GPS Systems — Overview

GPS Tracking, the current "buzz" in vehicle monitoring, seems to be so simple in concept that it seems fully understood at its mere mention, yet different people see it doing different things. Management welcomes the idea of keeping track of all

the comings and goings and doings of those for whom they are responsible. Workers fear that "big brother" would know everything they do all day and then be "second guessed" at every turn. Like most first impressions, both are wrong or certainly incomplete. For sure, t is well said that, *"You can't manage what you don't monitor"*.

A valid question is, "**How much information can I productively use, or even better, do I actually need?**" Who's going to watch the on-screen movement of the vehicles all day? Who has the time to watch the screen for even 1-3 hours per day to see how the drivers are driving?

Real time GPS data or "active tracking" could create a situation where it was interesting for awhile to see vehicles moving around on the screen, but it could soon become overwhelming to watch all the time. The system, especially "real time monitoring", could easily fall into such limited use as to become worthless if the system is not well integrated into everyday operations and viewed as indispensable by management and drivers alike. This is no easy task.

To obtain value from a "GPS" system, one certainly needs to know what a GPS system can really do, and just how it could be fully utilized.

Although it is difficult to change the name from the "GPS System", it really would be better called a **"Driver Behavior Modification System**" even though it might sound insensitive to imply that drivers are not perfect in following directions. You don't see many "vehicles" misbehaving all by themselves such that we should be watching just the vehicles. If a vehicle was caught going too fast or found in the wrong place, I'm sure the "vehicle" could make a good case that it was actually the driver's fault.

What makes up a GPS System?

In its simplest form, it's a device placed in a vehicle (usually under the dash) that can sense the vehicle's location relative to the GPS satellites above. There is no charge for receiving these GPS signals from the satellites. The collection of this location data can remain in the device within the vehicle until it's eventually downloaded daily or weekly as desired. This is known as "*passive tracking*", i.e. not real-time and not so useful for dispatch personnel. There is no monthly fee associated with passive tracking.

As an alternative, the location data can immediately be sent back to home base from the vehicle device for immediate display on a computer monitor. This is called "*active tracking*". Active tracking is done most often today using cell phone modems (cheapest) or by satellite transmission (most expensive) and active tracking always has a monthly service fee associated with it to cover the communications cost.

Some vendors provide a combination of passive and active tracking capabilities wherein all the data can be saved within the vehicle unit for eventual download up to 30 days later, and yet certain key location orientated data can be sent back immediately from the same unit. This immediate information is typically: GPS location, speed, direction, and vehicle and driver ID to keep the real time communications short and less expensive.

What's collected besides location data?

This question makes true the saying, "the devil is in the details". To keep it simple (which does not always mean best) many GPS vendors tout that all you need to do is install the unit physically under the dash, connect to a battery power source, ground source, and perhaps attach to the ignition key and you're done. You can now "actively" collect and view location, speed, and "assumed idling", all associated with time and date and vehicle (but not driver unless all drivers drive the same vehicle all the time).

The data is plotted on map software and shows the locations where speeding occurs; idling occurs; vehicle stops; and the vehicle presence in or out of customer designed "geo-fence(s). This describes the most basic GPS System and often, at first glance, seems just fine or at least, just what you expected.

It's very likely that if you started with such a basic system, within a month you might regret the purchase—I've had customers to whom this has happened. Often more question arise than are answered.

GPS Systems — Hardware options

Next, I want to more fully discuss the various hardware options available for GPS Systems. Not all vendors offer all options. Again, the basic GPS On board Computer device includes a CPU board, GPS receiver, some kind of communication port with antenna, with a wiring harness for attaching to: "constant power", a ground connection, and ignition power. All vendors will offer some way to get the data from the vehicle to the home base. These communication methods can include options such as a cell phone modem, network interfaces, satellite communication interface or some manual method of extracting the data. For some vendors, you can mix data extraction methods within one system as can be done with the Siemens-VDO System which I represent.

