

# 2012 National Traffic Signal Report Card *Appendices*

National Transportation Operations Coalition



# Appendix A

## National Summary Responses to 2011 Traffic Signal Operations Self Assessment

# National Traffic Signal Report Card

2012

## State Agency Summary Results

Management D

Traffic Signal Operations C

Signal Timing Practices C

Traffic Monitoring F  
And Data Collection

Maintenance C

**OVERALL D+**

# 2011 Traffic Signal Operations Self Assessment



Results for:

## National Summary

### Importance of Traffic Signal Management and Operations

Traffic signal infrastructure is responsible for assigning the right of way to vehicular and pedestrian traffic at intersections. Traffic signal management and operations ensure the proper design, location, operation and maintenance of this infrastructure to provide safe and efficient movement of pedestrians and traffic through signalized intersections. Domestic investments in traffic signal infrastructure conservatively exceed 27 billion dollars. Public agencies have a fiduciary responsibility to manage and operate traffic signal systems in a manner that protects public investment in these assets. Well operated and maintained traffic signals provide for the smooth flow of traffic along streets and highways at defined speeds by effectively managing the capacity of intersections to improve safety and mobility. Sound traffic signal management and operations programs achieve realistic operations objectives that result in reduced congestion and fuel consumption and lessen the negative impacts to air quality to improve the quality of life within our communities.

### Value of the Self Assessment

The 2011 Traffic Signal Operations Self Assessment is a tool to allow agencies to compare themselves with a composite of traffic signal operations best practices from agencies around the United States. The 2011 Traffic Signal Operations Self Assessment is part of the 3rd National Traffic Signal Report Card. The self assessment has been updated and improved to reflect comments received on previous versions, at a stakeholder workshop and from a technical advisory committee. The results of the self assessment will provide for some comparison to the results of the previous version, both for individual agencies and at the National level. The self assessment is not intended to suggest that all practices must or will be used in all cases. It is designed to serve as a tool to identify areas of strength and areas with opportunity for improvement in traffic signal system operation. It is expected that the Traffic Signal Operations Self Assessment and National Traffic Signal Report Card will continue to be released periodically.

### Conducting the Self Assessment

The self assessment solicits information that should be readily available to your agency without the need for special studies or data. The tool is completely self-scored and should take approximately one hour to complete. **The results and the names of participating agencies are completely confidential.**

A small-group exercise is the best method to conduct the Traffic Signal Operations Self Assessment. Those involved in the assessment should represent the key aspects of the traffic signal management process. Some suggestions for conducting the self assessment:

- Assemble a small group of participants who are the key players in your traffic signal operation and maintenance program.
- Provide participants with the self assessment tool in advance so that each may become familiar with the questions, particularly those questions pertaining to his/her role.
- Ask participants to score the designated section(s) and bring their score sheets with them to the assessment exercise.
- Consolidate the consensus scores into a single result and return your results for inclusion in the National Report Card.

## Scoring the 2011 Traffic Signal Operations Self Assessment

The 2011 Traffic Signal Operations Self Assessment consists of five sections:

- Section 1: Management
- Section 2: Traffic signal operations
- Section 3: Signal timing practices
- Section 4: Traffic monitoring and data collection
- Section 5: Maintenance

Each section contains a number of questions concerning traffic signal operation policies and practices. Respondents are asked to rate the extent to which a particular policy or practice has been adopted and implemented by their agencies. Score each question from 1 to 5, based on your program's progress through the end of 2011, or N/A as not applicable to your agency. All questions have equal weight in the section and overall score. For your own reference, it may prove useful to briefly document the reasons for each question's scoring and its connection to agency objectives.

Further, to assist agencies as they respond to the self assessment, the following notation in the survey indicates the questions relationship to generalized traffic signal program management plan elements:

- [FP] Fundamental Principal: Essential quality or value of an organization.
- [CO] Core Objective: Something that one's actions are intended to accomplish or attain as a result in support of a fundamental principal.
- [KS] Key Strategy: Plan or method for reaching a specific objective or result.
- [SA] Supporting Action: Processes or steps to achieve an objective.

The self assessment provides a benchmarking tool for agencies to evaluate how their traffic signal programs and practices support achievement of management and operations objectives and the expectations of system users and decision makers. Each question is followed by a short description that illustrates outstanding practice (a 5 score) or provides guidance on how to score within a range (1 to 5). This provides your agency with a potential target for improving your own traffic signal operation. **It is not anticipated that any agency will have a perfect score.**

Some questions apply only to agencies that have specialized equipment or applications. In those instances, "not applicable" (N/A) is provided as a scoring option. **Questions scored as "not applicable" will not contribute to the overall score and will not be included on your results sheet.**

In assigning a rating to an item, first decide which level of effort best fits the overall item response. Overall “best fit” does not require total agreement with each of the questions or the description for that scoring range. Assigning the actual score within the range requires evaluating the level of effort that has been applied within a particular area. Below is general guidance for scoring from 1 to 5:

**1. Not currently being done.**

- May have been discussed informally but no action has been taken

**2. Very little being done.**

- Minimal activity
- Issue has been acknowledged and is being investigated

**3. Efforts are moderate. Some good processes connected to agency objectives exist, but they may not be well executed—outcomes are mixed.**

- Has been put into practice on a limited or experimental basis
- Processes are not consistently applied

**4. Efforts are strong and outcomes are promising; however, there is room for improvement.**

- Has become a generally accepted practice consistent with agency objectives, but refinements or changes are being discussed or pursued
- Is done in practice but is not yet integrated as “standard procedure”

**5. Efforts are outstanding with good to excellent outcomes.**

- Has become accepted practice and is consistently implemented
- Policies and procedures are documented, connected to agency objectives and well integrated as “standard procedure”

**N/A. Not applicable: The question does not apply to your agency.**

## Summary Information

All information and responses to this self assessment will remain confidential.

The information below is requested so that we may contact you with questions regarding the information you have submitted. It also will be used as a mailing address for the certificate of completion and self assessment score summary we will send you in response to your completion of the survey and will enable us to correlate survey responses with demographics (organization type, size, etc.).

**1. Contact information:**           **241 responding agencies**

**Name:**

**Title:**

**Employer:**

**Address:**

**City/Town:**

**State/Province:**

**Zip/Postal Code:**

**Email Address:**

**2. Check one:**                   **Summary of All Submissions**

- 147** City/municipality
- 34** County
- 57** State/province
- 3** Other jurisdiction, please specify

**3. How many traffic signals does your jurisdiction operate and/or maintain?**

- Number of coordinated signals           **Subtotal: 71,719**
- Number of isolated signals               **Subtotal: 47,774**
- TOTAL: 119,493**

**4. What is your jurisdiction's population?**   **N/A**

- 52** Less than 50,000
- 86** 50,000 – 250,000
- 19** 250,000 – 500,000
- 26** 500,000 – 1,000,000
- 51** Greater than 1 million

**5. Indicate the number of in-house staff (FTEs) performing traffic signal management, operations and maintenance in the following categories:**

- Non-technical manager   **0.9**
- Engineering manager   **1.8**
- Engineers               **5.2**
- Other professionals   **1.8**
- Signal technicians   **9.1**
- Other technicians   **2.1**
- Administrative       **1.1**
- Other staff           **0.9**

**6. Indicate the number of outsourced staff (FTEs) traffic signal management, operations and**

**maintenance in the following categories:**

Non-technical manager	0.2
Engineering manager	0.2
Engineers	0.7
Other professionals	0.3
Signal technicians	1.4
Other technicians	1.2
Administrative	0.2
Other staff	0.2

**7. What is your jurisdiction's annual source of operating/maintenance funding for traffic signal management and operations? [NOTE: Amounts are based on responses only, not all states represented]**

	<u>Average funding</u>	<u>Total Funding</u>
Local	\$858,981	\$187,257,805
Regional	\$147,279	\$18,557,200
State	\$1,202,978	\$176,837,711
Federal	\$349,065	\$42,935,000
<b>Sum</b>	<b>\$2,558,303</b>	<b>\$425,587,717</b>

**8. What is your jurisdiction's annual source of capital funding for traffic signal management and operations? [NOTE: Amounts are based on responses only, not all states represented]**

	<u>Average funding</u>	<u>Total Funding</u>
Local	\$12,456	\$125,964,342
Regional	\$4,298	\$11,574,200
State	\$1,092,719	\$68,811,975
Federal	\$789,386	\$96,809,040
<b>Sum</b>	<b>\$2,088,211</b>	<b>\$303,159,558</b>

**9. How long does it take a project or program that addresses agency objectives in traffic signal management and operations to move from identification through the process to scope, program, budget, contract (if done) to the start of work?**

	<u>City/Municipal</u>	<u>County</u>	<u>State/Province</u>
Operating/Maintenance	7 months	6 months	7 months
Capital	16 months	17 months	16 months

**10. If your agency participated in the 2007 Traffic Signal Operations Self Assessment, as a result did your agency:**

	<u>Yes</u>	<u>No</u>	<u>In Process</u>
Define or revise operational objectives and requirements?	34%	51%	15%
Establish performance measures and standards of performance?	25%	52%	23%
Revise existing program without addition funds?	31%	60%	9%
Request additional funding for Operating/Maintenance?	46%	49%	4%
Receive additional funding for Operating/Maintenance?	24%	71%	4%
Request additional funding for Capital Projects?	46%	49%	5%
Receive additional funding for Capital Projects?	29%	65%	6%

**11. Are you willing to have your responses shared with the FHWA Division Office arterial management staff person in your state?** The information is for internal use at the Division Office only and the details of your response will not be shared with anyone else. The intent is to allow the Division Office staff to understand needs and offer to provide appropriate technical assistance and resources.

Yes: **217**                      No: **20**                      No Response: **4**



**Section 1—Management**

**NOTE: Individual question scores are the average of the responding agencies.**

Traffic signals are one of the transportation industry’s most visible points of service to the traveling public. Traffic signals automate the safe assignment of right of way among conflicting traffic movements to reduce or eliminate the need for full-time manual traffic control at a given location. While a traffic signal can eliminate the need for manual control of the right of way, it does not eliminate human involvement, intervention, or intelligence in service delivery—the customer understands this even though he/she does not know the underlying technologies or engineering involvement. The traffic signal system cannot be effectively maintained and operated without adequate planning and oversight. The issues addressed in this section are programmatic management actions that address these important functions.

<b>12</b>	<b>Has your agency identified the need for and established an objectives based program for managing traffic signal operations? [FP]</b>	<b>3.0</b>  (Score 1-5)
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The following describes the policies, processes and behaviors necessary for a score of 5:

- The high-level concept of operations, or “philosophy,” for how your agency operates signals is documented and shared with employees, decision makers and the public.
- The agency traffic signal program management plan, business plan, asset management plan, or other similar document that provides clear goals, objectives and performance measures for the intended results of the organization’s strategies and actions specific to your traffic signal program.
- Your agency’s staff is aware of the performance measures and goals of the program? Do they report on their progress toward achieving these goals? Does the agency evaluate its personnel based on their contributions to these goals?
- Your agency reports to agency leadership and to the public annually on your success at achieving these goals.
- Your program has a defined set of methods to evaluate the agency’s performance toward meeting system operations and maintenance or organizational objectives. This includes various field measures or studies on a recurring schedule on an established “control” or benchmark sections of signalized corridors for tracking performance (e.g., delays/vehicle/intersection, stops/vehicle/intersection, delay/pedestrian/intersection, travel time/section).
- Your staff has an established process to routinely coordinate planning for events, closures, emergency preparedness with special event organizers, permits officers, law enforcement and emergency service providers.

