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In-truck cameras at Toll NQX

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Information based on a symposium presentation facilitated by Sarah Jones at the Australasian Road Safety Conference (ARSC 2015), 14-16 October, Gold Coast, Australia

Introduction

Toll NQX is a business unit within Toll Group that specialises in long distance road freight solutions for Australia's northern routes. The operating environment is characterised by remoteness, harsh conditions, limited supporting infrastructure such as rest bays, and longer response times if things go wrong. Long distance, or 'linehaul', operations utilise high productivity vehicles such as B-doubles and road trains. It is not unusual for vehicle combinations to weigh up to 130 tonnes and represent a million dollar investment. Typically, vehicles are loaded within Toll NQX depots (of which there are 24) by loading staff, leaving drivers fresh for the task of driving. Unlike pick-up and delivery work which has the inherent stimulus of multiple drop-offs, interaction with customers and urban traffic flows, linehaul driving involves long stretches of one, single task: driving.

It is common for Toll NQX linehaul drivers to clock up 1000 kilometres over a 24-hour period and around 220,000 kilometres in a year. In comparison, Australian motorists drive an average of 15,530 kilometres per year (Roy Morgan, 2013). Professional freight drivers generally do not receive enforcement concessions because of their increased exposure relative to other (non-professional) drivers. They have the same demerit point thresholds and incur traffic infringements at the same or higher penalty levels than general motorists. (Professional drivers in New South Wales have a higher demerit point threshold than other drivers, RMS, 2015).

Linehaul driving is a solitary task without the myriad of workplace interactions many of us take for granted. This solitariness is often an attraction for linehaul drivers, but it creates unique managerial and safety challenges. For example, how can schedulers judge the fitness for duty of drivers they cannot physically see and assess? How can restorative rest be promoted in remote areas with limited facilities? What is the most effective and efficient response in the event of mechanical failure, rollover or weather event? Such challenges made the risk management opportunities afforded by technology deeply attractive to Toll NQX, and the business unit was an early adopter of GPS-enabled telematics (or "black boxes") for this reason.

In-truck monitoring for speeding events

Toll NQX introduced in-truck monitoring for speed management purposes in 2001, two years before the

	Moderate speed breach	Major speed breach	Critical speed breach
First offence	Formal verbal counselling to restate company policy	First and final formal written warning stating a further breach will result in termination	Termination of employment
Second offence	First formal written warning issued stating that two (2) further breaches will result in termination	Termination of employment	
Third offence	Final formal written warning stating a further breach will result in termination		
Fourth offence	Termination of employment		

