EXECUTIVE INSIGHTS

Freight Automation Is Coming to Our Roads. Will You Be Ready?

Companies developing AVs are making significant progress in their race to commercialise them. In the US, the California Department of Motor Vehicles alone recorded 6.6 million self-driven test kilometres in 2021,[1] an increase of 110% from the previous 12-month reporting cycle.

Most of these tests were focused on passenger AVs, which also get most of the attention from the media. However, autonomous road freight vehicles (AFVs) are likely to be amongst 'the first cabs off the rank', when it comes to mass commercialisation of fully autonomous technology. This is due to two important differences between AFVs and passenger AVs (explored in further detail in this document):

- Unlike AVs, AFVs can be rolled out in stages: AFVs can be restricted to operate on low-traffic arterial roads/highways and still be a very attractive option for freight companies looking to optimise 'middle mile' or trunk routes. The complexity of navigating such environments is significantly less than that of urban centres, and this use case is more aligned with the current capability of autonomous technology.
- Autonomy can deliver material cost savings: Freight is a commodity service. Early mover AFV adopters will enjoy a structurally lower cost base. Assuming service levels remain the same or improve, price could be used by early-movers to capture market share (whilst profit margins are maintained). The rollout of automation technology by a first-mover industry operator will reduce costs materially (and therefore reduce price), placing pressure on competing operators to do the same. This will drive a rapid adoption of AFV technology across the transport sector. Those who maintain the status quo will be priced out of the market.

This *Executive Insights* explores the state of automation technology for road freight vehicles, providing insight on the speed of rollout and the strategic/commercial implications for freight and logistics providers and those reliant on supply chains. It also highlights some of the key changes to the transport ecosystem that industry participants will need to adopt.

Freight automation is picking up speed

Investment in autonomous freight has increased significantly in the past few years and has enabled autonomous trucking companies to rapidly develop and test their technologies. In 2021, autonomous trucking companies such as TuSimple and Embark Trucks have become publicly listed, raising over US$681M and US$317M, respectively. Private investment has been crucial in the growth and development of the industry and will continue to enable companies to accelerate their development process.

The graphic below (see Figure 1) outlines the six levels of vehicle automation, as defined by the Society of Automotive Engineers (SAE). Currently, autonomous trucking companies are primarily trialling Level 4 autonomous capabilities (fully autonomous but restricted to certain routes).

Figure 1
SAE Automation Levels

SAE Level	0	1	2	3	4	5
Description	**No automation**	**Driver assistance**	**Partial automation**	**Conditional automation**	**High automation**	**Full automation**
Driver responsibility	Full control of all tasks	Control of most driving tasks	Supervision of all driving tasks	Manual control when requested	No manual control required	No manual control required
Vehicle responsibility	Provides alerts and warnings	Steering or speed control	Steering and speed control (supervised)	Steering and speed control (conditional, supervised)	Steering and speed control (conditional, unsupervised)	Full driving capabilities (unsupervised)

Source: Society of Automotive Engineers (SAE) - https://www.sae.org/blog/sae-j3016-update

Progress so far has been substantial, and Level 4 autonomous trucking is on the cusp of commercialisation, with market participants expecting commercial adoption by c. 2025. For example, TuSimple conducted an AFV test without a human safety operator in Arizona in December 2021. Their class 8 truck (capable of handling over 33,000 pounds of cargo) navigated an 80-mile drive along public highways and roads, with police and escort vehicles behind the truck for safety and surveillance.

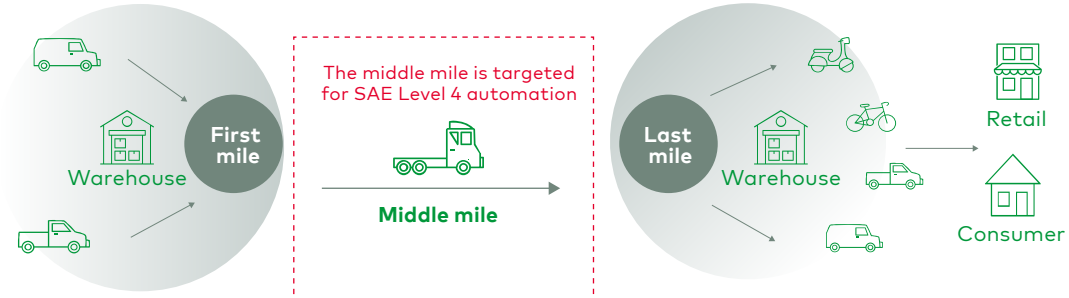
Companies such as UPS, DHL, FedEx and Union Pacific are all monitoring the disruptive potential of AFVs and are strategically conducting autonomous deliveries and pilot projects with the technology. Similarly, real estate companies such as Alterra Property

Group are investing in transfer point sites across the US 'Sunbelt' (States stretching from Southeast to Southwest of continental US) to create AV hubs with businesses like Embark Trucks[2]. In conjunction with autonomous trucking companies, these private companies are investing in AFVs and preparing operations for the implementation of AFVs sooner rather than later.

