Transport in transition: Preparing for a connected, automated and sustainable future

Learnings from the CCAT International Outreach 2023

ccat CENTRE FOR CONNECTED & AUTOMATED TRANSPORT

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Introduction

THE CENTRE FOR CONNECTED AND AUTOMATED TRANSPORT

The Centre for Connected and Automated Transport (CCAT) is a government and industry collaboration that aims to facilitate the transition to connected and automated transport. Our scope extends to all transport modes and sectors where connected and automated technologies will change the way we move people and goods.

CCAT has two key objectives:

- Develop a strategic vision for the infrastructure that supports connected and automated transport in Australia and New Zealand.
- Be the public champion for the transition to connected and automated transport in Australia and New Zealand.

Our membership comprises government transport agencies, digital and physical infrastructure providers, transport and logistics associations, and consultancies among other groups.

CCAT was established in 2022 by the Australian Road Research Board, now known as the National Transport Research Organisation.

2023 INTERNATIONAL OUTREACH

CCAT's International Outreach took a delegation of Australian government and industry leaders to the United Kingdom (UK), Sweden and Germany to explore how these countries are preparing for connected and automated transport. These countries were chosen due to their reputation as centres of excellence in the transition to connected and automated transport.

We anticipated that valuable learnings about the successes and challenges these countries had experienced could inform our own preparations for connected and automated transport back home.

The objectives of the International Outreach were to:

- Expose an Australian and New Zealand audience to emerging technologies, business models and infrastructure across roads and other transport modes.
- Understand what direction other government and industry leaders are taking to prepare.
- Establish key contacts and linkages for future collaboration.
- Bring learnings back to Australia and New Zealand to help us prepare our transport systems for connected and automated transport.

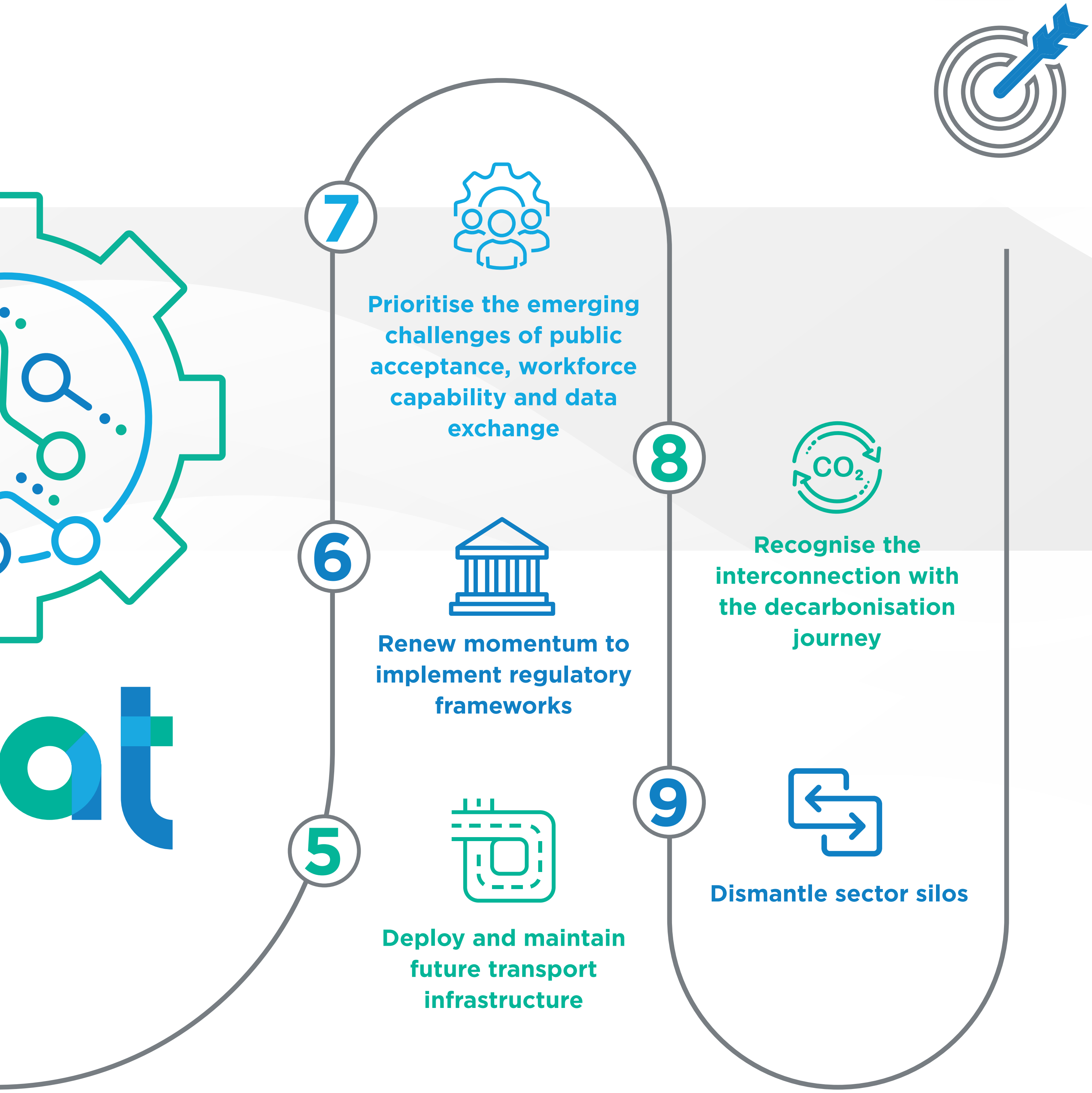
The delegation met with leaders from over 25 organisations including government agencies, infrastructure providers, vehicle manufacturers, telecommunications providers, software developers, researchers, consultants and transport associations.

Meetings centred on policy discussions about the progress made and challenges faced in the transition to connected and automated transport. Meetings had a road sector focus given the scale of the transition in this sector and the makeup of the delegation.

The International Outreach also incorporated the Power2Drive Exhibition in Munich, the leading international exhibition for charging infrastructure and e-mobility.

Summary of recommendations

1. Identify the imperatives for connected and automated transport
2. Establish a coordinated, government-led ecosystem
3. Ensure testing and research address implementation
4. Understand and prepare for the pipeline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Prioritise the emerging challenges of public acceptance, workforce capability and data exchange
6
Renew momentum to implement regulatory frameworks
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Deploy and maintain future transport infrastructure
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CO2
Recognise the interconnection with the decarbonisation journey
9
Dismantle sector silos

Meetings held

ARUP
AstaZero
DAIMLER TRUCK
einride
DRIVE SWEDEN
Die Autobahn
Fraunhofer IKS
TRANSPORTFÖRETAGEN
ZENZIC SELF-DRIVING REVOLUTION
national highways
Transport for West Midlands
IVECO
OXA Universal Autonomy
POWER 2 DRIVE | EUROPE
Intelligent Transport Systems UK Empowering Transport Technology
Smart Mobility Living Lab London
CONIGITAL CONNECTED DIGITAL
Solihull Metropolitan Borough Council
TRL
VDA German Association of the Automotive Industry
Centre for Connected & Autonomous Vehicles
BMW
DLR
ERICSSON
Q FREE
Department for Transport
SCANIA

Learning 1: Preparations address identified imperatives

We have come a long way since the simplistic and unrealistic forecasts that characterised expectations for the deployment of connected and automated transport nearly a decade ago. But the technology is still coming, and preparations in Europe have become more nuanced while maintaining momentum. There is a recognition that this technology can be harnessed in different ways to address a number of public and commercial imperatives including safety, driver shortages, economic diversification and decarbonisation.

The CCAT delegation was struck by the momentum to prepare for connected and automated transport in the UK, Sweden and Germany. Government and industry have long recognised that this technology can address some of the transport sector's enduring wicked problems and can also be harnessed to create new opportunities. This has created strong imperatives to prepare for the technology and a detailed understanding of how deployment can achieve public and commercial outcomes.

