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TRANSPORT 2040

TRUCK PLATOONING: THE AUSTRALIAN CASE

TECHNOLOGY AND TRANSFORMATION

Published by

World Maritime University

DOI: <http://dx.doi.org/10.21677/itf.20190814>

ISBN: 978-91-984865-7-5 (print)

ISBN: 978-91-984865-8-2 (online)

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The research was financially supported by the International Transport Workers' Federation (ITF). The research enjoyed academic freedom and ITF did not interfere with the objectivity in the research or steered the results in any way.

TRANSPORT 2040

TRUCK PLATOONING: THE AUSTRALIAN CASE

TECHNOLOGY AND TRANSFORMATION

ACKNOWLEDGMENTS

This report is part of the study, entitled *Transport 2040: Automation, Technology, Employment – The Future of Work*, a research project undertaken by World Maritime University (WMU) and financially supported by the International Transport Workers' Federation (ITF). The ITF financial support that was provided to carry out the research for this report is gratefully acknowledged.

A team of researchers at WMU, under the coordination of Jens-Uwe Schröder-Hinrichs and Dong-Wook Song (Co-Principal Investigators), worked on this report. The research was carried out by Tom Vöge. The production was done by Tiago Fonseca. The study was carried out under the overall guidance of Cleopatra Doumbia-Henry, President, WMU.

The layout of the report and the graphics were provided by Phoenix Design Aid A/S. The report was edited by Alexandra George (through Prime Production Limited).

This study is the result of almost two years of intensive research under the umbrella of the *Transport 2040: Automation, Technology, Employment – The Future of Work* Report. Our special thanks to all interlocutors consulted for this report for their valuable time, interest and openness in sharing their views and knowledge. We are grateful that they were willing to impart their experience and views. All those consulted were under a strict confidentiality policy whereby the Chatham House Rule and non-disclosure agreements were applied.

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INTRODUCTION

INTRODUCTION

As indicated in the Acknowledgments section of this report, the research work forms part of the earlier study, entitled *Transport 2040: Automation, Technology, Employment – The Future of Work*, undertaken by the World Maritime University (WMU) and commissioned by the International Transport Workers' Federation (ITF). The overall trends and a global overview provided in that volume are detailed in a series of Technology and Transformation studies, which provide the reader with an enhanced perspective that focuses on a local context.

This study details a transport mode, a specific technology option in a specific country. In particular, this study covers truck platooning in road transport, with the focus on Australia. The *Transport 2040: Automation, Technology, Employment – The Future of Work Report* identified a series of key trends in the context of future transport technologies vis-à-vis transport workers' employment situation and the wider ramifications on the market. Some of these trends are mode-specific, technology-specific, or specific to a certain geographic location and thus they do not develop in the same manner in all local contexts.

Vehicle automation in the road sector, with all its potential implementation scenarios, has been high on the political agenda for a number of years now, with its promise of road safety and transport efficiency improvements. In the absence of clarity as to when, in what shape and for which purpose high levels of automation will be implemented, truck

platooning (also often referred to as truck automation) is often quoted by experts as one of two likely first-use cases to be realised, the other one being shared mobility public transport services in urban centres.

Australia is an interesting geographic region to consider truck platooning in more detail, both in terms of offering an enabling environment and in its possible integration into business models or problem solving through using this technology. The expert discourse on road vehicle automation is often very technology focused, starting with the solutions rather than analysing problems and responses first. The huge distances and dispersed communities in Australia have long posed specific transport problems, with unique solutions having been devised and implemented.

Key technologies in this context are, first, the emergence of "road trains", i.e. very long combinations of up to three trailers being pulled by a truck. While their safety is generally guaranteed because of their use in remote areas – admittedly, accidents can happen in remote regions although their occurrence is far less likely than in populated regions – more recent technologies, such as the Intelligent Access Program (IAP), are using tracking technologies to limit usage to pre-defined safe corridors. Truck platooning, where multiple trucks are operated with minimum headways using "virtual tow-bars", could be then seen as the logical next step. In addition, fully autonomous vehicles are already in operation in Australian mines.

SUMMARY OF THE METHODS

A

A. SUMMARY OF THE METHODS

The analysis undertaken for this study is based on the thematic expertise of its main author, an extensive review of the literature in the field and on the interlocutors consulted in Australia for additional background material and information.

The information and data collected follow three main analytical themes: technology-related issues, the specific country-industry factors and the impacts on jobs and employment and any wider labour market implications to be considered (see Figure 1).

FIGURE 1 Methodology followed

AUTOMATION IN ROAD TRANSPORT

The background is a blue-toned aerial view of a multi-lane road. Several cars are visible, each enclosed in a dashed white circle with curved arrows indicating a circular or automated path. Dotted lines connect these circles, suggesting a network or data flow. A large, dark blue diagonal shape cuts across the right side of the image.

B

B. AUTOMATION IN ROAD TRANSPORT

B.1 BACKGROUND

Historical Context

The automation of road vehicles has captured the public imagination and has been a consistent component of a future vision in public culture since the 1950s. Research and development (R&D) work and testing only started in earnest in the 1980s with the emergence of the necessary computing power. While cars were and still are the main vehicles being used, the 1990s saw the first tests with trucks in the European-funded research projects CHAUFFEUR and CHAUFFEUR II¹. While project outcomes were encouraging, it took two more decades until further developments took place.

Further scientific breakthroughs in the areas of sensor technology, communication technologies and further improvements in computing power have enabled further work on road vehicle automation. This together with the “mobility revolution” of Transportation Network Companies (TNCs), dock-less electric bike sharing and dock-less electric scooter sharing has brought a wide variety of proposed vehicle and service concepts utilising automation to the forefront. In terms of automation of freight vehicles ideas range from sidewalk robots² to supermarkets on wheels³ and to truck platooning.

In Europe the so-called “Truck Platooning Challenge”⁴, organised as part of the Netherlands’ European Union (EU) Council Presidency in 2016, was aimed at demonstrating the concept through a multi-country corridor. The technology approach chosen was relatively low-tech, with trucks following a lead vehicle at minimum distances, with only the use of a “virtual tow bar”, but with drivers in control of the vehicle otherwise. Key considerations were multi-brand and cross-border issues. This demonstration culminated in the development of some guiding principles in this space, referred to as the “Declaration of Amsterdam”, which covered both truck platooning and road automation more generally.