Most will offer 2-way communications between the vehicle and home base, but that capability, when present, can vary widely from just being able to electronically confirm data has been exchanged (computer "handshaking" with no apparent driver benefit) to elaborate hardware and software interfaces involving an in-vehicle display, driver input device, and even printer and/or barcode wands inside the vehicle. The more sophisticated the vehicle interface, the more potential for driver input errors resulting in the old adage, "garbage in, garbage out". Generally, drivers as a group have not proven to be reliable at data input.

In addition to the above wires, some GPS Systems have an additional 2, 4 (most common), 8, and even 16 additional input wires to "sense" other electrical "events" simultaneously on the vehicle. A very common one is to sense the use of a vehicle's brakes, turn signals, and special equipment like a PTO. Other possibilities are limited only by your imagination and tempered by its informative value, reliability, and accessibility. I'll list a few to start your minds going: headlights for daytime safety, brake light, turn signals, Jake brake, seatbelts, yellow external warning light, sweeper broom, snow plow, 4WD, trailer brake, oil pressure, engine temperature, clutch activation, reverse back-up light, door light, tire pressure sensor, trailer connection, g-force sensor, by-pass filter change indicator, etc. Certainly not all vehicles need all these items monitored, but the more inputs the vendor provides, the more versatile will be the monitor especially in large mixed fleets.

In addition to sensing vehicle functions (VDO calls these functions "events"), being able to change or modify a vehicle's function based on various conditions is often of value. Some vendors provide this capability and usually there are not more than 2 such independent functions available. Perhaps the most common theoretical use for this capability, yet least frequently used function, is to shut down the vehicle if it's driven outside a certain geographical boundary (geofences) to prevent theft. The reason it's not often used is that it's very unsafe. For example, most would say it's not good to completely shut down a vehicle in the middle of a freeway going 60 mph. It would be better to only cripple the vehicle in some way or shut it down only when its speed falls below 25 mph while outside the geographical boundary or only after management (who could be notified by cell phone by the vehicle itself on the Siemens-VDO System) decided to shut it down.

Most GPS systems rely on the GPS data stream to calculate vehicle speed. This is quite reliable, but not quite as good as actually sensing the vehicle's speed pulses that go to the speedometer. Also, most vendors simply define idling as "ignition on and vehicle not moving" which is often true, but not always. True idling is determined by sensing the vehicle's rpm pulses and sensing zero speed pulses.

Much of the cost justification for GPS Systems is based on fuel related savings yet most have no way to count the "fuel actually burned" so "fuel use" factors are estimated and applied to loosely identified "fuel using activities". For example, if you are only estimating idling in the first place (by

just assuming that the key being on and vehicle not moving is always idling), you can't possibly know how much fuel you're really using while idling to begin with. Also, there is good and bad idling, necessary and unnecessary idling, even required idling. Examples are: "high idle which is not bad on diesels; and it's necessary to idle an emergency vehicle just to keep the batteries charging when the emergency lights are on; and PTO use requires "idling" just to work at all.

Idling can be a "non-road-use" of fuel and therefore qualifies as non-taxable fuel use meaning that if you can identify and quantify it, you can get a 30¢ or so per gallon fuel tax rebate if you are qualified.

This leads to another option some vendors offer which is the ability to interface and take data off of the vehicle's "data bus" such as OBDII, the new CAN replacement for OBDII, and for larger vehicles, the J1708 data bus. The Siemens-VDO unit can get speed, rpm, fuel burned, and fault codes off such vehicle interfaces.

Sadly, few GPS systems provide a means to identify the driver. The ones who don't provide driver identification suggest that once you are looking at some errant vehicle behavior, you simply refer back to a "dispatch log" to see who was or is driving the vehicle when the "bad stuff" occurred. If two workers take out a vehicle and switch who's driving the vehicle throughout the day, the logs will not always answer the "who" question. When I discuss more about "driver behavior modification", later in this article, you will see how important it is to have driver identification as a part of the system.

Just having a good number of input and output sensor wires is not enough. Vehicle "functions" are not always described just by the presence or absence of electricity on one wire although it is sometimes enough. Think of vehicle functions as "events" for the sake of this discussion. Some events are adequately defined simply by the presence or absence of electricity on a wire. Some such examples are: headlights on or off, brakes on or off, PTO on or off, etc. Some events need to sense actual voltages on the line like temperature, oil pressure, tire pressure and other analog devices.