Table 1. Toll Group's consequence table for speed breaches

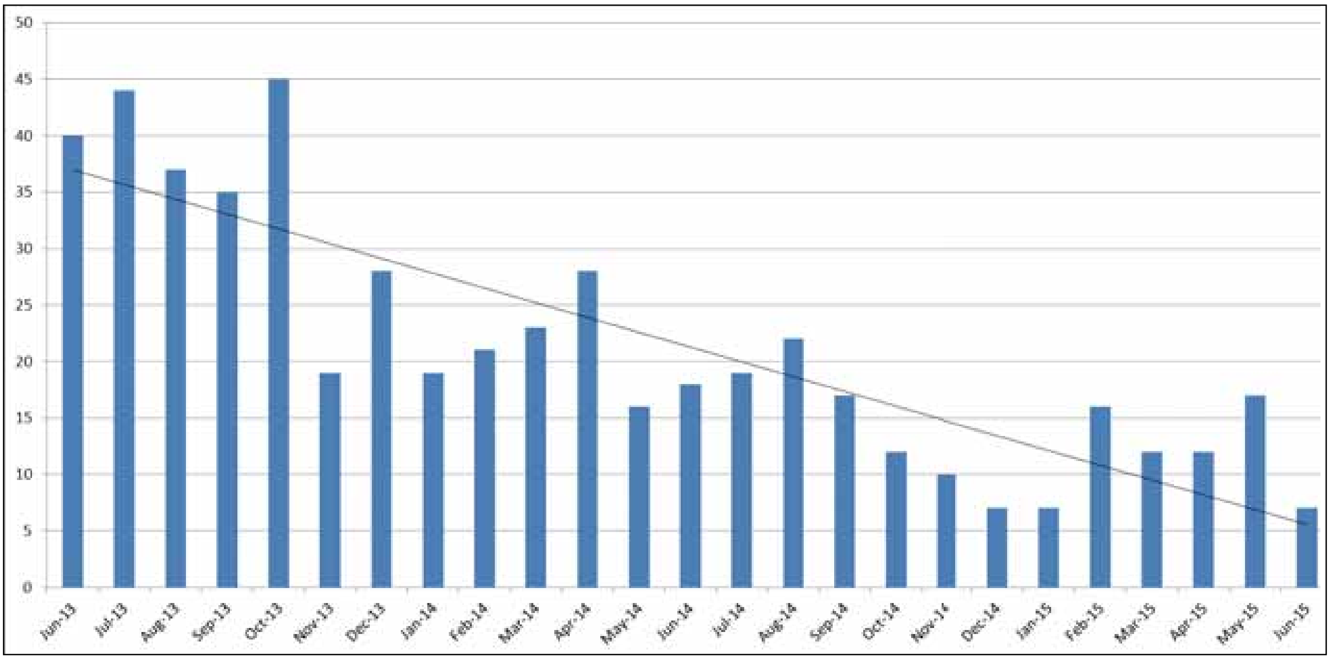

Figure 1. Speed events in Toll NQX from June 2013 to June 2015

landmark *Compliance and Enforcement Bill* which introduced a chain of responsibility approach to speeding. Telematics devices were installed that recorded engine speed data from the engine management system and relayed it to an independent analyst based in Newcastle. This data was used by Toll NQX to identify speeding events and build a profile of riskier routes, conditions and drivers.

In July 2013 Toll Group introduced an Australia-wide speed management standard and in-truck monitoring standard. The standard classifies "speeding events" as any incident at or above 4 kilometres per hour over the vehicle's regulated speed for three seconds or longer. The telematics device records the total time each speeding incident is sustained at or above 4km/hour by driver and location. Speeding events are classified as either 'critical', 'major' or 'moderate' and result in codified consequences as shown in Table 1.

As indicated in figure 1 above, Toll NQX achieved a significant and sustained reduction in speed events between June 2013 and June 2015.

The vast majority (99%) of the speeding events shown in Figure 1 were for moderate speed breaches, which are incidents where the breach was less than 10km/hour over the speed limit. As such they resulted in verbal counselling of drivers, which was an opportunity to coach the driver in behavioural change and to reiterate the importance of the Toll values, including that no job is so important that it cannot be done safely. In an industry that has sometimes prioritised productivity ("getting the job done") over safety, this is an important cultural shift. Toll NQX has further driven this cultural change by instituting a business unit policy that B-doubles be speed-limited to 95 km per hour.

Despite the safety benefits yielded by speed monitoring, Toll NQX was frustrated by the limitations of the telematics data. The data indicated speed, location and time but shed no light on the surrounding circumstances. It revealed the 'what' but not the 'why' or the 'how'. This often made it difficult to establish an objective root-cause understanding of an incident. For example, a speeding incident above 100km/hour might suggest a defective speed limiter. But speed limiters (which are mandated for heavy vehicles) do not work effectively on steep downhill runs. Telematics data could reveal nothing about factors such as road condition and topography that would point to a downhill gradient sufficient to 'over-ride' a speed limiter. Similarly, telematics data could not provide Toll NQX with crucial information such as traffic conditions, signage, animal interaction, weather events, driver state (such as fatigue and distraction) or the behaviour of other road users: all of which can influence speeding.

Further impetus for an approach that went beyond telematics data was provided by the introduction of the heavy vehicle national law (HVNL) in all states except Western Australia and the Northern Territory from February 2014. The 'reasonable steps' component of the HVNL requires that incidents and near-misses be approached as learning opportunities and catalysts for change. Identifying and remedying past compliance problems is a matter that courts may consider in deciding whether reasonable steps have been taken (HVNL section 622 (1jc)). An analytical and proactive approach to compliance issues can therefore establish a reasonable steps defence in the event that an on-road incident occurs. Such a defence can be important in protecting the reputation of both the organisation and the driver.

In-vehicle cameras

Recognising the limitations of telematics data and mindful of how reasonable steps was likely to be constructed in the HVNL, Toll NQX began introducing in-vehicle cameras in trucks in 2011. The introduction followed a year of research and investigation into the capability of the technology and its implications for drivers. Toll NQX selected a product called 'DriveCam' which records both in-cab and external footage. The footage is both visual - capturing the driver and the road ahead - and audio within the vehicle cabin.

