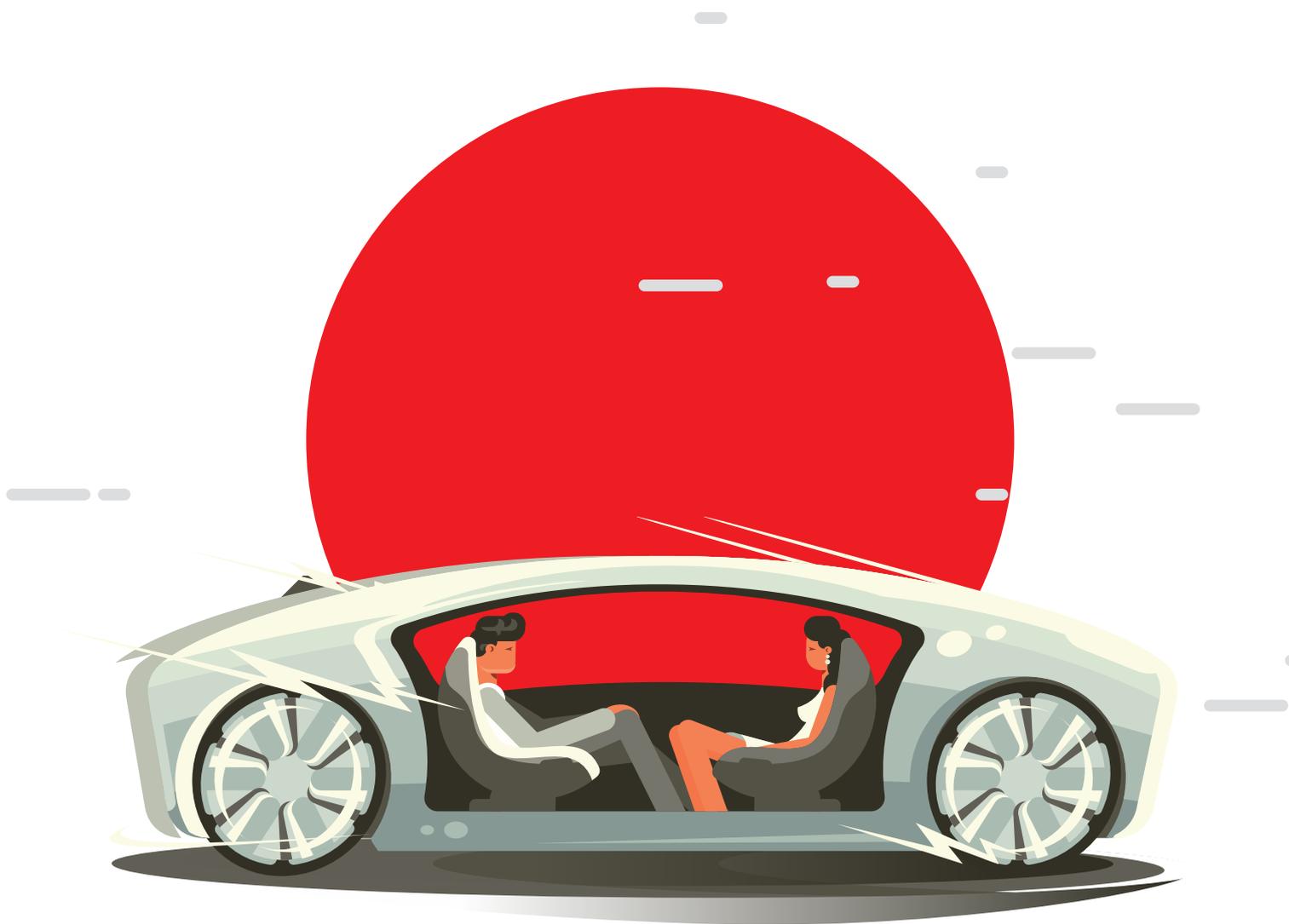
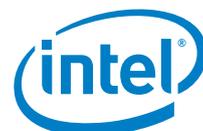


OLYMPIAN ODDS

How autonomous driving could
shake up Japan's auto behemoths



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1. Racing ahead?

In 2020, as scores of athletes and visitors descend on Tokyo for the Olympic Games, the taxis that shuttle them to and from venues may well be driving themselves.

