ASCIP Pilot Project

Utilizing a School Bus Tracking System to Increase Transportation Safety for Staff, Students, and the General Public

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Executive Summary

School bus transportation serves many customers and educational purposes, including special needs students, daily route students, school-related special events, field trips, and athletics which result in the transportation of thousands of students each day. School bus transportation is a source of constant concern and exposure for districts. Districts seek to minimize the frequency and severity of negative incidents by promoting driver accountability and safety as well as student safety. Methods to assist districts in identifying and remediating preventable incidents include tracking, recording, reviewing school bus-related incidents.

Capistrano Unified School District (CUSD) experienced a significant loss related to its school bus program. The district desired to address the cause of this loss and improve school bus transportation safety for students and employees. The district decided to pilot a program which would address student safety and expand in scope such that the program would improve overall bus service, including daily home-to-school roundtrips, road trips to athletic events, and field trips. The district received a grant from ASCIP to retrofit all active school buses with Global Positioning System (GPS) and student tracking hardware and software. The results of this pilot project are presented in this report.

Description of Project

Capistrano Unified School District (CUSD) is located at the southernmost tip of Orange County, California. It serves approximately 54,000 students over a 200 plus square mile area. Its transportation fleet is comprised of 133 active route buses with 36 spares. The district transports approximately 4,500 students daily, 1,100 field trips annually, and travels approximately 1.3 million miles every school year.

The Alliance of Schools for Cooperative Insurance Programs (ASCIP) awarded the district two risk control grants – one in 2014 and the other in 2016. The first grant allowed the district to retrofit all active school buses with the Zonar GPS system and student tracking hardware. These modules allow for real-time, verifiable electronic vehicle inspections and access to multiple reports, including, but not limited to, speed tracking, student location at time of pick-up and drop-off, vehicle location, path history, idling times, zone reports, and inspection duration times, among others.[1]

The second grant allowed the district to upgrade the GPS system to include wireless tablets. Tablets enhance the drivers' abilities to perform inspections by including note capabilities and to photograph defective items. Mechanics are able to access the driver reports to initiate electronic work orders and to track corrective measures. Dispatchers are able to send two-way messages to drivers, reducing radio traffic, and to send addresses which can be depressed by the driver to receive audible navigation directions. Drivers are able to complete forms electronically versus paper, and these forms are immediately accessible to accounting, billing, and management staff.

Over the course of two and one-half years, the district gathered data to analyze a number of key performance indicators (KPIs).[2] For purposes of this analysis, the district concentrated on six: over-the-legal-limit speed tracking, idling times, on-time delivery performance, number of students left on parked buses, number of missing riders, and urgently needed repairs or maintenance tasks.

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[1] Amend, A., Dukes, T., Bosco, B. et al. Eur. Transp. Res. Rev. (2010) 2: 157. https://doi.org/10.1007/s12544-010-0035-0

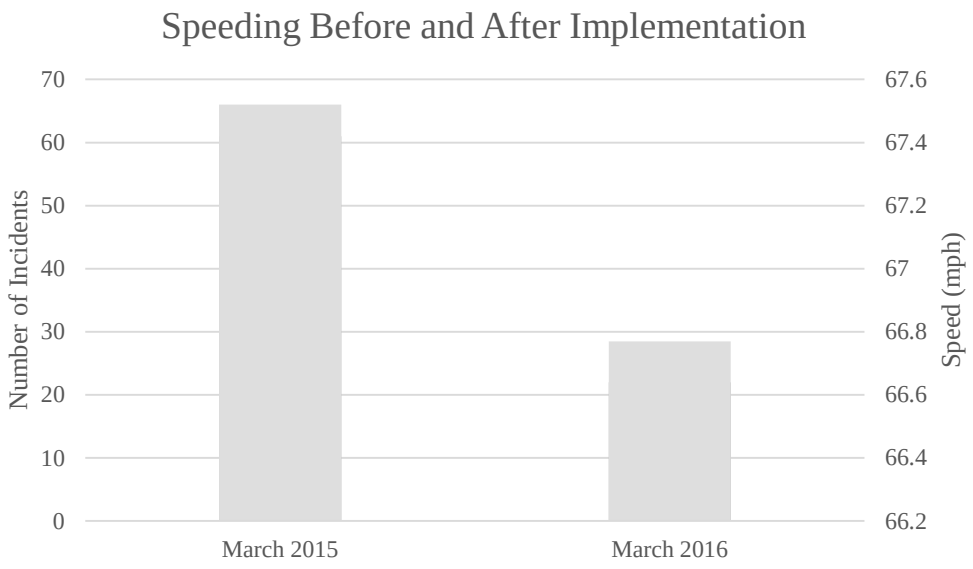
[2] Chung, Eli-Hwan & Shelby, Amer. (2007). Expected Time of Arrival Model for School Bus Transit Using Real-Time Global Positioning System-Based Automatic Vehicle Location Data. Journal of Intelligent Transportation Systems. 11. 157-167. 10.1080/15472450701649398.