At the beginning of 2017, the International Road Union (IRU) commissioned a report on the “Commercial Vehicle of the

Future”⁵. Among many technology trends identified in that document, truck automation and platooning were seen as key future developments in this space. This report also states that “...the implementation of large-scale truck platooning across the EU is a good example of political and legislative facilitation of new, compatible, EU-wide solutions, as well as interoperability between existing systems”.

Further deployment of Intelligent Transport Systems (ITS) is also likely to further contribute to the digitalisation of the road haulage industry. Other aspects covered by this study include fuels and innovative vehicle designs. A study by the International Transport Forum of the OECD looked at data-driven governance of road freight transport⁶, particularly in the context of truck platooning, given the highly data-rich environment, which will be created as an enabler for such systems. However, this is more of a long-term vision.

Components and Features

Automation of road vehicles reflects a clear technological trend globally, developed and tested by a mix of traditional car manufacturers, as well as new players with more of an IT background. Whilst R&D work and testing is ongoing, the implementation scenarios, which will succeed, are not clear for the time being. One of a few concepts (urban shared mobility being another one), which experts perceive as being closer to the market, is truck automation and platooning on grade-separated and not signal-controlled motorways. Key factors for this are the economic benefits behind it and the relatively simple and controlled operating environment involved.

The economic motivation for haulers to use automated vehicles is mainly based on savings in personnel costs in the case of no staff being present in the cab, or of relaxed driver working-hour regulations in the case of staff still present in the cab, but with a drastically reduced workload. In addition, wider issues such as fuel economy, road safety, congestion and labour market effects can

¹ European Commission CORDIS, ‘Promote Chauffeur II’.

² Nanalyze, ‘8 Delivery Robot Startups for Last Mile Delivery’.

³ Fast Company, ‘The Grocery Store Of The Future Is Mobile, Self-Driving, And Run By AI’.

⁴ Dutch Ministry of Infrastructure and the Environment et al., ‘European Truck Platooning Challenge 2016’.

⁵ Transport & Mobility Leuven and International Road Transport Union (IRU), ‘Commercial Vehicle of the Future: A Roadmap towards Fully Sustainable Truck Operations’.

⁶ OECD/ITF, ‘Data-Led Governance of Road Freight Transport: Improving Compliance’.

also be addressed. Figure 2 below shows an overview of the potential fleet owner impacts and the wider societal impacts of truck platooning.

In the context of truck automation and platooning different approaches are currently being developed and trialled, including retrofitting of vehicles, lower automation levels with comprehensive assistance functions, freight matching ("Uber for freight"), and fully autonomous fleets. For the purpose of this study, truck platooning will be defined in terms of technologies and service concepts, as a basis for the further analysis of activities and to provide a sufficient level of focus:

- Higher levels of automation (see Figure 3 for the SAE Levels of Driving Automation) beyond merely providing assistance functionalities (i.e. SAE Level 1 and 2), i.e. SAE Levels 3 to 5, where, at least, for parts of the trip the driver is out of the loop.
- Thus a system where one or more trucks have their lateral and longitudinal movements controlled by the vehicle without input from the driver.

- Technology applications can vary from individual autonomously operated truck, twinning of the truck where the vehicles following are automated, and larger platoons where only the first or no vehicle is manually driven.
- Business models with or without a driver/staff inside the cab.
- System solutions with or without the need for a central control centre.

While R&D work and testing is already underway, we might see the systems and technologies described above enter into the market as fully commercial applications in the not too distant future. As it would appear unlikely that one specific product will capture the whole market, even when assuming a quick route to market and a relative wide uptake among hauliers, a mix of old (i.e. fully manually operated) and new is to be expected; with new services relying on varying automation levels, technology options and business models. In terms of technology options, automation levels can vary from assistance to full automation (i.e. SAE levels 1 to 5), with differing requirements for drivers or operators within the vehicle.

FIGURE 2 Main industry issues addressed by Truck Platooning

Adapted from Roland Berger⁷.

⁷ Roland Berger, 'Automated Trucks: The next Big Disruptor in the Automotive Industry?'

FIGURE 3 Categorisation of Vehicle Automation Levels

Adapted from SAE⁸.

Their roles will range from being fully in charge of the vehicle to operating it on some parts of the journey to almost no involvement in the driving task. During the transition period from no automation to some level of technology saturation within the fleet, which might be rapid or prolonged, interaction will take place between these vehicles with varying capabilities. Particularly at the beginning of this period, solutions that require a human inside the cab appears to be a likelihood, in addition to solutions utilising human operators outside the cab, controlling the vehicle from a control room, similar to motorway traffic management centres. Both scenarios will reduce the driver workload, which would in turn enable a revision of current rules governing driver working and resting hours.

At a later stage of the transition period towards full automation capability, solutions may be available which do not require

any human supervision or interaction, either within the vehicle or in a control centre. If such a scenario is considered, it would then allow a 24/7 utilisation of vehicles not bound to any driver-based rules in the absence of a physical driver. This large improvement in efficiency would therefore constitute a clear business model for the haulage industry. On a societal level, the likely improvements of road safety performance of these vehicles would also be beneficial, although a more nuanced look at accident data might show the emergence of new accident scenarios. These would be based on the different “behaviour” of vehicles controlled by algorithms rather than humans.

In addition, there is the question as to how society or the media will frame the discourse on possibly large road safety performance improvements on the one hand, but potentially fatal accidents, which might still occur, caused not by a

⁸ SAE International, ‘SAE International Releases Updated Visual Chart for Its “Levels of Driving Automation” Standard for Self-Driving Vehicles’.

distracted driver but by a “robot”, on the other. This could set back public acceptance by a large measure. Furthermore, the growing political pressure to adhere to the principals of the safe systems/vision zero approach for road safety might require a completely new technology, such as full vehicle automation, to have such high levels of safety that nearly no incidents with fatalities or serious injury are possible. Whether or not this can ever be a realistic expectation is a different matter.

