FreightSync Proof of Concept

Investigating value creation from the exchange of freight vehicle data with transport agencies

Final Industry Report
Project 3.83

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Victoria State Government Department of Transport and Planning · tca Transport Certification Australia

Preface

The Sustainable Built Environment National Research Centre, Australia, the successor to the Cooperative Research Centre for Construction Innovation, remains committed to making a leading contribution to innovation across the Australian built environment industry after more than two decades of operation. We are dedicated to working collaboratively with industry and government to develop and apply practical research outcomes that improve industry practice and enhance our nation's competitiveness.

We encourage you to continue to draw on the results of our Centre's applied research to deliver tangible outcomes for your operations. By working together, we can transform our industry and communities through enhanced and sustainable business processes, environmental performance and productivity.

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Executive Summary

This project undertook an investigation, through a proof-of-concept approach, of the potential for near real-time data to be securely exchanged between freight operators and transport agencies through a trusted intermediary in a manner that delivers mutual benefit. Based on partner interest, the project focused on two main areas, namely (a) securing the exchange of data and (b) considering possible associated benefits. It involved a discrete trial of data exchange in collaboration with industry partners. The project was undertaken in close collaboration with industry partners to ensure a robust application of research findings from SBEnrc Project 3.73: *Road Freight and Network Efficiency.*[1]

The aim of the project sought to demonstrate how the exchange of data between road freight vehicles and transport agencies can be achieved for mutual benefit using a trusted third party to investigate how such a system would work in practice, and this has been achieved. The ability to link data from road freight vehicles with traffic management and transport planning systems provides numerous benefits to all involved. If the growth in freight in Australia is not properly managed, it may lead to reduced efficiencies, increased costs, safety issues, network congestion, increased noise and air pollution, and higher road construction and maintenance costs.

The freight sector will also likely see a number of disruptions including changes to vehicle types (such as the use of drones, electric vehicles and 'right-sized' vehicles), new software platforms and their interoperability (such as mobility-as-a-service platforms allowing ride services to integrate passenger and freight services), new database options (such as blockchain technologies allowing for streamlined supply chain interactions and authentication) and ageing transport infrastructure. It is important for transport-related agencies to identify ways to harness existing network infrastructure and strategically select new approaches that reduce costs and disruption associated with the projected freight growth.

Given the high value of freight, there has been much attention paid to ways to increase the efficiency of freight movement, with Infrastructure Australia estimating that transport and logistics contributes 14.5 per cent of Gross Domestic Product.[2] Initial efforts largely focused on detecting freight vehicles as they approach traffic lights, much like emergency vehicles, to improve overall vehicle flow.[3] Results suggest, however, that despite some localised improvement it is likely that last-minute detection will actually have a detrimental impact on the effectiveness of system-wide signalling.[4] Hence, unlike the movement of a small number of emergency vehicles across an entire city, this approach may not deliver benefits when applied to freight vehicles across a transport network, calling for a more dynamic approach; one that will involve new forms of data exchange and the use of advanced analytics.

There are a number of different methods to detect, classify and track vehicles, each having strengths and weaknesses, each with different levels of accuracy and associated costs. Technology in this space is advancing quickly, having started with a focus on roadside sensors and communications devices and shifting quickly to GPS and mobile devices. Larger freight operators that carry an estimated 80 per cent of freight and represent, say, 10 to 12 per cent of the 42,000 road freight companies in Australia are likely to be well-equipped; however, the remainder are typically reliant on mobile devices to access traffic information.[5]

A number of government agencies, industry bodies and research institutions are producing public freight-related datasets; however, these often focus on highly aggregated historical data rather than real-time tracking data held by freight and logistics companies. The direct linking of data from freight vehicles with traffic management systems stands to provide a number of benefits. These benefits include reducing congestion, improving safety, reducing freight vehicle trip times, informing alternative routing for freight vehicles and informing transport planning and investment decisions.

