Liveable Cities

Data Acquisition Platform – Technology Review

November 2020

B001183

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1. Introduction

Liveable Cities is a division of LED Roadway Lighting Ltd., a Canadian-owned and operated clean technology company with a focus on smart street lighting products including LED streetlights, network technologies and smart sensors.

Livable Cities has developed a streetlight radar sensor called the Data Acquisition Platform (DAP). The DAP installs in the photocell socket of a standard streetlight, or it can be acquired as an integrated module within a new streetlight fixture. It measures and records the spot speeds of nearby vehicles and the data is transmitted to a database and software program where it can be accessed and analyzed by practitioners through the cloud.

This report presents the results of a comparison of the DAP unit against other devices typically used by Public Road Authorities to measure speeds. As other studies have quantified the accuracy of the DAP data, this report will focus on the comparison of the deployment, operations, conspicuity and cost of the DAP units vs. other commonly used devices across the country.

2. Municipal Survey

A survey of municipalities across Canada was undertaken to gather information on the common studies and applications which require traffic data and the challenges, benefits and costs associated with various data collection devices and methods.

2.1. Respondents

The survey was launched via a series of individual emails on July 27, 2020. The email contained a link to a site with a SurveyMonkey questionnaire. A follow-up reminder was issued after 3 weeks to those who had not responded, and the survey was then closed on August 31, 2020. The following 11 agencies responded to the survey providing a total of 13 individual responses:

- City of Montreal (2)
- City of Saskatoon
- City of Vaughan
- City of Toronto
- Halifax Regional Municipality
- Region of Waterloo
- City of Windsor
- City of Brampton (2)
- City of Hamilton
- Region of Durham
- Town of Oakville

Note the City of Montreal and the City of Brampton had two independent people respond to the survey, from different departments within each organization.

2.2. Key Survey Outcomes

A complete listing of the questions and responses to the survey is provided in Appendix A. While all survey responses help to inform the marketing and future development of the DAP unit, the two responses to the survey that directly influence the contents of this report are as follows.

The responses from all agencies to the question "For what applications do you use Speed Detection Technologies" helped to formulate the list of applications described in Section 3. The responses are summarized in Figure 1.

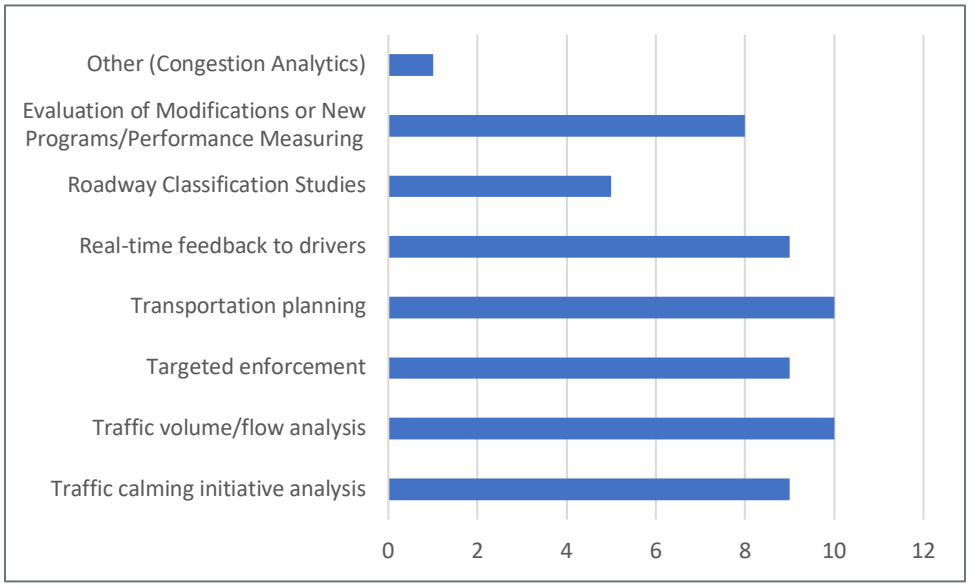

Figure 1 - Number of Respondents by Speed Data Application

Of note, there is a large number of individuals (10 of 13) that use speed data for traffic volume/flow analysis and transportation planning applications. Other popular applications include real-time feedback to drivers, targeted enforcement and traffic calming initiative analysis.