<b>13</b>	<b>Does your agency have an operations plan that considers resources to provide traffic monitoring and management activities? [FP]</b>	<b>3.0</b>  (Score 1-5)
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Score using:

1. No staff or resources are committed or available for traffic monitoring or management on a regularly scheduled basis.
2. Staffing and resources are committed and available for traffic monitoring and management activities; however, these activities are not scheduled to occur on a regular basis.
3. Staffing and resources are committed for traffic monitoring and management and occur on a regularly scheduled basis during normal business hours.
4. Staffing and resources are committed for traffic monitoring and management activities, occur on a regularly scheduled basis during normal operating hours and are extended when traffic conditions are abnormal.
5. As a normal operational practice, staffing and resources for traffic monitoring and management are scheduled to accommodate peak traffic periods both during and outside of normal business hours and are extended further

when traffic conditions are abnormal.

<b>14</b>	<b>Has your agency identified the need for and established a standardized outreach program that communicates proactively with the public and policymakers regarding signal operations? [FP]</b>	<b>2.9</b>  (Score 1-5)
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The following describes the policies, processes and behaviors necessary for a score of 5:

- Provides information on signal outages, excessive delays, crashes, utility or work zone closures, or other conditions affecting travel at or near traffic signals.
- Shares documented response times, frequencies, performance goals and measures with the public through Web sites, brochures, articles, or other media.
- After investigating signal complaints from the public, follow up with the requestor to provide feedback about the final disposition of the issue.
- A readily accessible and direct mechanism to contact traffic signal staff within the agency specifically regarding traffic signal operations is available to the road user with publicized contact information.
- Has a defined policy regarding how traffic signal operations staff should communicate with the media.

<b>15</b>	<b>As part of your traffic signal management program, does your agency have a cross-jurisdictional and/or regional agreement (formal or informal) regarding signal coordination and operations? [CO]</b>	<b>2.8</b>  (Score 1-5)
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Score using:

1. No discussions have taken place with other jurisdictions.
2. Cross-jurisdictional signal timing coordination, particularly in support of freeways and major corridors, occurs on an informal basis with no formal written agreements in place to maintain the practice.
3. Cross-jurisdictional signal timing coordination occurs with all relevant adjacent jurisdictions and is documented in a formal written agreement that does not include performance measures, maintenance, or coordination standards, or objectives that establish consistent operations from the perspective of the road user.
4. Cross-jurisdictional coordination occurs with all relevant adjacent jurisdictions and is documented in a written agreement that does include performance measures, maintenance and coordination standards, or objectives that establish consistent operations from the perspective of the road user (e.g. common time base, cycle lengths, calculation of offsets to support continuous traffic flow).
5. All items in 4 and cross-jurisdictional operations are supported through an active continuous exchange of data detailing signal coordination and traffic conditions. Stakeholders meet frequently to ensure the optimal operation of the system.

N/A: My agency does not border another jurisdiction for which cross-jurisdictional operation would prove beneficial to the road user.

<b>16</b>	<b>Does your agency have an objective linked to a policy or process within your program to receive, assess and accommodate requests for special pedestrian needs (e.g. visual disabilities or elderly pedestrians) at signalized intersections? [CO]</b>	<b>3.6</b>  (Score 1-5)
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Score using:

1. Your agency does not accommodate special pedestrian needs.
2. Your agency does not have an objective linked to a policy or process but modifies pedestrian timing on an “ad-hoc” basis in response to requests.
3. Your agency does not have an objective linked to a policy or process but modifies pedestrian timing and installs accessible pedestrian devices on an “ad-hoc” basis.
4. Your agency has an undocumented objective linked to a policy or process to receive, assess and accommodate

requests for special pedestrian needs; modify pedestrian timing; and install and maintain accessible pedestrian devices.

5. Your agency has a documented objective linked to a policy or process in your program to receive, assess and accommodate requests for special pedestrian needs; modify signal timing; and install and maintain accessible pedestrian devices in accordance with documented procedures. Your agency provides feedback to individuals and/or organizations regarding the disposition of their request.

<b>17</b>	<b>Does your agency have an objective linked to a policy or process within your program defining design traffic signal parameters such as clearance intervals, detector timing, minimum greens, and pedestrian intervals for signalized intersections? [FP]</b>	<b>4.0</b>  (Score 1-5)
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Score using:

1. Your agency does not have a policy or process that defines overall design traffic signal parameters.
2. Your agency does not have an objective linked to a policy or process but incorporates design traffic signal timing on an “ad-hoc” basis as needed consistent with general engineering practice.
3. Your agency does not have an objective linked to a policy or process but incorporates design traffic signal parameters on an “ad-hoc” basis as each signal modification or new design is created consistent with general engineering practice.
4. Your agency has an undocumented objective linked to a policy or process that defines overall design traffic signal parameters and incorporates them into new or modified traffic signals.
5. Your agency has a documented objective linked to a policy or process in your program that defines overall design traffic signal parameters and incorporates them in to new or modified traffic signals in accordance with documented procedures.

<b>18</b>	<b>Do you provide technical and professional development for your agency’s workforce in traffic signal operations? [FP]</b>	<b>3.5</b>  (Score 1-5)
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For a 5 score:

- You provide resources and encourage continuing technical training programs to include training from equipment suppliers, software suppliers and continuing education courses for technicians, operators and engineers.
- Salaries, benefits, awards, or responsibilities are established to encourage staff to obtain relevant licenses, certificates and degrees.
- You encourage your employees to apply for professional certifications such as the IMSA traffic signal certification, TPCB, Inc. Traffic Signal Operations Specialist (TSOS) certification and/or the TPCB, Inc. Professional Transportation Operations Engineer (PTOE) certification.

<b>19</b>	<b>Has your agency considered the need for and established a process to actively monitor and manage traffic flow in the majority of the traffic signals in your agency’s traffic signal system? [SA]</b>	<b>3.7</b>  (Score 1-5)
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Score using:

1. Your agency operates electromechanical or solid-state traffic signal controllers with no capability to actively monitor or manage traffic flows.
2. Your agency operates a traffic signal system that has the capability for providing active monitoring and management of traffic flows on a limited basis; however, no resources have been committed to utilize these

functions.

3. Your agency operates a traffic signal system that is capable of providing active monitoring of traffic signal status (i.e. flashing, preemption, operation mode) on a limited basis; no active management of traffic signal timing or monitoring of traffic flow occurs; traffic signals are typically operated in a time-of-day mode.
4. Your agency operates a traffic signal system that is capable of monitoring traffic signal status (i.e. flashing, preemption, operation mode) on a limited basis, with active alarms for critical failures. The traffic signal system is capable of providing information about traffic flow and altering signal timing in response to traffic conditions; however, these features are not actively utilized.
5. Your agency operates a traffic signal system that is capable of real-time monitoring and management of traffic flows. Traffic signal status (i.e. flashing, preemption, operation mode) and information on traffic flow is available in real time and signal timing can be actively monitored and modified to accommodate current traffic conditions. The traffic signal system is capable of operating in a traffic-adaptive or traffic-responsive mode.

<b>20</b>	<b>Does your agency have an objective, policies and supporting capability in place to modify its signal systems operation to address planned events, such as to aid in emergency situations requiring evacuations; to allow passage of military convoys; to accommodate traffic diverted from freeways due to crashes or closure; and to handle extraordinary volumes of temporary traffic following planned events such as football games, concerts and other special events? [KS, SA]</b>	<b>2.8</b>  (Score 1-5)
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For a 5 score:

- The agency works closely with local, State and Federal agencies to assist with special events.
- Tow trucks are provided or are staged at key points to aid in the removal of disabled vehicles.
- The agency collects advanced information on all major special events so it can plan accordingly.
- It has agreements with local universities, concert venues and other special traffic generators to share in the traffic control requirements.
- Signal timing and signal operations have been developed to accommodate the needs of the special events.
- It has established communications and agreements with Federal, State and neighboring jurisdictions relative to regional emergency situations as well as media outlets.

<b>21</b>	<b>Does your agency have plans or procedures in place to modify traffic signal operation in response to unplanned events, such as crashes, roadway construction, freeway incidents, inclement weather, or other unexpected occurrences? [SA]</b>	<b>2.7</b>  (Score 1-5)
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For a 5 score:

- Notification procedures exist for contacting signal operations personnel during non-standard business hours.
- Signal operations personnel have the capability to monitor and/or change signal timing remotely, such as with a laptop computer.
- Special timing plans have been developed and are available for use during freeway incidents, roadway construction activities, or other special events.
- Contact lists and procedures for contacting neighboring jurisdictions have been established so that information concerning signal operations can be shared during incidents.

<b>22</b>	<b>Do all traffic signal-related activities defined as projects have a clear objective, strategy, implementation plan, and desired outcome that result from systematic project development process? [KS]</b>	<b>2.8</b>  (Score 1-5)
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For a 5 score all projects would have:

- Documentation of what agency staff do that the proposed project would support. The activities are broken down into a list of user needs (Concept of Operations).
- For each need, project requirement(s) are defined that must be fulfilled to satisfy that need (Requirements).
- Design of project such that all requirements are met (Traceability Matrix).
- Test the project components against the design (Verification).
- Test the ability of the project to support the activities defined in the concept of operations (Validation).

<b>Results for Section 1—Management</b>	<b>34.9 pts.</b>  <b>63.5[ D ]</b>  (Max. 55)
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**Section 2—Traffic Signal Operations**

Traffic signal management strategies support operations efficiency while maintaining safe movement. In addition, these strategies provide signal timing that minimizes and balances congestion while promoting smooth flow. These strategies must manage traffic conditions predictably and consistently. Reviewing and updating the timing and operational aspects of signalized intersections on a regular basis is extremely important, especially where changes in traffic volumes and/or adjacent land uses have occurred since the last review. This is important for all signalized intersections, regardless of whether they are isolated or coordinated or whether the coordination is provided by a central system or a smaller, more localized system composed of even a few intersections. Traffic signal coordination is one of the more vital aspects of traffic signal control because it ensures that motorists are able to travel through multiple intersections in a corridor with minimal stopping and short delays. The issues addressed in this section include review and update of the phasing sequence, detectors, displays, timing parameters (settings) and other related operational aspects of individual signalized intersections, as well as the timing, interconnection and operation of coordinated systems.

