DEVELOPING A FUEL SAVINGS PROGRAMME – FINDINGS OF A NZ INITIATIVE

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Abstract

This paper reports initial findings of a trial undertaken for the purpose of reducing vehicle fuel demand.

The approach taken was to monitor vehicle fuel consumption (km/l) and, depending on the trialist, varying functions of time and location data including either one or all of the following attributes: vehicle speed relative to regulatory limits; acceleration and deceleration exceeding thresholds. The trial took a small sample of vehicle operators on a customer journey with the aim of establishing the themes and requirements, necessary to improve the use of the vehicle in regard fuel demand and safe operation.

The key finding was that the value of fuel consumption data, in terms of promoting desired driver behavioural change, was relatively limited. It is likely that a more effective approach to achieve the desired outcomes, of reduced fuel demand and safe driving, is to focus reporting around the driver behaviour attributes that underpin those outcomes.

Keywords: Reducing Fuel Demand, Fuel Consumption, Driver Behaviour, GPS, Telematics, Harsh Acceleration and Braking Events, Vehicle Time and Location, Digitally Based Fuel Saving Programme.

1. Introduction

Consistent with growing global trends, New Zealand has an increasing focus on reducing the environmental impact of road transport operations, particularly in regard to diesel fuel consumption. Transport uses nearly half of New Zealand's energy and it is the biggest consumer of oil. Collectively heavy vehicle (greater than 3.5 tonnes) fleets spend NZ$1.3 b per annum on fuel[1] and this typically represents 12 to 20 per cent of operating costs[2]. New Zealand diesel fuel spend as a proportion of operating cost may appear low compared to other international jurisdictions, this is because unlike many jurisdictions where the cost of fuel incorporates government tax in the pump price, in New Zealand tax is not collected when diesel is purchased. Instead a tax based on vehicle mass and distance is paid separately.

Studies have shown that most road transport fleets have the potential to save at least 10% of their fuel bill which can equate to an increase in the bottom line profit of a fleet operator by 10–30%[3].

Over the last several years there has been significant investment in and uptake of GPS technology monitoring vehicle location and time. For the purpose of this paper, that GPS technology will be referred to as "telematics". Due to commercial sensitivities it is difficult to obtain an accurate measurement of this uptake but it has been reported that approximately 24% of New Zealand's 130,000 heavy vehicle fleet (exceeding 3.5 tonnes) has telematics systems fitted and in terms of heavy vehicle kilometres travelled, a much higher proportion is monitored by telematics.

Historically New Zealand demand for vehicle telematics has primarily been underpinned by the benefits that real time vehicle location data bring to fleet dispatch and route management. However, over the last few years there has been growth in the use of telematics, firstly because of the administrative benefits it brings to heavy vehicle tax collection; and secondly as a tool to improve driver behaviour.

One of Z Energy's (Z) sustainability goals is to help its customers reduce fuel consumption so it was deemed necessary to accurately measure fuel consumption accurately. Z undertook a trial to establish what its customers required to determine whether to pursue driver behavioural change as a means to reduce fuel use. It was assumed that driver behaviour attributes, such as: speeding, idling, and harsh accelerations (laterally and longitudinally) are significant contributors to safe and fuel efficient driving. The trial approach was to analyse fuel purchase and telematics data which would then allow fuel consumption to be derived and monitored over time thereby enabling the measurement of the effectiveness of different efforts to reduce fuel consumption.

2. Trial

Prior to the Z trial some vehicles were fitted with telematics systems and some had a degree of connectivity with engine management systems either via the OBD port or the engine ignition system which enabled monitoring of vehicle idling. For those vehicles that did not already have telematics, a variety of telematics systems were fitted, some with direct feedback to the driver and some without. There were 5 different telematics systems/providers used across the 37 vehicles. Across the different telematics systems it was identified there was variance in the reporting thresholds for longitudinal accelerations. However, for the purpose of this trial no effort was made to rationalise or normalise those thresholds. Therefore it is acknowledged that when exception reporting was aggregated across multiple fleets, “harsh” braking or acceleration events were recorded as having occurred regardless that those events may not have been recorded if one of the other telematic systems with higher thresholds had been used.