A focus on the middle mile

As AFVs are introduced with Level 4 autonomy, they will be initially restricted to predetermined routes. It is likely that they will initially be assigned to high-frequency and high-volume middle mile freight tasks between major logistics hubs (see Figure 2). Furthermore, the middle mile is mostly completed on freeways, highways and main roads at high speeds in low traffic and involving low interaction with pedestrians. Making it ideal for the emerging technology.

Figure 2
First, middle and last mile characterisation



Route characteristics			
Speed	Low	High/Med	Low
Traffic	Med	Low	High
Terrain	Semi-Urban/Industrial	Highway	Semi-urban/industrial
Vehicle type	MCV**/HCV*** trucks	HCV*** tractor trailer	LCV*/MCV**/HCV*** trucks

Notes: *Light commercial vehicle **Medium commercial vehicle ***Heavy commercial vehicle
Source: L.E.K.

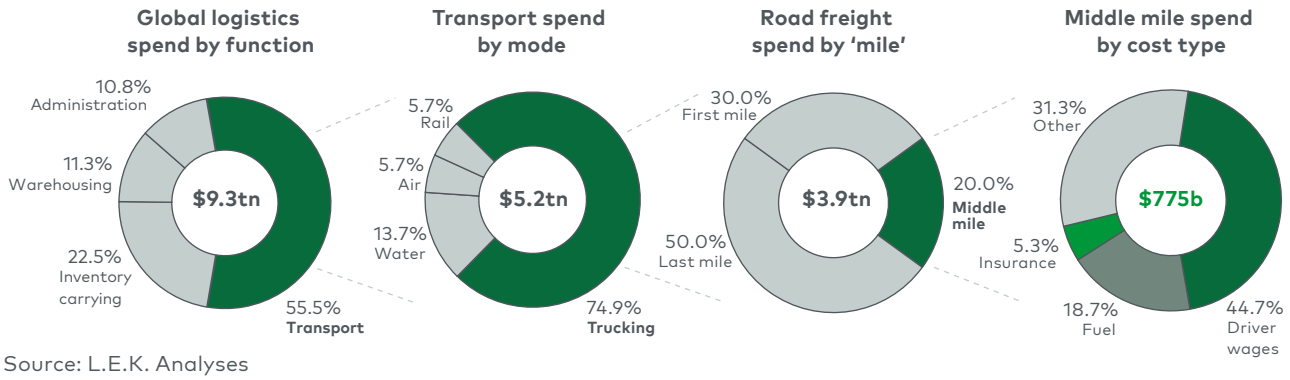
Transport in the 'first mile' (from origin to aggregation hub) and the 'last mile' (from regional logistical hub to end delivery destination) will remain the domain of human drivers until autonomous technology matures further.

This application of AFVs will have a knock-on effect on how transport operators configure their supply chain infrastructure to get the most benefit from the new technology and achieve a cost advantage over peers. In a market where price is a key differentiator, an AFV-optimised distribution network can be a game changer for smart transport operators to edge ahead of the competition.

The compelling cost case for freight automation

The financial opportunity for SAE Level 4 AFVs (expected level at introduction) is considerable, as it allows for a significant reduction in a sizeable cost bucket. Logistics make up a significant cost for businesses, broadly encompassing activities such as transportation, warehousing, inventory carrying and associated administration. Armstrong & Associates estimates that in 2019 (pre-COVID-19), $9.3tn USD was spent on logistics globally.[3] Transport represents the majority of logistics cost (c.55%). Trucking by road is by far the most significant, representing c.75% of transport costs or $3.9tn USD p.a. globally. L.E.K. Consulting estimates that middle mile transport could comprise c.20% of road freight costs, which corresponds to a spend of c.$775bn USD p.a. globally (see Figure 3).

Figure 3
Impact of AFV rollout on the freight cost stack



Source: L.E.K. Analyses

Potential savings on middle mile transport costs through use of AFVs arise across three main categories: driver wages, fuel and insurance costs.