[1] Hargroves K (2021) *Introducing the 'FreightSync Roadmap': Linking road freight data and traffic management systems – Final Industry Report,* Project 3.73. Sustainable Built Environment National Research Centre (SBEnrc), Australia.

[2] Infrastructure Australia (2018) 'Australia's growing freight task: Challenges and opportunities', 31 October 2018. Infrastructure Australia, Canberra, ACT.

[3] Kari D, Wu G and Barth M (2014) 'Eco-friendly freight signal priority using connected vehicle technology: A multi-agent systems approach'. IEEE Intelligent Vehicles Symposium; and Ioannou P (2015) *Design and Evaluation of Impact of Traffic Light Priority for Trucks on Traffic Flow.* Metrans Transportation Center, University of Southern California, California.

[4] Zhao Y and Ioannou P (2016) 'A traffic light signal control system with truck priority', IFAC-PapersOnLine, vol. 49, no. 3, 377-382, May 2016.

[5] National Transport Commission (2016) *Who Moves What Where – Freight and passenger transport in Australia.* National Transport Commission, Melbourne, Victoria.

According to a study in 2014 by Ernst & Young, rising congestion levels and urban encroachment are reducing the efficiency of the freight sector.[6] This then raises the question of how the movement of freight can be made more efficient, particularly within metro areas, while being embedded in the wider transport system.

Given the value of freight to the economy, there has been much work done to investigate ways to increase the efficiency of freight movement. However, on the whole, limited technical capacity and interconnectivity between the freight sector and the transport system has meant that such efforts are yet to demonstrate meaningful improvements.

Early approaches have involved freight vehicles being equipped with GPS guidance systems that can provide information to the driver on the level of congestion along potential routes. Private companies are offering tracking and analytics services to monitor vehicle location to ensure the use of approved routes and monitor driver behaviour, such as harsh braking or exceeding speed limits.

Although such passive approaches stand to deliver some benefit, they are ultimately restricted by the fact there is no direct interaction with the transport system.

More recent efforts have focused on investigating the potential for freight vehicles to interact directly with traffic lights to gain priority signalling at intersections, using similar technology to that used by emergency vehicles.[7] Early trials based on simulations have shown there is potential for improvement at the intersection level.[8] However, it is not clear if this translates into reduced overall trip times, as it may be the case that ad hoc responses by individual traffic lights due to last-minute notifications from trucks will have a detrimental impact on the effectiveness of system-wide signalling. Hence, unlike the movement of a small number of emergency vehicles across an entire city, this approach may not deliver benefits when applied to many freight vehicles moving all across a transport network, calling for a more dynamic approach; one that will involve new forms of data exchange and the use of advanced analytics.

A key outcome of SBEnrc Project 3.73 was the development of the FreightSync Roadmap.[9] The Roadmap was designed to provide a pathway that outlines key steps involved in transitioning from the current situation, where freight vehicles are largely invisible to traffic management, to one where the entire transport network is managed with a full view of freight (and other heavy vehicles). Such a transition would enable benefits to be created well beyond ad hoc responses. The Roadmap includes a staged pathway to investigate and respond to stakeholder concerns, opportunities and challenges related to data exchange, and to explore options to provide robust solutions in collaboration with stakeholders.

[6] Ernst & Young (2014) *A Study of the Potential for Dedicated Freight Infrastructure in Australia.* Final report to the Australian Government, Ernst & Young.

[7] Kari D, Wu G and Barth M (2014) 'Eco-friendly freight signal priority using connected vehicle technology : A multi-agent systems approach''. IEEE Intelligent Vehicles Symposium; and Ioannou, P (2015) *Design and Evaluation of Impact of Traffic Light Priority for Trucks on Traffic Flow.* Metrans Transportation Center, University of Southern California, California.

[8] Zhao Y and Ioannou, P (2016) 'A traffic light signal control system with truck priority', IFAC-PapersOnLine, vol. 49, no. 3, 377-382, May 2016.