From a labour market perspective, changes of the tasks and overall role of an on-board staff inside the vehicle or staff in control centres (see Box 1 below for the comparison between operation with/ without control centre) will be discussed in the later sections of this report, both on a general level and in regard to the specific situation in Australia. In addition to the

better road safety performance of automated trucks, savings in fuel and related decreases in emissions from aerodynamic improvements through minimum gaps between equipped vehicles are also expected. In this context, a literature review carried out for the IRU Commercial Vehicle of the Future report suggests that reductions in emissions of up to 25 per cent are possible, with an average of approximately 15 per cent, according to another study⁹.

The IRU study also points out that in practice the potential could well be lower, citing the following factors:

- The highest reduction figures are probably based on a comparison between a platoon and a single truck, but in practice trucks already form de facto platoons, driving at close distances.

BOX 1 TRUCK PLATOONING CONCEPT WITH/WITHOUT CONTROL CENTRE

Adapted from OECD/ITF 2017¹⁰.

⁹ Tsugawa, 'An Overview on an Automated Truck Platoon within the Energy ITS Project'.

¹⁰ ITF/OECD, 'Managing the Transition to Driverless Road Freight Transport'.

- Various foreseen design improvements to vehicles will already reduce the aerodynamic drag of the vehicles involved.
- The effectiveness of platooning increases with vehicle speed. Therefore if voluntary speed limits of 80 km/h are introduced, such effectiveness will decline.

Implementation Potential

Despite expert opinion quoting truck platooning and automation as one of the most likely early implementation scenarios of vehicle automation technologies, at this stage uncertainty prevails in terms of identifying the implementation potential of this technology.

While the relative simplicity of the operating environment, i.e. motorways compared to complex urban situations, for example, combined with the relatively clear economic incentives for hauliers, who would support this, the only way forward is to review road maps, which have been compiled for this technology.

Figure 4 below shows the automated freight vehicle development path, as put together by the European Road Transport Research and Advisory Council (ERTRAC). According to this road map:

- Assistance functionalities will prevail until approximately 2022.
- Automated truck platooning (here defined as an SAE Level 2 application) is possible from 2020.
- High automation (SAE Level 4) is possible in confined areas now, on dedicated roads from 2021 and on open roads from 2026.
- Full automation (SAE Level 5) will only be possible beyond 2030.

While the previous ERTRAC road map for freight transport automation was part of a wider effort on road vehicle automation, a more detailed analysis in a stand-alone document on freight transport includes road maps for different scenarios and implementation areas, and more details on the legal

FIGURE 4 Automated Freight Vehicle Development Path

Adapted from ERTAC¹¹.

¹¹ ERTRAC, 'Automated Driving Roadmap'.

BOX 2 STRATEGIC ROAD MAP FREIGHT AUTOMATION ON OPEN ROAD

Legal Framework	Electronic freight transport information regulation			
	Performance based regulation vs weight and dimensions	Automation regulation on open roads		
Labour Environment		New role acceptability		Responsive innovation
	Driver fuel efficiency & safety coaching	Automated trucks coaching (include remote driving); Smart loading & intelligent goods coaching		
Infrastructure	Materials; Components			
		Mix of charging/fueling infrastructure; Standardization		
Services		Infrastructure diagnostic & maintenance		
		Smart Speed; Fill rates measurement		
	Integration of SCM systems; New business models	Automated trucks platooning		
Vehicle	C-ACC Truck platooning; Traffic Jam Chauffeur	Automated Truck; Platooning; Highway Chauffeur	Highway Pilot platooning	Highly automated vehicle
	Lightweighting; Tyres; Aerodynamics	High Capacity Vehicles (HCV)		
	Highly efficient ICE PWT (increasing share of alt. fuels)		High-voltage architectures; Electrified road systems	
	Hybrids; Plug-in hybrids; Battery electric truck			
	Range extender		Hydrogen solutions	
	New safety and security solutions			
TODAY		2020-23	2024-27	2027-30+

Adapted from ERTAC¹².

framework, labour environment, infrastructure, services and vehicles have been added. The key information for the open road scenario, i.e. the application of road freight automation to motorway corridors are as follows:

- In terms of technology, assistance functionalities are available now, low automation platooning will be possible from 2020, higher automation platooning from 2024, and highly automated vehicles from 2027
- New regulation is necessary to allow automation on open roads
- Labour market effects need to be addressed through training in order to enable acceptability of this technology
- There is a technology overlap of vehicle automation with electrification and the use of High Capacity Vehicles (HCV)

While the above examples of road maps for truck platooning were drawn up specifically for the situation of the European Union (EU) and its Member Countries, parallels can be drawn for the situation in Australia. A discussion can also take place about the areas where development might well be different, shaped by the unique characteristics of Australia vis-à-vis Europe/European countries, while at the same time bearing in mind the lack of clarity going forward.

Many of the sequences to go through in order to achieve higher levels of vehicle automation in the road freight sector are fully out of national government control (e.g. any necessary technology development such as sensor technology, artificial intelligence, IT and communication infrastructure), or at least partially out of control (e.g. any regulatory issues, which are subject to supra-national jurisdictions, such as type approval processes, as governed by the United Nations Economic Commission for Europe).

¹² ERTAC, 'Long Distance Freight Transport: A Roadmap for System Integration of Road Transport'.

But of course situations can also arise where a national government, i.e. Australia in this context, can accelerate implementation through a specific regulatory policy, subsidies for technology uptake, or the opening up of specific corridors for testing and commercial operation of truck platooning.

But since none of the public trials planned have yet occurred and all existing applications are industry-driven and take place on private roads means that the situation in Australia currently resembles that in other developed countries. This underscores a broader applicability of these road maps.

B.2 REVIEW OF TESTING INITIATIVES

A number of truck platooning initiatives are underway globally, both government as well as industry driven. Trials have been conducted, are underway, or have been planned in these countries and regions: Australia, China, EU, Japan, Korea, Singapore and the United States.