The other question, which guides the content of this report, was posed as: "Please rank the importance of the following factors when determining which speed data collection technologies to use?". From the responses to this question depicted in Figure 2, the factors used to assess alternative data collection devices (as documented in Section 4) were generated and refined.

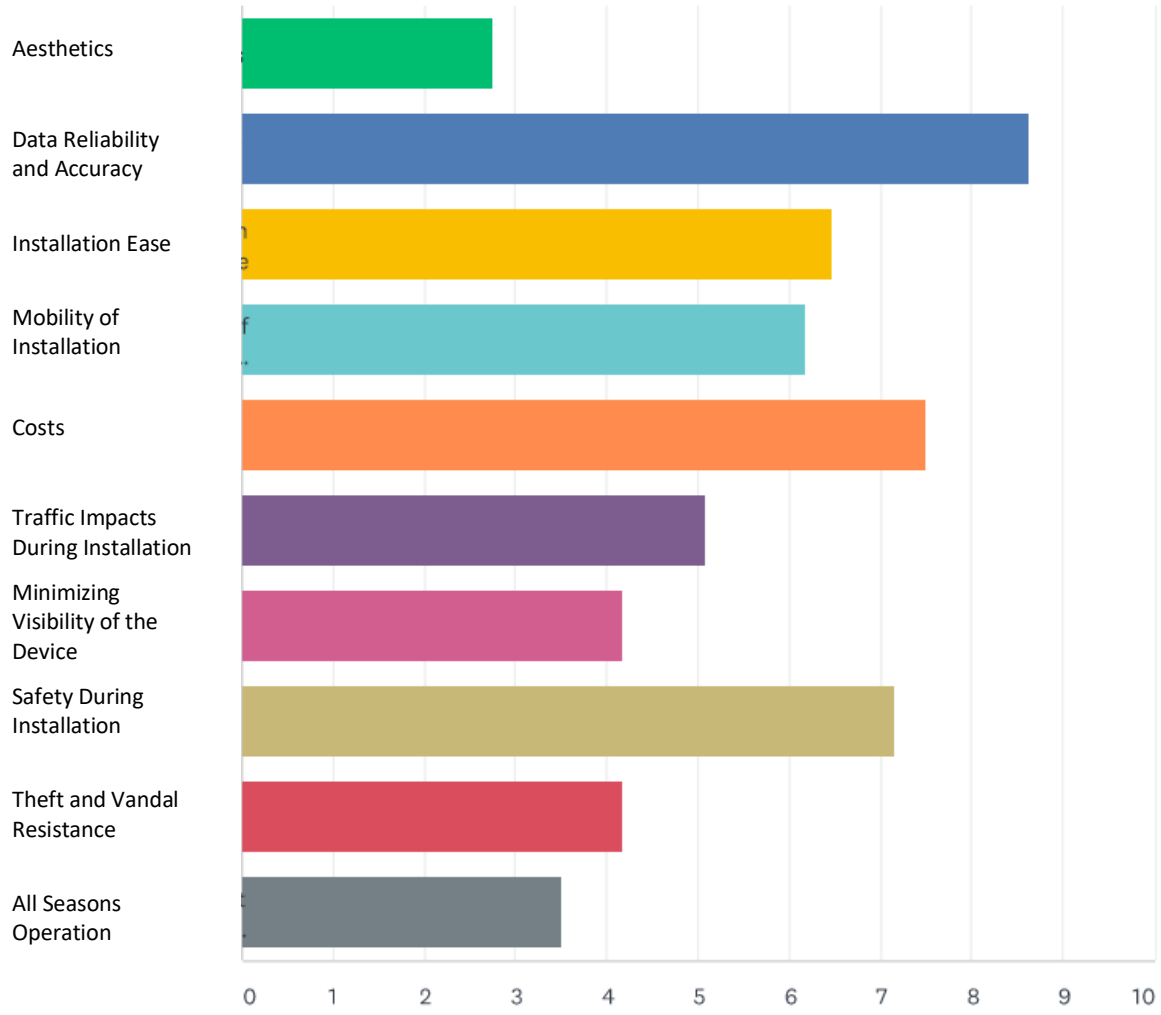

Figure 2 - Relative Importance of Device Characteristics

Data reliability, cost and safety during installation were ranked 1, 2 and 3 respectively by survey respondents.

Appendix A lists the full set of questions and responses.

3. Potential Applications for Speed Data

Livable Cities indicates that the DAP unit is particularly well suited for roadways up to three (3) lanes where speeding vehicles may create safety concerns for other road users including cyclists and pedestrians. As a radar unit, it measures and records speeds. Other data types such as volumes may also be captured to add context to the speed data but are not its primary function.

Traffic speeds have a range of traffic planning, engineering and operations applications, including:

- Analysis for traffic calming initiatives;
- Assist in targeting enforcement;
- Assessment of roadway improvements (e.g. resurfacing); and
- Evaluation of new programs and policies (e.g. changes to parking regulations).

Many of these applications are supported by the responses from the municipal survey. It is within the context of these applications that a comparison is made to other data collection devices.

However, in addition to the studies above, speeds can be a valuable supplement to traffic volume data for the following applications:

- Assessing the need for road improvements;
- Roadway classification studies;
- Effects of work zones on traffic; and
- Effects of diversion from nearby disruptions or construction.

4. Technology Comparison

Several devices are commonly used to acquire the traffic data needed to support the applications listed in Section 3. These devices include:

- The Data Acquisition Platform (DAP);
- Pneumatic Tubes;
- Spot Video; and
- Radar Speed Boards.