Other events can be much more complicated and fewer vendors can handle these. These events involve combining several factors into one event. For example, an "incorrect use of the PTO event" is usually described as using the PTO with the engine over 1200 rpm for longer than 10 seconds. One wire does not have all that information on it. These combinations are defined in the software and give great flexibility to the system. Other "combination events" might be: over speeding over 65 mph for longer than 20 seconds without the emergency lights on; driving in reverse over 8 mph for more than 2 seconds; turn signal on longer than 2 minutes while driving; coming downhill over 25 mph through the hairpin curves (but not going uphill through the same curves); etc. The need to define "combination events" cannot be overstated as you can see.

You now have a better understanding of the options or building blocks available on GPS Systems today. The prevalent concept of watching a screen representation of your vehicles moving all day barely scratches the surface of the real potential value of a "GPS System". I think you can see that generally, especially for a mixed fleet, the more options available the better.

Driver Behavior Modification

There has always been some degree of righteous wonderment by fleet managers as to how their vehicles are being driven in spite of a plethora of rules, special training, etc. Horror stories abound. What to do about it has not been so clear. Certainly, if management drove with an employee, the employee would drive acceptably. That leads one to conclude that driver monitoring could prove to be of value if management had the time to ride with everybody all the time.

With today's GPS technology, it's often assumed that a good monitoring technique might be to watch all the vehicles as they move about on a screen using GPS. That could be a good alternative to having a manager ride with each driver all day

with the added advantage that he could watch over several vehicles at the same time on the screen. There's one big problem with this approach—which manager/supervisor has the time to watch the screen all day every day and make notes or cell phone calls to address errant driver behavior? There is a better way.

First, remember that vehicles are not the problem—it's the drivers. We need to monitor, and most importantly, ***alter the driver's behavior in a positive way to really accomplish anything.*** The study of "human behavior modification" always gets around to two significant areas of focus to cause behavior to change and those are "feedback" and "consequences". To be most effective, feedback needs to be sure, consistent, accurate, fair, prompt, and preferably not negative in its overall nature. Good or bad, evaluations should not be based on isolated or sample incidents, but reflect habitual or patterned behavior.

What capabilities should be included in a "driver behavior modification" system? First we should monitor all significant behaviors relative to "good driving" in our specific environment such as speeding, rapid stops and starts (aggressive driving clues), excessive idling over "x" minutes per incident (not just total idling), driving in the right rpm range according to the vehicle's specifications, frequency of brakes on over 45 mph, good route planning, and perhaps other factors as specific circumstances warrant like the correct operation of optional auxiliary equipment.

Generally we should have a written driving policy and be able to monitor and enforce it consistently and with ease. Of course drivers need to be trained or at least informed relative to their driving responsibilities.

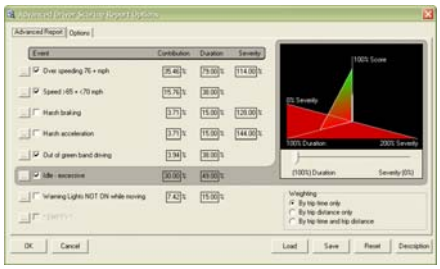
With these guidelines, at a minimum, the GPS System should monitor speed; either by a direct connect to the vehicle's speedometer or by receipt of GPS data, preferably every second so the speed average doesn't miss high peak speeds through long averaging between GPS data collection intervals. The same can be said for rpm, acceleration, and deceleration data, all of which involve very short durations (often 1 second) of potential bad driving behavior. Without second-by-second resolution of this data, this information would be almost worthless either for driver evaluation or for accident reconstruction efforts especially in court situations.

Next, to be the most responsive, consistent, and the least confrontational, immediate feedback should be provided by the GPS monitor itself. It should notify the driver of each errant behavior immediately via an in-cab "beep" and/or light. With such a system the driver would certainly know which behaviors were not acceptable instantly and be able to adjust their driving accordingly without waiting days for verbal or written feedback. The also don't feel the need as strongly to "defend" their errant actions.

