

Selecting and Implementing GPS and In-Vehicle Monitoring System (IVMS): obstacles and how to overcome

by

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Keywords: Global Positioning System (GPS), In-vehicle Monitoring System (IVMS), Transportation Safety

Abstract

This article is about selecting and implementing Global Positioning System (GPS) and In-Vehicle Monitoring System (IVMS) for vehicles carrying dangerous goods such as explosive and oxidizers. The author wishes to share the obstacles faced and the learnings based on his own experience and the experience of others in implementing the GPS and IVMS. The GPS and IVMS is considered an administrative control by monitoring driver behaviours and helping them to improve via coaching, training, and consequence management. The obstacles and suggestions to overcome them are shared. The organisation of the author has achieved some improvement in transportation safety after the implementation of the GPS and IVMS. These systems are not “the magic bullets” to eliminate transportation safety incidents in the explosive industry, but they are helping organisations to reduce the risks of transportation safety by reducing the probability of drivers’ unsafe behaviours. There are many other important transportation safety programs that an organisation must deploy to improve transportation safety further, and all must be driven by leaders to ensure improvement in transportation safety.

Background

It is paramount to improve transportation safety for vehicles carrying dangerous goods such as explosives and oxidizers as there have been many high consequences transportation incidents in the explosive industry worldwide in recent years. Usually, unsafe acts of the driver and unsafe conditions such as the condition of the vehicle or the road are the main contributors to transportation incidents. This article describes the selection and implementation of Global Positioning System (GPS) and In-vehicle Monitoring System (IVMS) which may be useful in improving transportation safety changing the behaviour of drivers. In the hierarchy of risk controls in figure 1 below, at first glance, one may argue that it should be categorised under the “Engineering Controls” tier as it involved installing hardware such as in-cabin cameras and sophisticated software to monitor and analyse driver’s behaviours. Through in-depth analysis into how the GPS and IVMS may help to improve transportation safety, the author thinks that the GPS and IVMS should fall under the category of “Administrative Controls” as it changes drivers behaviour instead of isolating drivers from any possible hazards.

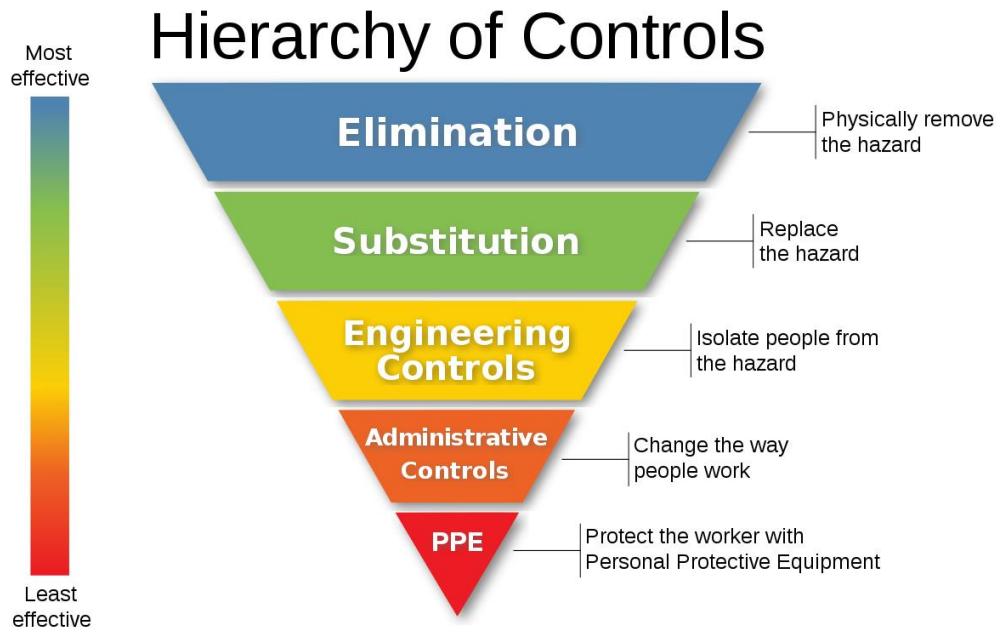


Figure 1: Hierarchy of Risk Controls

Selecting GPS and IVMS

There are many GPS and IVMS vendors in the market and one may find it difficult to choose if we do not have a clear objective which parameters do we want to monitor and what do we intend to do with the data that we collected through the GPS and IVMS system. Table 1 shown below describes the main selection criteria for GPS and IVMS that one should consider. These criteria are suggested based on the author's experience through implementation.