[9] Hargroves K (2021) *Introducing the 'FreightSync Roadmap': A pathway to linking freight vehicles and transport systems – Final Industry Report*. Sustainable Built Environment National Research Centre (SBEnrc), Australia.

What Does the Term 'FreightSync' Mean?

The term FreightSync refers to the ability to link freight vehicle data with traffic management and transport planning systems in near real time to improve traffic conditions and inform system planning and investment decisions. Given that the exchange of data stands to benefit both the freight sector and the transport agencies, there needs to be strong buy-in from the early stages to ensure that key issues are resolved, such as access and privacy, with the associated initiatives being necessarily well-informed and strategically deployed.

The term FreightSync has been chosen to describe the exchange of specific data between freight operators and transport systems for mutual benefit.

This type of functionality is in its early stages of development and calls for consideration of new intermediaries or supporting systems to ensure trust. An important consideration is how to deal with data security to ensure that firstly the data being exchanged is secure, and that it is only used for purposes that have received consent.

What is the Value of a FreightSync Approach?

There is a range of benefits that can be achieved by appropriately exchanging data between the freight sector and transport agencies. These are:[10]

a. *Improved Traffic and Transport Planning Outcomes* – Providing access to information on freight vehicles, including classification, location and destination, can improve traffic flow conditions across the network; for example, via responsive signalling to manage cycle times and offsets and other adaptive traffic management methods, such as predictive analysis. Such data will allow traffic management systems to understand both current and near-future behaviour of freight vehicles, allowing for tailored traffic responses and even direct communication with freight vehicles on preferred routes and timings. Along with short-term traffic management benefits, data exchange can improve transport planning decisions and associated investment in the longer term.

b. *Direct Benefits to Operators* – Apart from benefits to traffic management, there is a range of other benefits for operators, such as: automated clearance for road access for various vehicle classification types; improved vehicle flow at loading points; informing freight forwarders of the anticipated level of driver promptness; consistency across state borders; and linking freight tracking with container parks, rail services and port stevedores to improve synchronisation.

c. *Positioning for Future Benefits* – Such a system of data exchange would position the sector to take advantage of a range of future digital productivity options. For instance, as explored in SBEnrc Project 1.64,[11] using emerging digital distributed ledgers can deliver new value to the logistics sector.[12] Such values include: providing access to secured proof-of-origin and sourcing evidence; streamlining transactions across the supply chain; and providing a rich pool of information for artificial intelligence to optimise freight routes, staging and storage of freight and inform the potential for sharing facilities and avoiding running empty.

[10] For more information, see Hargroves K (2021) *Introducing the 'FreightSync Roadmap': Linking road freight data and traffic management systems – Final Industry Report.* Sustainable Built Environment National Research Centre (SBEnrc), Australia.

[11] For more information, see Hargroves K, Stantic B and Allen D (2020) *Exploring the Potential for Artificial Intelligence and Blockchain to Enhance Transport – Final Industry Report.* Sustainable Built Environment National Research Centre (SBEnrc), Australia.

[12] Hargroves K, Conley D and Stantic B (2021) 'The potential for blockchain and artificial intelligence to enhance the transport sector', *Journal of Civil Engineering and Architecture 15*, 146-155.

1.0 Introduction (cont'd)

How Does the FreightSync System Function?

To implement the FreightSync system a critical issue to overcome is ensuring that data exchanged between freight operators and transport agencies is secure and can only be used for the expressed purpose. This is achieved by incorporating a trusted third party, referred to as the 'Freight Observatory'.[13] As part of this project, Transport Certification Australia (TCA) played the role of the Observatory and received data from project partners under consent agreements that restricted use to the prescribed purpose, unless as part of a legal requirement, as shown in Figure 1.

Many of the benefits available are also relevant to other large and heavy vehicles such as buses, shuttles, garbage trucks, cement trucks and the like. This is of particular interest given that many cities around the world impacted by growing congestion issues are now seeking to shift away from private vehicle-dominant transport infrastructure to shared rapid-transit corridors serviced by buses and shuttles.[14]

Figure 1: FreightSync Data Exchange Flow Chart

How Can Adoption of the FreightSync Approach be Staged?