The expected safety benefits of connected and automated technologies on public roads and private sites are of course still a key driver to prepare. While the potential safety benefits of automated vehicles are envisaged in time as the technology is deployed and represents a larger proportion of the vehicle fleet, cooperative intelligent transport systems (C-ITS) can reduce injuries and save lives now.

Interestingly, the delegation heard more about the pressing commercial imperatives for automated vehicles, with their ability to address driver shortages in freight and public transport being high among these. The global driver shortage applies across countries and industries and is only escalating as an issue as the number of drivers decreases while the freight task increases (due to population growth, urbanisation and changing consumer behaviour). In addressing this issue, we heard how automation also has the potential to reduce total operating costs and allow for more flexible and reliable operations.

Arup hosted the CCAT delegation in London for policy discussions with a range of government and industry stakeholders. We heard that in the UK, where the government is largely focused on using connected and automated mobility in mass transit applications, the technology is seen as a way to address public transport challenges such as driver shortages, the rising costs of bus operators, lagging public transport ridership, the availability and reliability of services, and decarbonisation.

The UK Government has proactively sought to ensure the deployment of new transport technologies supports public outcomes, rather than being led by the technology. *The Future of Mobility: Urban Strategy* identifies the benefits the government seeks from innovations in mobility and sets out principles to achieve them.[1] These principles include transport system elements that mobility innovations must support such as mass transit, the transition to zero emissions, reducing congestion and integrated transport. Clear guidance for the testing and deployment of connected and automated technologies can be derived from these broader principles, and the results of this can now be seen in the types of use cases the government is supporting for trials, focusing in particular on mass transit, logistics and freight.

The UK Government has also proactively identified how to harness the technology to leverage broader opportunities beyond the transport sector. It is pursuing the deployment of connected and automated mobility as a way to stimulate the manufacturing industry, deliver economic growth and introduce new skilled jobs. The government aims for the UK to carve out a niche as a global leader in the automated vehicle technology space. The future market in the UK is estimated to be worth as much as £42 billion by 2035 and could create as many as 38,000 jobs.[2]

Connected and automated transport is also being pursued as part of sustainability and decarbonisation agendas in Europe. It is expected that connected and automated vehicles will take more direct routes, enable more fuel-efficient driving, encourage mode-shift and decrease traffic congestion with the right supporting settings. Automated vehicles are also largely expected to be zero emissions vehicles.

Importantly, there was the acknowledgement that even without these imperatives, connected and automated transport technologies are coming anyway and momentum is necessary to be ready. Timelines for deployment may be longer than stated by manufacturers in the early days of the technology's development, but the deployable use cases are edging nearer. It is therefore important to identify what outcomes we want to achieve from the technology and prepare our transport systems and communities in a way that ensures these outcomes are achieved.

[1] Department for Transport. (2019). Future of Mobility: Urban Strategy, London, p 9.

[2] HM Government. (2022). Connected & Automated Mobility 2025: Realising the benefits of self-driving vehicles in the UK, London, p 18.

Case study: Better journeys – Luton DART

Luton Airport was not competing well with London's other airports. A particular problem was how people got to the airport, with most travelling by private car. An existing bus service ran between the closest railway station and the airport terminal, taking 10 minutes and running every 20 minutes. The journey for travellers from London took close to an hour.

The airport's owners, Luton Rising (a subsidiary of Luton Council), approached Arup with a number of objectives for a mass passenger transit system: to improve passenger experience, reduce operational and capital costs, and lessen the impact on the environment.

The solution was Luton DART (an acronym for Direct Air-Rail Transit), an automated people mover powered by cable. It reduces the travel time between the railway station and the terminal to under four minutes, runs every five minutes during peak times and is open 24/7. It opened in March 2023, and at the time of CCAT's visit, was the newest such installation in the world. The system is future-proofed to be able to accommodate a second terminal at Luton Airport should one be built, with the addition of another shuttle.

In normal operations the Luton DART runs fully automated – the speed, train movements, door opening and closing, dwell time at stations and passenger announcements are all pre-set without any interference required from an operator. Two operators are used for safety and passenger experience – one to oversee the system remotely and intervene if necessary and the other to help passengers directly by selling tickets and providing assistance.

The Luton DART is fully integrated with the Luton Airport Express train from London, so passengers can now travel from London to Luton Airport in 32 minutes.

Image credit: Arup

Learning 2: A strong ecosystem drives progress

A strong ecosystem is important to support the deployment of connected and automated transport. We observed that active, coordinated government engagement and funding has made a huge difference to the progress made in Europe. We were also impressed by the collaborative approach taken by industry which viewed the government as a welcome and positive partner. Meaningful collaboration between government, industry and the research sector is seen as vital to deliver a safe transition to a connected and automated transport future that achieves positive public outcomes.

The UK, Sweden and Germany have all built strong ecosystems to support connected and automated transport.

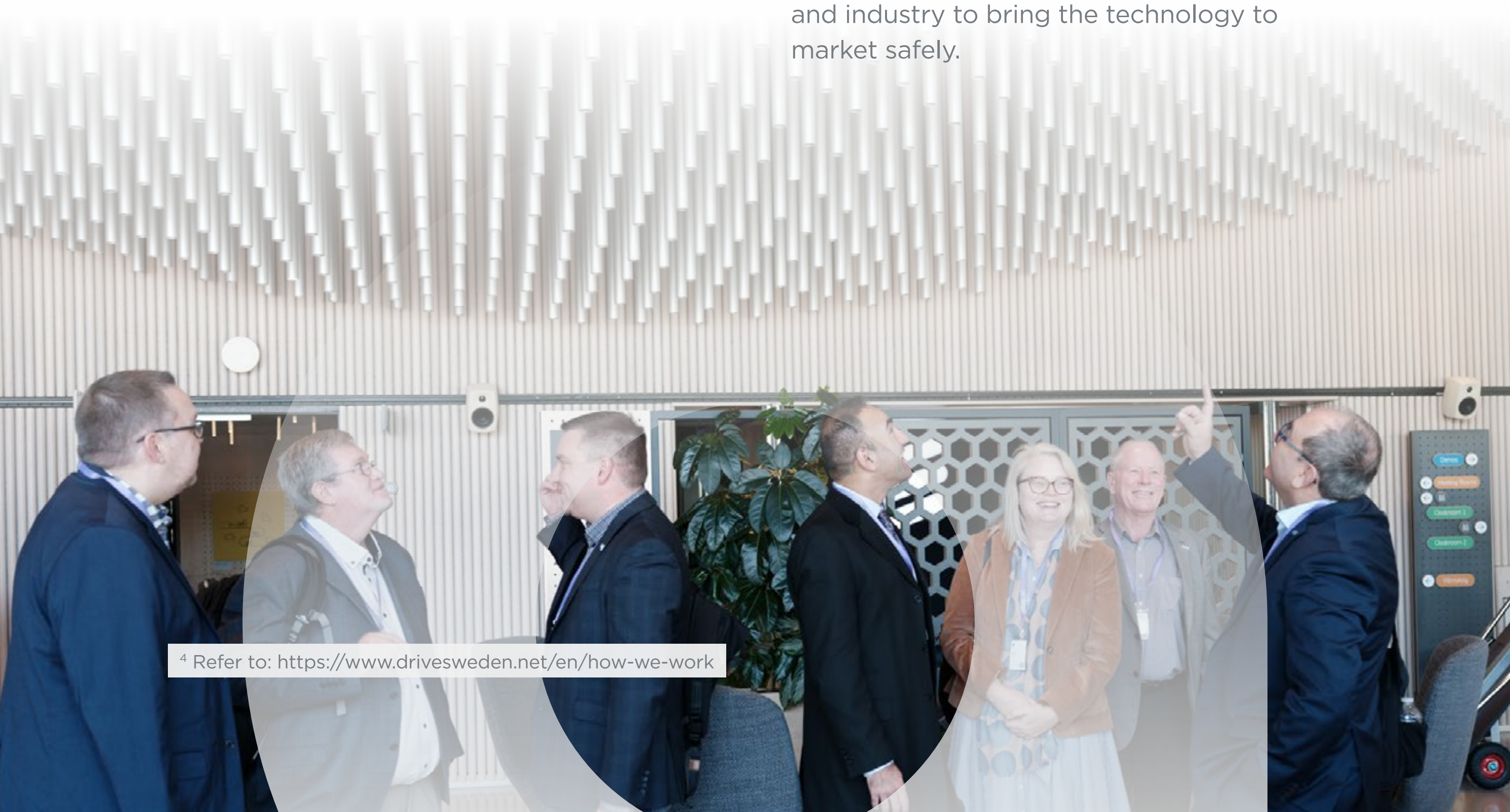
In the UK, the national government sits at the centre of this ecosystem. After 'driverless cars' were first presented as an opportunity in the *National Infrastructure Plan 2013,*[3] the preparation for connected and automated mobility has been heavily funded and strategically led. Collaboration within government is strong, recognising the broader outcomes it is hoped the technology will address. For example, the Centre for Connected and Autonomous Vehicles is a joint Department for Transport and Department for Business, Energy & Industrial Strategy unit. It brings together industry, academia and all levels of government to test and develop policy and to build UK capabilities and supply chains. Government and industry collaboration is also strong, which has helped to create an ecosystem of supporting agencies, diverse and extensive trialling partners, innovative research facilities and increasing capabilities within industry and different levels of government to support the transition to connected and automated mobility.