Item	Main Selection Criteria for GPS and IVMS	Considerations
1	Accurate GPS location and speed based on second-to-second data point and availability of related software features	<p>Some GPS systems in the market are only able to provide 5 to 10 second data points. This is crucial for incident investigation as we want to see the accurate speed and location of a vehicle before, during and after a transportation incident to learn from the incident.</p> <p>Some features usually come with the GPS and IVMS such as geofencing, route setting, email and mobile alert, panic button, fuel sensor option, tracking on map, vehicle and fleet utilisation.</p>
2	Front/in-cabin camera and ADAS (Advanced Driver Assistance System) to aid driver and monitor drivers' behaviour for coaching purposes. For example, departure alert, distraction alert, no seatbelt alert, yawning, and eyes closing alert, headway monitoring alert, forward collision alert et cetera)	<p>In some countries, implementation of in-vehicle monitoring system may violate privacy related regulation. This needs thorough review during scope setting and even getting consents from drivers and crews.</p> <p>Some systems also come with gyroscopes and accelerometer which are useful for road condition analysis and driving behaviour analysis.</p>
3	Video alerts with cloud-based access to be able to retrieve remotely.	<p>Cloud-based video alerts by default can be sent to the server in the datacentre by internet connectivity. This is useful in case the front/in-cabin camera with its micro-SD card or other storage device is damaged or missing following an incident. For example, a harsh braking video right before an incident accessed remotely may help to give insights on what are the immediate causes of a transportation incident.</p> <p>However, cloud-based video alerts are subjected to internet connectivity and signal strength. Most of the quarries and mines are in the remote areas, so this may be useful only on highway or public roads with decent internet connectivity. In future, adoption of 5G may improve this feature and even more functionalities will be available like big data and artificial intelligence (AI) learning.</p>
4	Driver ID with key fob, driver Key Performance Indicators (KPI) measurement, and driver application.	<p>Each driver can be rated based on their driving behaviours and further coaching session can be given based on the alert categories. It is important that the vendor provides the driver KPI dashboard and customisation of the driver KPI as different organisation may have different problem/driving cultures and goal setting processes to monitor the driving behaviour. Some vendors are also able to provide mobile application access for the driver as direct feedback of their driving performance daily/weekly/monthly.</p>

5	Purchase or subscribe to the systems	Subscription of such systems is better than acquisition due to the rapid evolution of available technology in the market, although subscription is slightly more costly.
6	Support from the vendor	GPS and IVMS are also subjected to breakdowns and wear and tear. It is crucial to have good support from vendors to perform trouble shooting and repairs.

Table 1: Main Selection Criteria for GPS and IVMS

The main obstacle of selecting GPS and IVMS is the many different features available from different vendors and their support capabilities. You need to know the scope of your project and your budget before selecting the GPS and IVMS. You also need to understand the requirement based on a problem statement developed together with the drivers and the team who will be going to use and monitor the GPS and IVMS and develop your own selection criteria.

Implementing GPS and IVMS

Below are some foreseeable obstacles in the process of implementing GPS and IVMS on your trucks and suggestion to overcome it.