Challenges

The obvious challenge facing Toll NQX was how to introduce camera technology in a way that was least intrusive for drivers and protected privacy but still enabled the root-cause analysis that GPS telematics couldn't provide. One of the attractions of DriveCam from Toll NQX's perspective is that it continually records and then deletes data, except in the case of a 'G force event' or when activated by the driver. G-force events include sudden braking, harsh cornering, and the 'bounce' produced by uneven road surfaces or swerving. Where a G-force event occurs DriveCam records 12 seconds of vision and audio: the eight seconds leading up to the event and the four seconds afterwards. Drivers can also elect to record data by pressing a button in the cab.

An additional layer of privacy protection is provided by the fact that the recorded data is analysed by a third party based in California in the United States. This third party analyses the footage and emails data that may warrant further investigation to a limited number of specially trained Toll NQX staff. These staff are bound by a code of conduct that stipulates the conditions under which they may view footage (for example, no one else may be in the room when it is viewed) and what they may do with it.

Drivers had concerns that the footage would be used primarily as a disciplinary tool to performance manage and even sack drivers. An extensive dialogue between management and staff emphasised that the footage would be used as an educative and coaching rather than a punitive tool. Toll NQX drivers' experience with the speed management policy provided a useful precedent in this regard. The dialogue also emphasised the value of the footage in objectively assessing why incidents occurred and providing drivers with a defence. This latter point is very important. Where an on-road incident occurs, there is often an assumption that the heavy vehicle driver is likely at fault. Camera footage provides a means of establishing liability more clearly and objectively than the recollection of the parties involved. The power to activate the system where an incident or near miss is imminent was highly attractive to drivers. Take-up of the system was further incentivised by deploying the DriveCam system in the newest vehicles. As the prospect of driving the 'latest and greatest' trucks is highly attractive to many drivers, this provided positive reinforcement for the DriveCam system.

Following the consultation period, most drivers readily adopted DriveCam. There were instances of drivers attempting to obstruct the camera's view with towels, resulting in disciplinary action. Such incidents now occur only rarely and almost invariably with new drivers. The only jurisdiction in which the technology posed an industrial issue was in Victoria, where the Transport Workers' Union argued against the technology in a case before the FairWork Commission. The Commission found in Toll Group's favour, noting that 'the evidence indicates the system can contribute to better safety outcomes in the road transport industry and should be considered by the parties in this context' (FairWork Commission, 2014, p. 15).

Results

To date, more than 140 Toll NQX prime movers have been fitted with the DriveCam system. Each camera costs around $1000 to install and $90 a month to monitor. Toll NQX is therefore outlaying $151,200 in monitoring fees each year and has incurred $140,000 in non-recurrent capital costs. Additional indirect costs are incurred through the need for Toll NQX personnel to review the footage. This is estimated at around $40 per unit, per month, representing an annual spend of $67, 200 (Toll, 2013).

Around 3,700 video clips are on forwarded to Toll NQX from the third party provider each month. The vast majority of these clips (about 94%) require no further follow-up. Typically these are incidents where the camera has been triggered by the truck travelling over a pot-hole (although ironically there have been instances where trailers at the back of a combination have rolled and the system has not registered a g-force event). As indicated in Figure 2 below, the motor vehicle incident (MVI) rate has trended downwards since in-truck cameras were introduced in 2011. A motor vehicle incident is defined as 'an incident involving a registered vehicle carrying out work for Toll, resulting in damage to the vehicle and/or third party vehicle/property'. The radical reduction between December 2010 and December 2011 should be interpreted with caution as this period coincided with changes to how data was inputted into the system. However, the data shows a near halving of MVI frequency rates between December 2011 and April 2015 when the methodology remained consistent.

The video footage has proven invaluable as a learning and remediation tool. In instances where the Toll NQX driver's behaviour has led or contributed to an incident, the objective nature of the footage has helped defuse what might otherwise have been a difficult and contested intervention. Driver managers report that the footage sometimes shocks drivers, who have a different or partial recollection of what occurred. Toll NQX's company doctors speculate that this partial recollection occurs because the drivers experience a high cognitive load during an incident. Their focus is on managing the incident, which seems to impact recollection. The camera footage enables the incident to be dissected and analysed with minimal emotiveness. This makes it a powerful learning tool. As