For those who do not respect the feedback and don't modify their behavior, there must be some consequences. That means that the supervisor must catch errant behavior through the reporting system. Even a perfect driver has valid reasons for occasionally violating the driving policy guidelines. For example, if a situation demanded that he slam on the brakes to avoid hitting a child running into the street to get a ball, that would be a very acceptable rapid deceleration. There could be such exceptions for every facet of our monitoring. We can't simply respond to some violations listed on our reports, nor do we have time to discuss them all. We must put them in context within the group averages and consider the type of area we operate in, and weigh those different factors.

Who's going to make all those judgments? Imagine that you have only 20 drivers and you have an average of 12 various report pages of information for each driver covering one week of driving. Now, assume you want to counsel with the worst 3 or 4 drivers and you want to reward the best 1 or 2 drivers out of the 20. Who's going to take all those daily over speed, excessive rpm, excessive idling, rapid start and stop report listings and route maps (240 pages of such information in our senerio), count the incidents, their durations, and evaluate their severity, then weigh them against your driving policy, and put the drivers in "best to worst "order with enough documentation that you can discuss the appropriate issues with each driver with confidence so that true objectivity will be perceived by all—even the union. That's a BIG job and it won't get done very often nor very well by hand even if the information could be gathered by a GPS System.

This potential "evaluation workload" points to another "mandatory" criteria we should look for if "driver behavior modification" is what we're seeking. Wouldn't it be nice if the computer software looked through all the relevant data for the week (or month or day or whatever period) and came up with a "grade" that reflected management's priorities with enough detail to get to the heart of these driver specific problems. If the 20 drivers received grades of 92, 95, 55, 68, 82, 78, 43, 58, 60, 38, etc. (and 100 was best) based on the data from the GPS on-board computer, it would not take long to find the top 2 and worst 3 drivers from those 20 scores.



If this grade was made up of "weighted components" such as speeding, idling, rapid decelerations & accelerations, as well as driving outside the ideal rpm range, it would be nice to see the score on each grade component. Without a respected, objective, impartial, yet efficient grading system, the data will bog you down almost as bad as if you had to watch a "GPS Screen" for the whole day every day! You will soon find yourself only looking at a snippets of the data and talking with only a few of the drivers occasionally, thereby opening yourself to the valid question or accusation, "Why are you're picking on me?", or worse, the drivers figure out that "nobody seems to care enough to be watching anymore" so they fall back to driving how they want again.

With a grading system that was easy to use and completely objective, one could turn "vinegar into honey" for the drivers by providing a driver incentive plan to reward good driving. Rather than looking at management and this GPS monitoring system negatively, it could be turned into a positive motivator—a reward generator. Some no-cost rewards might be that those with the best "grades" get the newer vehicles as they become available or they get the best parking spot or even the best routes or first overtime opportunities. Good drivers might get a gold braid on their cap or a "Master Driver" jacket patch if they have a grade average of 90 or more for 6 months and x miles. Studies show that positive recognition is much more valuable as an incentive than money.

Driver meetings can take on a different flavor. In a meeting of 100 drivers, there's probably less than 10 "bad apples". Nevertheless, perhaps half the agenda twill often focus on several "thou shalt nots" made necessary up by the "bad apple's" erant driving. The ninety good drivers again feel tainted by the bad behavior of a few. With a good grading system, the bad ones will be identified and dealt with individually and the meeting time might well include recognition of those with outstanding grades over various times—a much better and more positive meeting.

Vehicle monitoring is touted as a means to reduce fuel costs and maintenance costs. I will say that all of the GPS Systems do that to some degree for some time. What makes one better, or more likely to reduce those costs than another over the long term? It stands to reason that these costs are reduced in proportion to the improvement in driver behavior, since it's the driver who's the variable in this equation. The better the tool is for "driver behavior modification", the more savings. In summary, you need accurate information and prompt feedback on the driving characteristics you want modified. You also need an objective grading system that makes it easy to evaluate a driver's progress over time.