Item	Obstacles	Suggestions to overcome
1	Installation of the GPS and IVMS may be affected by the availability of the vehicles. Delivery order and demands may affect your project progress.	Working together with the team who can manage the delivery order (if the project is being carried out by a different team than the team who has control over the assets) and arrive at a feasible schedule for installation and managing customers' expectation.
2	May introduce additional hazards with the installation of the GPS and IVMS	Management of Change (MOC) need to be performed to properly address risks that may arise from the installation and implementation. For example, wiring of the electrical supply to the GPS and IVMS must be installed by a certified electrician. Use of battery isolators to prevent sources of ignition of the truck during parking or after a rollover may affect the functionality of the GPS and IVMS. Additional power sources for the GPS and IVMS must be reviewed properly without introducing new hazards to the truck.
3	Driver IDs or Driver key fob may be mixed up	Driver IDs or key fobs need to be assigned with proper tracking to prevent the error of your data in the system by wrongly identifying which ID belongs to which driver.
4	Driver is unaware of the introduction of the GPS and IVMS and its purpose	Engagement with drivers needs to be done properly. Consent may be needed if IVMS is involved to prevent violation of any personal data act in your country. Some IVMS systems come with Advanced Driver Assistance Systems (ADAS) and they may send alerts to the driver during a violation. Drivers need to be informed of the basic functionality of the GPS and IVMS such as the use of a panic button. They also need to be briefed on the conditions that may be considered a violation for transportation safety. If you want to introduce consequence management for violations, grace

		periods must be given for the driver and a clear policy must be written and cascaded down properly.
5	No clear responsibility and accountability to use and monitor the GPS and IVMS	Implementing of the GPS and IVMS seems to be just plug-and-play. It is bigger than that. A great system without anyone using it will be just another “nice to have white elephant” project. In-depth introduction training and multiple refresher training need to be given to the users who are responsible for monitoring and using the system. A party may also be assigned to deal with the vendor on maintenance and repair of the system as it may fail after some time period (just as anything else does). Clear handover of the system installed to the relevant parties who are responsible to run and maintain the system is also crucial to ensure its success. Periodical audits may be deployed to ensure that the system is maintained its intended functionality.
6	Lack of continuous effort to develop to use the GPS and IVMS	At the start of the project, everyone will be excited but when facing real life challenges during the implementation of the GPS and IVMS to improve transportation safety and drivers’ behaviours, the objective and vision of having the system may be lost. A transportation safety committee may be established to overcome this issue. Meetings should be held periodically to monitor the trend of the drivers’ behaviour, driver coaching arrangements, consequence management and other related transportation safety initiatives. These could include setting up a monitoring centre with big screens to accommodate the dashboards as well as enhancement project with vendor to add more sensors to the system or improve the dashboards.

Table 2: Possible obstacles of implementing GPS and IVMS and suggestions to overcome them

Features of GPS and IVMS implemented in Austin Powder Malaysia Sdn Bhd

GPS IVMS ADAS – Driver-facing camera

Video Alerts Setting

- Headway monitoring
- Left and right lane departure warning
- Forward collision warning
- Yawning
- Eye closing
- Drinking
- Smoking
- Phone call
- No Driver/Driver Monitoring
- System angle abnormal
- Distraction
- Seatbelt

Driver-facing camera

Figure 2: GPS IVMS Video Alerts Setting

Cameras and Example of Cloud-based Video Alerts



Harsh braking alert (front and in-cabin cameras)



Forward Collision Warning – “Danger” (front camera)

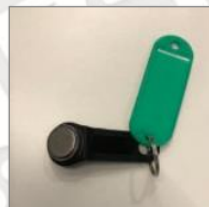
Figure 3: Cloud-based video alert

GPS IVMS ADAS – Driver ID & Customizable Key Performance Index

Driver KPI Monthly 2 Report Data

Show 100 entries Search

SINo	Driver Name	TotDist (km)	TotDrv	OS	HA	HB	XDIR	YDIR	BanHr	CntDev	TotWH	TotDrvDays	Driver In
1	MMU V	7853	0	5	0	19	0	0	0	0	5	23	98
2	MMU K	7716	0	6	0	1	0	0	0	1	11	22	98
3	ISO Ba	7602	0	2	0	0	0	0	0	9	0	22	98
4	MMU J	7148	0	1	0	0	0	0	0	0	2	21	100
5	MMU A	6259	1	2	0	1	0	0	0	4	4	20	98
6	MMU A	5786	0	4	0	1	0	0	0	1	3	16	98
7	MMU F	4951	0	1	0	5	0	0	0	1	4	19	99
8	MMU S	4782	0	5	0	1	0	0	0	1	1	17	98
9	MMU S	4664	0	0	0	1	0	0	0	1	1	25	100
10	MMU S	4605	0	0	0	7	0	0	0	1	0	15	98
11	MMU K	4009	1	12	0	2	0	0	0	2	3	16	99
12	MMU F	3814	0	21	0	0	0	0	0	0	4	14	93
13	MMU C	3629	1	154	0	2	0	0	0	2	3	13	49
14	MMU Y	3540	0	25	0	0	0	0	0	1	3	9	88
15	MMU S	2726	0	0	0	2	0	0	0	2	0	14	99