The scope of the trial was limited to identifying the data and information desired by customers to leave them best informed to make a determination on pursuing driver behavioural change as a means of reducing fuel use, therefore the findings reported below are based on customer feedback. With the exception of obvious outliers, no effort was made to verify the accuracy of the information provided by the telematics nor was any effort made to validate the trends and relationships reported. Z took the position that it was entirely at the discretion of the trialist whether it mattered enough to that party or individual to change behaviour. It was not Z’s role to judge whether any change should or should not be sought by any trialist.

It is not implied by this paper that driver behaviour is more or less important in improving fuel intensity compared to any other methods or approaches, such as increasing freight productivity by improving vehicle selection; vehicle loading; scheduling or route optimisation.

3. Findings

Trialist feedback was collected from drivers and fleet managers. Z’s findings and the feedback is presented below across 4 main areas.

3.1 Fuel Data Management

Trial customers purchase fuel product (either petrol or diesel) on a Z Fuel Card, which is similar to a credit card except purchase of products is typically limited to petroleum products. Assuming a vehicle’s fuel tank is consistently refilled to the same level then the distance travelled between fuel purchases and the respective fuel volume purchased enables fuel consumption to be derived. When refuelling typically the driver records a cumulated vehicle distance reading, from the vehicle odometer or hubodometer, although with some trialists, instead of relying on the driver to record distance travelled between refuels, the telematics system provided the distance travelled. The distance data was combined with the respective fuel card data resulting in fuel consumption being reported.

Inconsistent refuelling practice, for example not refuelling to the same ‘full” level each time poses a risk to data accuracy. For customers consuming large amounts of fuel, such as those using hundreds of litres of fuel per 12 hour shift, collecting a relatively large number of consecutive refuel volumes and journey distance information and reporting an aggregated consumption value for multiple journeys can reduce this inaccuracy. However, for vehicles with multiple operators such as those operating 24 hours a day, where there was a desire to establish and compare fuel consumption between drivers and shifts, then inconsistencies in refuelling practice could significantly skew the data and create issues of data credibility. This is because if one driver does not completely refuel the vehicle, whether intentionally or not, the respective consumption rate will appear better than actual and the amount not refuelled will become allocated to the following driver's task, resulting in that measure looking correspondingly poorer.

The effectiveness of using fuel consumption data to accurately monitoring the impact of a fuel savings programme using is challenging and questionable, particularly if there is inconsistent refuelling practice. Integrity of the data is even more problematic for customers refuelling with relatively low frequency.

It was difficult to determine vehicle specific fuel data if the fuel card was used to refuel more than one vehicle.

Whilst many of the above issues appear relatively simple to resolve by implementing well-disciplined and rigorous administrative processes, due to a range of operational issues there are on-going challenges that pose risk to the reliability of fuel consumption based on fuel card data.

3.2 Context

If fuel consumption (km/l or l/100km) is used as an indicator of performance, then customers wanted the operational activity to be taken into consideration. The context of the vehicles' activity was important, particularly if comparisons were to be made between vehicles and drivers.

Context associated with Vehicle Activity

The value of measuring fuel consumption over time without any allowance or consideration of the activity type was particularly significant for trialists operating heavy vehicles with a diverse and unpredictable activity involving powered units towing a variety of trailers, (semi or full [dog] trailers) with little or no regularity. Such practice is common for many heavy vehicle operators in New Zealand.

Other vehicle related challenges impacting the integrity of monitoring specific vehicle fuel consumption included: the accurate accounting of the fuel used by auxiliary units, such as engines powering the hydraulics system for container lifters or refrigeration units; and allowance for vehicles that required the engine to operate while parked driving power take-offs.

Context associated with Operating Environment

When comparing drivers within their respective fleet, some fleet managers took a view that the operating environment must be factored into the reporting of driver behaviour metrics. For example, some fleet managers expected and accepted a high number of harsh braking events when the vehicle was spending a large proportion of its operating time on highly congested motorways.