Like improved fuel economy, safety is another often mentioned benefit of GPS Systems. Interestingly, in a large study in Europe where vehicle monitoring is mandatory for commercial vehicles, it was shown that ANY type of vehicle monitoring would provide a 28% reduction in accidents! Still, one could ask: Are some monitors better at improving safety than others? Again, logic tells us that the systems that are most effective at changing driver behavior would yield the safest drivers and likely provide the best documentation should an accident happen.

GPS Systems — Risk Reduction

GPS Tracking is often seen as synonymous with risk reduction which implies both security and safety enhancement. There are good reasons for

this, but like anything, it works best if it's done right.

The most common GPS security feature I hear touted is the ability to define a "geographical operational area" and then if a vehicle goes out of the area, its engine is shut down. This sounds great at first, but if the vehicle was in the middle of a busy traffic and the engine quit, it would create no small safety hazard. A better idea might be to say to the GPS Unit, "If it's out of its area and going less than 25 mph, then shut down the engine". Along with that, you might turn on its flasher light(s) and the GPS unit could call several phone numbers to report an out of area situation no matter the vehicle speed. You might call dispatch, the supervisor, 911, or whomever simultaneously. Not all GPS systems can do this however.

Along that same line, the GPS System could provide more safety in "man-down" situations. A service worker could wear an "alert fob" on a necklace while working, and if he becomes injured and is within 300 feet of his vehicle, pressing the alert button could have the vehicle's GPS Unit call several people for help. Those receiving such calls would see the vehicle ID and its current GPS position on their cell phone.

The need for these life saving functions might be rare, but they are invaluable when needed. Their cost/benefit is hard to calculate. There are though, many more common safety enhancement opportunities with the right GPS system.

Vehicle accidents are a more common risk than vehicle theft. Their historical annual costs can be determined to a certain extent. The cost of a life lost is not so easily measured. The costs associated with most accidents involve items such as: vehicle and/or property damage to yours and other's assets; loss of skilled worker time; loss of key assets for a time; loss of supervisor time; legal expenses; settlement costs; and even bad publicity. If you are a "government agency" these costs rise exponentially because of the "deep pockets" syndrome.

Let me tell you about the success a customer of mine experienced in this area. The customer is ADA County Paramedics in Boise. Surprisingly to some, emergency vehicles are the most accident prone of any vehicle on the road in America. ADA County Paramedics wanted a system for only one purpose and that was to provide good information to better defend themselves when these accidents happened. They had no expectation that an On-Board-Computer (OBC) might help them reduce the actual number of accidents because they assumed, as most do, that accidents are simply accidents that happen. They just wanted better documentation relative to the accidents that would stand up in court so they would not be so much at the mercy of flaky witnesses and juries that felt the government could afford to pay no matter what.

What were their results? After more than four years now, they have not had any accidents involving their drivers! In the beginning, they never asked how the system was going to be cost justified. They just liked the information that could be provided and they bought the system.

A year or so later, their in-house mechanic was noticing extra brake parts piling up and he began to calculate the financial effect of the longer brake life they were now getting. Before, on the ambulances, they were changing brakes and front rotors every 5,000 miles at about $800 per change. During the first year with the VDO System they began to get 45,000 miles per set of brake pads and they needed no rotor replacements. This added up to enough savings in brakes and rotors alone to pay for the entire VDO System in a year! They know there were other maintenance related savings such as tires, fuel, and transmissions, but they did not research those savings in detail.

Safety was improved and money was saved, but how did this happen, and could it be done for you as well? The key to this whole case was controlling harsh braking and rapid accelerations—not something that first comes to mind when GPS Systems are discussed. Not many GPS Systems can even watch for such occurrences let alone help control them. You need to be sensing speed based on wheel movement and not using GPS signals for speed, especially if you want to document wheel spinning or skidding on slick roads.

The paramedic supervisor ran a test using the first vehicle we installed. He was asked to both accelerate and then stop the ambulance as harshly as he would ever want the drivers to do from now on. That established a threshold for each ambulance in mph/sec of deceleration and acceleration. Those thresholds were loaded into the VDO OBC unit and a buzzer was programmed to go off in the vehicle if they ever exceeded those thresholds.