<b>23</b>	<b>Does your agency have a documented process in place to manage approved signal phasing and timing settings for each intersection? [SA]</b>	<b>3.8</b>  (Score 1-5)
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The following describes the policies, processes and behaviors necessary for a score of 5:

- The inventory is centrally accessible.
- The inventory is composed of either paper or electronic formats.
- Processes are in place for updating the inventory.
- Changes to phasing and timing settings are approved by a designated authority.
- Field changes are documented in the central office inventory.
- They are incorporated into the agency’s traffic signal management plan.

<b>24</b>	<b>Does your agency have a documented signal timing review process that involves routine investigations or studies of individual intersection, area-wide or corridor signal timing in response to appropriate performance measures or within a specified time frame? [SA]</b>	<b>3.2</b>  (Score 1-5)
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For a 5 score, a signal timing review should include the following:

- Routine reviews in response to complaints or land-use changes.
- Routine reviews of traffic volume changes at significantly congested intersections and high-priority arterials.
- Comparison of new intersection turning movement counts and pedestrian volume data and/or other traffic flow data to old data to determine if traffic flow patterns have changed.
- Evaluation of travel time/delay information and saturation flow data at critical intersections.
- Review of traffic signal phasing and turn lane designations to determine if changes or adjustments will improve operations.
- In coordinated systems, review of system master control parameters and algorithms to determine if the system is operating optimally (traffic-responsive or traffic-adaptive parameters).
- Routine review of crash data to determine if any safety deficiencies exist that may be addressed through signal timing adjustments.
- A comprehensive system for monitoring all of the above, including a scheduled updates with a maximum of 3 years between reviews.

<b>25</b>	<b>Does the signal timing review consider operational objectives to direct data collection requirements to inform the design of timing revisions? [KS]</b>	<b>3.4</b> <small>(Score 1-5)</small>
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For a 5 score, the following are obtained and analyzed in a manner consistent with the operational objectives:

- Recent turning movement counts and other volume data (such as from system detectors).
- Crash history and previous complaint records.
- Transit service.
- Intersection geometry and network configuration.
- Detector layout and configuration (min, gap & max times relative to type, size and location of detectors)
- Freight activity.
- Pedestrian volumes.
- Observations of field conditions are always conducted (on-site or via video cameras) in both peak and off-peak periods.

<b>26</b>	<b>When performing a signal timing update, does your agency review intersection signal timing parameters in comparison to operational objectives? [SA]</b>	<b>4.0</b> <small>(Score 1-5)</small>
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For a 5 score, the timing evaluations include:

- Settings that affect each approach's green time (initial green, vehicle extension, maximum green, etc.).
- If in a coordinated system, settings that affect progression from one intersection to the next (offset, etc.).
- Detector layout and configuration (min, gap & max times relative to type, size and location of detectors).
- If any physical changes to the roadway or approach speeds occurred since the last review, updates to design parameters such as yellow change interval, red clearance interval and pedestrian clearance intervals for all phases.

<b>27</b>	<b>As part of a timing review, does your agency make it a policy or practice to include assessments of other related measures that could make the signalized intersection operate more safely and efficiently? [SA]</b>	<b>3.8</b> <small>(Score 1-5)</small>
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For a 5 score, these assessments include all of the following:

- Adding coordination with adjacent signals or adjusting offsets.
- Adding or removing the intersection from late-night or off-peak flashing operation in accordance with applicable policies.
- Changing the type of control (pre-timed vs. semi-actuated vs. fully-actuated).
- Verifying that a traffic signal is the most appropriate solution in comparison to other traffic controls (e.g. all-way stop) or roadway designs (e.g. roundabout).
- Changing left-turn control modes (permissive only vs. protected-permissive vs. protected only) and left-turn phase sequence (leading vs. lagging vs. "lead-lag" vs. "split-phase") for one or more left-turn movements.
- Other operational changes, such as adding or eliminating vehicular or pedestrian phases, re-striping to increase the number of lanes, changing the lane-use assignments, improving signing, optimum signal head visibility, etc.

<b>28</b>	<b>Does your agency conduct comprehensive reviews of area-wide or corridor signal timing? A comprehensive review should include but is not limited to the following: review of a.m., p.m. and other peak and off-peak periods to determine if cycle lengths are adequate and are being used during the appropriate time periods; corridor offsets are field-reviewed to determine if arterial progression is adequate; intersection splits are field-reviewed to determine if intersection delays are being minimized; and queuing patterns are observed in the field to determine if any turn-lane blockages or spill-back into adjacent intersections is occurring. [SA]</b>	<b>3.6</b>  (Score 1-5)
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N/A – My agency does not have any area-wide or corridor traffic signals.

Score using:

1. Comprehensive reviews are not conducted.
2. Reviews are conducted in response to citizen complaints only, and only the location identified in the complaint is reviewed.
3. Reviews are conducted in response to citizen complaints only, and the entire area or corridor is reviewed.
4. Comprehensive reviews are conducted on all critical areas or corridors that have undergone significant changes, such as new traffic generators, geometric changes, installation or removal of new signals, etc., over the past 12 months, and at least once every five years.
5. Comprehensive reviews are conducted on all area-wide or corridor signal timing plans.

<b>29</b>	<b>After a need for changes in timing settings is identified and new settings developed, are mechanisms and resources in place to ensure that the new settings are implemented, evaluated and fine-tuned in the field in a timely manner? [SA]</b>	<b>3.6</b>  (Score 1-5)
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Score using:

1. Procedures and/or lack of resources delay field implementation of timing updates for many weeks or even indefinitely.
2. New timing is developed and implemented longer than 2 months or as time permits.
3. New timing is developed and implemented within 1-2 months after the need has been identified.
4. New timing is developed and implemented within 2 weeks.
5. Most timing is developed and implemented within 2 to 5 working days.

<b>30</b>	<b>Does your agency have the means to identify, schedule, examine and adjust, as needed, those traffic signals in close proximity to railroad-highway grade crossings to prevent vehicles from being trapped on the tracks due to traffic signal operations? [SA]</b>	<b>3.8</b>  (Score 1-5)
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N/A – My agency does not have any railroad-highway grade crossings.

For a 5 score:

- An inventory of all traffic signals within 200 feet of grade crossings exists, including those signals operated by



others within your jurisdiction (i.e., State department of transportation).

- Signal preemptions are installed at those grade crossings with and without active traffic controls in place.
- Increases or decreases in train movements, speeds and that of vehicle traffic are regularly measured.

<b>31</b>	<b>Does the process of developing new area-wide or corridor timing include the use of traffic signal optimization analysis tools, validation of optimized timing, field installation, observation and fine-tuning consistent with operational objectives? [SA]</b>	<b>4.1</b>  (Score 1-5)
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The following describes the policies, processes and behaviors necessary for a score of 5:

- The process of developing the new signal timing should be based on a well-defined process that begins with consideration of operational objectives that directs data collection that may include turning movement counts or data provided by traffic detectors installed in the system.
- The data are used as an input to traffic optimization analysis tools, which is used to generate an initial set of signal timing.
- This timing is then evaluated and, ideally, may be tested using traffic simulation.
- The resulting signal timing is installed and observed and additional field fine tuning adjustments are made where needed.

<b>32</b>	<b>In addition to the normal a.m. peak, off-peak and p.m. peak plans, do the timing plans used in your traffic signal systems include timing for weekends, holidays and other planned events? [SA]</b>	<b>3.5</b>  (Score 1-5)
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The following describes the policies, processes and behaviors for a score of 5:

- Traffic patterns have been studied to identify the time periods during which different traffic patterns exist.
- Timing plans exist to address routine traffic changes (more than three plans for weekday operation, weekends) and planned special situations (special events, holidays, weather, emergencies).
- Timing plans are implemented quickly and effectively whenever needed.

<b>33</b>	<b>Does your criterion for coordinating signals consider traffic flow characteristics, volumes and spatial separations? [SA]</b>	<b>3.7</b>  (Score 1-5)
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N/A – My agency does not have any coordinated traffic signals.

For a 5 score:

- Your agency has documented and implemented criterion for interconnecting signals.
- The criterion considers traffic flow, platoon characteristics, volumes, spatial separations and midblock friction.
- Your agency uses state-of-the-art techniques for determining when coordination would be beneficial.

<b>34</b>	<b>In areas with routinely unpredictable or highly variable traffic demand (e.g. in the vicinity of major shopping centers, universities, recreation centers, etc.) has your agency considered application of advanced controller features or operational strategies such as traffic-responsive or adaptive control? [SA]</b>	<b>2.8</b>  (Score 1-5)
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There are often roadways within a signal system that experience unpredictable changes in traffic flow patterns. Traffic-responsive control (in which timing plans are automatically selected based on measured traffic patterns) or traffic-adaptive control (in which signal timing is calculated online in response to measured traffic patterns) are both well suited to these situations.

N/A: There are no areas in my agency’s jurisdiction with unpredictable or highly variable demand.

For a score of 5, all of the following situations make use of traffic-responsive or adaptive control:

- Incident management corridors (routes that parallel an interstate or freeway).
- Corridors that serve resort areas.
- Corridors that serve cultural, athletic, or other entertainment venues.
- Shopping centers where demand fluctuates.
- Schools and major universities generating unpredictable traffic flows as a result of changing class schedules and school holidays.
- Other critical corridors or areas with unpredictable traffic flows.

<b>Results for Section 2—Traffic Signal Operations</b>	<b>43.2 pts.</b>  <b>72.1 [ C ]</b>  (Max. 60)
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**Section 3—Signal Timing Practices**

Some of the questions in this self assessment address output issues, such as the frequency with which signal timing is examined and the number of detectors that are operational. While these questions are important, it is equally important to consider the outcomes of these activities and whether they have met the intended results of the program’s objectives; in other words, determining the overall effectiveness of the signal operation that results from all of these activities. This section attempts to evaluate the effectiveness of the signal operation through consideration of the degree to which the agency employs signal timing practices that have been shown to produce efficient operation.

<b>35</b>	<b>When manually determining offset for signals in a coordinated system, do you take queue discharge time, two-way progression and turning movement arrivals into account? [SA]</b>	<b>3.8</b>  (Score 1-5)
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N/A – My agency does not have any coordinated traffic signals.

The following describes the policies, processes and behaviors necessary for a score of 5:

- The agency checks signal offsets produced by signal timing software through time-space diagrams and field observations.
- When manual timing is being developed, offset is calculated as the link travel time minus the time required to discharge standing queues.
- When midblock sources of traffic (such as major parking structures) are added to the network, offsets are adjusted to reflect the addition of vehicles to standing queues.
- When operational changes are made, such as modified bus stop locations, new turning restrictions, etc., offsets are adjusted to reflect the impact on standing queue length.
- Two-way progression and turning movement arrivals considered when offsets are adjusted.
- System offsets are reviewed and adjusted in the field so that variations in travel speed, queuing patterns, mid-block friction, or other field conditions can be accounted for.

<b>36</b>	<b>When timing a system of coordinated signals, do you evaluate and implement the most effective timing based on a comparative analysis of cycle lengths, offsets, phase sequence and other timing parameters? [SA]</b>	<b>3.9</b>  (Score 1-5)
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N/A – My agency does not have any coordinated traffic signals.