Sweden's innovation ecosystem is dominated by the 'triple helix' approach, which sees strong collaboration between government, industry and academia to deliver public outcomes. The CCAT delegation saw this model in action in Sweden's preparations for connected and automated transport. Industry leadership is driven by large, established players and smaller new entrants. We met with Ericsson and Scania, who showed us how they are shaping preparations for connected and automated transport through advocacy at the national level and leadership in international forums.

[3] HM Treasury. (2013).
National Infrastructure Plan 2013, London, p 65.

New entrants to the transport sector like Einride, a heavy freight transport service provider, are demonstrating new business models that can disrupt established ways of working in sectors like freight and logistics. At the same time, the government is investing in advanced research and testing for connected and automated driving through initiatives like the AstaZero test bed, the world's first proving ground and research institute for active safety and automated driving. Government and industry collaboration was demonstrated in discussions with Drive Sweden, a government funded strategic innovation program with 200 partners that collaborate to co-create, test and demonstrate new connected, shared and automated solutions that can contribute to more efficient use of vehicles, street space and road infrastructure in Sweden.[4]

In Germany, the government has moved quickly to enable connected and automated transport alongside an established industry that is quickly developing the technology solutions. The federal government has acted early to enable automated vehicle deployments through regulatory change, while the national rollout of C-ITS infrastructure is being managed by Autobahn GmbH. Autobahn and the Ministry for Digital and Transport work closely together on the planning and deployment of future transport technologies while also being strongly linked to the Ministry for Economic Affairs and Climate Action. Original equipment manufacturers like Daimler Truck are partnering with technology companies to introduce connected and automated solutions into their fleets, while others like BMW are focusing on delivering these solutions alone. Underpinning the deployment of the technology is a heavily funded research sector supported by federal and state government and industry to bring the technology to market safely.



[4] Refer to: https://www.drivesweden.net/en/how-we-work

Learning 3: Testing and research address implementation

European testing and research are geared towards implementation in the real world. Proving connected and automated transport technologies involves testing in diverse environments including living labs, test sites, mobility corridors and simulation. Research and testing also goes beyond testing the technology itself – for example, to look at integration into transport systems, how regulation will operate, and ethical deployment. Large amounts of project-based and long-term funding from government and industry are supporting this environment.

The CCAT delegation saw first-hand how a multifaceted testing and research environment is essential to safely move connected and automated technologies from development to deployment. We visited public urban testbeds, research laboratories and private test sites, and heard how enormous amounts of public and private funding are maintaining this research environment.

The delegation visited urban public testbeds in the UK and Germany. In London, we visited the Smart Mobility Living Lab (SMLL), which is run by the Transport Research Laboratory (TRL). SMLL is a physical testbed bought by the UK Government and partly funded by a government and industry consortium. The 'living lab' concept allows for testing of new technologies within the kinds of environments they will be deployed in. This in turn can enable a faster transition from trial to market-readiness.

SMLL consists of a 24-kilometre route in the Borough of Greenwich with more than 200 camera locations, vehicle-to-everything (V2X) units, roadside cabinets that connect to data centres, and a private fibre network. Public and private organisations can trial there at the early concept stage or commercial pilot stage.[5] Components, cars, code, connected applications and complete service models can be tested and validated in this real-world environment.

The German Aerospace Center's (DLR) Institute of Transportation Systems' test facilities include a stretch of dual two-lane motorway in Lower Saxony that is instrumented with cameras and allows for the testing and validation of automated driving functions on motorways and in the city. The data gathered through cameras replicates

[5] Refer to: https://smartmobility.london/test.

the data that in future will be collected by connected vehicles and infrastructure. The data from the motorway is received live, and a connected and automated vehicle can be inserted into live traffic through simulation. Their mosaic laboratory has connectable simulators that can demonstrate the interaction of different kinds of road users, vehicles and infrastructure (including the only bicycle simulator in the world). This research will be able to show what kind of infrastructure is needed to support advanced vehicles.

As well as urban test beds, in Sweden we heard from AstaZero about its independent testbed in a forest near Gothenburg. AstaZero is designed for testing and research on active safety and automated driving. It is owned by RISE Research Institutes of Sweden, an independent, state-owned research institute. AstaZero is open to any organisation to test vehicles and the complete system and environment on which they are operating. Its test environments include a high-speed area, multilane road, rural road and indoor 'DryZone'. The FLX Zone is an adaptable environment for testing transport and logistics in urban areas. Connectivity includes 5G, V2X and wi-fi. AstaZero also has access to expertise from RISE's more than 3,000 employees.

The CCAT delegation heard about the importance of simulation testing. Simulation is vital for testing the technology in complex scenarios and edge cases. Testbeds that have digital twins that allow for simulation testing also provide a way to validate both test methods. SMLL, DLR and AstaZero all provide for simulation testing in digital twins of their physical testing environments.

Companies of course have their own test sites. The CCAT delegation visited Scania's Gläntan circuit in Södertälje, Sweden, where we were lucky to see automated haul trucks undertaking a range of tasks without even a safety driver. The testing done at this site is 'factory testing', with tests then taking place in the customer's region – whether with the customer or on another site. In this instance, the trucks we saw were being tested for Rio Tinto mines in Western Australia.

Cross-border mobility corridors are another way that Europe is preparing for connected and automated transport. Ericsson is involved in the Trans-European Transport Network (TEN-T). TEN-T involves the creation of core network corridors that connect all European Union member states via various transport modes (road, rail, in-land waterways and transport hubs). These corridors have coordinated, multimodal transport infrastructure such as electric charging infrastructure and 5G. Autobahn's C-ITS Corridor Joint Deployment with the Netherlands and Austria involved a corridor between Rotterdam, Frankfurt and Vienna. The project took place from 2013 to 2021 and included the installation of short-range communication and cellular networks to deliver use cases such as roadworks warnings. At the end of 2021, roadworks warnings began real operations on German motorways. We also met with Q-Free and Einride who spoke about their involvement in the MODI trial, which will involve testing an automated truck within a logistics corridor between Rotterdam and Oslo.

Testing and research goes beyond proving the technology. DLR's Institute of Transportation Systems looks at how automated technologies will be integrated into the transport system rather than focusing on the technology itself. Also in Germany, Fraunhofer IKS's research focus is 'safe intelligence,' aiming to ensure cognitive cyber-physical systems are safe and trustworthy.[6] This is a challenge in a dynamic environment, where traditional approaches to the safety of automotive electronics and software cannot manage the increasing complexity and uncertainty of new technologies. Its unique approach brings together computer scientists with machine ethicists and philosophers. Core industries include mobility and off-highway domains, and the CCAT delegation heard about projects including AI-based road condition recognition using tyre noise patterns and AI-based automated manoeuvres for road vehicles.

Trials are also a way to test frameworks. Autobahn discussed the ATLAS-L4 research and development project, in which an industry and research consortium will develop a highly automated truck for hub-to-hub testing between logistics centres on Autobahn expressways. This project is fully funded by the Federal Ministry for Digital and Transport.