In the following section the status of these truck-platooning trials will be described in more detail:

- **Australia:** Here the already existing road trains¹³ show a clear implementation scenario with a sufficient economic incentive, a transport problem to solve and a simple operating environment. In addition automation is already in operation in mines, both for trucks¹⁴ and specific mining vehicles¹⁵. While government driven efforts on truck platooning have not yet materialised, work on Cooperative ITS for truck safety applications have started in New South Wales¹⁶.
- **Europe:** While some Member Countries have their own small trials and some vehicle manufacturers, notably Daimler¹⁷ Truck, Volvo¹⁸ and Scania¹⁹, are developing and testing truck automation and platooning, on the EU level, efforts are continuing on from the Truck Platooning Challenge with the EU-funded ENSEMBLE project²⁰.
- **Japan:** A consortium of Original Equipment Manufacturers (OEMs), including, among others, Toyota, Mitsubishi and Isuzu, carried out motorway trials near Tokyo in 2018 with platoons consisting of three 12-metre trucks, spaced about 35 metres apart and driving at 80 km/h. Similar to the EU Truck Platooning Challenge, each truck in the test run still had a human driver. The goal is to have entirely unmanned vehicles following one human-operated truck. The companies involved aim to reach this point in 2020 and bring the technology to market as early as 2022.²¹
- **Republic of Korea:** In 2018, during one test a truck from a Hyundai subsidiary carried out a fully autonomous journey, but with a safety driver on board, covering a 40 km distance.²²
- **China:** The first specific number plate for automated trucks was granted in 2018, and trials are planned to be conducted on public roads in Changzhou in Jiangsu Province²³. In addition Shanghai's city officials initially opened up 5.6 km of public roads for testing, but extended this to 37.2 km in September 2018, with tests including automated trucks²⁴.
- **Singapore:** A 10 km test route is being set up within the port of Singapore for trials to start around 2020/ 2021 to use automated trucks to provide transport between terminals.²⁵
- **United States:** In 2016 Otto (acquired by Uber) completed a 120-mile trip – famously for delivering a load of beer – from Fort Collins, Colorado, on the I-25 to Colorado Springs in automated mode using a safety driver²⁶. While this early trial was successful, Uber decided not to continue their truck automation efforts²⁷. In 2018 the Trump administration introduced policies to facilitate the introduction of automated trucks²⁸. In 2018 Embark²⁹ completed an automated, coast-to-coast trip, with a safety driver on board, travelling 2,400 miles over five days along

¹³ The Atlantic, 'How "Self-Driving" Trucks Connected the Australian Outback'.

¹⁴ SCANIA, 'Scania and Rio Tinto Trialling Autonomous Truck in Western Australian Mine'.

¹⁵ ProcureCon Canada, 'Here's How Rio Tinto Is Automating Its Haulage Network to Create an Iron Clad Supply Chain'.

¹⁶ Centre for Road Safety, 'Cooperative Intelligent Transport Initiative'.

¹⁷ See: <https://www.daimler.com/innovation/case/autonomous/automated-driving-daimler-trucks.html>, accessed 5 July 2019.

¹⁸ See: <https://www.volvogroup.com/en-en/innovation/automation.html>, accessed 5 July 2019.

¹⁹ See <https://www.scania.com/group/en/autonomous-transport-solutions/>, accessed 5 July 2019.

²⁰ See <https://platooningensemble.eu/>, accessed 5 July 2019.

²¹ NIKKEI Asia Review, 'Japan Launches Test of Self-Driving Truck Convoys'.

²² CNBC, 'Hyundai's Autonomous Truck Just Made a 40-Kilometer Trip on a South Korean Highway'.

²³ National Business Daily, 'China's First Self-Driving Commercial Truck Gets Nod to Road Testing'.

²⁴ Channel News Asia, 'Singapore to Start Trials of Driverless Trucks for Port Transport'.

²⁵ Channel News Asia, 'Singapore to Start Trials of Driverless Trucks for Port Transport'.

²⁶ Business Insider, 'Uber's Self-Driving Truck Went on a 120-Mile Beer Run to Make History'.

²⁷ Venture Beat, 'Uber Shuttles Its Self-Driving Truck Business'.

²⁸ US NEWS, 'The Race Is On After Feds Pave Way for Driverless Trucks'.

²⁹ See: <https://embarktrucks.com/>, accessed 5 July 2019.

the length of Interstate 10 across the southern United States³⁰. In 2019, the same company provided vehicles for Amazon to carry freight in automated trucks on the I-10 interstate highway³¹. In addition as of 2018, Daimler was developing a truck platooning system for the US market with the Cascadia model of the US subsidiary Freightliner,

carrying out tests on a private site³². In addition the Tesla Semi³³ was presented in 2019, which like Tesla cars, will feature an SAE Level 3 Highway Pilot. Peloton Tech³⁴ in the US is promoting another more service and business model-driven approach (see Box 3 below for more details on the operating principle).

BOX 3 OPERATING PRINCIPLES OF PELOTON TECH

CONNECTING TRUCKS

PLATOONING BENEFITS

Adapted from Future Car³⁵ and Peloton Tech³⁶.

³⁰ Transport Topics, 'Embark Self-Driving Truck Completes Coast-to-Coast Test Run'.

³¹ CNBC, 'Amazon Is Hauling Cargo in Self-Driving Trucks Developed by Embark'.

³² Trucks.com, 'Daimler Is Pushing Hard into Development of Automated Trucks'.

³³ See: <https://www.tesla.com/semi>, accessed 5 July 2019.

³⁴ See: <https://peloton-tech.com/>, accessed 5 July 2019.

³⁵ Future Car, 'Peloton Technology Ready to Launch Truck Platooning in 2017'.

³⁶ Peloton Tech, 'Facts about Peloton Platooning'.

B.3 REGULATORY INITIATIVES

As stated before, the relatively simple and controlled environment of motorways lend themselves to forming the use case for the implementation of road vehicle automation, in addition to factors relating to commercial operations and regulatory frameworks. The specific automation technology relevant factors include:

- Segregated traffic flows, which are grade separated, avoiding junctions and signals.
- The existence of an additional hard shoulder for emergencies and banning vulnerable road users.
- Higher levels of maintenance and clearer lane markings, which are machine-readable.