Driver wages: The greatest impact will be on driver wages, as these make up a substantial portion of transport costs. Reducing the reliance on human drivers has the added benefit of solving for the impact of driver shortages widely reported around the world. In the US, the shortfall was estimated to be 60,000 drivers in 2021, rising to 160,000 drivers in 2028.[4]

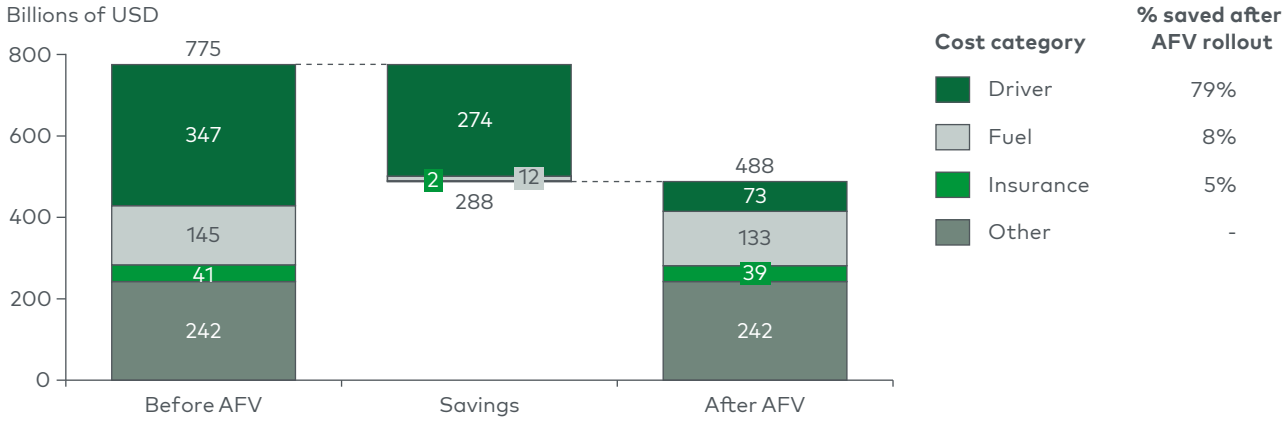
Fuel: After driver wages, fuel is the second-largest cost for trucking companies. AFVs can perform fuel-saving driving manoeuvres such as 'platooning', which involves a series of trucks travelling at constant speeds with a greatly reduced following distance. Drag is reduced in this configuration, which lowers fuel consumption. Researchers from Texas A&M University suggest that platooning can provide a 5%-to-20% fuel savings, depending on the gap, speed and number of vehicles in the platoon.[5]

Insurance: Lastly, AFVs have the potential to reduce insurance costs by dramatically reducing the occurrence of accidents. Approximately 94% of serious crashes involving trucks are caused by human error, with the number of crashes involving large trucks in the

US alone increasing by 125% between 2009 and 2018. AFVs will make for safer highways and minimise freight driver error significantly, reducing injuries and fatalities globally. This has a direct effect on insurance costs, with the potential to bring these down by as much as 5% to 10%.[6]

The World Economic Forum has published estimated cost savings in driver wages, fuel costs and insurance which could result from the rollout of AFVs: 79%, 8% and 5% in the base case scenario for these cost categories, respectively (see Figure 4). L.E.K. estimates that these savings, when applied to middle mile trucking costs, will result in annual global savings of c.290bn USD, which could be reabsorbed throughout the supply chain (as profits or reinvestment) and/or passed on to consumers in the form of cost reductions.

Figure 4
Potential savings on middle mile trucking after rollout of AFVs



Source: L.E.K. Analyses

The regulatory picture

Governments too are preparing for AFVs, as part of a broader legislative focus on accommodating and encouraging the use of AVs, by enabling certification, development and deployment of AFVs in their various regional and national jurisdictions.

The US has yet to enact national legislation, but public authorities such as the National Highway Traffic Safety Administration (NHTSA) have already released AV guidelines and standards. These are not enforceable but pave the way for formal legislation. In addition, 41 states have enacted legislation or executive orders relating to AVs. Each state has passed its own regulations surrounding the testing of AVs, covering issues around who can operate an AV, safety requirements for AVs and/or public trials, and the AV approval processes.

Similarly, China has enacted legislation (known as "Proposed Amendments of the Road Traffic Safety Law") which outlines what companies must do to successfully road test their use of AVs. At a municipal level, the city of Shenzhen has issued draft regulations

covering the entire process for the deployment of AVs. Japan has initiated a road legislation reform to allow introduction of L4 AVs. The proposed changes are expected to be presented by the end of 2022[7].

Much needs to happen, and there isn't much time

Despite the significant progress, there is still important groundwork to be done before the rollout of AFVs. With 2025 purported launch dates looming, it is clear that more than three years' worth of effort is required to prepare the world for AFV adoption by this time. There are several areas to consider:

Reconfiguring supply chain infrastructure: Freight owners and operators will have to reconfigure their supply chains to remain competitive. As mentioned earlier, a hub-and-spoke distribution model may be the best match for AFVs operating in the middle mile and therefore might be the best strategy to dramatically reduce operational costs.

But this will require a considerable rethinking of infrastructure, as well as finding and constructing new hubs in more efficient locations. Commercial real estate organisations and developers are becoming more aware of this potential, and they will be working with first-mover transport players to make the most of the limited number of locations in this new infrastructure paradigm.