Japan's government and major carmakers have set the Olympics as an unofficial deadline for launching a new generation of autonomous vehicles (AVs). The hope is that Japan can repeat its triumph at the 1964 Olympics, when the first high-speed *shinkansen* (bullet train) was unveiled,¹ cementing the country's reputation as a transport pioneer.

With such high stakes, AVs are likely to be confined to main expressways and dedicated routes close to venues. "Our target is to launch a commercial service in the early 2020s," says Tomoyuki Akiyama of Nissan, which is working on a fleet of driverless taxis with partner DeNA, a software firm. "We have set the 2020s as the target because that's the earliest we want to make it a reality, not necessarily because of the Olympic Games. That being said, we do hope to serve the increasing number of international visitors to Japan."

Yet some global competitors have announced much bolder schedules for launching full AVs. Some could hit the streets of major cities in the next few years, and Boston Consulting Group forecasts that by 2035 a quarter of global vehicles sold will be able to drive themselves.²

Japan's carmakers may need to hurry if they want to secure a place at the podium. Keeping up with the pack is crucial both at home and abroad. Japan's ageing population means there is a growing need for safe, flexible and on-demand transport services; various industries face a shortage of drivers. Cars are also vital to the domestic economy—Japan's is the third-largest automotive industry in the world and vehicles make up a quarter of exports.³ Tatsuo Yoshida, senior auto analyst at Sawakami Asset Management, suggests that Japan isn't as far behind as reports imply: "Japanese car companies are very conservative, so they are hesitant to advertise the autonomous aspects of their vehicles. Their mindset is: 'unless we are 120% sure, then we really don't want to say'."

Despite their natural coyness, Japan's car giants have noticeably stepped up their efforts in the past year or so, expanding pilot programmes in domestic and foreign locations, collaborating on key technologies and—such as in Nissan's case—joining up with tech firms. The next few years could prove decisive as testing programmes shift from pilot facilities to public roads—and the real race for the autonomous gold begins.

¹ Cameron Allan McKean, "Japan's Bullet Train, the World's First (and Still Best) High-Speed Rail Network, Turns 50", Next City, August 19th 2014, <https://nextcity.org/daily/entry/japans-bullet-train-the-worlds-first-and-still-best-high-speed-rail-network>

² "Revolution in the Driver's Seat: The Road to Autonomous Vehicles", Boston Consulting Group, April 21st 2015, <https://www.bcgperspectives.com/content/articles/automotive-consumer-insight-revolution-drivers-seat-road-autonomous-vehicles/?chapter=5>

³ Global production statistics taken from the latest release by OICA (Organisation Internationale des Constructeurs d'Automobiles), where Japan ranks third after China and the United States. <http://www.oica.net/category/production-statistics/2016-statistics/>. Transport equipment accounted for 24.8% of Japan's commodity exports in 2016. Source: Japan Automobile Manufacturers Association, <http://www.jama-english.jp/publications/MIJ2017.pdf>

2. An industry in transformation

A distinctive feature of Japan's preparations for a self-driving future is its collaborative approach. Government and industry have been researching autonomous technologies for many years, but these efforts received a boost in 2014 when officials promoted driverless technologies as one of ten key sectors to be developed under the country's cross-ministerial Strategic Innovation Programme (SIP).⁴ Co-ordinated by key industry figures (its current director is head of R&D at Toyota), SIP brings together representatives from companies, government ministries and leading universities. The aim is to speed up development by encouraging collaboration in areas that would be lengthy and costly to do alone, without stymying competition.⁵

For example, a new public-private partnership is currently working on a dynamic mapping system that will eventually be made accessible to all vehicles. The system will integrate detailed, three-dimensional map and road data with real-time traffic and weather information, along with locational co-ordinates from other vehicles. The goal is to have Tokyo mapped out in time for its Olympic debut.⁶ SIP partners are also swapping data on security issues, collaborating on simulations and sharing knowledge about how vehicles interact with passengers.

It's not just the technology that needs to come together, however; without human drivers, legal frameworks also have to adapt. According to Mr Yoshida, Shinzo Abe, Japan's prime minister, and his cabinet are particularly keen to make fast progress on the roll out of AVs but "there are many different government agencies involved in implementing their vision, and they have to deal with the nuts and bolts of the huge number of issues raised by self-driving cars."

