CITY OF HAMILTON
PERFORMANCE AUDIT REPORT 2013-19
GPS/AVL SYSTEMS PERFORMANCE REVIEW

Background

GPS/AVL is the acronym for Global Positioning System/Automatic Vehicle Location. These units provide a means for automatically determining and transmitting the geographic location of a vehicle. This data, from one or more vehicles, may then be collected by a vehicle tracking system to present a picture of vehicle travel.

A motion passed by the A,F&A Committee on March 25, 2013 requested that the 2013 Internal Audit Work Plan be revised to include GPS audits of randomly selected divisions where City vehicles have been retrofitted with a GPS system.

At the April 20, 2013 A,F&A Committee meeting, the proposed initial Performance Audit Work Plan was approved and included the following:

> *Various City vehicles are equipped with Global Positioning System (GPS) technology. Management may use recorded GPS travel information to assess employee productivity. This project will entail comparing GPS records to documented work assignments in order to identify areas where productivity and efficiencies may be gained.*

Objectives

The objectives of this review were:

1) To determine if documented completed work assignments and labour hours are supported by GPS data collected;
2) To identify opportunities to utilize the GPS/AVL systems to better manage staff for improved productivity and /or efficiency; and
3) To assess any capabilities within the various GPS/AVL systems for gathering data that could result in cost savings.

Scope

The scope of the audit included service areas with 15 or more GPS/AVL units, excluding HSR and EMS. The test date coverage ranged from September 2012 to August 2013. The processes involved in scheduling or providing work assignments to staff for the period of time being audited, the tracking of the vehicle operated by the individual selected for detailed testing and the back-end output of the work performed were reviewed. The capabilities of the GPS/AVL systems used, what aspects of the systems implemented and the extent to which management used the data generated were assessed.

Methodology

The work performed involved observation, discussion and detailed testing of samples selected from service areas with the greatest potential for maximizing the capabilities of GPS/AVL systems.

More specifically, the work included:

1. Environmental Scan
   - performed review across the City of Hamilton to identify the service areas that had GPS/AVL units within some/all of their vehicles.
2. Knowledge of Business
   - held meetings with the respective managers to obtain an understanding of the tracking software used and the number of GPS/AVL units installed in each division’s vehicles.
   - reviewed the processes and information systems used to document work scheduled and performed by the staff operating the vehicles with the GPS/AVL units installed.
3. Risk Assessment
   - performed risk analysis on each of the service areas based on factors affecting the efficiency, effectiveness and economy that could be impacted by the utilization of GPS/AVL technology. This risk analysis combined with the number of GPS/AVL units installed in vehicles for each respective service area provided the basis for determining the number of samples to be tested in each area.
4. Pilot Test of Systems and Supporting Documentation
   - determined the mapping capabilities of each GPS/AVL system used by the City to track the movement of vehicles.
   - obtained samples of front end scheduling documentation, if available.
   - obtained samples of the back end recording of work performed for subsequent matching of reported work to the mapping obtained in step above.
5. Vehicle / Operator Cross-reference
   - obtained listings of specific vehicle numbers cross-referenced with their respective assigned operators.
6. Detail Testing
   - tested selected samples to determine if the work that work assigned and indicated as completed was supported by the GPS/AVL mappings.
7. Management Opportunities
   - identified any opportunities where the GPS/AVL systems could be used to better manage staff for improved productivity and/or efficiency.
8. GPS/AVL Capabilities
   - identified any GPS/AVL capabilities that could potentially save costs based on research and discussions with management, users and Information Technology.

Audit Services conducted this review in conformity with the *International Standards of Professional Practice of Internal Auditing*. These standards require that Audit Services plan and perform the work to obtain sufficient, appropriate evidence to support the findings and conclusions based on the project objectives. Audit Services believes that the work performed provides a reasonable basis for the findings and conclusions.

Findings and Analysis

The City of Hamilton has three different tracking systems in place - Trapeze used by HSR, Interfleet software used by the Roads Division of Public Works and Trackforce (by Intergraph) used by Emergency Medical Services, Building, Municipal Law Enforcement, Water, Parking and Animal Control.

Not only does the fact that there are three different systems complicate efficiencies with respect to support and increase costs but the Trackforce (Intergraph) system is at its “end of life” in that there will no longer be any further development of this product. As such, the AVL Initiative Committee will be identifying whether a single Corporate-wide solution can be achieved which will satisfy the needs of all service areas.

There are 565 GPS/AVL units installed in City vehicles used by various divisions and sections. Roads (177), Building (35), Water (16) and Municipal Law Enforcement (29) were selected as areas for sample testing. HSR (234) and EMS (49) accounted for the largest areas not sampled.