Fleet managers felt that the regulatory speed environment (50km/h vs 70 km/h vs 100km/h etc) should be taken in account with any speed compliance reports. For example, some fleet managers were more concerned about drivers exceeding the speed limit by 10 to 15 km/h in an urban setting vis a vis the open road.

Adding Context to Indicators

As a result of this feedback Z sought to normalise indicators in ways that included: number of overspeed or harsh braking or acceleration events per kilometre (refer Figure 1). Z also considered proportioning speed events dependent on road type (urban or rural).

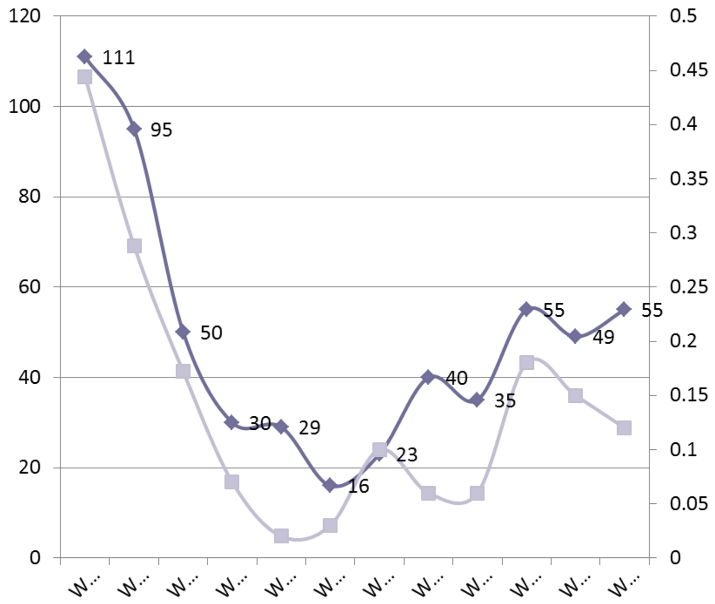


Figure 1 – Number of Speed Events per week (Left axis) and Speed events per km per week (Right axis) over a 12 week period

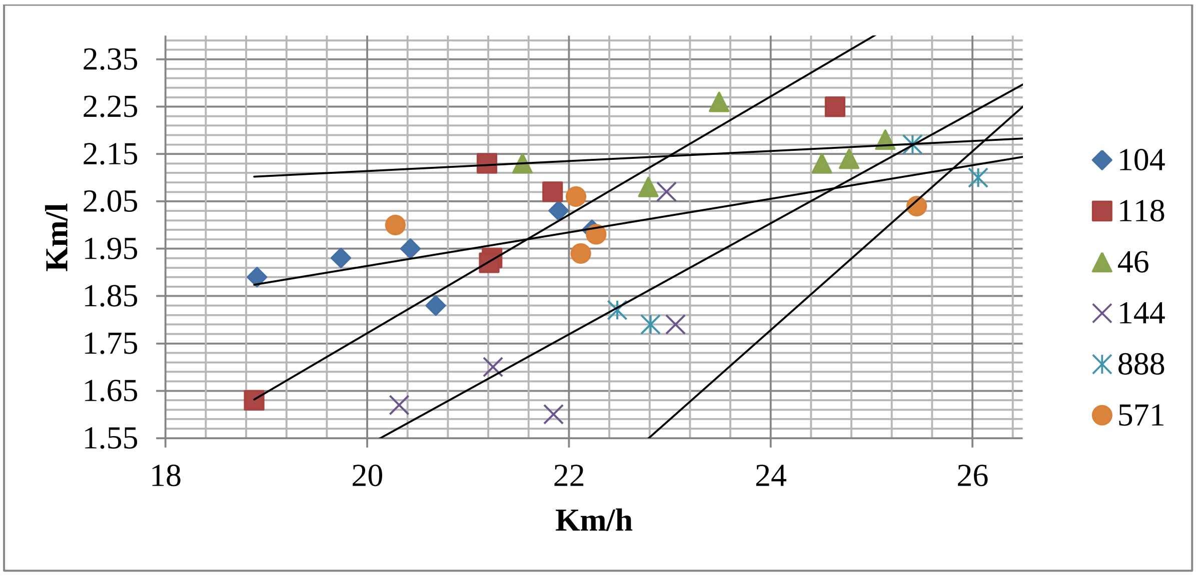


Figure 2. Fuel Consumption as a function of Vehicle Average Speed for 6 Vehicles

Figure 2 illustrates how Z used vehicle average speed to demonstrate the effect of operational differences on fuel consumption.