Observations

Over-the-Legal-Limit Speed Tracking

One of the greatest driving risks is excessive speed. Although school bus drivers are highly trained and constantly reminded about the risks of excessive speed, factors such as distraction, general motoring traffic flow, and pressure for on-time delivery can influence driver speed. Sharing speed data with drivers should be helpful with curbing risky speeding habits.

CUSD compared the average excessive speed from reports accessed through the GPS software. The software allows the driver to set up alerts based on established speed settings. CUSD administrators set maximum speed alerts of 65 miles per hour (mph) or greater. Thus, whenever a vehicle exceeds 65 mph, management receives an email alert. CUSD compared a random week in March 2015 to one in March 2016, and the results are illustrated in the following chart:



Although the average speed over 65 mph decreased only approximately 1%, the number of over 65 mph incidents decreased drastically by almost 64%. CUSD does not attribute the improvement to the mere installation of GPS technology. The district's practice of data transparency and utilization of data as a training tool has influenced driver behavior. Before installing the tracking systems, transportation and union leaders came together at the table. Through collaborative efforts, including employee input, the employees' union and district management identified the intended purpose of use which was detailed in a Memorandum of Understanding (addendum A).

Once the GPS systems were installed, the data was shared with drivers in an informal setting. Often drivers were surprised when notified of excessive speeding incidents, expressing curiosity regarding time of day and location of incident. In some cases, drivers are now requesting their own speed reports to self-monitor their performance.

Idling Trends

Fuel consumption accounts for a significant portion of any transportation operating budget. When added to that are the costs of maintenance related to the extra engine running time and emissions concerns, it becomes clear that the financial and societal costs of idling are too large for school districts to ignore.

With the intention of influencing driver behavior, CUSD posts weekly idling reports, based on idling incidents beyond 20 minutes, on the driver's bulletin. Through the GPS software, CUSD gathered idling data over a 36 month period and compared idling trends during the month of March 2016 to that of April 2017. Besides accessing idling times, the software also compiles estimates of idling costs and emissions data. Trend results are illustrated in the following table:

	Total Idle Time	Total Cost	CO	NOx	HC	PM	CO^2
March of 2016	144:24:25	$953.05	3326	11987	1330	162	666253
April of 2017	44:48:38	$295.72	1022	3704	397	37	206730
Decrease	100:24:13	$657.33	2304	8283	933	125	459523
% Decrease	-69.30%	-69.04%	-69.27%	-69.09%	-70.15%	-77.16%	-68.97%

CO – carbon monoxide; NOx – nitrogen oxides; HC – hydrocarbons; PM – particulate matter; CO^2 – carbon dioxide

The results were significant - nearly 70% reduction in idling time resulting in a 70% cost savings (approximately $7,200/fiscal year) and a roughly 70% reduction in emissions.

On-Time Delivery

A significant passenger transportation KPI is on-time delivery of students. Instruction time is crucial to educating students and is also strictly audited. Instructional minute data is often used to justify compensation levels and reimbursements to districts. The GPS software allows administrative staff to

access student arrival times by predetermining a school site within a geo-fence zone. By periodically accessing this data, staff can determine necessary adjustments to routes to ensure consistent on-time delivery. If a particular driver shows a pattern of tardiness, zone alerts can be set to automatically monitor/audit that particular driver on the particular route.