The characteristics and attributes of each of these four devices are compared in this section. In each case, these devices record speeds at a spot location. Other devices (such as Bluetooth recorders) derive speeds along a segment of the road. When using devices on road segments, it is important to account for the influence of traffic control devices (such as stop signs or traffic signals) on the speeds of vehicles. To reduce potential confusion when comparing devices, only those intended to record speeds at a spot location are included in the comparison.

Another important consideration is that of long-term (i.e. more than 2-weeks) vs. short-term deployment. Of the devices listed, only the DAP unit is intended for long-term deployments. ***Consequently, if the continuity of data for more than 2-weeks is required, the DAP unit is likely the preferred selection.*** It is therefore the short-term scenario that is considered in the evaluations below.

The factors used for the evaluation broadly cover deployment, operations, conspicuity, characteristics of the data and cost. Individual factors have not been weighted, implying each factor is of equal importance relative to the others. As the evaluation is intended to inform a range of environments and applications (as listed in Section 3), it is difficult to identify relative priorities for these factors.

Each device is listed and scored separately below and then compared as a group in Section 5. The scores are based on a scale from 0 to 5 with a higher score denoting a positive. For example, a device with a score of 4/5 for 'Ease of deployment' suggests it is easier, simpler, or faster to deploy than a device with a score of 2/5. It is acknowledged that the scores are somewhat subjective, but they are intended to be compared across the four devices **in the context of the applications** listed in Section 3.

4.1. DAP Technology

The DAP is a unit that installs in the photocell socket of a standard streetlight, or it can be acquired as an integrated module within a new streetlight fixture. It measures and records the speeds of nearby vehicles and transmits the data to a database and software program where it can be accessed and analyzed by practitioners through the cloud.