Chief among those issues is safety. Until recently, regulations required drivers to remain in the vehicle during pilot tests, ready to apply the brakes if necessary.⁷ In May, the National Policy Agency, one of four government bodies involved in SIP, officially set guidelines that allow remote testing of vehicles, without a driver present.⁸ Experiments have already been conducted in a number of low-traffic areas, but the cabinet office wants more vehicles tested in real-life conditions. This year it announced it would be allowing large-scale tests to begin on highways, as well as selected main roads.⁹

Self-driving vehicles won't just have to watch for pedestrians and potholes—to enable them to react to their environment they will have to be connected to other vehicles around them, and to the internet. This raises fears over hacking. As part of the SIP, researchers have begun simulating cyberattacks that will help inform a new set of cybersecurity protocols for software developers, expected to launch next year.¹⁰

It's not just the technology that needs to come together, however; without human drivers, legal frameworks also have to adapt.

⁴ Hajime Amano and Takahiko Uchimura, *A National Project in Japan: Innovation of Automated Driving for Universal Services, Road Vehicle Automation 3: Lecture Notes in Mobility*, Springer International Publishing, 2016

⁵ Details of the various goals of the SIP-adus programme are described on the Cabinet Office's website, www8.cao.go.jp/cstp/panhu/sip_english/28-31.pdf

⁶ Ibid

⁷ "Japan sets approval criteria for driverless vehicle road tests," *Japan Times*, June 1st 2017, <https://www.japantimes.co.jp/news/2017/06/01/business/japan-sets-approval-criteria-driverless-vehicle-road-tests/>

⁸ Ibid

⁹ Seigo Kuzumaki, "Automated Driving System: Freedom of Mobility and Safety through Automated Driving Systems and Advanced Infrastructure", Cross-ministerial Strategic Innovation Promotion Program, http://www8.cao.go.jp/cstp/panhu/sip_english/29-32.pdf

¹⁰ Ibid; Shinya Tsuchida, "SIP-adus Next Generation Transport Activity Update: Automated Transit Services for the 2020 Tokyo Olympics", Cross-ministerial Strategic Innovation Promotion Program, http://www.sip-adus.jp/wp/wp-content/uploads/TRB96th_report5_Tsuchida.pdf, p17

¹¹ Ibid

¹² Ibid

¹³ "Ranking Automated Driving Systems", Navigant, April 2nd 2017, <https://www.navigant.com/insights/energy/2017/ranking-automated-driving-systems>

¹⁴ Cadie Thompson, "Nissan begins testing its driverless car on the streets of Japan", *Business Insider*, November 10th 2015, <http://www.businessinsider.com/nissan-is-testing-its-driverless-car-in-japan-2015-11>

¹⁵ Ibid

¹⁶ Hans Greimel, "Toyota to show autonomous mettle at the Olympics", *Automotive News*, August 13th 2017, <http://www.autonews.com/article/20170813/RETAIL03/170819965/toyota-to-show-autonomous-mettle-olympics>

¹⁷ Sam Byford, "Honda reveals its plans for autonomous vehicles", *The Verge*, June 8th 2017, <https://www.theverge.com/2017/6/8/15761272/honda-self-driving-cars-autonomous-level-4-date>

¹⁸ Danielle Mouio, "The 18 companies most likely to get self-driving cars on the road first", *Business Insider*, September 27th 2017, <http://uk.businessinsider.com/the-companies-most-likely-to-get-driverless-cars-on-the-road-first-2017-4>

¹⁹ "GM to launch autonomous cars in big cities sometime in 2019", *CNBC/Associated Press*, November 30th 2017, <https://www.cnbc.com/2017/11/30/gm-to-launch-autonomous-cars-in-big-cities-sometime-in-2019.html>

²⁰ Mouio 2017

²¹ "Driverless electric vehicle developed in France completes first test run in Japan", *Japan Times*, July 18th 2017, <https://www.japantimes.co.jp/news/2017/07/18/business/tech/driverless-ev-developed-france-completes-first-test-run-japan/>

²² Sean McLain, "Honda-Waymo Talks Stuck in Slow Lane, CEO Says", *The Wall Street Journal*, July 20th 2017, <https://www.wsj.com/articles/honda-waymo-talks-stuck-in-slow-lane-ceo-says-1500555972>