Driver Key Fob



Driver Key Reader

Figure 4: Customisable Drivers' Key Performance Indicators

Fatigue & Yawning Dashboard

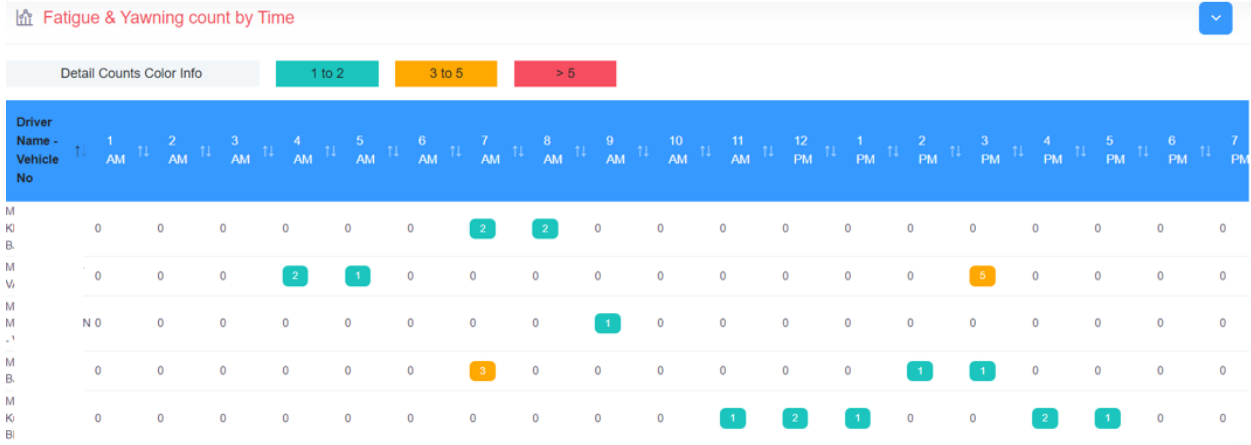


Figure 5: Management dashboard on Fatigue and Yawning

Fatigue, Yawning, Distraction Trend

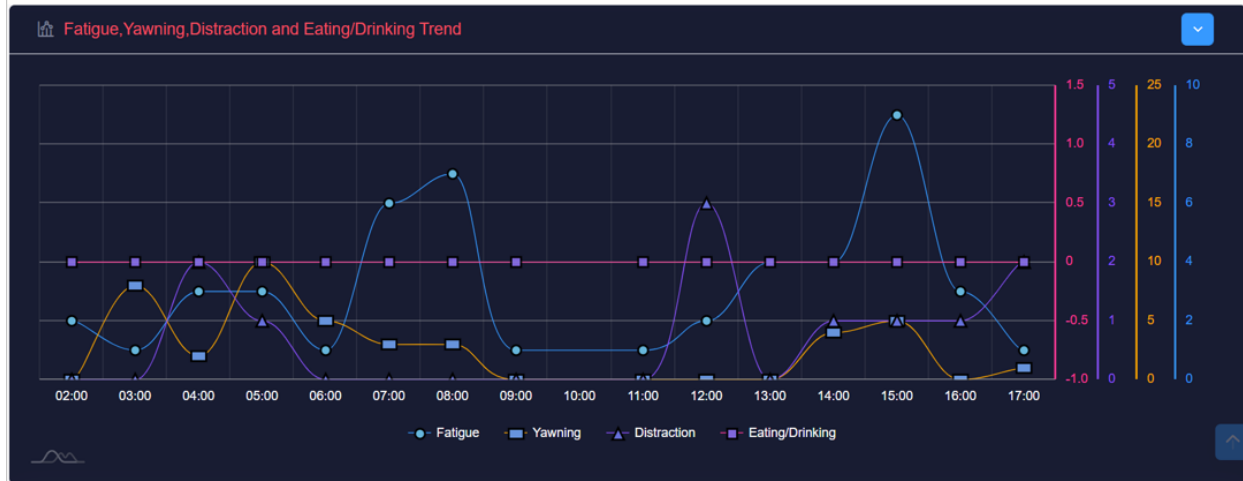


Figure 6: Management dashboard on Fatigue, Yawning, Distraction and Eating/Drinking Trend

Improvements after implement GPS and IVMS

After an emulsion MMU (mobile manufacturing unit) rollover incident happened in June 2020, Austin Powder Malaysia (APMY) consolidated their previous multiple platforms Global Positioning System (GPS) into one platform

and added In-vehicle Monitoring System (IVMS) in the vehicles transporting Dangerous Goods. The project began with scoping and selection of vendors in early 2021. Installation was completed towards the end of 2021. Following the implementation, we can see some improvements in MMU and Emulsion Tanker transportation safety in data collected in 2022 (see charts below):