CUSD reported 92% on-time arrival performance during the 2016-17 school year, as opposed to 87% the year prior, a 5% improvement.

Students Left on Buses and Missing Students

Two of the most important passenger transportation KPIs are the number of students left on buses and the number of missing student riders. Of course, these KPIs should always be zero since these acts literally endanger the lives of students. The school bus GPS monitoring systems help ensure that the number of students left on buses as a result of walk-throughs is zero since sleeping or hiding riders are discovered during the walk-throughs (which are mandated by the systems' sensors and tracking data). In the first 2 ½ years of the systems' use, the District documented eleven cases of students (or about one per every 5400 walk-throughs) who were found as a result of a walk-through. In addition, by having the systems cross-check student riders' RFID tags with daily ridership logs, the District found (or confirmed that they were not riding) thirteen students (or about one for every 4900 trips) as a result of this student tracking feature. The GPS monitoring systems help ensure that such very low frequency but potentially severe occurrences do not happen.

Enhanced Maintenance

Another important school bus KPI is completion of pre- and post-trip inspections of school buses. Using the Zonar-based inspection sensors, the District's driver inspected buses approximately 119,328 times over the first 2 ½ years of the system. In 1134 cases (approximately once every 100 inspections), safety and/or maintenance issues were discovered and corrected. This enhanced vehicle upkeep prevented an unknown but positive number of crashes and trip delays.

Policies & Procedures

In addition to implementing GPS tracking technology, CUSD adopted clear policies and procedures to delineate the appropriate use of these tools. Among these procedures were trainings. During the study period, forty-seven individual staff trainings were completed as a result of tracking metrics, and fourteen safety training meetings were held based on Zonar data. Since the GPS software

provides a unique IDs to each user, any activity by a user is tracked and logged. A user with administrator rights can access any report and track all activity, whereas a dispatcher or mechanic is set up with limited permissions, determined by the administrator. Supervisory staff has been delegated the responsibility to track certain KPIs and frequently share relevant data with all drivers.

The software also allows administrators to check the status of the system by running a simple activity audit report to make sure each vehicle is sending and receiving a signal to and from the satellite. Security alerts have been set up to keep management staff alerted via email if a vehicle has traveled beyond district boundaries, a driver has performed a vehicle inspection too quickly, or if a child check is not performed within 5 minutes of arrival to terminal. Policies have been set to address and act in accordance to each alert received.

Conclusion

With GPS and student tracking hardware, districts can now easily capture relevant information that can be summarized into key performance indicators (KPIs) which are potentially useful to everyone who is interested in analyzing school bus transportation performance.

CUSD reports that the success of its GPS tracking program can be attributed in large part to the transparency of its process. The technological tools absent thoughtful leadership would be a wasteful investment. A district contemplating implementation of GPS tracking should learn from others before discussions of the concept with its Board and or represented bargaining groups.

ADDENDUM A

MEMORANDUM OF UNDERSTANDING

All drivers shall be notified of the presence and use of GPS devices on District owned vehicles. The primary intent and purpose of the GPS tool is respond to crisis situations more effectively, identifying location of mobile employees, ultimately enhancing the safety and security of those employees. This technology will also assist the district in routing its resources more effectively. This equipment shall be used to confirm vehicle location, speed, and idling time. The District will not use the GPS device to monitor a route or driver. If unsafe, illegal driving, or misuse of a district vehicle is reported, the GPS tool may be utilized to confirm or disprove the allegation.

If a driver performance issue (i.e., excessive speed, excessive idling) is confirmed via the GPS data, management will use the data as a training tool to help employees correct faulty performance.

If a serious violation of the law or board policy or a pattern of unsafe behavior occurs and is confirmed through GPS data, the data gathered may become evidence in the disciplinary process.

A driver may request available GPS data gathered from a vehicle while he/she was operating a vehicle. Management shall provide the available data within 3 business days of the request.