The updated guidelines form part of an implementation timetable that envisages having partial AVs—so-called Level 2 vehicles, able to conduct various operations like braking, accelerating and steering—market-ready by 2020.¹¹ Semi-automated Level 3 models—able to drive autonomously on dedicated routes, like highways—should arrive soon after. By 2025 fully driverless cars (Level 4) could start making their own way onto Japan's public streets.¹²

Table: Key government targets on AVs

By 2020	Level 2	Partially automated, in functions like braking and steering
About 2020	Level 3	Semi-automated, driver only intervenes if prompted
By 2025	Level 4	Fully-automated, no driver necessary

Source: SIP-adus

This incremental approach could work to the carmakers' favour. Although technology companies often grab the headlines when it comes to AVs, recent research by Navigant, a consultancy, indicates traditional carmakers still have the edge, as they are able to add new automated features to their existing models.¹³

Alongside stalwarts such as GM, Ford and Daimler, Japan's Nissan is currently considered a front-runner in partially automated vehicles. It was the first Japanese carmaker to receive an AV licence for its Serena minivan, which launched in 2016.¹⁴ The Serena offers several automated functions but as yet can only self-drive along a single highway lane. The company plans to release a model with lane-switching capability this year, followed by an autonomous system in 2020 that can handle busy city streets and navigate intersections.¹⁵ Toyota and Honda are working to a similar schedule, with each testing vehicles that will be able to drive alone on highways within the next two years.^{16,17} All three companies are aiming to launch full AVs—in line with SIP targets—by 2025.¹⁸

However, with this timetable, the Japanese auto giants could still be left trailing their global peers. Reports from GM suggest a fully self-driving model, which is currently being tested in narrow streets around San Francisco, could be launched before 2020.¹⁹ It hopes to soon overtake Waymo, a technology pioneer owned by Google's parent company, in terms of the number of test-miles clocked. BMW, Daimler and Ford are also aiming to have Level 4 vehicles on roads by around 2021.²⁰

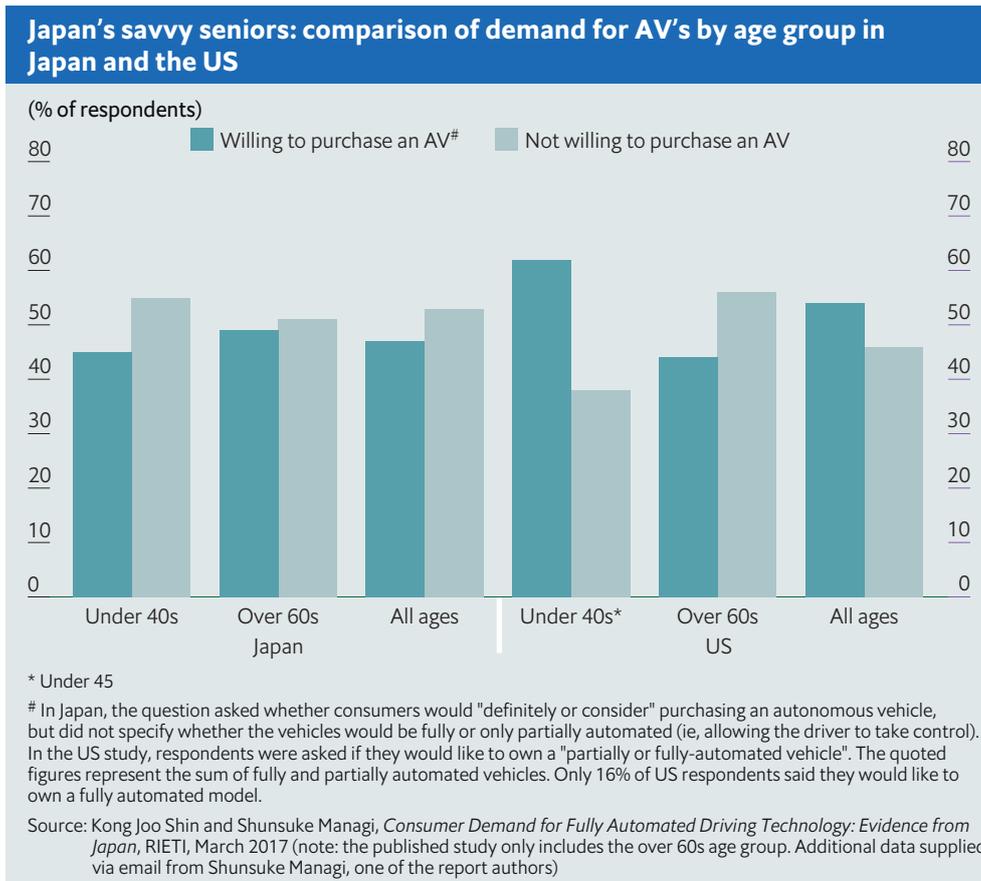
In response, new entrants are appearing in Japan, such as DeNA and SB Drive, an automotive software company spun out from mobile phone giant Softbank (which recently bought a stake in Uber). Both are trialling their own fleets of autonomous buses at various pilot sites around Japan.²¹ Meanwhile, car giants are buying up small software firms, and looking to partnerships abroad. Toyota, for one, has established a US\$1bn research and development centre in Silicon Valley to develop robotics and artificial intelligence, while Honda has been in talks with Waymo for some time.²²