Fuel intensity
Ideally, there needs to be context added to fuel use data and an accurate understanding of fuel intensity is of much greater value than merely knowing fuel volume for a given distance travelled. One way to enhance fuel consumption reporting would be to report fuel intensity as a function of the productive work completed, for example the amount of fuel used to transport a product of nominated weight and distance, with due consideration given to significant variations in operating environment. In the absence of sufficient data to have a good understanding of fuel intensity, some trialists compared fuel purchased against the respective vehicle revenue generated.

3.3 Benefits and impacts

The trialists were initially sought for the purpose of developing a programme focussed on fuel savings however, during discussions it became apparent that the areas of benefit underpinning their interest in the use of telematics to monitor driver behaviour fell in 3 broad categories, namely: financial; personal safety; and reputation. Across the trial group there was variation in the degree and number of interest areas.

Financial
The potential financial benefits associated with vehicles being operated at the desired level appeared in three areas of operating cost, namely: fuel, insurance, and repairs and maintenance. The latter two being of greater relevance to operators of heavy rather than light vehicles.

When presented with reports on the number of harsh braking or speeding events, there was interest at both driver and fleet manager levels regarding the magnitude of the potential monetary benefit associated with reducing the number of these events. The premise being that knowledge of the potential benefit was important to justify and determine whether to pursue any behavioural change. For example, one owner driver expressed the view that if the savings was in the order of $20 per week, that would be insufficient to justify changing behaviour. Table 1 illustrates one method used to demonstrate the potential financial impact of the drivers' behaviour by comparison with readily available fuel consumption rates[4].

Table 1 – Impact: Fuel - Financial and Carbon Footprint vs Benchmark

Trialist	Best consumption during trial	Worst consumption during trial	Carjam Benchmark
l/100km	4.69	5.15	5.7
Ltr fuel for 45,000km	2,111	2,312	2,565
($) Annual Spend	$4,433	$4,855	$5,386
Potential Savings ($)	$947 (better than Carjam benchmark)	$531 (better than Carjam benchmark)	

Personal safety
Z discussed future possibilities with trialists based on the assumption that any future vehicle monitoring system would incorporate telematics. Therefore, it then followed that subject to managing issues around access and personal privacy rights, this would enable real time knowledge of vehicle location. For one trialist, their greatest interest was in identifying vehicle location and movement. This desire followed an incident where an employee took ill while undertaking a long distance journey and consequently the operator did not arrive at the destination when expected. This trialist therefore saw significant value in being able to identify the vehicles' locations at any time as a means of managing the safety of its drivers and this was by far the area of benefit they valued the most.

Reputation
For some trialists operating vehicles that displayed company branding, their interest in monitoring driver behaviour was predominately based on enabling them to manage the risks associated with undesirable driver behaviour that could result in complaints being made by members of the public thereby damaging their brand.

Impact Summary
During the trial, fuel was the only cost Z made any attempt to provide a link between driver behaviour and potential financial impact and this tended to be viewed at the extremities rather than developing any accurate correlation across the range of behaviours. It is inherent therefore that further consideration be given to the significance of the severity of events. For example, there is interest in establishing the difference in the cost of fuel for a driver travelling at 10km/h over the speed limit for a known proportion of their distance travelled vis a vis travelling at 20km/h.

In addition to better understanding the impact of driver behaviour on fuel costs, similarly establishing the impacts on safety, and on the cost of repair and maintenance, would also leave customers much better informed on whether they elect to pursue any behavioural change. Providing indicative impacts associated with various levels of driver behaviour on fuel, safety and repair and maintenance costs is the subject of future Z research.