MMU & Emulsion Tanker Dashboard 2022

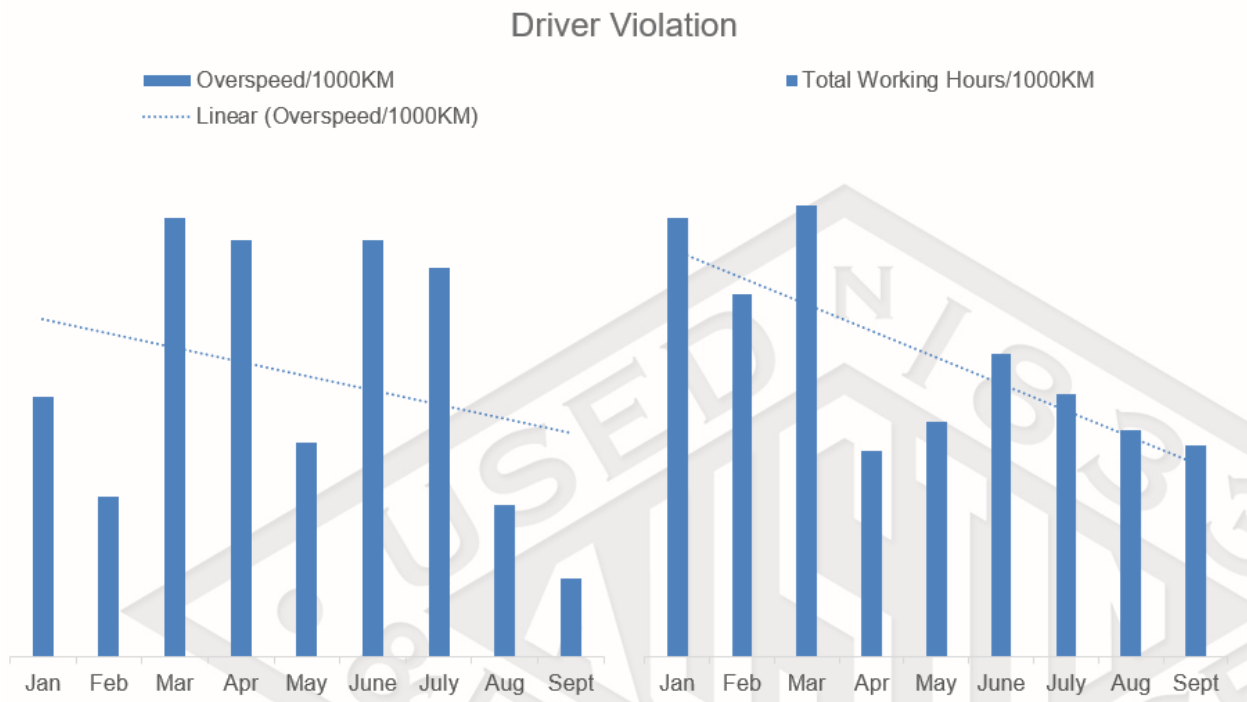


Figure 7: Overspeed and Total Working Hours Violation

MMU & Emulsion Tanker Dashboard 2022

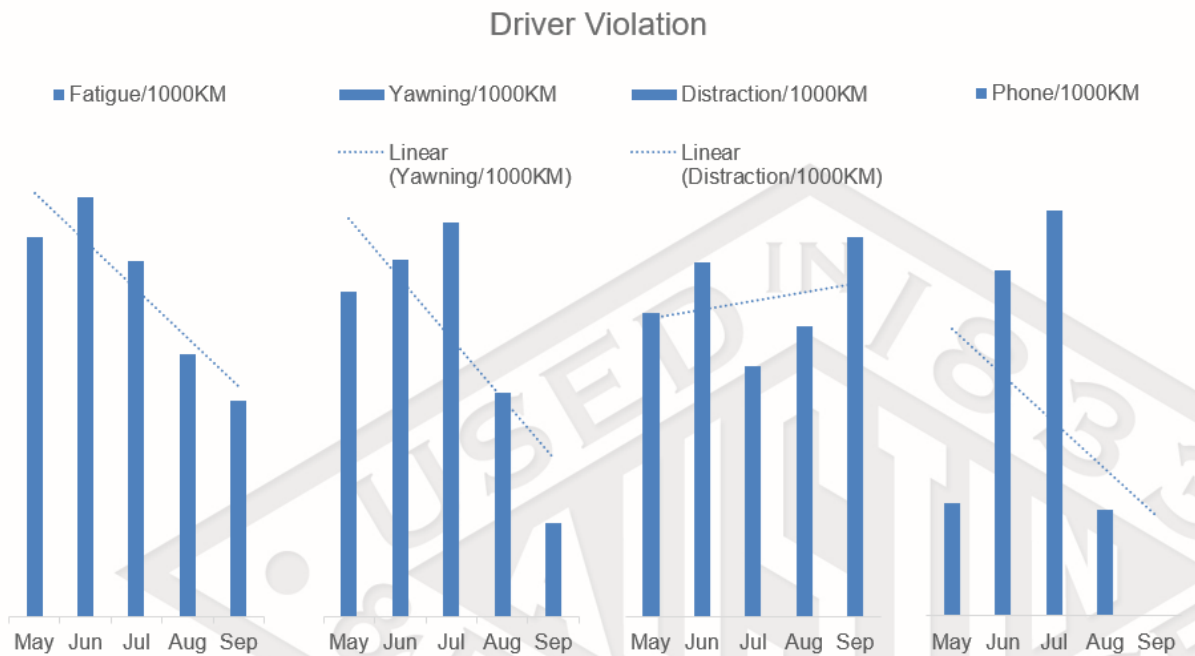


Figure 8: Fatigue, Yawning and Distraction Violation

We can see that the fatigue violation (eyes closing in particular) and yawning detection have been reduced after the Total Working Hours violation was reduced from January to September 2022. Overspeed violation is on a downward trend after implementing the GPS & IVMS system together with a throttle limit introduced in 2021 (data not shown). However, there is still room for improvement. For some reasons distraction has increased (could be other distractions as the phone usage detection is on a downward trend) and the team is still investigating the trend.

The team will continue to monitor and improve the driver violation trend via driver coaching, training, and consequence management to improve the overall transportation safety in APMY. The numbers can be improved further. More work needs to be done for MMUs and emulsion tanker transportation safety and we expect to see some good results for explosive delivery as well soon. The system may also be extended to the third-party Ammonium Nitrate Transporter as well.

Conclusion

GPS and IVMS are some of the tools that we can deploy to help improve drivers' behaviours. With this system we can monitor these behaviours and provide appropriate training and coaching to prevent any violations on the road. Other transportation safety aspects need to be covered as well, not limited to fatigue management, vehicle preventive, maintenance program and defensive driving training. Involvement of leadership is of the utmost importance to ensure the success of such initiatives. The transportation safety journey for APMY continues and the team wishes to continue to improve to ensure all drivers/crews and other innocent road users can go home safely every day.