As well as testing the technology, the ministry is using the trial as the mechanism to further develop the approvals process under Germany's already-enacted automated driving legislation.

Enormous amounts of money go into testing facilities and research from both industry and government, and large consortia are involved both in establishing testing and research programs and delivering projects. The UK Government has put hundreds of millions of pounds into funding rounds for trials (matched by industry), with these rounds gradually narrowing from exploratory through to only commercially viable use cases. The MODI project will cost €28 million over 3.5 years, while the BMW-led Tempus test field will cost €15.64 million. Scania is rebuilding its test track for autonomous and electric vehicles at a cost of one billion Swedish krona (about 140 million AUD). In Germany, both the DLR and Fraunhofer IKS are funded in part by government, industry and competitive tenders for projects. Total revenue for DLR's Institute for Transportation Systems is 70 million, while DLR itself has revenue of over 1 billion.

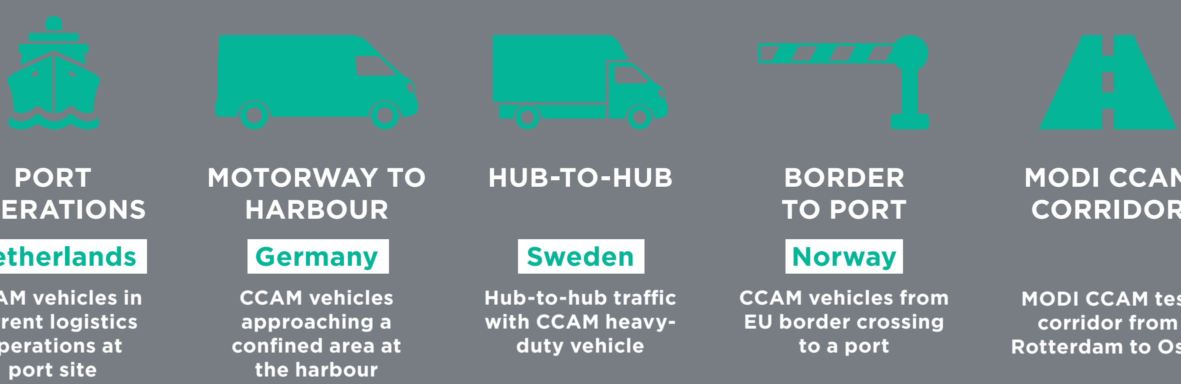
[6] Refer to: https://www.iks.fraunhofer.de/en/institute.html.

Case study: Trialling as a way to test business models, infrastructure and regulatory frameworks – the MODI project

In Stockholm, the CCAT delegation heard from Einride and Q-Free about their involvement in the MODI project. The MODI project aims to accelerate the introduction of connected, cooperative and automated mobility (CCAM) vehicles to improve European logistics chains. It will do this by testing autonomous vehicles in five use cases from the logistics supply chain. It is delivered by a 34-organisation public-private partnership from eight countries.

Q-Free creates intelligent solutions for efficient, safe, and environmentally friendly transportation based on innovative technology and open platforms. They described their involvement with Einride in the MODI project's border to port use case, which covers a logistics corridor from Rotterdam to Oslo. It includes a border crossing across a bridge, which will raise a number of challenges to work through including different traffic regulations (e.g., default speed limits and headlight rules), maps and map coordinate systems (national grid systems), cybersecurity trust anchors and mobile network services.

FIGURE 1: THE FIVE MODI LOGISTICS SUPPLY CHAIN USE CASES [7]



[7] Refer to: https://modiproject.eu/about/#use-cases.
Image credit: MODI project.

Learning 4: The pipeline is becoming clearer

In Europe it appears that hub-to-hub heavy vehicle freight and mass transit applications are the nearest-to-market use cases for automated road transport. It is not a coincidence that these use cases seem to have the strongest business case. C-ITS technology is here and can provide safety and productivity benefits now; national roadmaps for its rollout are already being implemented. The role of the vehicle manufacturer is evolving into service provision, and new entrants to the market are demonstrating new ways of doing business.

Though timelines for the deployment of automated transport have slowed, it is clear that the technology is coming. Some use cases and trends are emerging faster than others.

Automated trucks are in development by multiple manufacturers and their partners, with a particular focus on hub-to-hub (highway) freight tasks. We heard from Scania, Iveco, Daimler Truck and Einride that the business case for this use case is strong given issues like driver shortages and operating costs, and the lower level of complexity that automated driving systems need to manage on highways. The automated trucks being developed operate at level 4 automation; level 3 does not appear to provide any real benefits for this use case.[8] Projected timelines may see these vehicles commercially deployed by the end of this decade, with an initial focus on North America and then Europe.

[8] Levels of automation are described in SAE International's SAE J3016.

Mass transit applications such as automated buses, shuttles and rapid transit (e.g., Luton DART) are being pursued, particularly in the UK where they align with broader outcomes sought from new transport technologies.

Automated light passenger vehicles such as private cars or robotaxis do not seem as close to commercialisation in Europe as they are in the United States. Urban environments are complex, and the business case and commercialisation to offset increased vehicle costs is a challenge. A greater level of public acceptance is also required. However, the application is being pursued. The CCAT delegation met with BMW, who have approval for vehicles operating at level 3 automation in limited scenarios on highways in Germany. And in the UK, the Cambridge Connector project will see on-demand, self-driving taxis operating around university campuses and integrated with existing transport services.

The CCAT delegation did not hear from any companies developing vehicles with level 5 automation.

The CCAT delegation also learned about use cases in off-road domains. Automated trucks are being used on private sites, with mining and port environments having their own business case but also providing learnings for manufacturers to take into more complex public domains. Connected and automated machines are a focus for construction sites in the UK. At DLR, the CCAT delegation saw a remote operation work desk for rail, designed by human factors experts. It could be used to monitor and manage multiple trains.

Some technologies have been tested and deprioritised. TRL spoke about its HelmUK advanced platooning trial that evaluated how connected platooning might influence transport operations. Sponsored by the UK Government, the trial consisted of three 40-tonne articulated heavy good vehicles operating on motorways with driver-assisted platooning at a 0.8 second time gap. Findings included that platooning was functional and safe with no effect on driver workload, but drivers were still required to manage most junctions. Ultimately, limited fuel savings meant the business case was not strong and would likely mean limited industry uptake initially. It was noted, however, that trial changes such as using cooperative rather than close platooning, or having dedicated freight lanes, would have resulted in higher fuel savings. As well, productivity benefits such as addressing driver shortages were not a consideration for the trial.

Business models in road transport are also changing. Vehicle manufacturers no longer provide just the vehicle but offer services enabled through connectivity such as data provision and transport and logistics management. We heard this particularly from the heavy vehicle manufacturers, but BMW also noted its connected services such as cloud-based dynamic mapping and over-the-air upgrades in passenger vehicles. Einride is a new type of transport service provider that offers its customers an entire turnkey solution for freight routes. In London, we met with software developer Oxa. Oxa not only develop automated driving systems for its customers but also mobility platforms, journey monitoring and booking systems.

While some vehicle manufacturers like Scania and BMW develop automated technologies in-house, others like Daimler Truck and Iveco are partnering with software companies that develop the automated driving systems that are incorporated into their vehicles. The software providers themselves also have different solutions, some of which encroach on the role of traditional vehicle manufacturers. Conigital, a software company we met in London, can either retrofit or custom build automated vehicles for industrial and commercial fleets.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Case study: New business models – Einride

Einride is a transport service provider that provides its customers with fully electric and cost competitive shipping of goods from A to B, focused on heavy duty road freight. Customers make no capex investment because Einride provides an entire turnkey solution. Einride sources the vehicles and operational partners (e.g., drivers, insurance, maintenance) and provides the charging infrastructure. Einride also provides the 'brain' that manages the fleet, 'Saga'. Saga is fuelled by data and powered by AI; its functions include monitoring the vehicle battery, driver rest tracking and fleet management. When a customer route is determined to be safe, the vehicles can also run autonomously, with a remote supervisor monitoring operation. The CCAT delegation saw how driving jobs might change in the future, with drivers still required for this remote monitoring role and potentially for driving trucks for any parts of the journey outside of the automated hub-to-hub route.