Each time the buzzer went off, it was recorded for management to see and the software deducted some "points" from the driver's grade that established how well he was driving. At first, for about two weeks, the drivers complained vigorously about the buzzer being too sensitive. But after two weeks or so, it became a non-issue and brakes were saved and accidents eliminated!

Were there other factors that contributed to such a dramatic result? Yes, but the above factors were most significant. Other factors might be more significant for your fleet, but habitual aggressive driving is a common issue worth fixing for safety reasons.

What else can a GPS System do to improve safety? Over speeding frequency can be drastically reduced and not just the fastest speed allowed on the freeway. We can set up "geofences" that pertain to certain roads that have lesser speed limits and buzz and "grade" over speeding on those roads too—even school zones can be watched for speeding. If there is a dangerous hairpin curve on a hill in your area, it can be defined so if they approach the curve coming down hill, the speed will be monitored, buzzed, and graded, but not going up hill on the same curve.

Monitoring speeding itself is not as simple as it appears. Most drivers want to be treated fairly and be assumed to have a sense of responsibility. It's also not good to foster the impression that the system is just more "big brother". If the speed limit was 60 mph, most systems will simply watch for all speeding 61 mph and over and give you a list of such incidents and then management is expected to discuss these incidents with the workers. These are not fun discussions for either person and seem overzealous in a short time—if management even takes the time to have the discussions. In the spirit of fairness and assumed personal responsibility , I would set the GPS speed limit at 62 mph to allow some room for inaccurate speedometers then record nothing until after 45 seconds of over speeding to give the driver a chance to make adjustments himself and/or make a reasonable passing maneuver. After 45 seconds I would have the GPS System buzz the driver to warn him that his speed was creeping up too high and still not record an "over speeding event" yet. After giving the driver 10 more seconds to slow down, and if he hadn't yet slowed down, I would begin to record an "over speeding event" that would affect his grade and appear on various reports. This technique treats drivers with much more respect and, if a driver has many thus recorded speeding incidents, one would conclude they were willfully speeding and one could deal with that appropriately. Not all systems have this flexibility.

Here are some other things that, if monitored and controlled, will improve safety: driving in reverse greater than 5 mph; driving in the daylight without their headlights on; "tailgating" in traffic; watching for spinning wheels or skidding especially on slick roads; making sure the vehicle warning light(s) and signals are used appropriately; make sure your vehicles are not being used inappropriately especially if drivers take the vehicle home; make sure all doors are closed until the vehicle comes to a complete stop; correct and safe operation of auxiliary equipment such as a PTO, etc.; and finally, if workers start on time throughout the day, they often don't have to rush to make up lost time. Generally workers quickly become more conscientious drivers within 2 weeks and that's a good thing.

Another security and safety consideration is the potential for vehicle theft. It would be good to get a GPS System that could address that problem. The VDO unit has a no cost option to use its "starter interrupt" feature. Drivers are identified by the GPS OBC Unit as they insert their blue key into the GPS Unit to begin a trip. The vehicle can be wired so that without inserting that blue key, the vehicle will not start. To take this a step further, the blue keys can be coded so they will only start certain vehicles (or all vehicles if you want) so drivers not trained to operate certain types of vehicles can't start them

even though they have a blue key for another vehicle type. Once a vehicle is shut off for an amount of time set by you, the blue key is needed again to start the vehicle. It's hard to steal such vehicles.

In summary, you can certainly say there are great potential safety and security benefits available on certain GPS systems, but not all vendors offer all the same benefits.

Cost Savings and special features

In this section I will discuss additional potential areas for cost savings and discuss special features and options not yet mentioned. Also, I'll briefly address implementation strategies and the management requirements of the System.

When discussing cost justification, different people look for different levels of detail. Some do no more than say I want it or I need it so let's just do it— using the same logic and cost justification technique one uses to select a desk or chair. Others want to dissect every detail such that the cost to "cost justify" the system actually makes the project cost prohibitive. Some-where in between would be a good approach.