The following describes the policies, processes and behaviors necessary for a score of 5:

- Signal timing optimization analysis tools and/or traffic simulation software are employed to evaluate a range of cycle lengths, leading to implementation of the most effective cycle length and resulting in a comparative analysis.
- The cycle length at minor intersections with light traffic is minimized by utilizing half-cycle lengths or another sub-multiple to reduce control delay.
- Signal operational modes are selected to accommodate situations such as oversaturated crossing arterials, pedestrian movements and other unique site conditions (for example, alternate max. greens, free running, etc.).
- Modifications to coordinated signal timing parameters are not implemented prior to analysis and understanding of the impact on surrounding intersections operation.
- An appropriate number of timing plans or signal timing strategies, such as traffic responsive or adaptive control, have been deployed to address traffic demands during all time periods. For example, your agency considers that multiple a.m., p.m. and off-peak plans may be needed to fully address traffic demands.
- Field observation, fine tuning and calibration of signal timing plans and strategies are completed prior to finalizing timing plans.

<b>37</b>	<b>When timing a system of coordinated signals, do you evaluate the timing using time-space diagrams or other technique(s), and evaluate different phase sequences (for example, leading left turns vs. lagging left turns vs. lead-lag, while recognizing left-turn trap issues) at intersections that appear to be interrupting the progression? [SA]</b>	<b>4.0</b>  (Score 1-5)
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N/A – My agency does not have any coordinated traffic signals.

The following describes the processes for a score of 5, recognizing that phasing can have a significant impact on the ability to provide two-way progression along a coordinated arterial:

- When new arterial timing is being developed, the agency produces time-space diagrams that are used to qualitatively evaluate the two-way progression that has been developed.
- Intersections that appear to interrupt the progression are evaluated to determine whether phasing changes will have an impact on the progression.
- New phasing is entered into the signal timing program to evaluate its impact on the program’s estimate of performance measures.

<b>38</b>	<b>When timing actuated controllers, do you evaluate the following factors? [SA]</b>	<b>4.0</b>  (Score 1-5)
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N/A – My agency does not have any actuated controllers.

For a score of 5, all of the following factors are considered:

- Cycle length is optimized to utilize the lowest cycle length that will efficiently and effectively serve the traffic demand.
- Volume/density timing is utilized where appropriate.
- Turn lane blockages and spill-back into adjacent intersections are minimized.
- Vehicle delay is equitably balanced across all intersection approaches.
- Vehicle extension times are set based on established practices to provide the safest and most efficient movement of pedestrians and vehicular traffic through the intersection.
- Timing is field-reviewed and adjusted to account for actual field operating conditions.
- During periods of congestion, maximum green times are set to reflect the demand on each phase.

<b>39</b>	<b>During periods of light traffic flow or at night, does your agency consider the need to apply signal timing methods that minimize delays? [KS]</b>	<b>3.9</b>  (Score 1-5)
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For a 5 score, your agency uses some or all of the following as appropriate:

- Cycle lengths are optimized along the corridor to utilize the lowest cycle lengths possible while maintaining adequate progression along the arterial.
- Minor intersections are half-cycled where appropriate.
- Intersections are analyzed and grouped according to cycle length needs.
- Intersections are placed into “free” (fully actuated) mode as appropriate.

- Minor intersections with very low side-street traffic volumes may be placed in a flashing mode of operation consistent with agency traffic safety objectives and policies.

<b>40</b>	<b>Does your agency address intersection approaches in the system where traffic in left-turn or right-turn bays exceeds the effective green capacity of the corresponding traffic signal phase and blocks through movements during the green period, or are there approaches in your system where queues of thru traffic block access to left- and right-turn bays? [KS]</b>	<b>3.4</b>  (Score 1-5)
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The following describes the policies, processes and behaviors necessary for a score of 5:

- Intersections performance is monitored or reviewed periodically to ensure that there are no instances of queued traffic in turn lanes blocking through movements.
- When a problem is identified, signal phasing and/or splits are adjusted within a specified timeframe to reduce or eliminate the problem.
- The system cycle length is re-evaluated to ensure that it is appropriate.
- Specialized signal operation, such as the use of queue detectors, servicing of a left-turn phase twice per cycle, right turn overlap phases, modification of lane assignments during peak traffic flows, or other innovative signal timing techniques, is utilized.
- System offsets are adjusted to reduce queuing of through traffic.

<b>Results for Section 3—Signal Timing Practices</b>	<b>23.0 pts.</b>  <b>76.6 [ C ]</b>  (Max. 30)
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## Section 4—Traffic Monitoring and Data Collection

A robust program and supporting systems are needed to determine the condition of traffic flow on roadway networks. These programs and supporting systems would collect data connected to agency objectives to:

- Provide input to traffic signal control operation.
- Monitor systems in real-time.
- Formulate strategies to effectively manage and control the flow of traffic.
- Monitor flows over long periods of time via data archiving.
- Distribute to others, such as the peer agencies, public, universities and local planning programs.
- Assist in incident response and management.

<b>41</b>	<b>Does your agency have a regular, ongoing performance monitoring program to evaluate the achievement of operational objectives? [FP]</b>	<b>2.5</b>  (Score 1-5)
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For a 5 score, operational objectives are clearly articulated and drive requirements for the type and frequency of data collection:

- The data represent traffic conditions for relatively short periods of time, such as every 15 minutes.
- Arterial travel time, average delay, number of stops, or other performance-based data are regularly collected.
- Your agency commits resources to the collection and analysis of the data.
- The data collected are used to determine the need for further study or system changes/modifications.
- Data trends are identified and reported on a regular basis.
- Collected data are analyzed to better manage planned and unplanned events.
- Collected data and resulting analysis are used for regular formal reports to management and policymakers.
- The data are combined or cross-tabulated with data that may be collected by others, such as weather data, crash data, construction data, event information, etc.

<b>42</b>	<b>Do you periodically assess the quality of the data you collect? [SA]</b>	<b>2.5</b>  (Score 1-5)
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The following describes the program elements for a score of 5, recognizing that data sources may include traffic and pedestrian volumes, delay, stops, etc. as well as system data such as vehicle/pedestrian detection data, system alarms (failures), controller alarms, detection alarms, conflict monitor and controller data:

- You have a formal data quality assessment program.
- You know within practical limits how many of the collection and monitoring systems are working correctly.
- You are able to quickly identify when the systems are not operating correctly.
- You repair systems and devices in a short period of time.
- You have defined metrics and a process upon which to assess data quality. For example, you use other collection methods and systems to verify accuracy of specific technologies at specific locations and use this information to calibrate the systems and devices.
- You prepare a report documenting the quality of the data collected.

<b>43</b>	<b>Do you have a process to archive the collected data? [SA]</b>	<b>2.9</b>  (Score 1-5)
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For a 5 score:

- There is a formal and well-documented archiving system to store the collected data.
- The data are quick and easy to access in a well-documented/standardized electronic format.
- The data are easy for all partners' use in analysis.
- The archive system also includes data quality attributes.

<b>44</b>	<b>Do you actively share collected data? [SA]</b>	<b>2.6</b>  (Score 1-5)
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For a 5 score:

- Your data are shared with regional operating partners.
- Your data are available for use in regional planning models.
- Your data are available for use in teaching and research at local colleges and universities, if applicable.
- Your data are readily available to road users and other customers using traveler information systems such as a Web-based traffic conditions map.
- Your data are available in real-time.
- Collected data is used to report the benefits and costs of signal timing updates to senior management, elected officials and the public.

<b>Results for Section 4—Traffic Monitoring and Data Collection</b>	<b>10.4 pts.</b>  <b>52.2 [ F ]</b>  (Max. 20)
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**Section 5—Maintenance**

The maintenance function supports the key strategy of field infrastructure reliability that leads to effective signal operation. A well-timed system must be accompanied by effective maintenance if it is to provide high-quality service to the motoring public. This section can be used to assess the effectiveness of the planning, management and execution of maintenance activities.

<b>45</b>	<b>Does your agency have established field infrastructure reliability objectives supported by policies and processes, and commit resources (in-house or contracted) to provide for timely response after a critical malfunction is reported? [KS]</b>	<b>4.3</b>  (Score 1-5)
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Score using:

1. During regular business hours, a technician is at the intersection by the next business day after receiving notification, and no provisions exist for technician response outside of regular business hours.
2. During regular business hours, a technician is at the intersection within 8 hours after receiving notification and within 16 hours outside of regular business hours.
3. During regular business hours, a technician is at the intersection within 4 hours after receiving notification and within 8 hours outside of regular business hours.
4. A system is in place to monitor and verify critical malfunctions, technicians are dispatched only when necessary, during regular business hours at the intersection within 2 hours and within 4 hours outside of regular business hours.
5. A system is in place to monitor and verify critical malfunctions, technicians are dispatched only when necessary, during regular business hours at the intersection within 1 hour and within 2 hours outside of regular business hours.

<b>46</b>	<b>Does your agency commit maintenance resources and manage maintenance activities to ensure that traffic operations meet safety needs and customer requirement levels? [KS]</b>	<b>3.7</b>  (Score 1-5)
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For a 5 score, your agency:

- Commits specific funding to repair, replace, or upgrade signal equipment, cabinets, controllers, detector cards, etc., based on their specific life cycle.
- Commits specific funding to repair, replace, or upgrade signal infrastructure: poles, junction boxes, conduit, cable and signal heads based on their specific life cycle.
- Has a policy for timely replacement of sensors/detectors that are destroyed or disabled by roadway maintenance or permitted utility activities. The replacement of sensors/detectors is included as part of the maintenance project scope or utility work.
- Does not commit funded traffic signal resources to unfunded non-traffic signal activities (ITS, CCTV, DMS, incident management).
- Provides an easy way for customers to notify the agency of signal problems.
- Has a performance measurement and/or asset management program for reporting to management and the public of the quality of signal maintenance response times.



<b>47</b>	<b>Does your agency consider operations and maintenance capability and resources in the design of traffic signal infrastructure and selection of control devices? [FP]</b>	<b>3.5</b> <small>(Score 1-5)</small>
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For a 5 score, your agency:

- Documents design standards to show how they impose resources commitments on operations and maintenance resources.
- Maintains consistent design standards to minimize the need to maintain unique equipment in the infrastructure.
- Ensures infrastructure reliability and ensures that the ability to support with financial, analytical and technical resources are key considerations in the deployment of new or modified designs.
- Scales the maintenance commitment to growth and change, so that as equipment, location and technology increase or differ, fiscal and human resources increase/change proportionally.

<b>48</b>	<b>Does your agency provide regular training programs for traffic signal maintenance personnel? [KS]</b>	<b>3.7</b> <small>(Score 1-5)</small>
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For a 5 score, your agency:

- Provides funding and encourages maintenance personnel to regularly attend technical training programs to familiarize themselves with the latest equipment and procedures associated with traffic signal maintenance.
- Provides training programs that include courses offered by manufacturers and suppliers relevant to the specific equipment currently in use as well as courses dealing with the general theory of traffic signal and computer maintenance and operation.
- Requires certification: For example, the TPCB, Inc. Traffic Signal Operations Specialist (TSOS) certification and/or the IMSA traffic signal certification is required for traffic signal technicians.