Globally, motorway networks are often privatised, using concession models and/or tolls. These approaches result in more funding being available than for other road infrastructure. Its simpler nature and better maintenance creates an environment that is more suitable and more easily handled by vehicle automation technology, compared to urban roads, for example. This makes truck platooning a likely first to the market. If one adds the fact that much long-distance road freight is being transported on this type of road – then a clear business model emerges.

One issue going forward in this space is the underlying regulatory framework. While many jurisdictions are attempting to ready themselves for road vehicle automation, no specific legislation for the specific use case of truck platooning on motorways exists. An early attempt was the Federal Automated Vehicles Policy, which the National Highway Transport Safety Administration (NHTSA) in the United States released in 2016³⁷. This regulatory update was generic in nature, not covering specific use cases of automation technology. The emergence of more targeted regulations would help all stakeholders involved, giving them the necessary assurances.

In addition, the cross-border aspect of long-distance road freight means that potentially multiple legislative approaches have to be addressed, showing a clear need for harmonisation across borders. This has thus been a key motivator for carrying out the Dutch Truck Platooning Challenge. Drivers had to comply with specific factors including the following:

- Traffic flow-related, including speed, vehicle following distance and overtaking;
- Platooning permit-related, including the type/lane of motorway to be utilised;

- Platooning approach-related, including communication and coupling/decoupling.

The issue of harmonisation of regulations is specifically relevant in the United States, where different states have developed different regulatory approaches for automated road vehicles. While these generally do not constitute new regulatory approaches, but rather a temporary relaxation of rules to allow testing on public roads, they have common requirements, including the following ones:

- defining the concept of an automated vehicle, generally requiring a safety driver.
- basic rules that all traffic laws are to be adhered to, including recognizing law enforcement staff or vehicles.
- the vehicle manufacturer or system operator has ultimate responsibility for incidents.

Based on these regulatory principles, permits for testing of automated vehicles on public roads in the United States generally require a safety driver within the test vehicle, adequate insurance and further applications in case of a move from testing to commercial operation. But these generic approaches for automated vehicles still lack the level of detail required for truck automation and platooning. Until these are in place, the following may hinder technology deployment:

- the required minimum safe following distances not being suitable to platooning systems;
- no guidance on operation of platoon, including communication and coupling/decoupling.
- absence of the harmonisation of regulations affecting truck platooning at various levels.

In November 2016, Australian transport ministers agreed to a phased reform program so that conditionally AVs can operate safely and legally before 2020, and highly and fully automated vehicles from 2020. Since then work has been carried out on national guidelines for automated vehicle trials, on regulatory options to assure automated vehicle safety, on motor accident injury insurance and automated vehicles, and on safety assurance for automated driving systems³⁸. In the following section, the country specific industry factors for truck platooning in Australia will be discussed in more detail, including the financial, regulatory, technological and labour market aspects.

³⁷ US Department of Transportation and National Highway Traffic Safety Administration, 'Federal Automated Vehicles Policy'.

³⁸ National Transport Commission, 'Automated Vehicles in Australia'.

THE AUSTRALIAN CASE

C

C. THE AUSTRALIAN CASE

C.1 ECONOMIC ASPECTS

The economic benefits of automating road freight transport generally is personnel savings if eliminating the physical presence of a driver inside the cab and/or relaxation of driver regulations (i.e. maximum working hours and frequency and length of rest periods) where an operator is still in the cab, but with a vastly decreased workload. This could maximise the efficiency of the vehicle, ultimately keeping AVs running constantly.

Some of the elements above will likely be offset by the initial investment into these highly sophisticated and costly vehicles. In addition to upfront costs, some business models offered to the haulage industry might also include a monthly subscription for specific back-office functionalities offered, which also needs to be considered in the wider economic analysis. In addition, the haulage industry will also be taking on the risk of investing in an untested technology.

In case of an operating model using a control centre, operated either by the public sector (similarly to urban traffic management and control centres) or by industry, this will invariably further increase operating costs. On the other hand, if improved road safety, fuel savings and emission reductions can be achieved in a provable manner, then government support in the shape of tax breaks, for example, might potentially lighten the financial burden.

In addition to the generic business model, case-specific situations can also arise where vehicle automation technology can address individual issues. In the case of Australia, the ongoing use of automated equipment in mining areas is a clear example for a situation like this, albeit within closed-off private sites, thus avoiding many of the technological and regulatory hurdles present in areas open to the public.

Other Australia-specific use cases for truck platooning can also be envisaged. These include two distinct areas of operation unique to the Australian situation:

- **Specific links between mines and logistics hubs:** Australia has embraced the concept of High-Capacity-Transport (HCT) like few other countries globally, due to very country specific issues. For specific links, often from sites of the mining industry, to ports and other logistics centre, the only way for the Australian mining industry to remain competitive globally, in the absence of adequate rail links in the region, is to use technology that improves transport efficiency. While this is currently being done by allowing extended size and dimensions for trucks in exchange for complying with a tracking scheme, further benefits can be expected from adding the benefits of truck platooning.

- **Routes currently served by road trains:** This involves long-distance freight transport in simple controlled environments in very low-density areas and with minimum traffic. Here, road trains were initially devised in order to maximise efficiency, i.e. drivers per load. There is thus a very clear business model for truck platooning in this context, with further efficiency maximisation/cost savings through either the elimination of drivers, or the relaxation of driver regulations to the point that vehicles can be run 24/7.

It is thus clear that Australia provides very specific additional economic incentives for the deployment of truck automation, in addition to the more generic ones applying to other regions. In private sites this technology is already being used and first trials in public areas appear imminent.