The purchase and installation of GPS units is at the discretion and cost of the division/department. As such, various models are installed with differing functionalities. Tracking maps and data in regards to vehicle location can be obtained from all GPS/AVL systems. Additionally, the speed, start time and shut down time can also be provided from all the systems. Beyond these capabilities, systems vary as does the use by individual areas. The areas selected for review by Audit Services use either Interfleet or Trackforce software. Since the introduction of GPS technology into City vehicles, close to $1.5 million has been spent from 2006 – 2013 for the Interfleet and Trackforce software. Annual maintenance and connectivity costs run close to $200,000 a year.

With respect to the first objective of this review, i.e. **whether GPS data collected supports the other corporate documentation of completed work assignments**, the detailed testing of specific vehicles/operators resulted in GPS/AVL data and subsequent analysis that generally supported the locations where staff had been assigned or had indicated work had been completed in other records and/or documents maintained by the City. However, in many instances, the hours of actual equipment movement (use) as per the GPS/AVL records did not account for the equipment hours booked to the activities. For example, according to GPS data, a sweeper was active for approximately 4¾ hours of an 8 hour shift. Even allowing for the driver’s lunch and breaks as well as truck clean up, fueling and water fill ups, as required, does not account for the difference in the 8 hours booked as equipment use to the street sweeping activity and the span of time that the Stop Reports indicated that the equipment was actually active. Management could only surmise what other activities might have been done for the balance of the 8 hours of labour booked to the sweeping activity as no records were kept for the last hour of the shift.

In investigating **opportunities to better utilize the GPS/AVL systems,** a number of operational practices that may negatively impact the usefulness and functionality of GPS/AVL systems and data were noted during the review. They include:

- Standard recording and record management procedures did not exist.
- The maintenance of all supporting documentation including work schedules, daily activity reports and/or system reports was not evident for some of the test samples.
- In situations where specific routes for work activities are not applicable (e.g. patrol units, fixing shoulders of roads, etc.), the back-end documentation of work completed, including the locations visited and approximate times, were not always available. This made comparison to GPS/AVL data inefficient.
- The records of vehicle assignments were not kept on a current basis. In the test sample, instances were found where the date of a new vehicle assignment or the identity of a vehicle assigned as a temporary replacement were not known. Installation of GPS/AVL units in these vehicles could not be confirmed.
- The data entry in AMANDA and Hansen of the work completed was not performed on a timely basis. Even though some vehicles are equipped with laptop holders and modems to facilitate “on the go” data input, information was often not entered into these systems until the next day or even later. This reduced the potential for management to match work reported as having been performed against the locations visited.
- Municipal Law Enforcement Officers (MLEs) record their notes manually in a small notepad and then subsequently transcribe the notes into AMANDA. When the notes were entered into AMANDA, the officers were not required to utilize the “Attempts” section to record the date of their work and the amount of time spent. Instead the “Comments” field was sometimes used. As it is a text field, it was not conducive to extracting data for reporting and comparing to GPS/AVL data.
- Safety of staff is the primary reason given by management for acquiring and maintaining GPS/AVL units installed in City vehicles. In several instances noted in which the vehicles had not moved in a lengthy period of time, management had not investigated and could not provide reasons for such immobility.

Addressing these identified issues would provide more opportunities to utilize the GPS/AVL systems to a greater extent in managing staff productivity and efficiency.

In assessing **GPS/AVL functionality and capabilities,** the review identified a functionality provided by the GPS/AVL systems that could potentially result in cost savings. Idling time is tracked by the Roads Interfleet system. For the applicable test samples selected, the range of idling time as a percentage of the total shift time ranged from 13% to 36%. The cost of idling for all trackable times through Interfleet for the period January 2013 to August 2013 was estimated at $43,136 (which is about $64,704 annually when extrapolated).

In regards to reporting, the Trackforce software is not user friendly. During testing, the users in various divisions utilizing this software were not able to produce a mapping based on historical data. Even with support from IT, file conversions and use of other software were required to view a trail of a vehicle’s path. There were also numerous instances where completed tasks had been indicated by inspectors, MLEs or vehicle operators. However, no activity data for the assigned vehicles could be located in Trackforce. No definitive reasons for such discrepancies could be provided.

The functionality that would notify a supervisor or management of situations when a vehicle has not moved for a predetermined length of time was not available. This was one of the primary justifications for installing GPS/AVL units given by staff in interviews.

Recommendations

This first set of recommendations deals with suggested steps which should be implemented in order that management can utilize the GPS/AVL systems to more effectively and efficiently manage staff and work activities and potentially improve productivity and save costs.