Image credit: Einride

Learning 5: Legacy infrastructure will not be enough

Both digital and physical infrastructure play an important part in supporting automated technologies.

The connected infrastructure that supports C-ITS can create safety and productivity benefits now, and act as an enabler for faster and safer rollout of automated transport technologies. National planning and investment are facilitating the harmonised rollout of this technology, while the standardisation of V2X technologies remains unresolved.

Physical infrastructure also plays an important part in the rollout of automation. While there does not seem to be a push from either government or industry to significantly upgrade the physical condition of the road network to accommodate automated vehicles, maintaining good road condition is vital to enable commercial operators and consumers to use their vehicles to their maximum capability and in an undisrupted way.

The vehicle manufacturers the CCAT delegation spoke with were not planning for their automated vehicles to rely on changes to infrastructure. However, researchers showed us that it is unrealistic to expect the technology to be 100 per cent safe, just as human drivers are not. Investment in digital and physical infrastructure changes will enable the safer, faster and uninterrupted deployment of automated transport.

CONNECTED INFRASTRUCTURE

Both DLR and Fraunhofer IKS noted the importance of connected infrastructure in delivering both a safer road network now and the safe deployment of automated vehicles in the future.

Governments are prioritising C-ITS now. In Germany, the rollout of consistent national C-ITS infrastructure has been facilitated by the transfer of the management of Germany's motorway network from the 16 states to Autobahn GmbH. The CCAT delegation heard about Autobahn's 10-year C-ITS rollout plan. Autobahn aims to use intelligent transport management to deliver a safe and reliable road system that will also enable automation and electrification. They are working with vehicle manufacturers on various communication solutions including wi-fi, cellular and a national access point for data exchange. A comprehensive suite of connected services is being delivered in the rollout plan. The first use case, roadworks warnings, was deployed in 2021. Autobahn cited reduced risk of accidents, more efficient traffic flow and lower carbon emissions as key benefits of this use case.

Given the broader imperatives for automated technology such as driver shortages, road safety and decarbonisation, connected infrastructure also provides an opportunity to deploy automated vehicles faster and gain these benefits sooner, rather than waiting for automated technologies to be 100 per cent perfect – which is unlikely.

For example, DLR noted that traffic light signals are designed for human–infrastructure interaction. While cameras on vehicles can detect traffic lights well, this detection is not always perfect, which has seen automated vehicles disrupting emergency services in early deployments in the United States. This could be addressed by moving to vehicle-to-infrastructure (V2I) communication between smart traffic lights and automated vehicles. Traffic light programming could also be modified to avoid situations that are difficult for automated vehicles to handle or situations with a high conflict potential.

Fraunhofer IKS showed that the question is not necessarily how to bring vehicle technology up to a 100 per cent standard – but instead, how to engineer a safe solution and minimise risk once understanding the limitations of the technology. Ultimately, there should be a balance between equipping the vehicle and equipping the infrastructure to enable deployment.

BMW highlighted some specific connected infrastructure learnings. For automated driving on roads without oncoming traffic, vehicles will use a precise high-definition map with frequent over-the-air updates. As such, 4G coverage should be approximately 99 per cent available on roads in the vehicle's operational design domain. For urban traffic, real-time traffic light information could already create large improvements for the operation of current advanced driver assistance vehicles but is seen as a precondition once vehicles are operating at level 4 automation. BMW also noted they did not see a need for vehicle-to-vehicle communication.

At the same time, there are challenges that need to be resolved to roll out connected technologies successfully. The VDA, the German Association of the Automotive Industry, touched on the issue of standardisation for V2X communications. Original equipment manufacturers do not want to put both 5G and dedicated short-range communications (DSRC) systems in their vehicles, and some are choosing to pursue one or the other. This then becomes a problem for infrastructure providers deciding which systems they should build their connected infrastructure for.

PHYSICAL INFRASTRUCTURE

Both Autobahn in Germany and National Highways in the UK noted that companies responsible for automated vehicles should ensure their driving systems can operate on the roads in their current condition. However, National Highways noted that this might mean that approved operational design domains for automated vehicles could be quite limited, while Autobahn noted that if road conditions became degraded due to maintenance issues, it might necessitate the suspension of approvals to operate automated vehicles.

National Highways did note the importance of automated vehicles being as safe as possible, and for that reason, the organisation was looking at what standards could be tweaked to bring up the road condition. More fundamental changes were not being considered in the near-term.

Physical infrastructure choices can also optimise other outcomes from the technology beyond safety. The HelmUK trial showed that driver-assisted truck platooning showed small fuel savings that were not likely to provide enough of a commercial imperative for fleet operators. However, it is likely that fuel savings would be greater if changes to junction design were made to accommodate platooning, or if dedicated freight lanes were used. The business case for this investment would of course need to be considered.

Case study: C-ITS rollout in Germany

In 2018, Autobahn GmbH was established to manage Germany's highway network, in a transfer of power from state to federal government. It commenced operations in 2021. Among other efficiencies, this restructure has allowed for a harmonised C-ITS rollout plan for Germany. A full suite of connected services is being developed, including warnings about roadworks (already deployed), emergency vehicles, maintenance vehicles and traffic jams, tunnel information, weather information and route advice, as well as cellular and DSRC[9] networks and a more standardised network of traffic centres. The first deployment, roadworks warning, enables drivers to receive warnings on their in-vehicle display systems that they are approaching short-term roadworks. ITS roadside units communicate with the vehicle via DSRC, and original equipment manufacturers can opt-in to put the requisite Autobahn software in their vehicles to receive this data. In the future, these roadside units will also be able to receive information.

Long term, Autobahn noted the virtualisation of roadside infrastructure where dynamic data from the road can be brought directly into vehicles without requiring roadside infrastructure. This step-change would require new approaches to interoperability, standardisation, IT security and data privacy, among other things.

Figure 2: C-ITS AT A GLANCE, AUTOBAHN GMBH

Image credit:
Autobahn GmbH des Bundes, Germany

[9] DSRC is referred to as ETSI ITS G5 in Europe.

Learning 6: Early regulatory frameworks can guide industry development

Regulatory approaches to enabling automated vehicles differ, but countries are moving closer to implementation. Germany and the UK have quickly moved to develop legislative frameworks for the commercial deployment of automated vehicles. Frameworks are harmonised nationally, while international harmonisation remains a future goal. Germany's legislation aligns with the emergence of nearer-to-market use cases like hub-to-hub transport and mass transit on fixed routes, providing some certainty to manufacturers about their path to deployment. The German Government is using trials to operationalise statutory roles.

The UK Government has a roadmap to 2025 for the deployment of automated vehicles. At this end point, the safety assurance approval scheme and legislative framework will be in place. This has been designed to coincide with the completion of the government's commercial deployment pilots, when commercial services will become ready for investment.

The government has moved quickly to enable automated vehicles through regulatory change. Since 2017, it has introduced an insurance framework, developed cybersecurity principles, and revised the Highway Code to include the term 'self driving'. A complete national regulatory framework for the commercial deployment of automated vehicles was developed by the Law Commissions of England & Wales and Scotland and consulted on over 2018–2022. The Australian regulatory framework provisionally agreed by ministers is highly regarded, and the UK framework draws on concepts developed here. However, though the UK started developing its framework after Australia, the UK has now moved beyond Australia in the implementation journey. The UK Government quickly accepted all the Law Commissions' recommendations and now has a Bill awaiting introduction to the parliament.

In Germany, the pace of regulatory change has been even quicker. Federal legislation has been passed to allow both level 3 and level 4 automated driving in limited operational design domains. Level 4 operation does not require a driver present in the vehicle, but does require a remote operator, who can oversee multiple vehicles. The use cases enabled through this legislation align with the technology being developed by multiple manufacturers that CCAT met with. Manufacturers could therefore see Germany as a market for early commercial deployments.