3. Mobilising local drivers

Although Japan's government and industry want to remain in the global race for AVs, the country is likely to conquer the home market first. SIP states as its strategy the twin goals of improving safety and providing "next generation" transport for Japan's cities and rural areas. Success in such initiatives at home could allow for more rapid deployment abroad.

Japan's birth rate is at an all-time low and it is predicted that, within the next 20 years, one in three people will be over 65, compared with around one in four today.²³ This makes Japan's silver customers a segment the carmakers cannot afford to ignore. "I am pretty sure [the Japanese car companies] are targeting older drivers," says Shunsuke Managi, research fellow at RIETI, a think-tank.

The good news is that Japan's older population appears fairly open to letting autopilots take the wheel. Mr Managi cites figures from a recent RIETI poll of over 250,000 people



²³ 26.6% of the population was aged 65 and over in 2015 and the share will rise to 33.3% in 2036. Source: *Population Projections for Japan (2016-2065)*, National Institute of Population and Social Security Research, April 2017, http://www.ipss.go.jp/pp-zenkoku/e/zenkoku_e2017/pp_zenkoku2017e.asp

across Japan, which found that almost half of those aged 60 and above would consider purchasing an AV, compared with 45% of adults aged 40 and below. This contrasts with a common perception of older people being warier of new technologies. A similar (though smaller) poll in the US found that 74% of drivers over 60 would be “very” or “moderately concerned” about riding in a full AV, compared with 57% of drivers aged 18-29.²⁴

Confidence in domestic brands may explain Japan's open-minded elders, especially given its carmakers' reputations for safety and reliability. In a global survey by Deloitte, respondents in Japan displayed a decisive preference for having traditional carmakers bring AVs to the market, compared with new entrants (including technology firms).²⁵ In other countries, including Germany and the US, each with their own established car brands, preferences were more evenly split.

If AVs prove popular with older citizens, this could speed up their acceptance elsewhere. With younger people increasingly shunning car ownership, drivers are getting older, leading to fears about safety. Even though Japan has among the lowest rates of road fatalities in the world,²⁶ the over 65s are more than three times as likely to be involved in a car accident than those below 65.²⁷ In the RIETI survey, respondents cited “mitigating problems” caused by elderly drivers as the main advantage of AVs, with a “reduction in the burden” of driving—namely, congestion—coming in third.