<b>49</b>	<b>Does your agency have a process for performing regular proactive preventive maintenance and operational reviews to assess the condition of the traffic control system? [KS]</b>	<b>3.9</b> <small>(Score 1-5)</small>
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Score using:

1. Your agency has no process; regular preventive maintenance and operational reviews are not performed.
2. Your agency has no defined processes; performs *limited* preventive maintenance and operational reviews only if time/man-power permit.
3. Your agency has defined processes; performs *limited* preventive maintenance and operational reviews when time/manpower permit, including verification of signal/pedestrian indications.
4. Your agency has defined processes; performs *regular* preventive maintenance and operational reviews at least annually with limited documentation for some or all equipment.
5. Your agency has a defined process for *regular* preventive maintenance and operational reviews, including comprehensive semi-annual maintenance review, quarterly operational reviews and annual conflict monitor/MMU testing; all including formal documentation for some or all equipment.

<b>50</b>	<b>Does your agency maintain complete configuration management (schematics, interconnection information, software documentation, etc.) and inventories of all traffic signal control equipment? [KS]</b>	<b>3.8</b>  (Score 1-5)
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For a 5 score:

- Complete inventories include all intersection equipment, including traffic signal controllers, ancillary equipment such as flashers, conflict monitors, load switches, actuation sensors and system detectors, including detector locations, the number and types of sensors.
- Complete inventories also include all communications devices and communications facilities.
- Configuration management information includes the interconnection and disposition of all equipment located at field installations, the central system and in the maintenance facility.

<b>51</b>	<b>Does your agency monitor the traffic signal system and receive notification within a specified timeframe when there is a malfunction of critical intersection components? Critical malfunctions include items such as controller failure, power outages, red indication failure, railroad preemption failure, etc. [SA]</b>	<b>3.5</b>  (Score 1-5)
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For a score of 5, your agency is provided with malfunction notification of all critical intersection components within defined timeframe, and agency personnel are prepared to effectively respond within an established response period to these malfunctions as needed.

<b>52</b>	<b>Does your agency have a maintenance management system for evaluating equipment reliability, scheduling maintenance activities, evaluating maintenance staff performance, tracking costs/expenditures, and determining the maintenance impact of system modifications and upgrades? [SA]</b>	<b>2.9</b>  (Score 1-5)
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Score using:

1. There is no maintenance management system.
2. Maintenance management is accomplished through paper recordkeeping.
3. Maintenance management is accomplished through electronic spreadsheets.
4. Maintenance management is accomplished through a fully computerized system.
5. Maintenance management is accomplished through a fully computerized system, and the maintenance management system is actively used for evaluating equipment reliability, scheduling maintenance activities, and tracking costs by activity.

<b>53</b>	<b>Does your agency have battery backup or a plan for power outages that may include items such as emergency generators? [SA]</b>	<b>3.3</b>  (Score 1-5)
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Score using:

1. No battery backups, emergency generators, or other resources are provided.
2. Your agency is developing a plan to provide for operation during power outages.

3. Your agency has a plan to provide for operation during power outages.
4. Your agency is implementing a plan to provide for operation during power outages.
5. Your agency provides battery backups, emergency generators, or other resources at all critical intersections.

<b>54</b>	<b>Maintaining the functionality of detection systems is an important component of an effective and efficient signal timing program. What percentage of your agency’s detection systems are operating as intended in your traffic signal management plan? [SA]</b>	<b>4.0</b>  (Score 1-5)
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N/A – My agency does not have any traffic signal detectors or detection systems.

The following describes the program elements for a score of 5:

- Agency has specific criteria for detection being operational.
- Agency has methods to identify and report detection failures in a timely manner.
- Agency has specific process and timeframe for repairs of detection systems.
- 95 percent or more of detection is operational.

<b>Results for Section 5—Maintenance</b>	<b>36.5 pts.</b>  <b>73.0 [ D ]</b>  (Max. 50)
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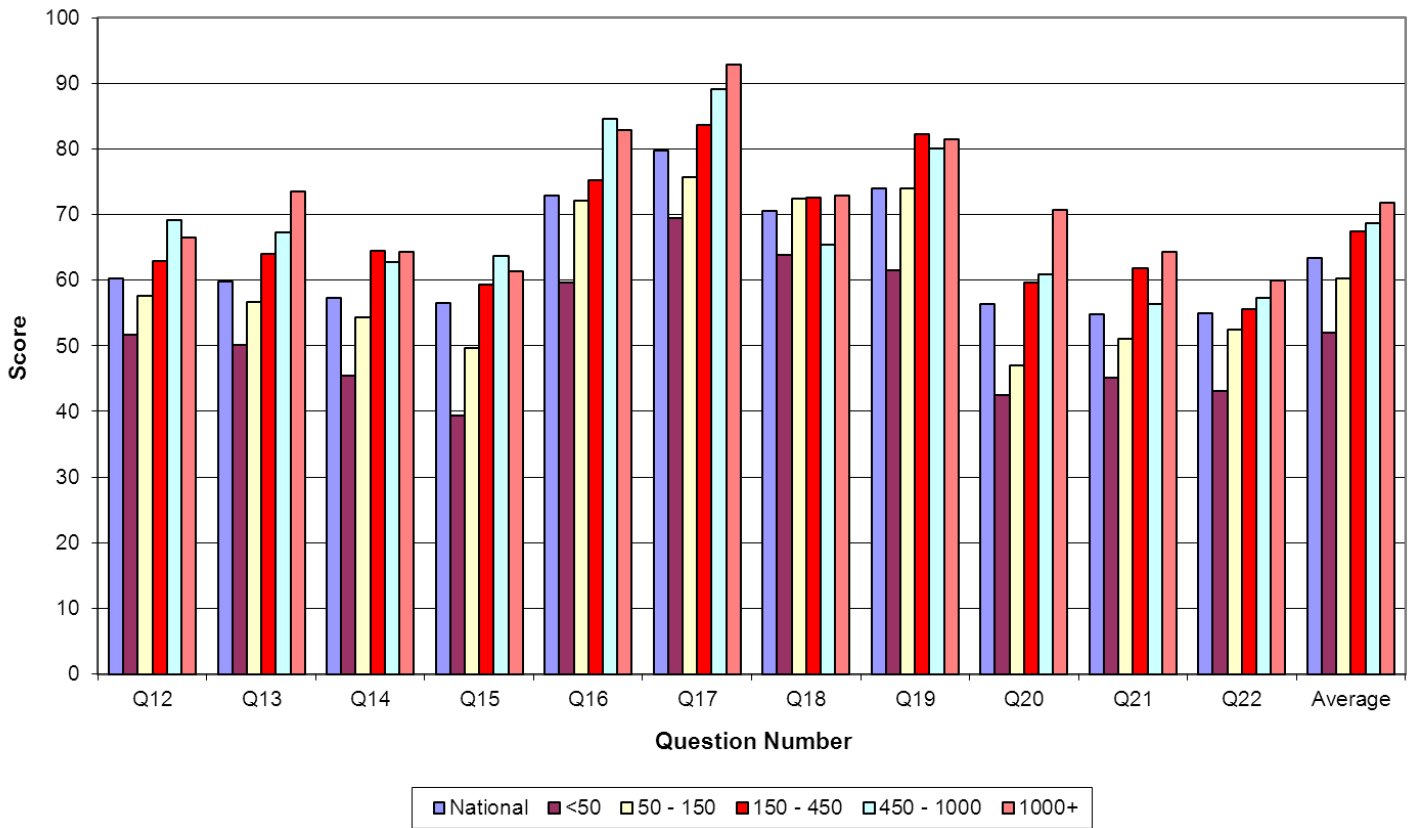
## Thank you.

We hope the 2011 Traffic Signal Operations Self Assessment has helped your agency evaluate the operation of its traffic signal system operations. We ask that your results be provided for inclusion in the National Traffic Signal Report Card. **Individual results and names of participating agencies are completely confidential and are not released.**

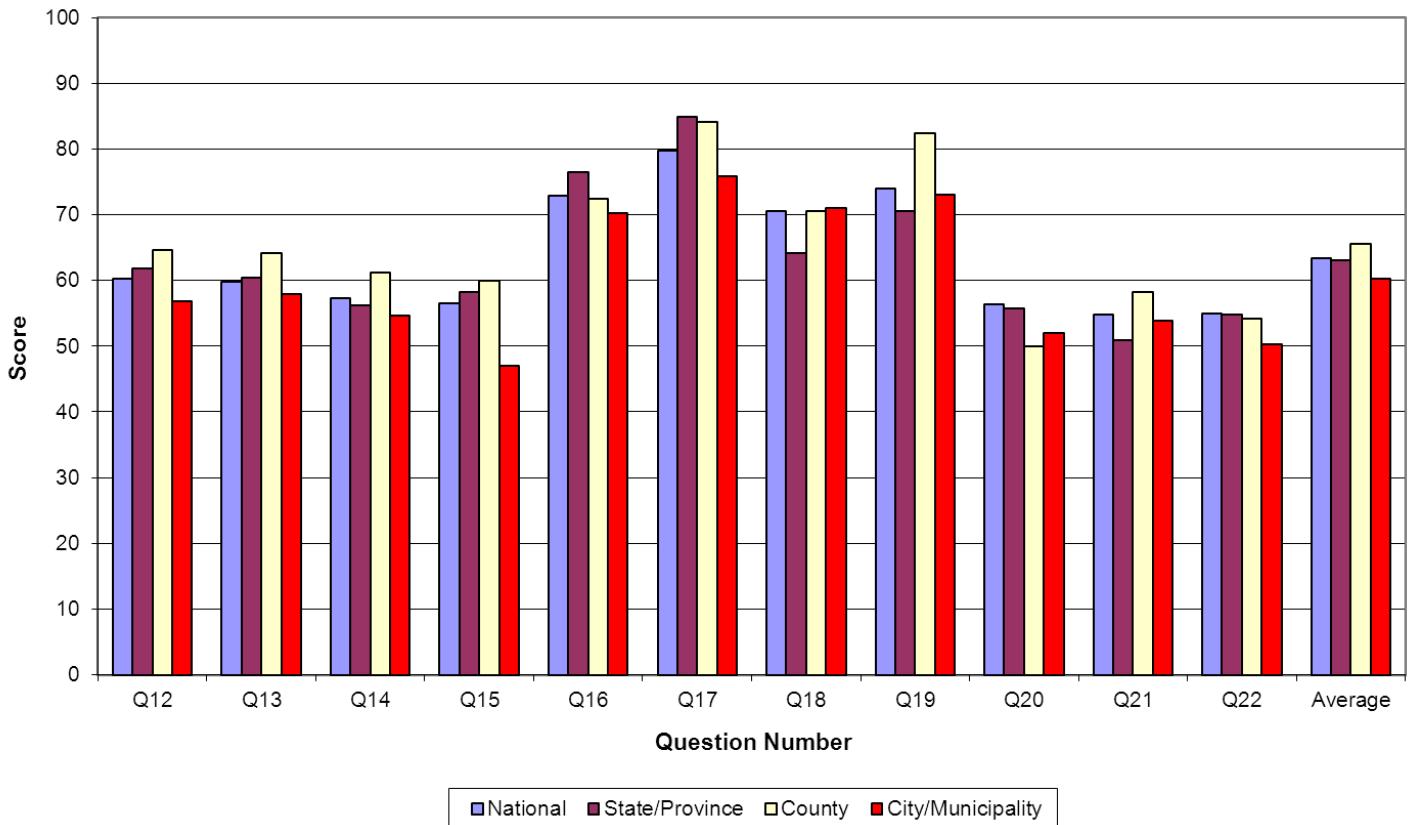
<b>Overall Results for All Sections</b>	<b>148 pts.</b>  <b>69 [ D ]</b>  (Max. 215)
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**Appendix B**  
**Results by Section**  
**2011 Traffic Signal Operations Self Assessment**