According to Australia's NTC³⁹, the following characteristics apply to freight transport:

- In 2013–14, the national domestic freight task totalled 726 billion tonne-kilometres, of which rail accounted for half and road one-third. Just over 75% of the tonne-kilometres on Australia's road network and 99.8% on the rail network are associated with intrastate freight, with the balance being longer-distance interstate freight.
- The domestic freight task increased 50% in the 10 years to 2016 and is forecast to grow another 26% by 2026.
- The global financial crisis caused a one-off drop in Australia's road freight and has slowed economic growth since. This means it is unlikely that the prediction of the Bureau of Infrastructure, Transport and Regional Economics' (BITRE) that road freight would double by 2020 will be realized, although it will be achieved several years later.
- Rail freight in Australia is dominated by the transportation of bulk commodities over long distances. While iron ore and coal account for 80% of the rail freight task, rail is also important for transporting other bulk commodities such as grain, sugar, fertiliser and mineral sands, especially to seaports.
- Rail and road compete strongly for long-distance non-bulk freight, but as distances increase, rail competitiveness increases.
- Around 8% of Australia's non-bulk rail freight is carried along three main corridors, namely between the eastern states and Perth, between Melbourne and Brisbane, and between Brisbane and northern Queensland.

³⁹ National Transport Commission, 'Who Moves What Where - Freight and Passenger Transport in Australia'.

- Road freight in Australia specialises in delivering time-sensitive/perishable commodities, such as fresh fruit and groceries, consumer goods such as white goods and electronics, and construction material such as steel, concrete and timber. Road competes with rail in moving bulk commodities, such as cattle, grain and processed metals over longer distances.

Figure 5 below shows additional information from the same report, detailing commodity types carried by road freight and the tonnage carried for each commodity type.

FIGURE 5 Data on Road Freight Transport in Australia

Adapted from NTC⁴⁰.

C.2 REGULATORY AND GOVERNANCE ISSUES

Globally, regulatory hurdles for any type of automated road vehicle persists, with the legislation of many countries requiring a driver to be in charge of the vehicle, or at least to be able to take over at a moment's notice. While the testing of automated vehicles on public roads has been taking place for years now, it is important to point out that these tests do not result from updated or revised legislation. They are rather exemptions, calculated risks, in order to enable the industry to carry out tests. These tests are all temporary in nature. However, there is now a governance solution in sight which would involve permanent commercial operation of such vehicles.

The legislative framework is however complicated as separate and mostly uncoordinated pieces of legislation are in place for vehicles and for the types of mobility services provided. In addition, legislation often

applies on multiple levels, ranging from international/intergovernmental levels (e.g. efforts for global harmonisation of type approval processes for road vehicles) to the national level, and even regional and city level (e.g. urban public transport provision). Currently, there appears to be a "stretching" of regulations, which is still possible for lower levels of automation, for example, assistance functionalities, but will fail with the highest levels of automation.

The Australian Government has supported the safe introduction of automated vehicles through a regulatory reform process since 2015⁴¹. According to the National Transport Commission,⁴² a number of regulatory barriers exists in Australia for road vehicles with high levels of automation generally, but these would then also apply to truck platooning. The report identifies the following specific issues in this context:

⁴⁰ National Transport Commission.

⁴¹ National Transport Commission, 'Automated Vehicles in Australia'.

⁴² National Transport Commission, 'Regulatory Reforms for Automated Road Vehicles'.

- **Supporting on-road trials and demonstrations:** There are currently no nationally consistent guidelines or conditions for on-road trials of automated vehicle technology.
- **Supporting automated driving that requires a human driver:** It is unclear who is in control of an automated vehicle when the human driver must monitor the automated driving system and intervene if requested. The enforcement interpretation of proper control that requires a human driver to have at least one hand on the steering wheel is likely to become outdated.
- **Automated driving that does not require a human driver:** There is no regulatory framework in place for governments to ensure the safe operation of automated vehicles that do not require a human driver. Road rules

and other laws, including many compulsory third-party insurance schemes, assume a human driver is present, and such a regulatory framework would not apply in the same way to vehicles that did not have a human driver. It is uncertain how government agencies would access automated vehicle data, and in what circumstances. Current Australian Design Rules (ADRs) and in-service vehicle standards have vehicle standards that require a human driver.

In addition, various trials of different systems and services are taking place throughout Australia⁴³. One of the trial projects was supposed to be looking at the use of truck platooning technologies in Western Australia. However, since the preparatory work undertaken in 2017, the projects have been postponed and have not yet been taken forward⁴⁴.

C.3 TECHNOLOGY FEASIBILITY AND SOCIAL ACCEPTANCE

As earlier indicated, both research, development work and the trialling of various types of automated road vehicles have been frantic over the last years. The application of these technologies to the road freight sector is generally seen by area experts as one of the most promising short-term implementation scenarios, based on the comparatively simple operating environment and the relative clear business model. In addition, many established vehicle manufacturers and emerging new companies are highly active in the truck platooning space.

This technology is thus beyond the prototype stage, but that does not necessarily mean it is ready at this time for mass application. True truck platooning would be at least SAE level 3 or above and it would thus be useful to look at these automation levels. SAE level 3 offers high levels of automation, but with the driver having to constantly monitor the system with a view of taking over control at a moment's notice. A driver is still required and the working time description would remain unaffected. This means that while the technology is ready now, it is unlikely to have a disruptive effect.

The highest level of automation - level 5 - according to many experts is decades away and might never be reached. This leaves level 4 as the main candidate. In a geo-fenced area full automation is possible without a driver on board or with an operator on-board, but engaged in other tasks. This thus constitutes a real business model for the haulage industry. However, while the technology is feasible – up to a point – public acceptance is another important factor on the path to implementation of truck platooning. A survey into acceptance of automated vehicles in Australia⁴⁵ found that:

- Most are aware of automated vehicle functions, but very few have experienced them.
- The community has concerns about many issues relating to fully automated cars.

- Less than half of all respondents are willing to pay more for fully automated cars than for their existing car.
- Most agree that there are many potential benefits from fully automated cars.
- Most people are comfortable with automated cars controlling most driving functions.
- People are least comfortable with automated cars changing lanes by themselves and following cars ahead too closely.
- People are more comfortable about taking control than giving control to partly automated cars.
- Most people would like to drive a fully automated car manually from time to time.
- Less than half of the people think that fully automated cars are safer than a car driven manually by a human.
- Females and males think differently about fully automated cars on some issues.
- People in different Australian States and Territories think differently about automated cars.