The implementation of the FreightSync approach is proposed to be implemented in four stages:

Stage 1. Understand the Landscape: This will include a series of general tasks such as reviewing examples, reports, strategies and the like, along with a set of specific tasks.

Stage 2. Plan the Approach: This will include configuring and provisioning key structures and frameworks in close collaboration with stakeholders.

Stage 3. Deliver Early Benefits: This involves identifying opportunities to deliver early benefits to demonstrate the value of the overall process, specifically early benefits.

Stage 4. Rollout Data Exchange: This involves creating an automated system that collects, curates and analyses data for the mutual benefit of freight operators and transport agencies.

The FreightSync Roadmap is the combination of a set of tasks and objectives for each of the three designated tracks over each of the four stages to reach a set of preferred destinations, as shown in Table 1.

[13] Department of Infrastructure, Regional Development and Cities (DIRDC) (2018) *Inquiry into National Freight and Supply Chain Priorities - Report*. Department of Infrastructure, Regional Development and Cities, Canberra, ACT.

[14] Newman P, Hargroves K, Davies-Slate S, Conley D, Verschuer M, Mouritz M and Yangka D (2019) 'The Trackless Tram: Is it the transit and city shaping catalyst we have been waiting for?' *Journal of Transportation Technologies*, 9, 31-55.

Table 1: The FreightSync Roadmap

	Stage 1: Understand the Landscape	Stage 2: Plan the Approach	Stage 3: Deliver Early Benefits	Stage 4: Rollout Data Exchange	Destination
Track A: Freight Operators – Data Collection					
Tasks	Understand current situation, expectations and benefits	Map out approach to data collection and storage	Create initial cohort of participants with compatible systems	Automate active industry-wide participation	Freight operators autonomously synchronised with transport system to reduce trip times
Outcomes	Identify specific risks and rewards from data exchange	Configure and provide data collection	Improved conditions on specific routes, at specific times	Feedback from transport system	
Track B: Freight Observatory – Data Curation					
Tasks	Understand constraints and expectations	Map out approach to data exchange and privacy	Create value from exchange to support wider data exchange	Automate and expand seamless data exchange processes	Manage seamless data exchange between freight operators and the transport agencies
Outcomes	Identify preferred performance criteria and structures	Configure and provide data exchange platform	Expanded data exchange to include additional participants	Improved access to other heavy and shared vehicles	
Track C: Transport Agency – Data Analytics					
Tasks	Understand opportunities and implications	Map out approach to using live data in data analytics	Create mutual value from initial cohort of data	Automate real-time data analytics and reporting	Real-time synchronisation of freight vehicles with transport agencies for mutual benefit
Outcomes	Identify current processes that can be enhanced	Configure and provide real-time data analytics	Improved outcomes to support rollout of data exchange	Improved modelling, evaluation and traffic management	

Overview

The purpose of the project, namely the 'concept' sought to be proven, was that freight logistics data which is currently inaccessible to transport agencies can be shared for mutual benefit by the private logistics sector with transport agencies by way of a trusted third party, namely the TCA, under approved consent agreements. As such, the emphasis at the proof-of-concept stage was on demonstrating that the mechanism for data exchange is robust and can be trusted.

Given this emphasis, the initial data that was considered was at an exploratory level, meaning that there is enough data for the associated transport agencies to explore potential benefits to traffic management and planning, without asking for too much, too soon from freight operators. Hence, the intention was to show that new data can in fact be shared, that the initial data was of some value, and that further data-sharing has the potential to create multiple mutual benefits.