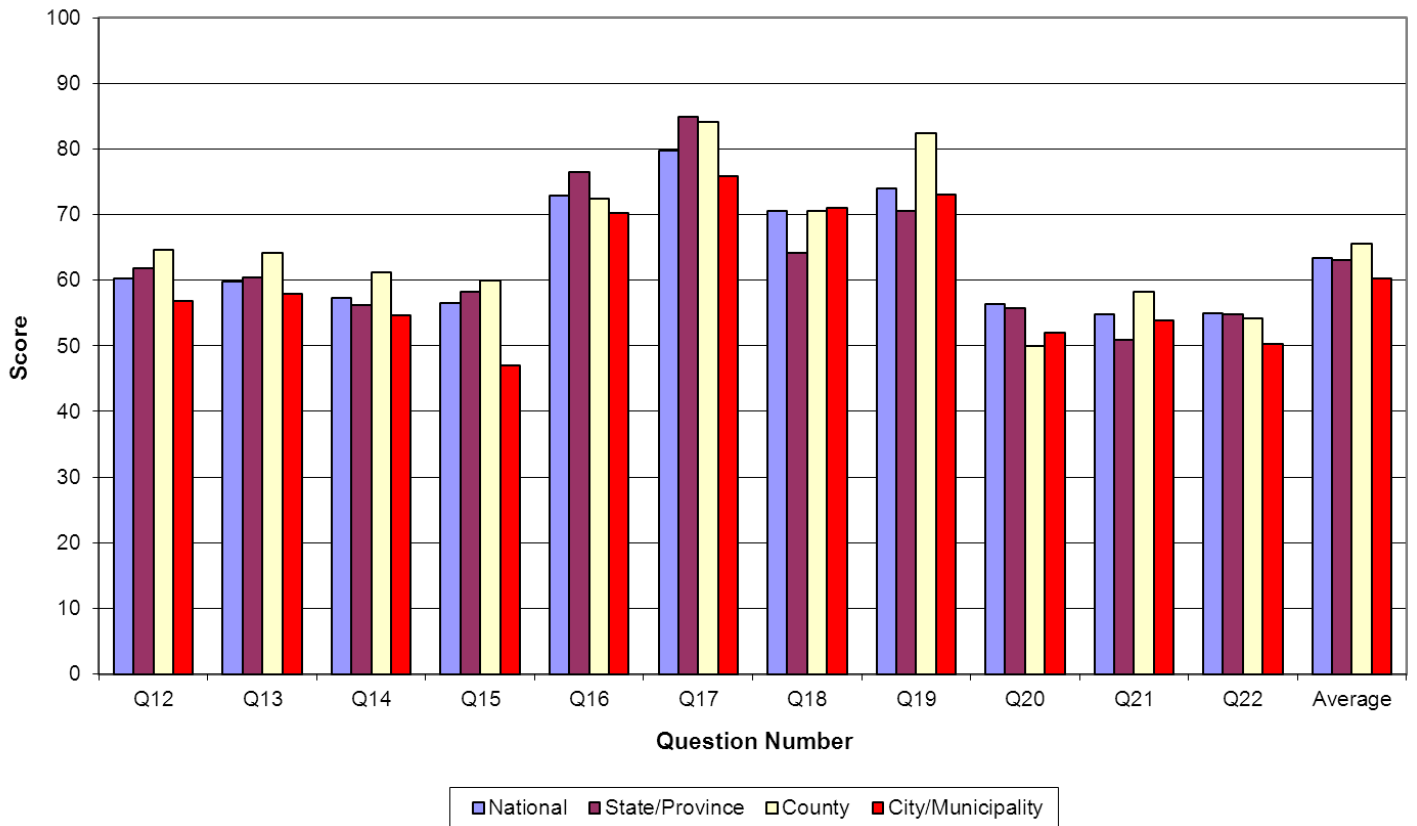
**Figure C-1: Management Results by Signal System Size**



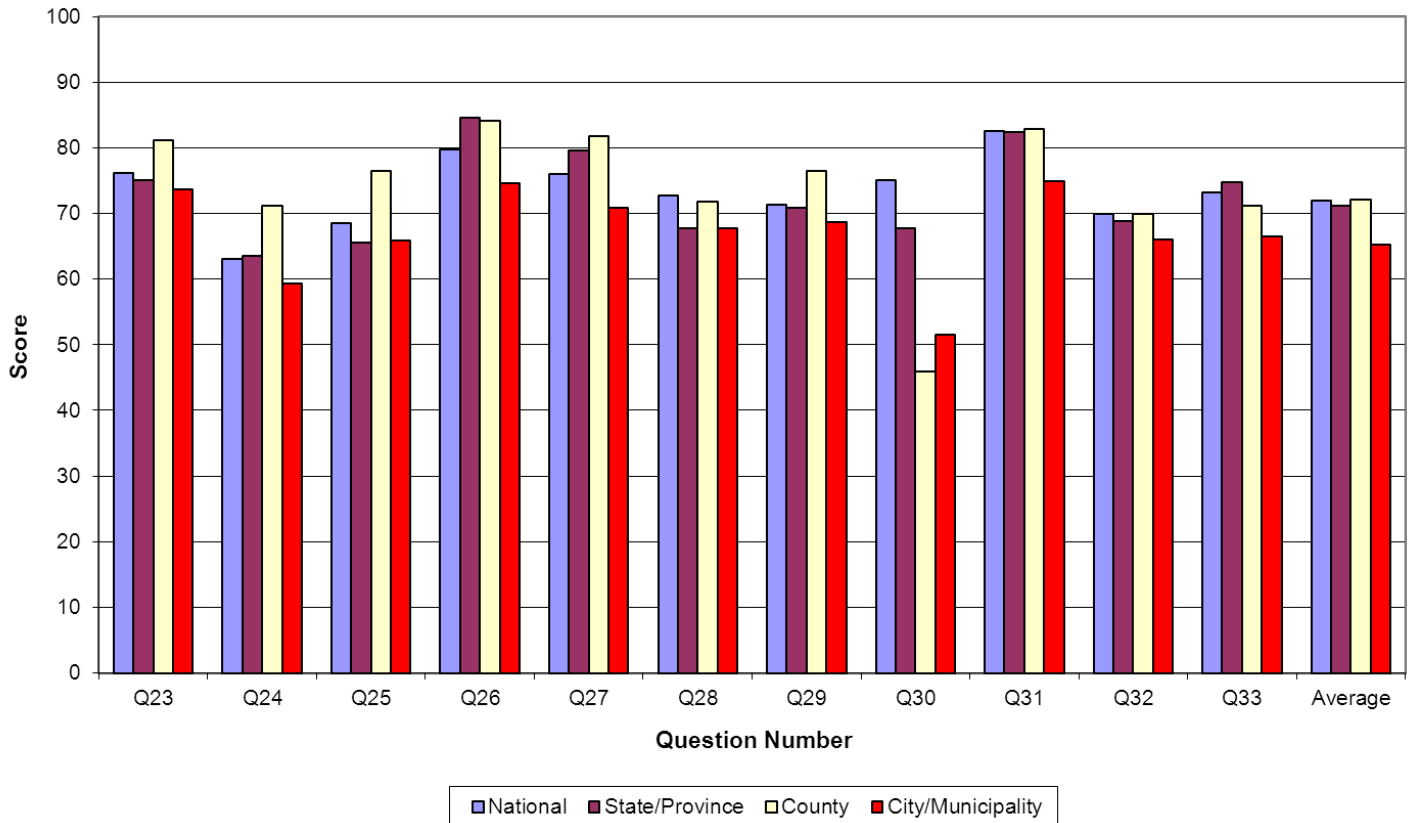
**Figure C-2: Management Results by Agency Type**



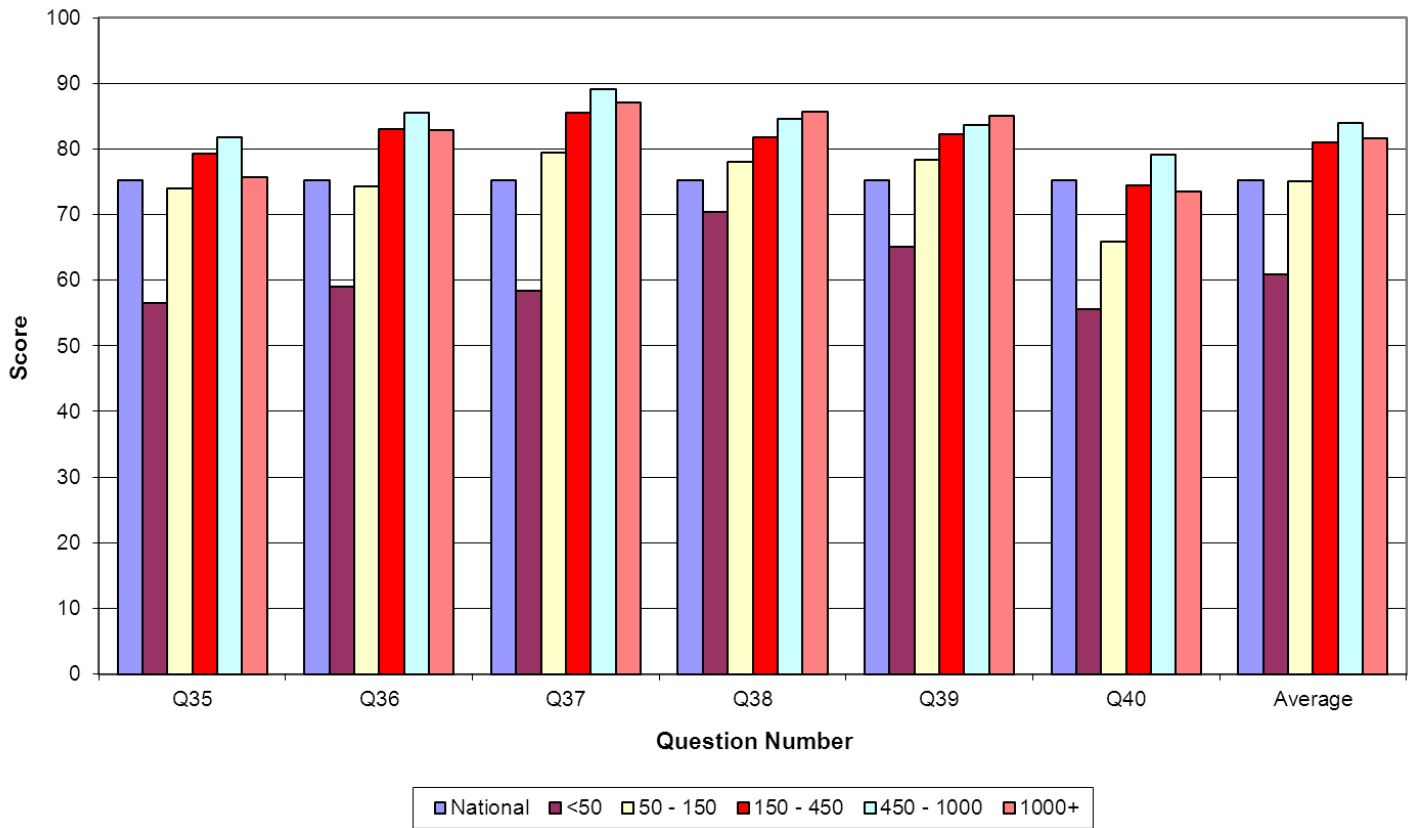
**Figure C-3: Traffic Signal Operations Results by Signal System Size**