While this survey and similar efforts around the world deal with automated vehicles generally and not specifically with truck platooning, one can assume that attitudes will be even more negative when it comes to large vehicles, such as trucks, in terms of road safety. This might well be alleviated somewhat by the presence of an on-board staff, even if that person is not directly in control of the vehicle. But as a note of caution results of surveys on issues the population has no direct experience with are notoriously unreliable. In addition early accidents can further sway opinion negatively.

⁴³ See <https://austroads.com.au/drivers-and-vehicles/connected-and-automated-vehicles/trials> (accessed 5 July 2019) for the current list of trials.

⁴⁴ Cobey Bartels, 'Opinion: Will Australia Ever See Platooning?'

⁴⁵ Regan et al., 'Preliminary Findings from the First Australian National Survey of Public Opinion about Automated and Driverless Vehicles'.

BOX 4 OVERVIEW OF SOLUTIONS TO TRUCK DRIVER SHORTAGE IN AUSTRALIA

Adapted from Volvo⁴⁶.

C.4 IMPACT ON THE LABOUR FORCE

Automated trucks are expected to reduce costs in the haulage industry by Euros 136 billion annually, according to Morgan Stanley⁴⁷. Considering labour accounts for 34% of the operational costs per mile in the United States⁴⁸, the largest chunk of savings is expected to be drawn from reducing labour costs, which could potentially account for Euros 57 billion in cost reductions each year. Increased productivity, resulting from the fact that driverless trucks can essentially be rolling for nearly 24 hours a day (11 hour-a-day

limit for human drivers) is expected to account for Euros 22 billion each year. Wheels rolling full-time translate into shorter delivery periods, and in turn increased deliveries, and thus increased company revenues.

Against the backdrop of these employer arguments for embracing automation technologies, it is important to look at the labour market dynamics. While a report on the labour market effect of truck automation found a potential for direct

⁴⁶ Volvo and Clemenger BBDO.

⁴⁷ Morgan Stanley Research Global, 'Autonomous Cars: Self-Driving the New Auto Industry Paradigm'.

⁴⁸ Hooper and Murray, 'An Analysis of the Operational Costs of Trucking: 2017 Update'.

job losses of 1 million drivers both for North America and for Europe⁴⁹, if this technology is being implemented quickly and comprehensively, the reality is that in many regions driver shortages are being forecast. This fact, combined with the likely slow implementation of truck platooning, paints a rather different picture. In Australia trade media reports driver shortages⁵⁰ and government action to address these⁵¹, with the industry (Volvo) also promoting solutions⁵². In terms of labour force impact, two distinct cases need to be considered, with very different implications on the fate of transport workers:

- **Operation without staff in the cab:** In this scenario vehicle operation would be completely autonomous without the need for any staff in the cabin. For the haulage industry this removes all driver personnel costs and would allow constant operation without any regulatory review. This would mean displacement of current drivers, with initially only a control centre role for them and only if such a solution would be implemented. Here, additional IT skills would likely be necessary and the available positions would be unlikely to absorb all displaced drivers. But given that automation is probably only possible on motorway corridors and that goods will have to be loaded/unloaded en-route the scenario with staff in the cab is the more realistic one to be implemented.
- **Operation with staff in the cab:** In this scenario, while high automation levels can be achieved in large parts of

the overall trip, there will still be staff in the cab. There will still need to be a trained truck driver, as the vehicle will need to be manually driven outside the geo-fenced area where full automation is technically feasible. In addition this driver/operator will also still need to carry out the traditional task of loading/unloading. But in addition there will be the potential for additional tasks, as much of the trip there would not be any activities otherwise, which would make the role very inefficient - and probably very boring. Likely alternative tasks will be clerical back-office work. For this, more IT skills would be required, so that the existing workforce would need an element of retraining, but would otherwise still use their original skills. In addition, this should appeal as a more fulfilling role to the workforce of tomorrow, which might not be interested in the traditional truck driver role.

The next section will look at workforce development in more detail, including changes to job profiles and individual tasks, skill-set availability and measures taken by employers, unions and the government.

The Volvo report on truck driver shortages in Australia suggested the following solutions from the haulage industry, the government and the media to counteract these trends. The potential positive impacts of assistance and automation functionalities on roles could further help with this, i.e. bringing the role of the truck driver into the 21st century and making it attractive to millennials.

⁴⁹ ITF/OECD, 'Managing the Transition to Driverless Road Freight Transport'.

⁵⁰ ATN, 'Australia Not Alone in Driver Shortage Concerns'.

⁵¹ ATN, 'Natroad Links with Paccar to Tackle Driver Shortage'.

⁵² Volvo and Clemenger BBDO, 'Professional Truck Driver - Shortage: How Driver Availability Impacts the Transport Industry & Australian Society'.

TRANSFORMATION IN THE LABOUR FORCE

A man wearing a cap and work clothes is focused on writing on a clipboard. The image is overlaid with a blue gradient. A large white letter 'D' is positioned in the bottom right corner, set against a dark blue background.

D

D. TRANSFORMATION IN THE LABOUR FORCE

While it is important for both government and the transport industry to formulate their responses to potentially disruptive technology trends, such as vehicle automation in the road freight sector, the broad uncertainty that still prevails does not allow a particularly detailed analysis of labour market developments and workforce development. As stated previously, despite concerted government efforts in this space, there have not yet been any trials – let alone permanent commercial applications – of truck platooning in public sites in Australia.

This fact probably points towards a slow market uptake, if any, i.e. one where governments and regulators can maintain control and where effects on workers will be gradual and manageable. But in this context it could be useful to look at an example where automated road freight vehicles are already in use in Australia, the mining sector. Here, the automation of individual trucks rather than platooning, the electronic coupling of two or more trucks, is being used and in private sites relevant conclusions from the experience can be drawn.

The first automated vehicles appeared in Australian mines around 2012 and labour unions' response was to raise concerns about driving jobs being replaced by automation technology⁵³. A more recent article suggests that a 90% reduction in staff in mines can be achieved by automating the driving task in mines⁵⁴. Overall, large efficiency gains appear possible here, which are a clear driver for the mining industry, particularly with a concentration in this sector of fewer and fewer players, effectively creating "Big Mining".