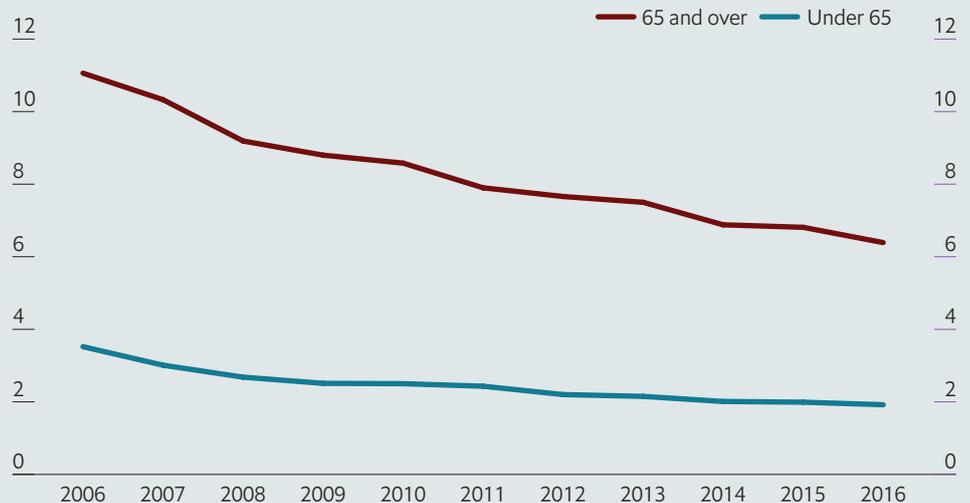
²⁴ Brandon Shoettle and Michael Sivak, “Motorists’ preferences for different levels of automation: 2016”, The University of Michigan: *Sustainable Worldwide Transportation*, May 2016, <http://www.umich.edu/~umtriswt/PDF/SWT-2016-8.pdf>, p7

²⁵ *What's ahead for fully autonomous driving? Consumer opinions on advanced vehicle technology*, Deloitte Global Automotive Consumer Study, January 2017. In the survey, 76% of respondents in Japan said they would trust traditional carmakers most to bring autonomous vehicles to the market. The figures in Germany and the US were 51% and 47%, respectively

²⁶ According to data by the World Health Organization, Japan ranks among the 18 countries globally with the lowest level of road fatalities in relation to its population. http://gamapserver.who.int/gho/interactive_charts/road_safety/road_traffic_deaths2/atlas.html, data accessed on January 25th 2018

²⁷ *Statistics of Road Accidents, Japan*, National Policy Agency monthly report, December 2016. In 2016, the ratio of road fatalities per 100,000 people under 65 was 1.9, compared with a ratio of 6.4 for over 65s. <https://www.e-stat.go.jp/en/stat-search/files?page=1&layout=datalist&lid=000001174329>

Solving an age-old problem: road fatalities per 100,000 people



Source: Japan Ministry of Internal Affairs and Communications

Although full AVs may be years away, older people are still likely to be among the first passengers to ride in driverless fleets. Japan's rural areas are ageing faster than its cities, and there are not enough young workers to drive buses and taxis, meaning elderly people that no longer drive risk being stranded. This year, DeNA trialled its self-driving buses in various controlled locations nationwide, shuttling the elderly to stores, banks

and hospitals.²⁸ If the technology proves successful, a full service, running on dedicated routes, could launch as early as 2020.²⁹

As Japan's workforce ages, AVs are expected to increasingly plug labour shortages, too. Japanese industry already has one of the highest levels of robot density in the world (deploying about twice as many robots per worker as the US³⁰), so AVs are a natural next step.

Japan's logistics sector is likely to be a major beneficiary of any new fleets. In early 2018 a convoy of self-driving trucks will be trialled on the Shin-Tomei Expressway, between Tokyo and Nagoya.³¹ At first, a human will sit in every truck but from 2020, thanks to new legislation, only the lead truck will need to carry a driver.³²

Other kinds of vehicles will also grow more autonomous in the coming years. Shipbuilders and shipping firms have partnered to develop autonomous cargo ships to revive Japan's flagging shipbuilding sector,³³ while agricultural companies are designing "robo-tractors".³⁴ This technology is well developed in the US but the Japanese versions must be adapted to farm small, waterlogged rice paddies (a much greater technical challenge than America's vast, flat crop fields).

²⁸ Naiomi Tajitsu, "Japan trials driverless cars in bid to keep rural elderly on the move", Reuters, September 12th 2017, <https://www.reuters.com/article/us-japan-elderly-selfdriving/japan-trials-driverless-cars-in-bid-to-keep-rural-elderly-on-the-move-idUSKCN1BN0UQ>

²⁹ Ibid

³⁰ *World Robotics 2017*, International Federation of Robotics, https://ifr.org/downloads/press/Executive_Summary_WR_2017_Industrial_Robots.pdf

³¹ "Japan looks to self-driving cars to bolster transport access", *Nikkei Asian Review*, February 15th 2017, <https://asia.nikkei.com/Politics-Economy/Policy-Politics/Japan-looks-to-self-driving-cars-to-bolster-transport-access>