It is recommended:

1. That standardized procedures be developed by service areas utilizing the GPS/AVL systems to ensure that all supporting documentation including scheduling and subsequent data entry of work performed be developed and enforced to enable the matching of reported tasks completed to the tracking of the vehicles’ travel paths. (Public Works – Roads & Water; Planning and Economic Development – Building & MLE)

2. That work/task completion data be entered into the supporting systems on an as completed daily basis to ensure reflection of current status. (Public Works – Roads & Water; Planning and Economic Development – Building & MLE)

3. That data be entered into the appropriate fields of the supporting systems rather than general text fields in a Comments area to enable the extraction of information for improved analysis by management. (Planning and Economic Development – MLE)

4. That a process to regularly track the assignment of vehicles to specific individuals be developed. The ability to manage the appropriate movement of staff is predicated on the assurance that the individual that is assumed to be driving a particular vehicle is actually using the identified vehicle. (Public Works – Roads & Water; Planning and Economic Development – Building & MLE)

5. That, upon completion of the above recommendations, user training be conducted to ensure that staff are aware of and comply with the new procedures. (Public Works – Roads & Water; Planning and Economic Development – Building & MLE)

6. That the Roads Division analyze the idling exception reports provided through Interfleet to identify opportunities to reduce the amount of idling in excess of 5 minutes (especially instances in excess of 30 minutes) to potentially reduce fleet fuel costs and to ensure compliance with the City’s Idling Bylaw. (Public Works – Roads)

The next set of recommendations will identify some additional opportunities to improve the capabilities within the existing GPS/AVL systems or to be considered during the search for a replacement system for the current corporate Trackforce solution to better serve the City’s operating departments.

It is recommended:

7. That the ability to track idling times and locations be incorporated into the new corporate GPS/AVL system. An analysis of results obtained could lead to a decrease in the cost of fuel and enable compliance with the City of Hamilton’s Idling By-law. (Corporate Services (IT) – AVL Initiative Group)

8. That the Geofence capabilities be considered. Such a function would alert a supervisor whenever a vehicle traveled outside its assigned area or the boundaries of the City of Hamilton. (Corporate Services (IT) – AVL Initiative Group)

9. That signals be implemented whenever a vehicle has not moved from a location for an extended period of time. This would provide management a tool to assess the appropriateness of the length of stay at a location based on the work that is being assigned or being performed. It may alert a supervisor to a safety issue with the driver that needs to be addressed or may identify situations in which the GPS/AVL unit has ceased to operate and requires repairs. (Corporate Services (IT) – AVL Initiative Group)

10. That appropriate telemetric capabilities be implemented in order that data collected be analyzed on a regular basis to improve the management of the operations or reduce costs. Telemetrics involve the electronic determination of status (e.g. plow up or down) or measurement of a quantity (e.g. amount of salt distributed over a particular area). (Corporate Services (IT) – AVL Initiative Group)

11. That the GPS/AVL data collected related to the locations of vehicles be reported on a streetview map to allow for the visualization of the tracking of a vehicle’s travel path. Such data should be readily available for the printing of mappings. (Public Works – Roads & Water; Planning and Economic Development – Building & MLE)

12. That integration between the AMANDA & Hansen systems and the GPS/AVL system be implemented such that the locations where work was reported as having been performed in the AMANDA & Hansen systems appear on the mappings produced. (Planning and Economic Development – MLE)

Conclusion

In the detail testing of randomly selected vehicles equipped with GPS/AVL systems, the resulting tracking maps and data of the vehicles compared appropriately to the locations where work was reported as having been performed. However, equipment use and corresponding labour hours booked to particular activities in supporting systems did not fully align with GPS/AVL data for vehicle use. Management could not provide documentation or other records detailing the differences.

Based on the amount of time required to currently obtain the supporting documentation, the difficulty in obtaining Trackforce data (in particular historical data) for vehicle mapping and the fact that it is very time consuming to compare the locations where work was alleged to have been performed against the mapping, it is Audit Services’ opinion that the use of the current GPS/AVL systems as a regular management tool is not effective or efficient.

Without the improvements to the operational processes external to the GPS/AVL systems, as noted under the Recommendations section, and either replacement of the systems or significant changes to the existing systems and interfaces, the comparison process is tedious and time consuming and may not be relied upon as records do not appear complete.

The current corporate GPS/AVL solution implemented in EMS, Building, Municipal Law Enforcement, Parking, Water and Animal Control is at its “end of life”. This provides the City of Hamilton with an opportunity to obtain a newer system with greater functionality that meets the needs of all users.

There are a number of potential benefits that can be achieved with a fully functional GPS/AVL system. These include:

- The ability to monitor idling time and potentially reduce fuel costs;
- The safety of staff in that the location of the vehicles could be tracked;
- Support to challenge legal claims as GPS will provide proof of the time and location of vehicles, speed, telemetrics such as whether the plow was up or down, the amount of salt put down, etc.;
- Potential integration with scheduling to identify the most effective route selection; and
- Improved worker productivity and accountability as well as management oversight.

However, the dollars that have been invested and the costs that continue to be incurred annually for the current GPS/AVL systems do not represent a good value for the money spent as the benefits noted earlier are not being realized.

The underlying premise is whether the potential benefits plus the ability and discipline to make and enforce the recommended adjustments to the operational processes as noted above outweigh the cost.