Though the enabling framework has been legislated, we heard from Autobahn that the responsibilities of those in the authorising environment for level 4 approvals and the approval criteria have not been fully established. Instead, the regulation provides the foundation for further operationalisation and evolution of these roles through trials like ATLAS-4. The legislative framework includes separate approvals for a manufacturer to receive a licence to operate in an operational design domain (assessed by the Federal Motor Transport Authority) and the specific operating area intended for use by the registered operator (assessed by road authorities – including Autobahn for all motorways). Autobahn noted these separate approvals may present challenges for scalability long-term.

Though the UK and Germany are creating national frameworks to accommodate automated vehicle supply and operation, the longer-term intention is to harmonise at least first supply requirements with international type approval standards as they develop.

In Sweden, Scania emphasised the importance of international harmonisation in the standards for autonomous trucking solutions. They are actively engaged with international bodies developing harmonised regulations for automated vehicles, including the United Nations Economic Commission for Europe (UNECE), the International Organization of Motor Vehicle Manufacturers (OICA), the European Commission and the European Automobile Manufacturers' Association.

Scania welcomed efforts to implement OICA and the European Association of Automotive Suppliers' automated driving regulatory roadmap to 2025. This includes finalising guidelines for the regulatory approval of automated driving systems and a new assessment and test method at the UNECE level. However, Scania saw a need for further work to reach the 2025 target of a framework to certify an automated driving system. This included planning for regulatory activities and a review of vehicle categorisation for automated vehicles.

In the UK we also heard from the Department for Transport and National Highways about their connected and autonomous plant roadmap to 2035. This provides a pathway to deliver automation in construction. One of the first steps has been to develop a framework to classify levels of automation. The framework provides clarity about the capabilities of different machines, providing a common language for industry to aid deployment of the technology on construction sites.

Learning 7: Emerging challenges concern people and data

While we have seen much progress to prepare for connected and automated transport on various fronts, emerging challenges have the potential to impact deployment. Major public policy commitments cannot be achieved without public support, and public acceptance is necessary if the technology is to be taken up and its expected benefits realised. The workforce must have the right skills to manage the technology. And the boom in the generation of data will lead to competing demands for its use, which must be managed securely and fairly.

The UK, Germany and Sweden have recognised that emerging challenges associated with the deployment of connected and automated transport must be prioritised.

PUBLIC ACCEPTANCE

Connected and automated technologies have the potential to deliver a number of benefits to society. But the technology is only part of the journey to deployment. If the community does not accept the technology, they will not use it.

The issue of social licence for automated vehicles was repeated by many stakeholders the CCAT delegation met with. Stakeholders agreed that public acceptance is critical, with safety assumed to be a key influencer for this acceptance. Fraunhofer IKS noted the importance of the technology being both safe and trustworthy for the public to place their trust in automated systems, and they suggested that standards were needed so societal expectations can be defined, with systems being designed and measured to meet those expectations.

The media also plays a significant role in the public's acceptance of the technology. In the UK, we heard of headlines about 'death trucks' describing the HelmUK trial. In the example of that trial, this criticism was unwarranted given the safety outcomes achieved – showing that regardless of the safety case, the media can contribute to public distrust of the technology.

The UK Government aims to increase public trust in connected and automated mobility by the time of expected early deployments in 2025. To meet this objective, the government is planning engagement on public priorities for the technology and communicating with road users about how to use and interact

[10] HM Government. (2022). Connected & Automated Mobility 2025: Realising the benefits of self-driving vehicles in the UK, London, p 13.

with automated vehicles.[10] Current initiatives being led by the Centre for Connected and Autonomous Vehicles include a connected and automated mobility adoption vision that sets out the societal benefits this type of mobility can achieve. The government is also delivering a report on how the community might use the technology in their local areas, based on public perception studies from all projects to date.

Safety concerns are unlikely to be the only factor that will impact public acceptance. Automating driving tasks in commercial fleets will influence those in driving jobs. Given the expected early use cases, truck drivers are likely to be one of the first groups affected. However, many stakeholders emphasised the importance of changing the narrative as they considered the extent of the global driver shortage and the increase in the global freight task meant it was unlikely that current jobs will be lost. Even where driving roles are affected, we heard that jobs would stay but tasks might change – such as being involved in customer experience on automated mass transit or remote monitoring for automated trucks. We even heard that the automation of hub-to-hub tasks could create improved work-life balance for drivers because they could spend more time in their communities focusing on first and last mile tasks or remote monitoring. As well, the creation of jobs in fields like engineering will mean there are more job opportunities for people in other fields.

WORKFORCE CAPABILITY

The connected and automated transport sector is a quickly expanding market of huge scale. Many new skills will be required in high volume – for example in engineering, computer and data science, and cybersecurity. Current professionals such as mechanics, network managers and road engineers may need to advance their skill sets to manage increasingly advanced technologies. Even Autobahn noted that new vehicle engineering capabilities would be required for them to take on their new role in the authorising environment for automated vehicles in Germany. Preparing for these shifts will take a concerted effort to ensure the workforce has the right capabilities to manage these new technologies.

DATA EXCHANGE

There are numerous issues about data that are still under debate. Connected and automated vehicles and infrastructure will produce vast amounts of data which can be used for many purposes – from ensuring the safety of road users to optimising road networks or aiding traffic enforcement. Fraunhofer IKS noted industry debate on whether there should be a central capture and analysis of this data. Vehicle manufacturers are unlikely to provide open access to their data sources given their customers' privacy concerns, but it raised the question of whether there should be a level of mandated open data as there is in the airline industry. The government agencies the CCAT delegation spoke to noted they were continuing to work with vehicle manufacturers to determine what information they could get from advanced vehicles.

BMW spoke of its 'car data platform', available in Europe and the United States. It gives customers full control over their data and its use while allowing secure exchange of vehicle data with others if they give their consent. For example, a customer can give permission to share information with an insurer. On the other hand, some companies are seeking to keep ultimate control over data, with customers like fleet operators paying a subscription to access data (while benefitting from the support provided).

At the same time, stakeholders were concerned about cybersecurity. Ericsson noted the increasing vulnerability of the transport sector to this challenge. Increasing connectivity will mean increasing the ability for hacking to disrupt fleets, traffic signs and in-vehicle systems. Addressing this risk must be a part of the technology rollout.

Learning 8: Decarbonisation is inextricably linked

Decarbonisation is the primary challenge facing the transport industry. The rollout of charging infrastructure provides a major obstacle to the rollout of electric vehicles, but there is also growth and innovation in the sector that is facilitating the decarbonisation journey. There is a link between the zero emissions, connected and automated journeys, and the time to harness this to support the transition to connected and automated transport is now.

CCAT's remit focuses on connected and automated transport, and therefore the CCAT International Outreach set out to learn how organisations are preparing for connected and automated technologies. Nevertheless, the foremost challenge currently facing the transport industry is decarbonisation of the sector, and this featured in many of the delegations' discussions with stakeholders. The CCAT delegation learned about the obstacles and innovations in the journey to zero emissions and heard how connected and automated technologies have a role to play in that journey.

OBSTACLES

The transport sector faces a complex set of challenges as it seeks to reduce carbon emissions. Transitioning internal combustion engine vehicles to cleaner technologies like electric vehicles is not just a matter of vehicle supply but, among other things, requires a massive overhaul of infrastructure including installing widespread charging networks. Although the countries the CCAT delegation visited are making progress towards local and European Union targets, there appears to be a mismatch between targets and growing vehicle supply on the one hand and the pace of the infrastructure rollout on the other. For example, the current rollout of public charging points in Germany is approximately 300–400 per week, though some targets would effectively require 2,000 public charging points per week. BMW estimated that at minimum, one charging point is required for every 20 vehicles. The VDA in Germany noted that challenges in the charging infrastructure rollout included supply chain issues for raw materials and parts caused by the COVID-19 pandemic and the war in Ukraine, and the need for grid development by the energy industry. They highlighted the importance of more international cooperation to improve national resilience.

Heavy vehicles pose unique challenges due to their high energy demands and limited alternative fuel options, and to date there has been a lack of heavy vehicle charging infrastructure. The CCAT delegation heard that liquid hydrogen and other CO2 neutral fuels will remain part of the ongoing solution in the heavy vehicle sector in the mid- to long-term, as well as biofuels in Sweden. This requires planning for other kinds of infrastructure like hydrogen refuelling stations.