³² Ibid

³³ "Japan aims to launch self-piloting ships by 2025", *Nikkei Asian Review*, June 8th 2017, <https://asia.nikkei.com/Tech-Science/Tech/Japan-aims-to-launch-self-piloting-ships-by-2025>

³⁴ Leo Lewis, "Japan in race to build driverless tractor", *Financial Times*, August 20th 2017, <https://www.ft.com/content/8fbf30fe-7e65-11e7-9108-edda0bcbc928>

4. The road ahead

Japan hopes its ostensibly cautious approach to introducing autonomous technology will help increase public acceptance, which sits at less than 50%,³⁵ especially if it improves safety. The Ministry of Land, Infrastructure, Transport and Tourism says driver errors account for 96% of accidents on Japan's roads; its innovation programme aims to cut road fatalities by a third by 2020.³⁶

But expert opinion is split on whether adding incremental automated features while relying on a driver for back-up is safe: as drivers gradually relinquish control, they can take longer to respond in emergencies, potentially increasing the risk of a fatal accident.

Even if global competitors get to Level 4 more quickly, their actual launch schedules could still be delayed by local laws: most countries have yet to put legislation in place allowing cars to travel driver-free on public roads. Ethical questions, such as how cars should handle accident situations that could result in the loss of life, also still need to be addressed.

In the long term, though Japan's drivers are fiercely loyal to local brands, global customers may be more fickle. New entrants, especially elsewhere in the region, will prove increasingly competitive. "China will make a very big contribution in the future," says Mr Managi. "They used to lag behind in electric vehicles...but once the government decided to invest, they started to catch up. Once they succeed in making a policy on AVs, they can move quickly."

As AVs precipitate a shift from private car ownership to on-demand or shared services, carmakers the world over could see their sales drop. At the same time, new business models in car ownership could allow them to capitalise on fresh opportunities, adds Mr Yoshida. Ridesharing is still a nascent trend in Japan, but carmakers in other markets are already altering their business models: BMW has its own carsharing scheme,³⁷ and GM is partnering with rideshare firm Lyft.³⁸ "[Shared-use vehicles] will run 24-7, so the servicing and spare parts industry will be much bigger than it is today," says Mr Yoshida. "And although fewer cars will be sold, the replacement cycle will be much shorter."

He adds that although Japanese car companies might not lead the pack right now, their core businesses could remain secure in the longer term. Japanese carmakers have decades of experience when it comes to mass producing high-quality vehicles at affordable prices. "Japanese cars are known for durability, reliability, quality and value. In the future, auto hardware will still need to satisfy those same requirements, and that's where the Japanese can continue to succeed."

³⁵ Kong Joo Shin and Shunsuke Managi, *Consumer Demand for Fully Automated Driving Technology: Evidence from Japan*, RIETI, March 2017, <https://www.rieti.go.jp/jp/publications/dp/17e032.pdf>

³⁶ SIP-adus programme overview, www8.cao.go.jp/cstp/panhu/sip_english/28-31.pdf

³⁷ DriveNow Car Sharing & Car Club, <https://www.drive-now.com>

³⁸ Steve Trousdale, "GM invests \$500 million in Lyft, sets out self-driving car partnership", Reuters, January 5th 2016, <https://www.reuters.com/article/us-gm-lyft-investment/gm-invests-500-million-in-lyft-sets-out-self-driving-car-partnership-idUSKBN0UI1A820160105>

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LONDON
20 Cabot Square
London
E14 4QW
United Kingdom
Tel: (44.20) 7576 8000
Fax: (44.20) 7576 8500
Email: london@eiu.com

NEW YORK
750 Third Avenue
5th Floor
New York, NY 10017
United States
Tel: (1.212) 554 0600
Fax: (1.212) 586 1181/2
Email: americas@eiu.com

HONG KONG
1301 Cityplaza Four
12 Taikoo Wan Road
Taikoo Shing
Hong Kong
Tel: (852) 2585 3888
Fax: (852) 2802 7638
Email: asia@eiu.com

GENEVA
Rue de l'Athénée 32
1206 Geneva
Switzerland
Tel: (41) 22 566 2470
Fax: (41) 22 346 93 47
Email: geneva@eiu.com