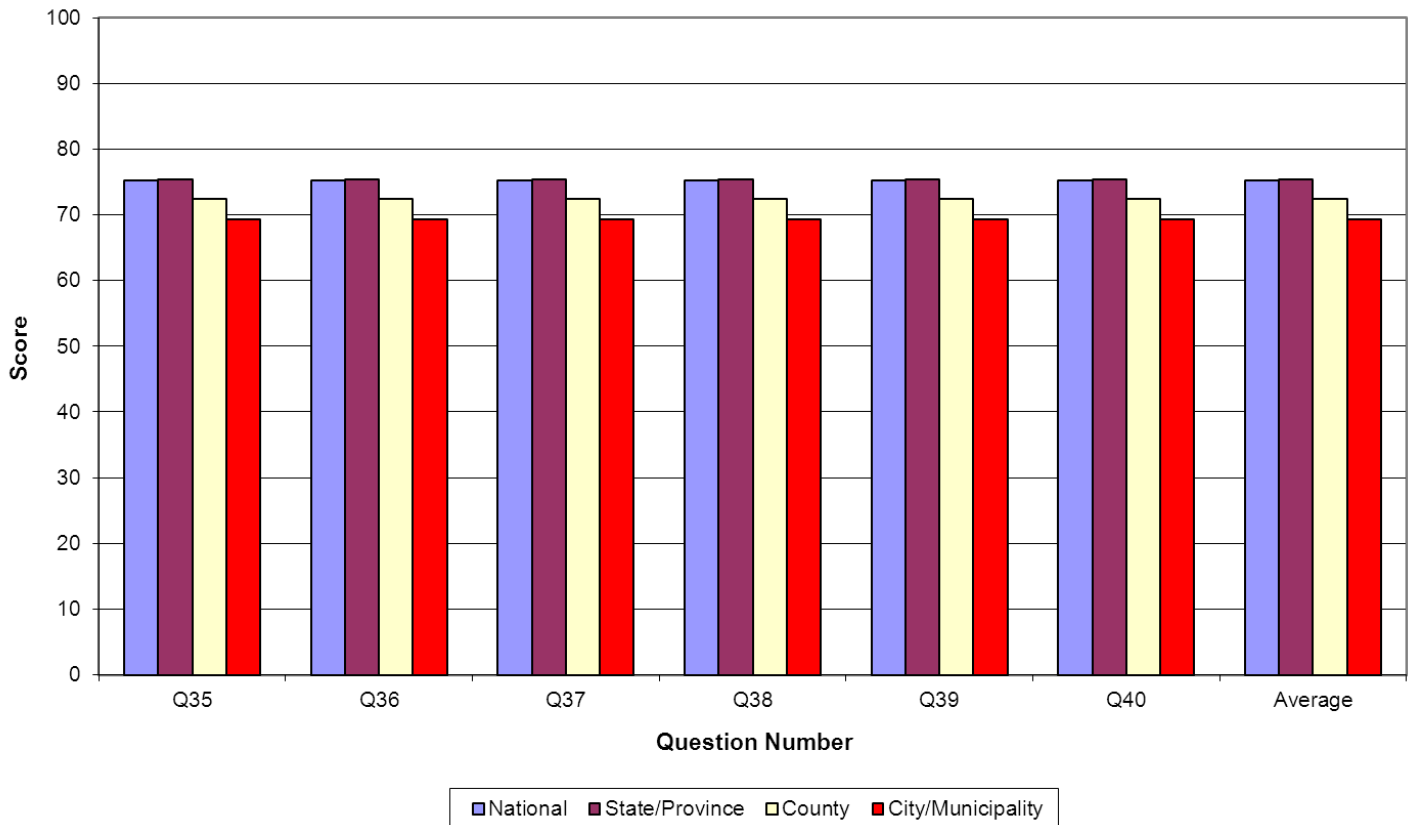
**Figure C-4: Traffic Signal Operations Results by Agency Type**



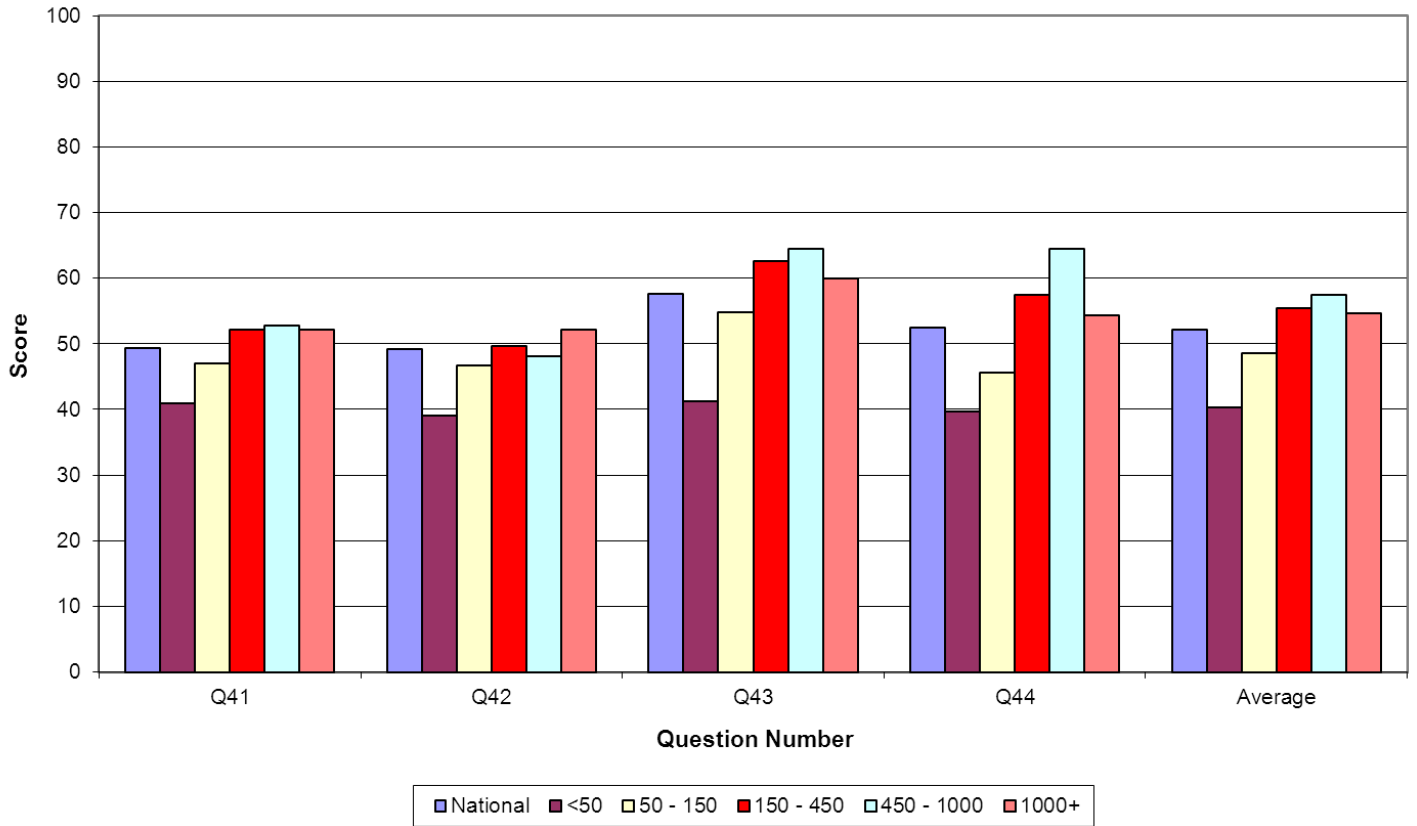
**Figure C-5: Signal Timing Practices Results by Signal System Size**



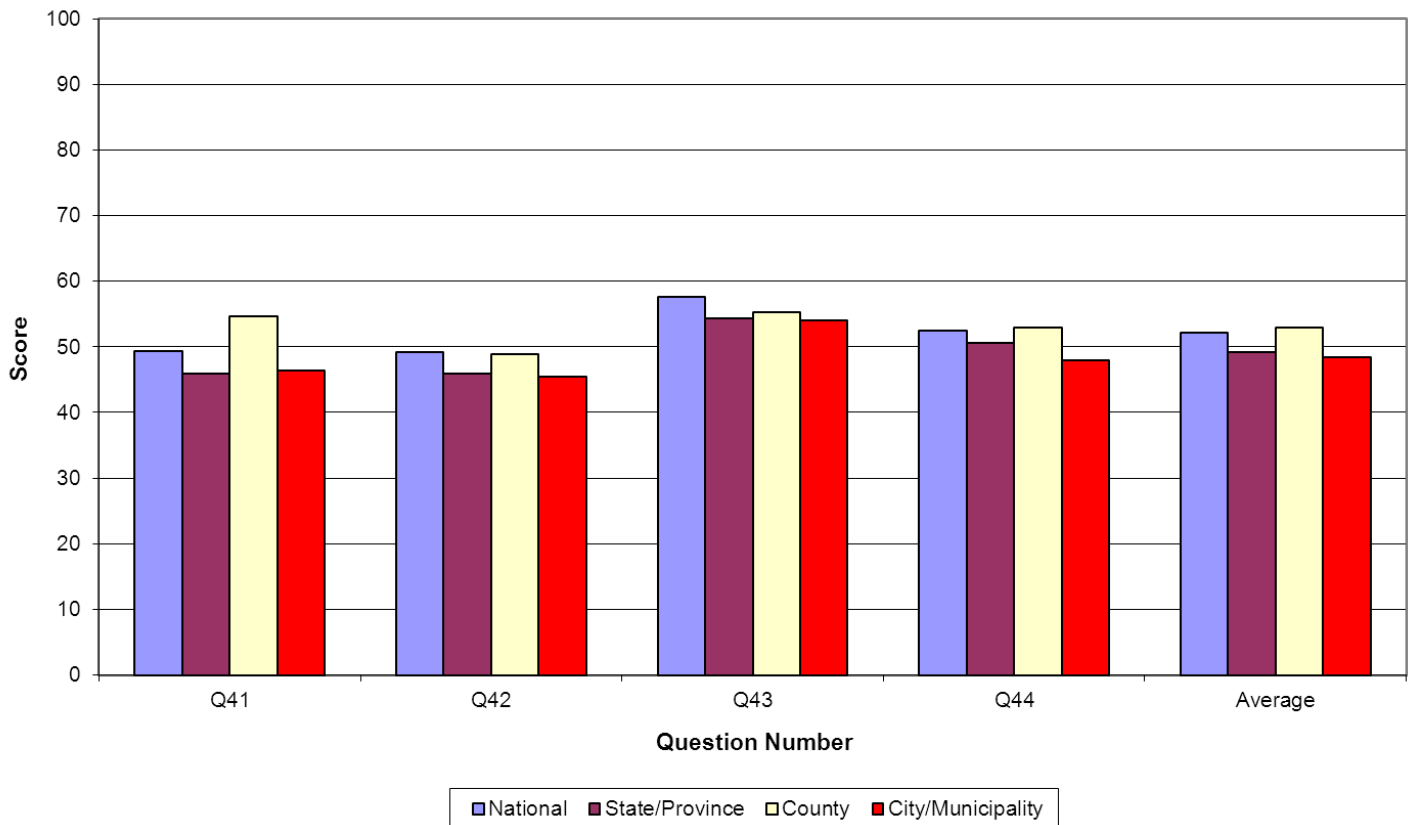
**Figure C-6: Signal Timing Practices Results by Agency Type**