The DAP technology can be applied for specific applications for local speed monitoring or be scaled to a wider network given its adaptability with existing streetlights for power. The use of the DAP unit on a wider network can help proactively identify safety and speeding issues while also generating data for the planning of future calming and enforcement initiatives.

Figure 3 - Data Acquisition Platform Unit

The following table shows the assessment results for the DAP unit:

Table 1 – Assessment Details for DAP Devices

Factor	Assessment	Comments
Deployment	2 / 5	• Restricted to locations with existing streetlights using photocells (i.e. will not function on controlled circuits) • Limited to locations that are suitable for detection widths of approximately 15 m • Utilizes an existing power source with no additional wiring /splicing required • Hardware can be installed once and left in place • Must be conducted by a trained and certified contractor / staff but very quick to install
Privacy	5 / 5	• No details associated with vehicles or road users are noted or retained.
Theft and vandal resistance	5 / 5	• Very difficult to access the DAP unit once it is installed
Persistence of data	5 / 5	• Data is available 24/7 once the device is installed and activated

Factor	Assessment	Comments
Data richness	3 / 5	• Speeds are available but other traffic-related data is limited (i.e. volumes)
Visibility	5 / 5	• Low impact on user behaviour • The device is not visible to passing road users
Contribution to urban clutter	5 / 5	• The device is not in eyesight at street level
Proven technology (radar)	4 / 5	• Reliable technology • Good in most weather
Costs	4 / 5	• Installation $100 / unit (assume 10-unit batches) • Operating from $10 to $50 / month, volume dependent • Installation costs can be spread amongst multiple units
Total Score	**38 / 45**	

4.2. Pneumatic Tube Counters

Pneumatic tube counters consist of a counter unit, usually chained to a pole at ground level, and flexible rubber tubes that are fastened to the road perpendicular to the travel lanes. As vehicles pass over the tubes, they squeeze the air inside which is registered by the recorder unit. Two tubes are needed to determine speed. They are set a known distance apart and the difference in time between pulses and the known separation of the tubes is used to determine speeds.

Figure 4 - Pneumatic Tube Counter[1]

[1] Source: https://tcsforsurveys.com.au/equipment-hire

The following table shows the assessment results for pneumatic tube counters:

Table 2 - Assessment Details for Pneumatic Tube Counters

Factor	Assessment	Comments
Deployment	3 / 5	• Typically, very short duration • Requires a nearby pole • Exposure to traffic while deploying tubes • Exposure on the roadside while deploying counter
Privacy	5 / 5	• No details associated with vehicles or road users are noted or retained
Theft and vandal resistance	2 / 5	• Tubes are easily damaged • Counter deployed at ground level can be stolen
Persistence of data	3 / 5	• 24/7 data available but generally for 10 days or less • Unavailable in winter
Data richness	4 / 5	• Speeds, volumes
Visibility	3 / 5	• Tubes are obvious to drivers, but most drivers are getting used to them or do not know what they do
Contribution to urban clutter	3 / 5	• Counters are small and relatively inconspicuous but do add to clutter
Proven technology (air sensors)	3 / 5	• Tubes may not detect e-bikes or smaller and can break or come out of counter
Costs	3 / 5	• $350 per count (leased) • Installation and rental costs are moderate, particularly since counters are temporarily installed
Total Score	**29 / 45**	

4.3. Video Analytics Counters

The equipment used for video generated counts commonly consists of a camera on a telescopic mast connected to a field computer. The computer receives the video stream and processes it in real-time, producing traffic-related data including turning movement counts, approach volumes, speeds and saturation flow.