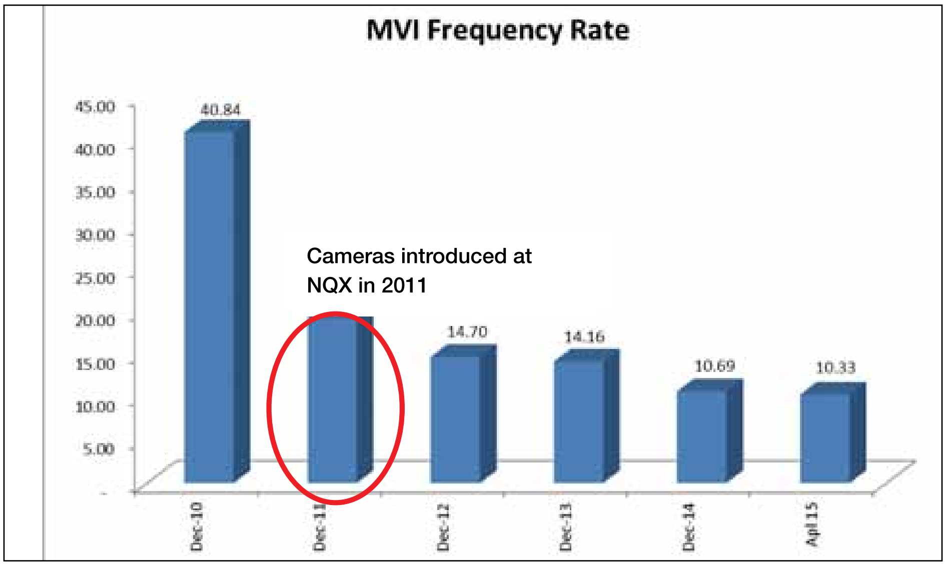

Figure 2. Motor vehicle incident (MVI) frequency rates at Toll NQX December 2010 to April 2015

a result 'managers are building meaningful relationships with drivers that centre on honest discussions about their behaviour, their health, their lifestyle and the risk environment' (King, 2014). No driver has been dismissed purely as a result of camera footage. Instead, camera footage tends to support observations of driver behaviour garnered though other channels.

Among the driver habits and behaviours that camera footage has highlighted is the use of seatbelts. The seatbelts in Toll NQX vehicles are high-visibility, so it is apparent in the camera footage if seatbelts are not being worn. Consistent with the findings of Mooren, the Federal Motor Carrier Safety Administration and others, Toll NQX grapples with a cohort of drivers that do not consistently wear their seatbelts (Mooren, 2012, FMCSA, 2015). The camera footage is helping to counter this. There have also been instances of heavy vehicle drivers following other vehicles too closely or cornering too fast. Both behaviours have seen noticeable improvements since DriveCam was introduced.

In instances where an incident has been largely or entirely triggered by circumstances outside of the driver's control, the footage is helping to establish liability and drive down investigation time and cost and insurance premiums. Toll NQX estimates the cost saving produced by in-truck camera footage to be around $15,000 per investigation (Toll, 2013). A review of motor vehicle insurance claims data for Toll NQX between July 2010 and June 2013 indicates that the average monthly number of claims reduced by a factor of around 2.5 following the introduction of cameras. This equates to an average monthly reduction in insurance claims costs of around $25,000 (Toll, 2013).

Not only has the footage driven costs down, it has also helped to shore up driver pride. The footage reveals instances of dangerous driving by other road users which has exonerated Toll NQX drivers internally and, in some instances, with external enforcement agencies. The competence and professionalism of drivers was noted by the FairWork Commission which, having viewed some of the footage, stated that the cameras 'provided some significant examples of the skill and quick thinking of drivers, enabling them to avoid what would otherwise have been the disastrous consequences of the seemingly unlawful and negligent actions of other road users' (FairWork Commission, 2014, p. 4). A future application of some for the footage may be to advise and inform regulatory bodies on 'share the road' campaigns.

One of the most surprising findings from the data is the extent to which driver distraction contributes to G-force events. The camera footage has revealed how apparently small actions can divert drivers' attention. These actions include inserting CDs, changing radio stations, using mobile phones and reaching for food and drink. In one instance, a rollover occurred on the Bruce Highway north of Brisbane when a driver reached into the fridge for his lunch. The fridge was located to the driver's left immediately adjacent to the driver's seat. Fortunately, the driver was not hurt in the rollover and there were no impacts for other road users. However, the cost incurred in repairing the vehicle, damaged freight and customer annoyance was considerable. That footage led Toll NQX to reconsider how cabin design and layout may inadvertently encourage driver distraction.