A key learning is that to be effective at the network level, such data collection needs to go beyond the spot detection of freight vehicles, often just moments before they arrive at an intersection, to include not only current location and potentially classification, but also the intended route and destination of the vehicle. There are three main barriers to the collection of such data, namely:

1. *Under-appreciation of benefits*: Given it is early in the process to link vehicle-generated data to traffic management and planning, there is currently a low level of appreciation of the tangible benefits to both freight operators and transport network managers.
2. *Overcoming a reluctance to share data*: A key barrier is the willingness to share private data with government agencies due to concerns about how it may affect competitive advantage or that it might be used for punitive purposes.
3. *Current capacity of traffic agencies*: Current traffic management systems are not yet equipped to process near real-time data to provide network-wide benefits. Efforts are underway, but access to data to test such systems remains a hindrance to progress.

The proof of concept involved requesting exchange of telematics data for a discrete period of time from two types of freight vehicles, namely:

1. *Large freight vehicles, Perth, Western Australia (WA)*: In partnership with Main Roads WA, BGC Australia and TCA, the project focused on data related to large freight vehicles undertaking urban container movement.
2. *Small freight vehicles, Melbourne, Victoria*: In partnership with Victoria's Department of Transport and Planning and TCA, the project focused on data related to small freight vehicles undertaking inner urban deliveries.

Method

The initial stage of the project involved the development of a consent agreement to allow private freight operators and telematics companies to securely share data with transport agencies via TCA as the Freight Observatory.

The next stage involved a participant recruitment process, undertaken for both heavy freight vehicles in Perth, WA, and small freight vehicles in Melbourne, Victoria. Efforts to recruit participants were focused on a direct approach to potential organisations with the following results.

Findings

Heavy freight vehicle data

Heavy freight vehicle data was secured under a consent agreement with SBEnrc core partner BGC Australia and provided to TCA for inclusion in the Telematics Analytics Platform (TAP). As part of the TAP, the data was pooled with data from a range of other sources to provide analytics around the travel patterns of heavy vehicles in Perth. The TAP is part of the National Telematics Framework and provides access to vehicle-generated data to road managers, regulators and other stakeholders, as can be seen in Figures 2, 3 and 4.

The secure portal provides access to view de-identified and aggregated road usage information including the creation of analytical reports, which include the journey counts of participating vehicles, unique vehicle counts by road and the average speed for each road.