Look for the areas with the greatest potential return and focus on those which can most easily be measured within your existing reporting system and when the cost justification is reached, call it good enough. If you already track fuel economy accurately by vehicle, that would be a great place to focus, but if you are not now collecting and reviewing such data, setting up a system to do so on every vehicle would likely take too much effort. Instead, you could select sample, representative vehicles install the GPS System on those vehicles, and begin to focus on just their mileage for a time with the idea that they would determine the potential fuel savings percentage that could be applied generally to the total fleet's fuel budget.

Additional savings accrue in the area of vehicle maintenance, but are often too difficult to measure in detail by vehicle over time, but such costs do deserve some estimated percent of improvement. Three percent overall maintenance savings is not unrealistic. Savings would accrue for: tires, transmissions, brakes, and other drive train parts because of reduced harsh or aggressive driving as a result of the "driver behavior modification" techniques discussed earlier.

The biggest expense and therefore the biggest opportunity in gross dollars for savings is personnel costs. Savings can result in reducing a full time employee, but more often it's expressed as an increase in productivity. Productivity too is difficult to measure individually if you are not now doing it. Nonetheless it's not difficult to conceive of and also deserves and estimated percent savings. Although productivity improvements are often referred to as soft dollars, they are most often closely related to the department's prime mission and are therefore very important. GPS Systems make workers more conscious of their time and whereabouts and they do make better time management decisions based on such accountability.

Another justification opportunity is to consider the value of being able to provide some service, some information, or other important function(s) you could do no other way as well or as inexpensively. In some cases, this might be the ability to provide prompt "man down" alerts and response using a vehicle or personal "panic or alert" button. For street sweepers it might be counting the miles or square feet of roads actually swept per month or the ability to prove that the sweeper did sweep a certain street on a particular day in question. The same applies for road plows in the winter. During significant storms or other emergencies, it would be good to see where all your assets have been dispatched. What's the value of such information to you and those you serve?

One final area of cost justification is safety and security. This area alone can easily justify the system, but its calculation is most difficult to put down on paper. To attempt to calculate a good number, we could begin by looking at the past "risk expenses", i.e. settlement costs for

deaths, injuries, lost wages, property repairs, etc for the last five or so years. This number might not be too hard to come up with. The difficult part is to forecast what similar events are potentially going to come up over the next five years. Then estimate how many of them the system will help prevent and/or to what degree will the GPS System be able to mitigate the financial impact of those events. Crystal ball anyone? What's a life worth?

Remember the case of ADA County Paramedics I discussed earlier? They only wanted better documentation for when their vehicles were in an accident so the settlements would not be so high. Do you remember their results? We don't know how far we could reduce their settlement costs because they've had no accidents in over 4 years!

Frankly, the only way the GPS System would not be cost justified easily within 2 years would be if you bought it and never used it.

Special Features

Grading–The ability to translate driving behavior into a numeric grade reflecting degrees of goodness is found in only a few GPS Systems, but most are quite limited and because of those limitations, are often deemed by the drivers as unfair. The VDO system allows you to create a grading matrix (or several) that are custom to the nature of various types of driving. For example, the factors relevant to how one drives a street sweeper will be different than those factors considered in driving a dump truck, or van or Vac Truck. Each of these might have different grading matrices to focus on certain aspects such as aggressive driving, speeding, and vehicle operations as they pertain to their function.

A department defines a series of "events" that will be monitored such as "several potential speeding areas, wheel spinning/skidding, harsh acceleration/deceleration, driving to fast in reverse", etc. Then combinations of these events are chosen to be part of the grading matrix. Each event can be used in any number of matrices. The events selected for a particular matrix is then weighted as to their relative importance. For example, wheel spinning might be twice as important in determining goodness as excessive idling, or they might be the same importance. Next, these events can have a "duration factor" and perhaps a "severity factor". Duration refers to how long was the speeding incident, and severity considers what was the fastest speed reached during the over speeding event. You can now weigh the relative importance between duration and severity. The duration of speeding is usually weighed more heavily than severity. All of these calculations can be based on either trip miles or the trip's duration or both equally. Finally a grade from 0 to 100 is calculated with 100 meaning that no violations occurred during the selected time period which could be over any number of days. Up to 8 events per grading matrix can be considered or as few as one. The number of events you can define is limited only by your imagination.