Consequently, Toll NQX has worked with truck and parts manufacturers to redesign cabin features. For example, many vehicles now feature dash-fitted phones that are set to auto answer, the radio can be controlled from the steering wheel and the fridge is now locked when the vehicle is moving so the driver cannot reach around and open it. Toll NQX went on to participate in a study commissioned by Toll Group on how truck cabin design and onboard systems might impact safety (Young and Lenné, 2014). Toll NQX also made the topic of distraction a feature of its toolboxing sessions and communications with drivers.

Lessons learned

Toll NQX's experience demonstrates the role that technology can play as an enabler of behavioural change. The key point here is that technology and data, by themselves, do not change behaviours. If the in-truck cameras had been introduced with less consultation, without privacy management and in a context that was punitive rather than remedial they would not have delivered safety results. The safety benefits emerged because the footage was used to educate and coach drivers and gave drivers some agency in when the system was activated. Further, both drivers and Toll NQX management benefited from a more efficient and objective means of establishing liability in the event of an incident.

In a broader policy and regulatory sense, Toll NQX's experience has challenged the conventional wisdom that speed and fatigue constitute the primary heavy vehicle driving risks. Heavy vehicle driver distraction has not received the same attention as speed and fatigue. For example, the accident causes analysed in one of the most credible and useful heavy vehicle accident data sources – the National Truck Accident Research Centre – include inappropriate speed and fatigue but not driver distraction (though it is conceivable that driver distraction is captured in one of the other reported categories). Where driver distraction is discussed as an on-road risk, such as in the *National Road Safety Strategy 2011-2020,* it is in a general rather than heavy vehicle-specific context.

Perhaps part of the reason for the comparative policy neglect of driver distraction in the heavy vehicle context is that it is not recognised within the chain of responsibility (CoR). CoR recognises that the actions and inactions of parties in the supply chain can affect and influence driver fatigue and speeding and the mass, dimension and load restraint of the vehicle. These five factors (speed, fatigue, mass, dimension and load restraint) are all represented in the heavy vehicle national law and all have extended liability offences attached to them. It is less clear how a party in the chain might influence driver distraction. The ways in which supply chain parties could prompt driver distraction – for example by phoning drivers to check on their whereabouts and estimated arrival time – are fairly easily managed by not disclosing driver contact details.

Further, it may be that distraction is assumed to be a *symptom* of driver fatigue, rather than a distinct behavioural category in its own right. But it may also be possible that distraction, as a form of stimulation, could counter fatigue. For example, anecdotal evidence suggests that interacting with other drivers on the CB radio is sometimes used by drivers to revive themselves. Toll NQX welcomes further policy investigation of the role of driver distraction in the heavy vehicle policy context.

Into the future, in-truck cameras could be adapted to play a role in mass, distance, location charging; if indeed that is the charging option pursued by government. Cameras could conceivably be configured to record not just the driver in-cab and the stretch of road immediately in front of the windscreen, but the road beneath the vehicle. Coupled with vehicle suspension data this footage could be relayed to the appropriate road funding agency to prompt road resurfacing or other mitigation. In the absence of an infrastructure response, road condition could be used as a factor in variable registration costs (harsher conditions cause greater wear and tear on vehicles and therefore impact productivity due to extra servicing requirements). Toll NQX will continue to explore the possibilities of in-truck cameras and share its experiences with policy makers.

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Driver State Sensing (DSS) machines at Toll Resources and Government Logistics

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Introduction

Toll Resources and Government Logistics (TRGL) is a business unit within Toll Group that specialises in logistics services to the oil and gas, mining, and government and defence sectors in Australia, Asia and Africa. It is a diverse and often high-risk enterprise that transports dangerous goods on public roads and on private roads owned and/or managed by mine sites. Goods carted include fuel, security sensitive ammonium nitrate, coal, iron ore, class 1 explosives, zinc and lead. Unsurprisingly, given the nature of the goods carted, TRGL operates in a highly regulated environment. A plethora of laws and regulations can apply to a single transport task, including the heavy vehicle national law, dangerous goods legislation, workplace health and safety laws and mining-specific legislation such as the Mining and Quarrying Safety and Health Act and the Coal Mining Safety and Health Act.

The incident at Mona Vale in New South Wales in 2013 illustrates the salutary importance of risk management in dangerous goods cartage. That incident left two people dead and five injured, caused a 60% reduction in the share price on the Australian Stock Exchange for the company concerned (McAleese Transport), cost 540 people their jobs and led to more than 300 vehicles in the fleet being