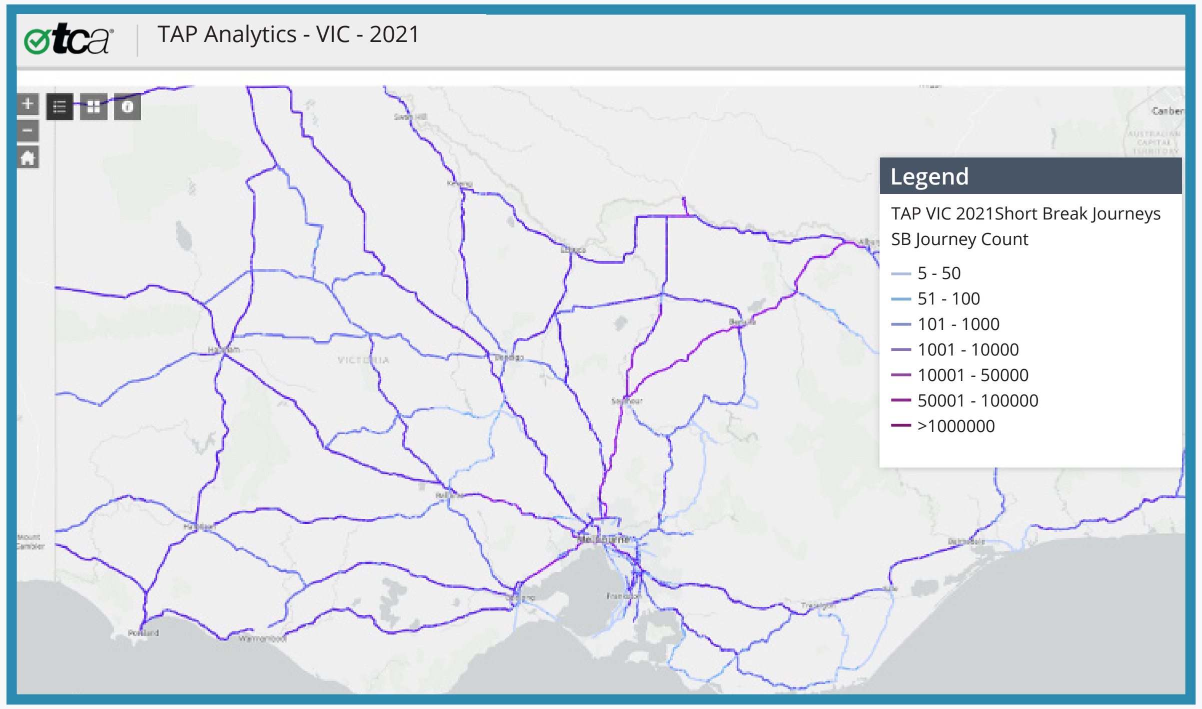

Figure 2: Sample Interface of the Telematics Analytics Platform
(Source: Transport Certification Australia)