Clearer and more uniform regulation to support efficient rollout of the technology: A fast and effective AFV rollout needs support from legislation, to ensure a safe introduction of the technology and to provide clarity on the rules and responsibilities affecting stakeholders so they can make informed decisions as to whether to participate and how.

Governments around the world have more work to do to advance their legislation and policies in this area, with Australia in particular lagging behind the US, China and Japan. As mentioned earlier, these countries have already introduced or enacted significant legislation to accommodate AVs. Unsurprisingly, these are also the countries spearheading the rollout of AV technology.

Changing the way our road signs work: Fundamental to AFV technology is an ability to read and/or communicate with the surrounding environment. AFV OEMs, governments, telcos, and road operators will need to develop and agree on an international set of visual and mobile communication standards that allow AFVs to reliably capture inputs from the road, such as variable speed restrictions, lane closures and other roadworks, and other day-to-day driving restrictions.

It could be argued that such standardisation is not required for autonomous vehicles on the road today (which generally are equipped with autonomous capabilities below Level 4

or are undergoing trials), but that comes at a cost, in terms of both development and local adaptation, and the hardware required for vehicles to read analogue inputs.

And at some point, as AV technology moves past Level 4, regulators and others need to plan for the prospect of road signage and other communication standards being minimised or done away with altogether.

Implications for the employment market: The introduction of AFVs will see shifts in demand for certain skills, requiring employers across several sectors to think hard about how they redeploy existing workers and train or reskill others.

Challenges will emerge mainly on two fronts. Firstly, over 2 million truck drivers across the US and Europe[8] will need retraining or a completely different pathway to other employment in other parts of the economy. Secondly, employees across all points of the supply chain that interact with AFVs are likely to require at least some form of training. This includes, for example, warehouse operators who will load, unload or otherwise interact with AFVs.

The technology required by AFVs — hardware and software for microprocessors, and cameras and other sensors — also needs development and maintenance. This will drive enormous opportunity and demand for skilled technology developers and maintenance technicians.

Fewer accidents, different insurance products: The spread of AFVs will go hand in hand with a fall in the accident risk rate of up to 94%[9] due to the elimination of human error. This presents a problem for insurance companies: insurance becomes less valuable when the risk levels drop. Also, if insurance companies decide to work with AFVs, they will need to develop a deep understanding of the AFV technologies in the market to accurately determine their associated risk profiles and deal with ongoing hardware and software updates to their insured AFV assets.

Finally, in a world where a vehicle's operating risk is determined by its installed software and hardware, we may see a shift in risk allocation and therefore a change in the insured party. Such shift would require insurers to radically adjust their commercial models and build new customer relationships.

A new direction for truck manufacturers: While human-driven trucks are not likely to become obsolete overnight, their use will steadily decline as AFV technology evolves and is adopted by transport operators. To remain relevant, traditional truck manufacturers will be faced with the decision of investing to develop or acquire their own autonomous capability or partnering with the technology players in this area (e.g., Aurora). Failing to

do this quickly will see them operating in a declining market, needing to play catch up to be competitive in the future freight industry.

The AFV revolution is nearly here

We expect to see a growing number of AFVs on our roads from 2025 onwards. The enormous opportunities in cost reduction and service efficiencies will provide a significant competitive advantage for those companies that adopt AFVs in their supply chains. Those that do not will quickly fall behind.

For those in the transport sector, the message is clear: there is much to do and little time to prepare for the substantial change that is already on the way.

Endnotes

[1]https://www.dmv.ca.gov/portal/file/2021-autonomous-mileage-reports-csv/

[2]Self-Driving Truck Company Embark Partners With Alterra Property Group

[3]Warehousing, Freight Brokerage & Ecommerce Trends, Armstrong & Associates (2020)

[4]https://www3.weforum.org/docs/WEF_Autonomous_Vehicle_Movement_Goods_2021.pdf

[5]https://tti.tamu.edu/researcher/next-level-trucking-autonomous-truck-platooning-a-game-changer-for-fuel-efficiency-safety/

[6]https://www3.weforum.org/docs/WEF_Autonomous_Vehicle_Movement_Goods_2021.pdf

[7]https://www.nippon.com/en/news/yjj2022030400318/; https://asia.nikkei.com/Business/Automobiles/Japan-to-create-legal-framework-for-level-4-self-driving-cars

[8]Managing the transition to driverless road freight transport, International Transport Forum (2017), Managing the Transition to Driverless Road Freight Transport OECD 2017.pdf

[9]https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812115

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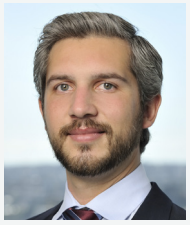

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