Figure 6 gives a sense of the size of the mining sector in relation to other sectors. The conflict between the Australian mining industry and the trade unions representing mining workers potentially affected by vehicle automation centres – as to be expected – revolves around two issues: on the question of whether jobs will disappear, or if roles and tasks will merely be upgraded (perhaps even improved), if training measures will be necessary; and, if the answer is in the affirmative, who will be responsible for funding and running these training programmes.

Moving on from the use of automated vehicles in the mining sector to truck platooning on public roads, the overall discussion on labour market effects is likely to be similar, but the specific service scenarios and the effects on driver/operator tasks require a closer look going forward. A study,

which assumed a wide-ranging, rapid and disruptive uptake of truck platooning, quoting an estimated 1 million displaced truck drivers both in the US and in Europe, developed the following labour market initiatives, which are intentionally drastic, given the chosen scenario:⁵⁵

- Establishing a temporary transition advisory board to advise governments on these strategies.
- Introducing a permit system to influence speed of introduction and associated job losses.
- Economy-wide support for underemployed individuals, such as universal income policies.
- Industry specific support for displaced drivers, consistent with good practice for general unemployment support, funded by the main beneficiaries of the technologies.

But the study also points out that "...the roles of drivers that remain would likely be less focused purely on driving, with the potential for more 'back office' tasks to be undertaken in the cabin. This could help make the truck driving profession more appealing than the existing roles." Applying the lessons learned from the mining industry and the analysis conducted in the previous sections to truck platooning in Australia – all the while acknowledging the uncertainty – the following key principles and related issues can thus be identified and developed.

Much of the effects on transport workers hinges on the questions whether staff remains in the cabin or not and if a remote control centre will be required or not. In the (possibly extreme) scenario, where no staff is in the cabin and no control centre is required, the effects on the labour market could be expected to be severe. In any of the other combinations of scenarios, no (or certainly less) jobs would disappear, but the roles would change. Here, training might be necessary to allow displaced drivers to pick up new skills. It is therefore necessary to look at this in more detail.

In the case of staff remaining inside the cabin, some of the original tasks will prevail, including manual driving outside geo-fenced areas allowing full automation and loading/unloading. But during the times when vehicle operates without human input, new tasks need to be created. Most

⁵³ Australian Mining, 'Unions Vs Rio: The Automation Battle'.

⁵⁴ The Guardian, 'Automated Mining Will Cost Jobs and Tax Income: It's Time for Governments to Act'.

⁵⁵ OECD/ITF, 'Commercial Vehicle On-Board Safety Systems'.

FIGURE 6 Industry Sector Job Projection for Australia to May 2023

Adapted from Sydney Morning Herald⁵⁶.

obvious here would be back-office tasks relating to the movement of goods. This would require some retraining measures regarding the necessary IT skills. In the case of remotely controlling trucks from an operation centre, a completely new role would emerge, but requiring drivers' expertise, plus again IT skills.

In both cases it can be argued that workers will operate in less risky environments, requiring more cognitive skills

when compared to the traditional role of a long distance truck driver. In the control centre scenario this would be likely. The economic benefit relies on one operator handling more than one vehicle, perhaps ten or more, a process requiring only very infrequent intervention. This certainly would reduce the number of jobs available. But this could be counteracted by the fact that in many countries and in particular the developed world, including Australia, the industry faces driver shortages.

⁵⁶ The Sydney Morning Herald, 'No One behind the Wheel: The New Workforce Driving Australia's Mines'.

CONCLUSION

CONCLUSION

Both hype and uncertainty surround the topic of road vehicle automation. While truck platooning is among the most likely scenarios where implementation will take place first, no widespread commercial application of this technology exist as yet. Currently, research and development is being conducted, as well as small-scale trials and demonstrations in many parts of the world. Despite the applicability of this technology to Australia and the country-specific use case, government efforts to demonstrate truck automation as part of a large portfolio of road vehicle automation trials have not come to fruition.

In terms of the labour market implications of truck automation, much depends on the technology and service solutions which materialise in the market. These include the options of retaining staff within the cab with less driving tasks, but more back office tasks; control of one or, in all

likelihood, more vehicles from a central control centre; and full vehicle autonomy without any human intervention. This gives an idea of the impacts on the work force and the potential need for retraining of staff.

The fact that this technology is already being commercially used in Australia in the mining sector within closed sites means that some experience has been accumulated, including the reaction from trade unions. The response from trade union bodies is the concern over redundancies due to automation. In the long-distance road freight sector this could be possible, as this analysis indicates. However, reports on driver shortages in the haulage industry paint a very different picture. Thus there is at least the potential that truck platooning will address both staff shortages and offer opportunities in the form of upgraded roles.

LESSONS LEARNED

- Fast-track public trials of truck platooning on open roads are being planned, with trials of many other applications of road vehicle automation already carried out.
- The regulations that would allow for trials do not exist currently. There will likely be exemptions from the current rules, based on a license scheme, insurance coverage and the definition of responsibilities.
- Australia-specific use cases **surpass** the more generic use cases and business models **which focus mainly** on decreased personnel costs, improved efficiency and relaxed driver rules:
 - The current corridors used for larger and heavier vehicles, the so-called “road trains”, which are mainly very straight sections of roadway without much other traffic;
 - Specific links (e.g. mines to ports or logistics centre) in remote areas where increased supply chain efficiency is vital to ensure the competitiveness of the industry globally.
- While developing and conducting trials for a new technology, which features a human presence within the vehicle or in a control centre, alternative roles for the drivers that are available should be showcased.
- The case of no human presence, either in the vehicle or in a control centre, will weigh up the job losses expected over time with technology implementation against reported driver shortages. An overall assessment of the labour market implications will need to be carried out.
- Full commercial implementation will be based on sharing experiences and lessons learnt from other truck platooning trials carried out globally.

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The World Maritime University was
established in 1983 under the auspices
of the International Maritime Organization,
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