**Figure C-7: Traffic Monitoring and Data Collection Results by Signal System Size**

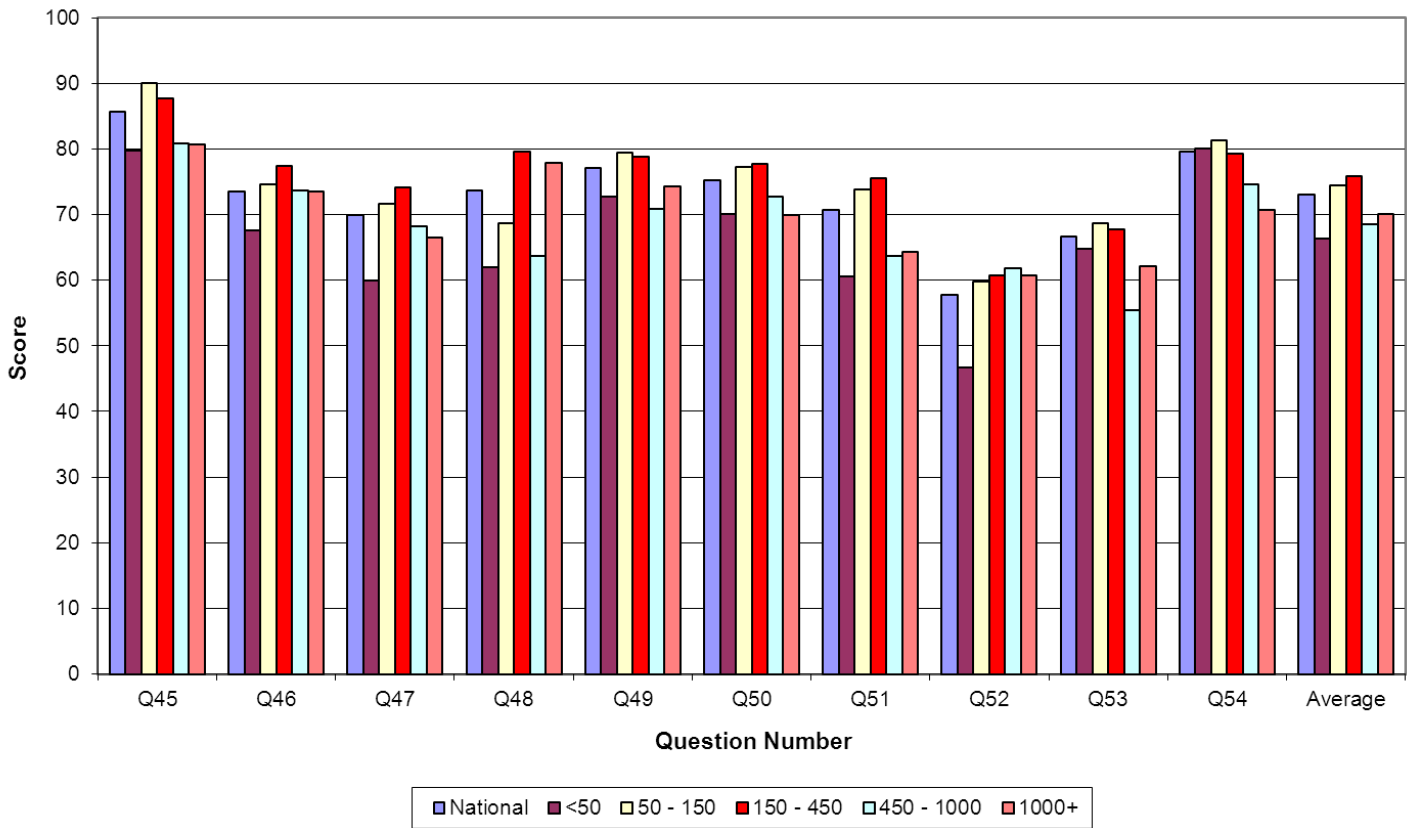


**Figure C-8: Traffic Monitoring and Data Collection Results by Agency Type**

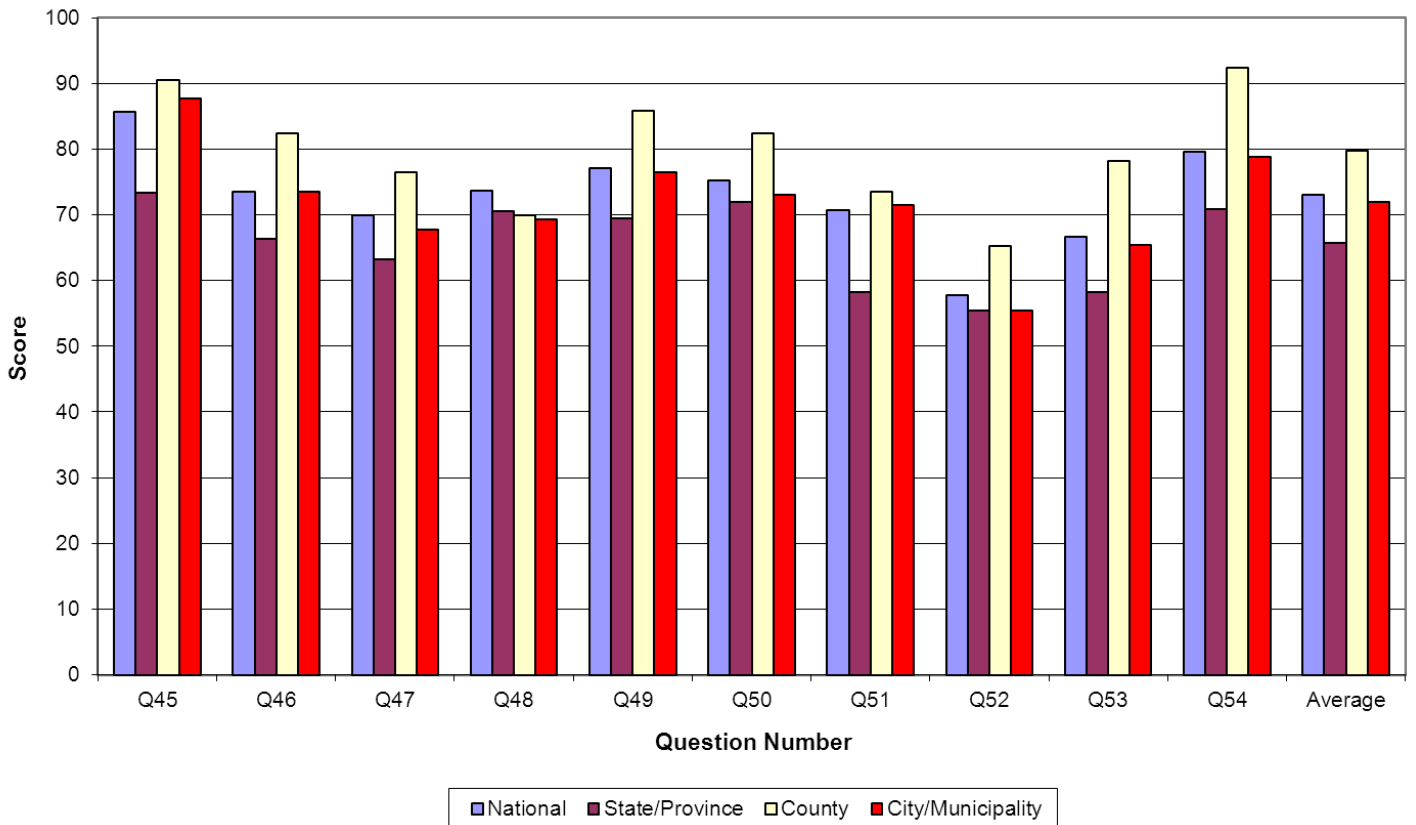




**Figure C-9: Maintenance Results by Signal System Size**



**Figure C-10: Maintenance Results by Agency Type**



**Table C-1: Number of Staff Performing Traffic Signal Work by Agency type**

Agency Type	Non-technical manager	Engineering manager	Engineers	Other professionals	Signal technicians	Other technicians	Administrative	Other staff
<b>In House Staff (FTEs)</b>								
City/Municipality <sup>1</sup>	0.6	0.9	2.7	1.1	4.0	0.8	0.7	0.5
County	0.4	1.0	2.0	1.0	7.4	1.3	1.0	0.9
State/Province <sup>2</sup>	1.0	4.6	10.4	1.5	19.6	3.4	1.0	0.4
<b>AVERAGE</b>	0.9	1.8	5.2	1.8	9.1	2.1	1.1	0.9
<b>Outsourced Staff (FTEs)</b>								
City/Municipality <sup>1</sup>	0.1	0.1	0.3	0.2	0.7	0.2	0.1	0.1
County	0.0	0.0	0.3	0.1	0.3	0.2	0.0	0.0
State/Province <sup>2</sup>	0.3	0.2	0.8	0.2	2.4	2.6	0.2	0.3
<b>AVERAGE</b>	0.2	0.2	0.7	0.3	1.4	1.2	0.2	0.2

Notes:

<sup>1</sup> Includes 11 results from Canada.

<sup>2</sup> Includes 6 results from Canada.