Figure 5 - Video Analytics Counters[2]

The following table shows the assessment results for video analytics:

Table 3 - Assessment Details for Video Analytic Counters

Factor	Assessment	Comments
Deployment	2 / 5	• Requires a nearby pole • Need to install a camera, cabling and counter device • Exposure on the roadside while deploying equipment
Privacy	2 / 5	• Some details associated with vehicles or road users are noted and retained
Theft and vandal resistance	3 / 5	• Equipment is conspicuous and relatively easy to remove
Persistence of data	4 / 5	• Data available 24/7 and for extended periods (but still temporary deployment)
Data richness	5 / 5	• Speeds, volumes, pedestrians, turning traffic, conflicts

[2] Source: https://miovision.com/datalink/scout/

Factor	Assessment	Comments
Visibility	4 / 5	• Cameras are noticeable, but most drivers don't associate them with their behaviour
Contribution to urban clutter	3 / 5	• Cameras and cables do add clutter
Proven technology (video analytics)	2 / 5	• Still some issues with video analytics during certain conditions (wet, night, inclement weather)
Costs	1 / 5	• Capital - $5,000 to $10,000 • Installation - $250 • Operating - $100 / year • Installation and rental costs are high relative to other count devices
Total Score	**26 / 45**	

4.4. Radar Speed Boards and Signs

Radar speed boards take many forms. The photos shown below show radar speed boards/signs mounted on a trailer and a post. The signs are designed to provide feedback to approaching drivers about their speeds and usually post a regulatory sign as well as a reminder of the posted speed limit. Many radar speed boards can digitally store the speeds that are recorded (and posted) which can be downloaded when the signs are decommissioned after use.

Figure 6 - Radar Speed Boards and Signs[3]

[3] Sources:

Trailer: https://www.inquirer.com/philly/news/Do_radar_speed_signs_slow_drivers_down.html

The following table shows the assessment results for radar speed boards/signs:

Table 4 - Assessment Details for Radar Speed Boards/Signs

Factor	Assessment	Comments
Deployment	3 / 5	• Can be difficult to find room on the roadside • Trailers require wheel locks or removal of wheels • Exposure on the roadside while deploying
Privacy	5 / 5	• No details associated with vehicles or road users are noted or retained
Theft and vandal resistance	2 / 5	• Solar panels and batteries are popular items for thieves
Persistence of data	3 / 5	• 24/7 data available but generally for 10 days or less • Unavailable in winter
Data richness	4 / 5	• Speeds, volumes
Visibility	3 / 5	• High impact to driver speeds (the real purpose of these units)
Contribution to urban clutter	3 / 5	• Deployments are temporary but visible
Proven technology (radar)	4 / 5	• Reliable technology • Good in most weather
Costs	1 / 5	• Capital $5,000 • Installation $200 (trailer) • Installation $900 (with new pole) • Trailers or speed boards are expensive when compared to data collection devices (but provide traffic calming)
Total Score	**29 / 45**	

Pole Mount: https://www.hamilton.ca/streets-transportation/driving-traffic/dynamic-speed-signs

5. Conclusions

Table 5 displays the results of the assessments in Section 3 and provides a summary of the key benefits and challenges associated with each data collection device. It is important to review the findings in the context of the applications for speed data listed in Section 2.

Table 5 - Comparison of Different Technologies

Technology	DAP	Pneumatic Tubes	Spot Video	Radar Speed Boards
Score	38	29	26	29
Key Benefits	• Persistence of data • Low cost	• Portability	• Data richness • Persistence of data	• Traffic calming
Key Challenges	• Complexity of Installation • Data richness	• Theft/breaking • Safety of deployment	• Cost • Data accuracy	• Cost • Driver adaptation

Based on the comparison in Table 5, the DAP Unit is one of the most practical ways of acquiring traffic speed data when it is required for longer duration studies (i.e. more than 2-weeks) for 3-lane roadways. But it is also cost-effective for shorter-term studies when compared to the other data collection devices that are widely available for spot speed data.

As the DAP unit continues to evolve, adding traffic volume counts to the capabilities of the device would allow it to be used to support several types of traffic studies including:

- Assessing the need for road improvements;
- Roadway classification studies;
- Effects of work zones on traffic; and
- Effects of diversion from nearby disruptions or construction.

The communications of these field units with a central program also make them ideal for other smart city applications.

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Appendix A – Survey Results

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