ADDENDUM B

For districts to analyze the costs and benefits of school bus tracking systems, and to receive the most value from such information, a multi-step analytical process that incorporates the following five step process as briefly described below can be utilized:

1. **Calculate**—Use the descriptions of the information provided to calculate a district's KPIs. Examples of KPIs include the following:

    a. ***Cost Indicators***: cost per rider, cost per bus, fuel cost per bus, personnel costs per bus, maintenance costs per bus, purchase/lease cost per bus.
    b. ***Operational Indicators***: buses per 100 riders, simple capacity use, daily runs per bus.
    c. ***Transportation Indicators***: fuel use per bus, miles traveled per bus, routes traveled per bus.
    d. ***Miscellaneous Indicators***: special needs student cost per rider/cost per bus, regular student cost per rider/cost per bus, number of special needs riders, number of regular riders, number of special needs buses, number of regular student buses.
    e. ***Fleet Management Indicators***: buses per technician, vehicle equivalent units per technician, fleet age, fleet odometer readings, fleet count (by type), average idling time per day, number of crashes, number of passenger-related incidents, average student ride times.

2. **Evaluate** – Use the measures to ask questions about how you do business and eventually, why some measures may be higher or lower than comparative districts.
3. **Focus** - Identify how changing business practices can have a positive impact on results.
4. **Develop standards** – Use historical trend (longitudinal) information and comparative results to establish goals and objectives for the changes.
5. **Measure** – Recalculate and reevaluate the impacts of changes over time.

A regular program of performance measurement can serve as a key tool in continually improving the cost competitiveness, safety, and quality of service provided by any operation. The results of this process can be useful to districts in providing the best, safest, and most cost-effective services to the students. The specific purposes of this process may include:

1. Defining a series of relevant KPIs of efficient and safe operational performance,
2. Developing a mechanism whereby districts will be able to compare their performance internally,

3. Increasing the availability of quantitative measures to evaluate operational performance,
4. Identifying best management practices through analysis and interpretation of school bus operational data, and
5. Establishing a mechanism to evaluate the impact of changes in policies or practices on transportation efficiency and cost effectiveness.

While a quantitative approach to reviewing performance is efficient and revealing, there are a number of inherent limitations that must be considered. These include:

1. **Data Quality** – The results achieved are only as accurate and complete as the quality of the source data. All uses of the data should take this factor into account.
2. **Qualitative Factors Affecting Performance** – Calculating quantitative measures of performance generally only provides a starting point in analyzing performance. All information and conclusions should be considered in the context of the specific operational requirements and constraints faced by a district. While some of these factors can be quantified, other important, albeit subjective areas, such as extra accommodations for special education students beyond those required for transportation, need to be considered as well.
3. **Performance Trends** – The analysis presented in this document provides a "snapshot" view of performance at a specific point in time. It is equally important to track trends in performance over time in order to determine whether decisions made are having the desired effect and to avoid misinterpreting a one-time calculation. Developing a comprehensive history of performance trends will require collection of data over an extended and continuing period of time.
4. **Service Delivery Approach** – Because different, but equally valid, approaches to providing student transportation services are found in many districts, quantitative metrics do not provide the only true and accurate measure of performance without a thorough understanding of how the various approaches to service delivery will affect the quantitative comparison.

Ultimately, the information that districts capture and the variables that districts utilize in constructing their KPIs are dependent upon the needs and goals of the district. Whether the concerns center on student safety, cost savings, minimization of environmental impact, or all of the above, KPIs can potentially help districts achieve their goal of maximizing the effectiveness of their school bus service programs.

References

Anund, A., Dukic, T., Börsbo, B. et al. Eur. Transp. Res. Rev. (2010) 2: 157. https://doi.org/10.1007/s12544-010-0035-0.

Chung, Eui-Hwan & Shalaby, Amer. (2007). Expected Time of Arrival Model for School Bus Transit Using Real-Time Global Positioning System-Based Automatic Vehicle Location Data. Journal of Intelligent Transportation Systems. 11. 157-167. 10.1080/15472450701649398.

Shaaban, K., Abdullah, K. et al . Smart Tracking System For School Buses Using Passive Rfid Technology To Enhance Child Safety. Traffic And Logistics Engineering-,.Vol.1,No.2,Pp.191-196,2013.