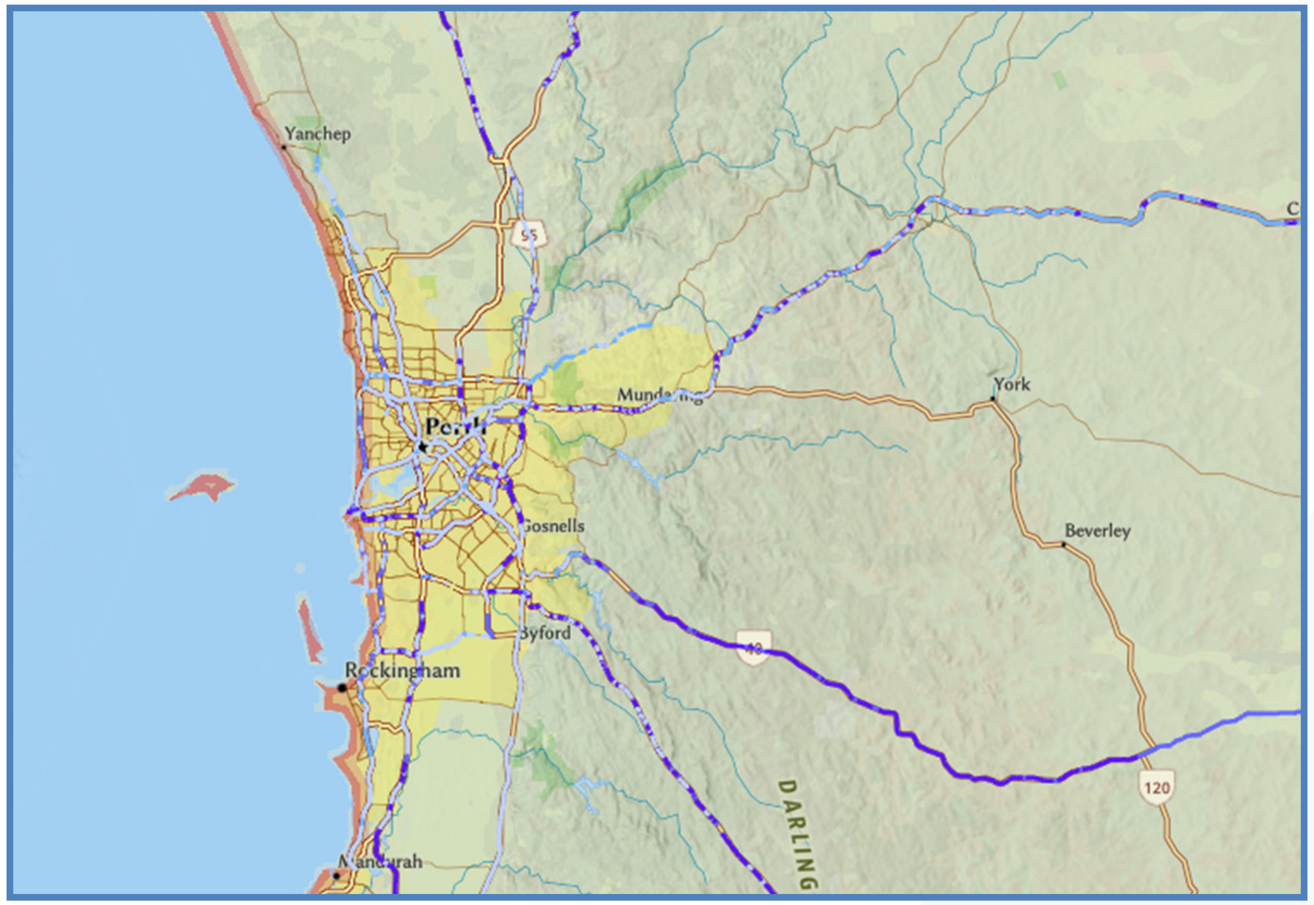

Figure 3: Sample Interface of the Telematics Analytics Platform
(Source: Transport Certification Australia)

Small freight vehicle data

The project team was unable to secure data exchange with small freight vehicle operators, despite lengthy promising conversations and engagement.

As will be discussed further, it appears that the trustworthy nature of the Freight Observatory allowed organisations to join the conversation; however, a lack of clarity around observable benefits rendered such organisations reluctant to exchange data on a voluntary basis.

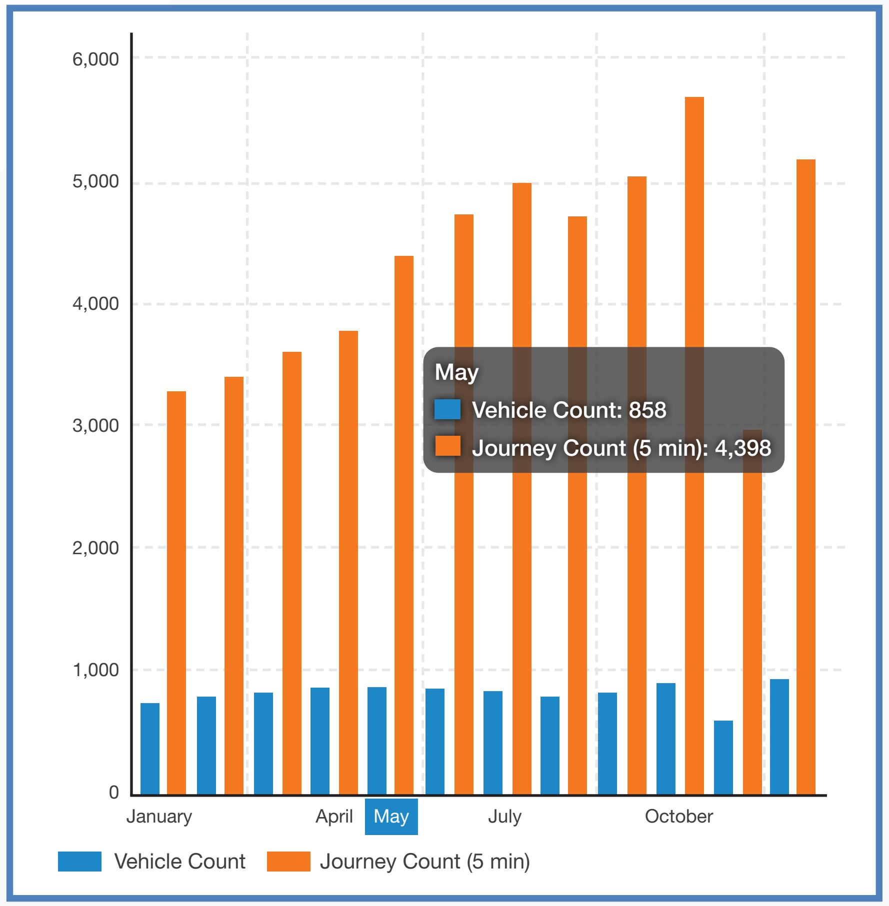

Figure 4: Sample Graph of Road Use Analytics and Reporting
(Source: Transport Certification Australia)

Recommendations

1. Involve the identification of at least one or two key areas of direct benefit to transport agencies, such as updating data in specific models and decision-making processes that will lead to preferred benefits to freight operators and other road users.