This grade can be used many ways. It's very useful during performance reviews. You can spot significant daily misbehaviors very quickly. On the positive side, grades can be used as a means to provide driver incentives—both financial and, often more effective, non financial recognition.

Some non-financial rewards that work well are: providing a preferred parking space for "driver of the week"; after six months of maintaining a quite high grade average and no "at fault" accidents, a driver might earn a "master driver" hat or jacket; new vehicles might go to the best drivers; preferred schedules or overtime might be offered to the best drivers; the best drivers could be designated "trainers"; etc.

Location Reports–This function refers to the ability to define geographical areas of virtually any size or shape, give them names, then having the software track when a vehicle enters them, how long it stays in them, and the time it leaves, and the distance driven to get there, and the peak and average speed while getting there. Some variation of this capability is present on most GPS Systems.

Reporting and Configuration Groups–If your fleet is large and varied, the set up and reporting options can become difficult to manage. The VDO system helps in several ways. During the original installation, vehicles are grouped as to their similarities and given names like "street sweepers", or vans, or dump truck, etc. then the first vehicle in each group is defined in the PC. The next vehicle in the group is then copied from the first to save time and maintain accuracy and consistency, but if a vehicle is only 90% identical to the rest of the group, only the 10% that's different needs to be changed thereby saving 90 percent of the setup time.

A similar problem and solution occurs when it comes to running reports. Both drivers and vehicles can be organized into reporting groups and both drivers and vehicles can be included in any number of groups. Next, you define the report's "criteria" such as which drivers or vehicles will be included, how many days will the report cover, etc. This definition can be defined, named and saved. Then daily, weekly, monthly etc. these "report criteria" definitions can be grouped as "batches", named, and saved so weekly a batch file could be run resulting in 7 different reports and graphs using the one batch file command.

Database–VDO uses Microsoft SQL Server for its database engine and uses crystal reports to define it reports meaning that if you use crystal reports, it's very easy to generate your own custom reports.

GPS Map Base–The default Map on which the tracking information is viewed is Microsoft MapPoint, but if you have your own mapping department, usually your own maps can be converted to be the GPS display base.

Maintenance Tracking–Any maintenance system needs to get mileage or hours of service data as a starting point for maintenance scheduling. The GPS System should be expected to provide this data as a byproduct of its tracking function. VDO allows you to accumulate both miles and hours of service for this purpose.

Trailer Tracking–Trailers sometime get "forgotten about" and are difficult to track for maintenance. The VDO has an optional device that connects to the trailer and is connected to the GPS System as the trailer lights are connected, so we know the GPS position it was picked up and disconnected and can thereby accumulate the miles traveled for maintenance tracking and better locate missing trailers.

Web Based or In-house–The most common GPS tracking systems are Web based and therefore offer more limited options in an effort to keep most of their customers the same for support purposes. One of the advantages of a web based system is that the system support is not dependent on your resources, but if you have a good IT support department they might well give you better service than Web based vendors. VDO offers both types of service. It's safe to say that an in-house system can be more tailored to your needs more easily.

System Management

Someone needs to motivate supervisors and department managers to stay on top of their drivers, using the GPS data, to make sure policies are uniformly applied and enforced. This way one supervisor who is not "with the program" can't simply ignore the GPS System without being noticed. A Supervisor grade is the summation of their drivers and that too can be rewarded.

Installation Considerations

I suggest installing two or three of each kind of vehicle to start with from a variety of departments so your people can be trained on how to install them and see what has to be done on different kinds of vehicles. Depending on the vehicle and what you want to monitor, it might take 2 to 5 hours per vehicle to install a VDO System using most of its options. Of course it takes longer at first while your people are learning.

After the initial training, I suggest installing by department and work group so the full value

is obtained most rapidly. If you have separate mechanics for major departments then those departments can be installed simultaneously.

If you would like, I will provide some samples of common reports and graphs other customers have generated. The file is PDF based and fairly large and would there for be best sent separately. Please let me know if you'd like to see the reports.