It also appears that the severity and type of behaviour attribute, may impact differently across each of the above areas. For example, generating a relatively large lateral acceleration during cornering may adversely impact safety however it may have little, or even be beneficial to fuel consumption.

3.4 Reporting

During the trial a range of reporting methods were used and customer feedback was sought. The main methods are discussed below. For some trialists, appointments were made for discussions fortnightly with the frequency of calls reduced to see if there was any change in the driver behaviour trends. In discussions at the end of the trial, all trialists reported that the method of pushing them the information to them at a predetermined time and having a scheduled appointment to discuss the results was much more effective than relying on the trailist to access the information at their discretion.

The preferred reporting style depended on the responsibilities of the individual, with a clear distinction being that a fleet manager would desire a different view to an individual driver. There was wide variation among trialists in their preference for the display of information with regard frequency and granularity of the data. There was also wide variation across fleet managers in terms of their level of interest in their view being limited to their fleet or to a more "global" picture of all trialists. This variation also extended to the areas being reporting, for example, some fleet managers preferred their drivers to be limited to tracking fuel consumption, yet others preferred that their drivers be shown impacts and driver performance relative to as many trialists as possible.

The most common desire by the trialists was that information provided to them be relatively brief and presented as action orientated information. There was a view that many of the commercially available telematics solutions provided significant amounts of data which required considerable effort from the fleet manager to assess and analyse before allowing determination on what priorities and action was needed.

Another common request was that drivers be informed when a driver behaviour attribute exceeded a nominated threshold, and this notification occur at a time as close to real time as possible. For example, several drivers were reported as undertaking harsh acceleration or harsh braking events however, in the absence of any real time signal indicating the occurrence of such an event, drivers had no understanding of where the threshold lay. The signalling of events in real time would better inform drivers and could assist them modifying their behaviour more effectively as opposed to them being given a historic summary which could be a week, fortnight or month after the events occurred.

Leaderboards

One of the telematics systems used in the trial allocated drivers a percentage rating proportional to the amount of distance travelled incident free and it allocated points related to the distance travelled, Table 2 refers.

Table 2. Example of Leaderboard

Rank	Name	Rating (%)	Points Earned
1	Z8	99.01	3,283.07
2	Z2	98.84	5,758.78
3	Z7	97.80	4,515.59
4	Z1	96.16	3,065.53
5	Z4	95.91	9,430.03
6	Z5	94.58	1,888.48
7	Z9	890.0	722.14
8	Z10	85.55	3,537.33
9	Z3	80.42	319.97