2. Data providers are shown exactly what type of freight vehicle data is used now for traffic management and transport planning, and its limitations, to reinforce the need for data-sharing from vehicles.

3. Further recruitment efforts for small freight vehicles should focus on associations or professional bodies as they are formed, given the growth of the sector.

4.0 Conclusion

In this project the SBEnrc has worked closely with industry partners to explore ways to encourage private freight operators to share vehicle-related data with transport agencies, with a focus on heavy freight vehicles in WA and light freight vehicles in Victoria. The research approach was based on the FreightSync Roadmap developed in the previous project, SBEnrc Project 3.73, and involved the use of a trusted third party called the Freight Observatory which, for the purpose of the project, was TCA.

The project began by working closely with partners, both freight operators and transport agencies, to develop potential consent agreements that could govern the sharing of such data between the Freight Observatory, TCA and the freight operators, to then be provided in an appropriate form to the transport agencies.

An early conclusion drawn from the project was that there was general agreement among partners that a suitable agreement with a trusted third party would be a key factor in the decision to exchange data.

The next stage of the project involved recruiting participants to share data with the Freight Observatory in both WA and Victoria. As part of this process, TCA was instrumental in identifying potential data providers and orchestrating conversations to explore the idea of data exchange.

The findings suggest that providing a trusted mechanism for freight operators to share data with government agencies could be achieved and was a big step forward. In the case of heavy freight vehicles, data was shared by SBEnrc core partner BGC Australia with the Freight Observatory which was incorporated with other data to inform a digital dashboard that stands to provide a valuable resource to transport agencies.

The decision to share data was not only influenced by the potential to use a trusted third party as a data broker, but also that there was precedent for heavy freight vehicles to share data and it was foreseeable that greater sharing would lead to direct benefits to operators.

As part of the project, TCA has also held additional conversations with SBEnrc members around new collaborations.

In the case of light freight vehicles, the research uncovered a complication once deeper engagement with industry was undertaken. Largely as a result of the COVID-19 stay-at-home requirements, the manner in which small freight is delivered has largely changed from parcels mostly being delivered to workplaces to parcels now mostly being delivered to homes. Furthermore, this shift to a decentralised demand has seen 'Uber'-style delivery services being used that no longer use the traditional 'little white vans' but rather use private cars that are given a cluster of packages to deliver in a particular time frame.

The use of private vehicles for small freight means that light freight vehicles may not be able to be detected and this raises questions around data-sharing that might have implications for the private vehicle owner.

With this context in mind, it was more difficult to identify tangible benefits for light freight vehicles from sharing data and this ultimately stalled the process and did not result in data being shared, despite operators joining the conversation based on the presence of the Freight Observatory. The higher level benefits presented did not seem to resonate, which may be due to the fact that the benefits suggested are likely to be captured in the long term and were often system-wide benefits.

Hence, it is concluded that there is a need for careful consideration of how such benefits are conceived and communicated to the data providers, including benefits to operators, agencies and general transport network users.

The project has provided valuable findings that suggest that as the trusted third party model has been verified for voluntary sharing of data, transport agencies can shift their focus to finding ways to foresee and communicate tangible benefits for freight operators to increase data-sharing. An alternative to this is to consider mandatory sharing of some level of vehicle data to inform traffic management and transport planning for system-wide benefit.

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Find out more:

Project webpages (including link to YouTube video):

FreightSync Proof of Concept – Investigating value creation from the exchange of freight vehicle data with transport agencies
https://sbenrc.com.au/research-programs/3-83/

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