Proposals for change discussed by the stakeholders we met with in the UK, Sweden and Germany include:

- Increasing investment in the infrastructure rollout and subsidies to incentivise companies and users to transition from internal combustion engine vehicles.
- Replacing charging infrastructure targets based on number of chargers with targets based on kW supply.
- Increasing the development of and access to the energy grid.
- Reviewing the structure of penalties and who they are applied to.
- Considering approaches to CO2 standards and pricing for heavy vehicles.
- Adjusting targets to accommodate the mix of fuels, such as electric, hydrogen fuel cell, hydrogen combustion and biofuels.
- Allowing longer, heavier trucks and increasing the allowable driving weight for drivers on a normal licence (because electric trucks are heavier).
- Harmonising standards on truck dimensions across national borders.

INNOVATIONS

All governments have decarbonisation plans and goals specifically for the transport sector. As well, Sweden and Germany are subject to comprehensive European Union targets. When the CCAT delegation visited Stockholm, Transpörtforetagen, the Swedish Confederation of Transport Enterprises, noted that they were waiting for the Swedish Government's next climate policy action plan. The plan, which must be produced by each new government every four years, provides important direction for industry on how climate goals are to be achieved.

Vehicle manufacturers and service providers all demonstrated clear progress and plans for the supply of electric and other clean vehicles. Scania, Iveco and Daimler Truck are all developing electric heavy vehicles. Einride has 500 battery electric trucks on order with numerous vehicle manufacturers, the largest order book in Europe and the United States. Ten per cent of BMW's customer purchases are now battery electric vehicles, with a target of 50 per cent by 2030. BMW is also trying to reduce its CO2 footprint during battery cell production.

Transpörtforetagen showed how they are encouraging more sustainable practices amongst their members in the road freight industry with their simple but innovative 'Fair Transport' certification. The certification independently assesses companies' performance in environmental responsibility, road safety and good conditions for employees. Criteria include the existence of climate policies, renewable fuel use and the sustainability of the fleet. The scheme is gaining momentum, with 10 per cent of their members' fleets already certified (more than 400 Swedish haulage companies). Members are increasingly incentivised to join as their customers begin to recognise the certification.

THE JOURNEY FROM ZERO EMISSIONS TO CONNECTED TO AUTOMATED

The CCAT delegation heard how many organisations see connected and automated transport as a contributor to the decarbonisation agenda, with more efficient journeys, decreased congestion and more fuel savings expected. As well, more advanced vehicles will likely be cleaner vehicles. In the UK, automated vehicles are assumed to be zero emission vehicles. At the same time, planning is necessary to ensure that optimal decarbonisation outcomes are achieved from connected and automated technologies.

Governments have clearly recognised that connected and automated transport is an important part of the decarbonisation journey, and they are providing clear messages about this to decision-makers and the public.

Vehicle manufacturers are pursuing zero emissions (particularly electric), connected and automated technologies at the same time, but deployment will likely be a journey from electric and connected first to automated when the technology, infrastructure and frameworks are ready.

At Arup, the CCAT delegation discussed the link between the decarbonisation agenda and the journey to connected and automated transport. Zero emissions, connected and automated technologies are not separate but inextricably linked and can be part of a coordinated approach. In today's world, where the clean transition is of the utmost importance, we have a unique opportunity right now to bring the planning for these technologies together.

Case study: Growth and innovation from charging infrastructure suppliers

The CCAT delegation attended the Power2Drive International Exhibition for Charging Infrastructure and E-Mobility in Munich, where we were able to engage with a staggering 415 suppliers presenting their products and services related to charging infrastructure and e-mobility. The exhibition was part of 'The smarter E Europe' conference and exhibition for Europe's energy industry, which included more than 2,400 exhibitors on-site.

The delegation spoke with suppliers of charging systems, electric vehicles, traction batteries and mobility services. The number of newly registered electric cars has risen rapidly worldwide, including in Germany where new registrations of electric vehicles per month exceed internal combustion engine vehicles. We saw that the development of charging systems reflects this upward trend, with the number of manufacturers and suppliers growing significantly and the variety of products on the market steadily increasing. Power2Drive itself had more than twice as many products and exhibitors since it was last held in May 2021.

Learnings from Power2Drive include:

- Charging points will be required in multiple domains – in the private sector, at home, on company premises and on public infrastructure. Public charging points will gain in importance quickly.
- For supply security in particular, it is important for authorities to provide basic nationwide supply. This will be increasingly important as fast charging stations are deployed on public areas and on roads.
- It is important to pay attention to forward-looking criteria such as the controllability of charging solutions and the use of electricity from renewable energy.

The CCAT delegation saw a number of innovative charging solutions. Power2Drive Award winner Hive Power has a software platform that enables fleet managers and original equipment manufacturers to use their connected electric vehicles to feed unneeded power back to households or the grid, maximising the profitability of their fleets.[11] We also saw automated charging options such as devices allowing fully automated battery swaps and automated digital charging robots.

[11] Refer to: https://www.hivepower.tech/flexo/smart-charging.

Learning 9: Silos will impede the future transport transition

The transport, technology and energy sectors are converging quickly. Alignment is needed in a number of contexts to ensure transitions in these sectors on various fronts are managed effectively. Preparing for future transport in sector-specific silos will only impede implementation.

The CCAT delegation learned about the benefits of collaboration across government and between the government, industry and research sectors in the transition to connected and automated transport. But the biggest coordination challenge comes from the need to effectively manage the increasing confluence of the transport, technology and energy sectors. This requires aligned planning across sectors, particularly to ensure future-proofed infrastructure. In this regard, there are still challenges in sectors working together and silos persist.

Ericsson stressed the importance of changing this. They discussed the increasing integration of sectors and showed how the harmonisation of business models, value chains and regulations across critical infrastructure is crucial for enabling safe and efficient mobility services over geographical domains. Alignment is needed throughout the infrastructure lifecycle – during its planning, development and operational phases.

The CCAT delegation saw how infrastructure decisions such as those about the rollout of C-ITS should be made in coordination with other sectors that will use the same assets. Ericsson focused on 5G, now an integral part of digitalisation across mobility services, such as vehicle operation, fleet management, traffic management and infrastructure management. Ericsson shared its perspective on cross-sector digitalisation, showing how technology horizontals including 5G overlay multiple sector verticals such as transport and energy. Ericsson's answer is to focus on digital infrastructure without being industry- or service-specific. They noted the potential to share assets across sectors if cross-sector digitalisation is done successfully.

They also noted that ensuring assets have 5G at the outset is much less difficult than trying to retrofit them later.

Importantly, the CCAT delegation observed that without the cooperation and coordination of the transport and energy sectors in particular, there is a very real risk that decarbonisation of the transport sector cannot be achieved. While transport sector goals for decarbonisation are an important step, they cannot be addressed by the transport sector alone. At the VDA and Transportföretagen we heard that one of the key challenges in the rollout of charging infrastructure for electric vehicles is the increasing demands that will be placed on the grid. The energy industry is lagging in development of the grid, with the view that increased capacity can be developed once the needs of the transport sector are clearer, rather than prioritising anticipatory grid development to enable the future charging network. Einride noted global inequities were already showing, with the ability of the grid to support charging needs varying across countries.

Recommendations

Recommendation 1: Identify the imperatives for connected and automated transport

Connected and automated transport is coming. The experience in Europe shows that with a more strategic vision, appropriate planning and momentum, there are many problems that the technology can solve and local opportunities that can be harnessed through it.

Governments[12] should take an outcomes-based approach to the deployment of connected and automated transport, identifying the imperatives that are important to them and the outcomes they want to achieve from the technology. Research, testing, framework development, infrastructure change and public engagement can then be targeted towards achieving those jurisdiction-specific outcomes. Renewed momentum is necessary to be ready for the technology in time.

Recommendation 2: Establish a coordinated, government-led ecosystem

In Europe we saw joined-up central leadership, meaningful industry collaboration and substantial use of the research sector to inform preparations for connected and automated transport.