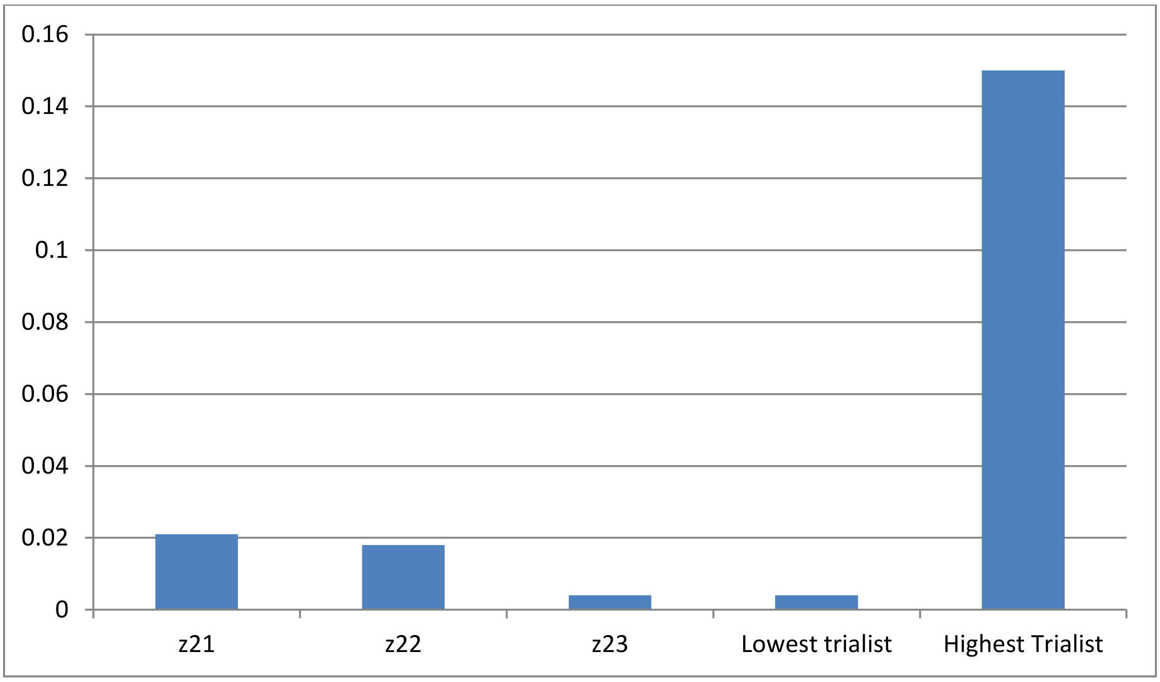
This style of "Leaderboard" allowed comparison of vehicles or drivers at a "global" level, in other words drivers across a range of fleets and activities could be measured and compared. For some trialists, this was useful however, in most cases the information provided in a Leaderboard was not deemed to be sufficient to warrant behavioural change. Some trialists took the view that it was unfair to compare drivers unless their task and operating environment was similar, and others believed they needed to understand the impact of their behaviour before they could determine whether any behavioural change was justified (section 3.3 above refers)

Other examples of progress reports

Table 3 - Example of Driver Progress Report

Fleet #		Fuel Consumption (km/l)	Idling Time as % of Run Time	Average Speed (km/h)
553	Week 2 (compared to week 1)	☺ 2.38	☹ 14	☹ 39
	Benchmark	1.99	9	45

Figure 3 – Harsh deceleration events per kilometre for Z Trial Fleet (3 vehicles) relative to wider trial group



4.0 Conclusions

This paper shares the findings from a small trial involving and 37 vehicles and 11 customers heavy of Z Energy Limited over a period of approximately 15 weeks, with most vehicles each covering several thousand kilometres of travel. The purpose of the trial was to identify the data, themes and information desired by customers to leave them best informed to determine pursuing driver behavioural change as a means of reducing fuel use. Based on the trial Z found there are many challenges to interpreting fuel consumption (km/l or l/100km) whether that be monitoring change of an individual vehicle or comparing vehicles at fleet level. The largest challenge is adding context to understand what the fuel is delivering in terms of productive work and taking into consideration the operating environment.

The intended outcome, reduced fuel demand, may be achieved by shifting the focus away from fuel consumption reporting and more towards monitoring, analysis and reporting on the driver behaviour attributes that underpin that outcome, namely the speed, longitudinal and lateral acceleration characteristics during the drivers' journeys.

Driver behaviour is more likely to change if analysis and reporting gives consideration to: the type of or differences in operating environment; the severity and impact of journey events; vehicle operators are given timely notification of events and coaching on the driving techniques that will lead to safe and more fuel efficient driving; and drivers and fleet managers are presented user friendly action orientated information that demonstrates progress. Programmes should focus on rewards and positive events rather than negative events.

It is more important that data presented to fuel saving programme users is credible rather than being complete in terms of covering every part of the vehicles' travel, in other words efforts should be made during analysis to ensure the data has integrity and the recording of events that are incorrect or doubtful should be removed. Given there will be variability in interest levels among users of an effective fuel savings programme, reporting systems should incorporate sufficient configurability to allow users to select the appropriate degree of levels of granularity desired. The user interface design can have a significant impact on the effectiveness of any digitally based fuel saving programme.

Z is undertaking further research on what makes an effective fuel savings programme.

5.0 References

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