of available data. Conducting historical and trend analysis can be challenging due to varying time periods across data sources. Longer access to the system, however, allows better long-term trend analysis as data accrues over time.

Topic	Specific Challenge	Lessons Learned / Recommendation
Data Governance	Vendor contract language restricted some data use and limited the ability to publicly report negative findings.	The data management and evaluation plans had to be modified to accommodate restrictions in license agreements, requiring flexibility in the evaluation process.
Workforce Capacity (e.g., impacts on jobs)	Compressed timelines increased the workload impacts to staff.	Develop a flexible workforce model that can adapt to the demands of project definition and grant application processes. As additional data sources are included, the workload may increase, potentially necessitating additional workforce.
Internal Project Coordination	Contract language did not meet vendor needs and delayed contracting process.	Include contracting language more suited to the industry and products and prepare to be flexible with the terms of the contracts.

5 DEPLOYMENT READINESS

The activities accomplished as part of Stage 1 have prepared the region for full-scale deployment both by helping agency staff members understand the use and value of these data and analytics platforms and by discovering institutional and technical barriers that need to be addressed.

The primary requirements for full-scale implementation are not technical. The systems and the data exist and, for some vendors, can be "turned on" at any time. While there is room to improve the data penetration and the efficiency and effectiveness of the reports and user interfaces, the more significant requirements are educational, institutional, and budgetary. Though many are aware of the innovative technology, only a handful have practical experience with it. As agency staff members used the systems through the evaluation process, they began to understand the potential uses and benefits of comprehensive traffic data and accompanying insights. With this understanding, they modified their individual workflows in ways that leveraged the technology and increased their workforce capacity. The next step is to share these benefits with more regional partners and increase budgets for shared access to the data and analytics platform.

Stage 1 activities allowed MARC to work through many would-be barriers, including legal, policy, and regulatory requirements; partnerships; and data governance.

Remaining tasks include the following:

- **Procurement and Budget**: Identify an ongoing funding source and procure/negotiate a long-term contract with a selected vendor.
- **Technology/Cybersecurity**: Complete modifications to the central signal system to allow the safe distribution of ATSPM data to the data analytics platform. This includes working with the IT division of each agency that hosts a central signal system to manage concerns with data privacy and cybersecurity.
- **Community Impact**: Develop a regular reporting process. MARC and its partner agencies will develop a regular reporting process that demonstrates continued benefits for all modes of travel. Specific reports can target improvements in safety, service to historically disadvantaged areas, environmental impacts, etc., and will be distributed to leadership among MARC and management and elected officials in each agency.
- **Public Acceptance**: Execute a public awareness campaign. Once at-scale deployment is underway, outreach efforts will provide public awareness of the activities of this project and the benefits and overall cost savings these and all OGL efforts provide.

5.1 Maintenance and Operating Requirements

The data and analytics platforms being evaluated through Stage 1 were existing systems maintained by each vendor. Therefore, these systems required minimal maintenance and operating requirements from agency staff members; their maintenance and operating requirements contributions primarily involved system configuration. For example, agency staff created their own dashboards and alert triggers, which brought attention to specific roadways, intersections, and conditions that needed attention. Agency staff members periodically verified and validated data quality for specific intersections or data types, which gave confidence that the information reflected real-world conditions.

5.2 Workforce Impacts

In city and county government, technician jobs are often covered by unions. The signal technicians for several of the agencies within OGL are members of the International Brotherhood of Electrical Workers (IBEW). A full-scale deployment will affect signal technician jobs in two ways. First, technicians may spend less time manually collecting data. Manual data collection can be very time consuming and can take away from signal repair and improvement work, so this change could benefit signal and system uptime goals and requirements. Second, skill levels required for technicians will increase as more time becomes available for learning the new platform and assisting with integrating data or running reports. In most signal shops, there is far more work than there is time to complete that work, and this project is not expected to cause a reduction in staff numbers.

6 WRAP-UP

Reflecting on the project's progress, team members were pleased with the demonstration. Evaluation data provided valuable insights into the usefulness and reliability of each platform. Despite minor challenges, there were few issues with the Stage 1 implementation. The platforms met most of the requirements, helping OGL and its partner agencies demonstrate improvements toward Stage 2 goals.

Other communities looking to use third-party data and analytics platforms can benefit from OGL's experience. Many vendors are trying to sell systems using simple acquisition methods such as purchase orders. While purchase orders may be applicable for some systems, these data analytics platforms are complex and require understanding and experience to know their impacts on agencies and communities. This Stage 1 project offered an extended demonstration for several systems, providing valuable insights and lessons learned that would not have been possible with a brief demonstration.

The following recommendations may help agencies minimize the time needed to realize the benefits of data and data analytics platforms for arterial management:

- Develop a full set of requirements and make them sufficiently flexible for vendors to offer alternative approaches that achieve the same outcomes.
- Request both data and data analytics platforms to avoid proposals from those who only provide one or the other.
- Vet any potential required modifications of existing systems with vendors and participating agencies (including IT) ahead of a solicitation.
- Be prepared to complete a high level of customization to simplify user experiences; and approach training with a goal of helping participants feel comfortable using the system for everyday tasks.

The evolution of technology and data offers an exciting opportunity for transportation agencies to gain insights into system operation in ways not previously possible. As agencies learn the value and limitations of these systems, many benefits, both known and yet to be discovered, have the potential to improve the quality of life through safer and more efficient transportation for the greater Kansas City region.

OPERATION GREEN LIGHT:
REGIONAL TRAFFIC SIGNALS PERFORMANCE MEASURES

FINAL IMPLEMENTATION REPORT

Kansas City Metropolitan Area

February 2025

MARC
MID-AMERICA REGIONAL COUNCIL