Government must recognise the leadership role it has to drive and shape the transition to connected and automated transport. It should create a cohesive ecosystem, where the government, industry and research sectors are all on a coordinated path to deliver connected and automated transport. Within government, relevant agencies including transport, innovation, industry, economic development, energy, climate change should all be part of the transition.

[12] In this section, 'governments' refers to the Commonwealth, state and territory governments of Australia and the New Zealand Government.

Recommendation 3: Ensure testing and research address implementation

Testing of connected and automated transport technologies occurs in many diverse environments. And research and testing in Europe show that the evidence base necessary for safely deploying the technology goes beyond just proving the technology itself, to understanding how it will be integrated into our systems and society. The funding that supports this research and testing ecosystem is vast and focuses not only on specific projects but also on setting up research institutions.

Testing should focus on demonstrating the safe operation of connected and automated technologies for Australian and New Zealand conditions, with government and industry working together to make use of diverse environments including living labs, test sites, simulation testing and mobility corridors within and across jurisdictional boundaries. Research and testing should also focus on the integration of the technology into our transport systems and on addressing societal standards for acceptance of the technology. Research funding from government should look beyond specific projects to fund the longer-term research needs required to support the technology.

Recommendation 4: Understand and prepare for the pipeline

In Europe, use cases for automated transport that solve problems are coming to the fore – automated heavy freight and mass transit in particular. Traditional transport sector roles are evolving, and new business models are emerging.

Given Australia and New Zealand are facing a number of the same imperatives as Europe for connected and automated transport such as driver shortages, governments should take note and prepare for emerging use cases that address these imperatives such as automated heavy freight and mass transit. Regulation, standards and infrastructure should be flexible enough to accommodate not only new technologies but new ways of doing business.

Recommendation 5: Deploy and maintain future transport infrastructure

Infrastructure change can deliver safer, faster and uninterrupted deployment of connected and automated transport, which is important given the many societal benefits expected from these technologies. While manufacturers are planning for automated vehicles to operate on the infrastructure as they find it, research is showing that safer deployment can be achieved with infrastructure changes, particularly the introduction of C-ITS. There is a demonstrable safety case for C-ITS use cases already, and the technology rollout is being coordinated nationally. Standardisation of V2X systems remains an important issue to resolve. Updates to physical infrastructure to support automated vehicles will enable faster deployment, allowing society to receive the technology's benefits sooner. And maintenance of the network is important to ensure businesses and consumers are not disrupted by suspensions to operate automated vehicles either by manufacturers or governments.

The deployment of harmonised, standardised connected infrastructure to support C-ITS should be prioritised by government and industry, and infrastructure providers should improve and continue to maintain physical networks, to ensure the safer, faster and uninterrupted deployment of connected and automated transport.

Recommendation 6: Renew momentum to implement regulatory frameworks

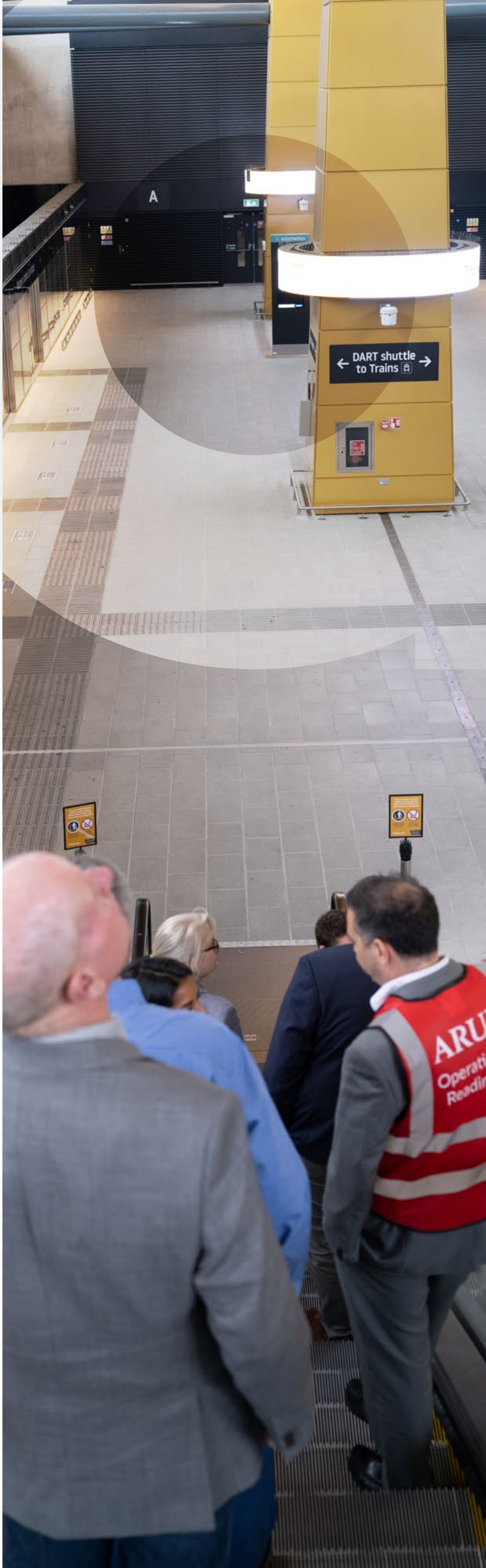
Governments and international organisations are acting quickly to develop regulatory frameworks for the commercial deployment of automated vehicles, while international harmonisation remains important. This not only enables the legal operation of these vehicles but provides a clear signal to industry about the pathway for their investment from trial through to deployment. Trials are being used as a tool to operationalise new statutory roles and ensure effective implementation.

Governments should renew momentum to deliver regulatory frameworks for the commercial deployment of automated vehicles to both enable deployment and encourage investment, while continuing to harmonise with international standards as they emerge. The operationalisation of statutory roles should be tested before or early in the commencement of these frameworks.

Recommendation 7: Prioritise the emerging challenges of public acceptance, workforce capability and data exchange

While we saw much progress to prepare for connected and automated transport on various fronts, emerging challenges have the potential to impact deployment. Governments in Europe have recognised that public acceptance is necessary if the technology is to be taken up and the expected benefits realised, and have begun to prioritise engagement accordingly. The workforce must have the rights skills to manage the technology. And the boom in the generation of data will lead to competing demands for its use, which must be managed securely and fairly.

Government and industry initiatives to engage the public and show them the benefits of connected and automated transport must become a priority. Ideas for bringing the public on the journey include showing them how the technology can be used in their communities, involving them in trials and communicating clear messages to counter negative media and public feedback. Government and industry should also quickly prioritise the identification and development of the capabilities our workforce requires to support the transition to connected and automated transport. Data exchange frameworks must be established to fairly share information that can improve public outcomes while maintaining cybersecurity and individual privacy. Given the number of competing interests, this will be a long-term undertaking requiring national coordination by governments.



Recommendation 8: Recognise the interconnection with the decarbonisation journey

The UK, Sweden and Germany are committed to the decarbonisation of the transport sector, but the transition to zero emissions includes a huge charging infrastructure rollout which is already undermining the ability to reach emissions reduction targets. Connected and automated transport is recognised as an important component in the decarbonisation toolkit.

Governments must ensure the infrastructure to support cleaner vehicles and processes is ready for increased supply from vehicle manufacturers and demand from consumers. Governments must ensure that frameworks and infrastructure are in place to ensure connected and automated transport contributes rather than detracts from the decarbonisation agenda; and the opportunity to link the zero emissions, connected and automated transitions now should be seized.

Recommendation 9: Dismantle sector silos

Future transport can no longer be planned for in a transport sector silo as the transport, technology and energy sectors converge. In particular, decarbonisation of the transport sector is a cross-sectoral issue, requiring fundamental change beyond the transport sector into the energy and land use sectors.

Governments must work across relevant agencies and with industry to ensure the demands of zero emissions, connected and automated transport can be met by the transport, technology and energy sectors. Coordination across these sectors must be prioritised now to ensure silos do not further impede the transition to a safer, cleaner and more productive future transport system.


FusionSolar @Hall C1

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