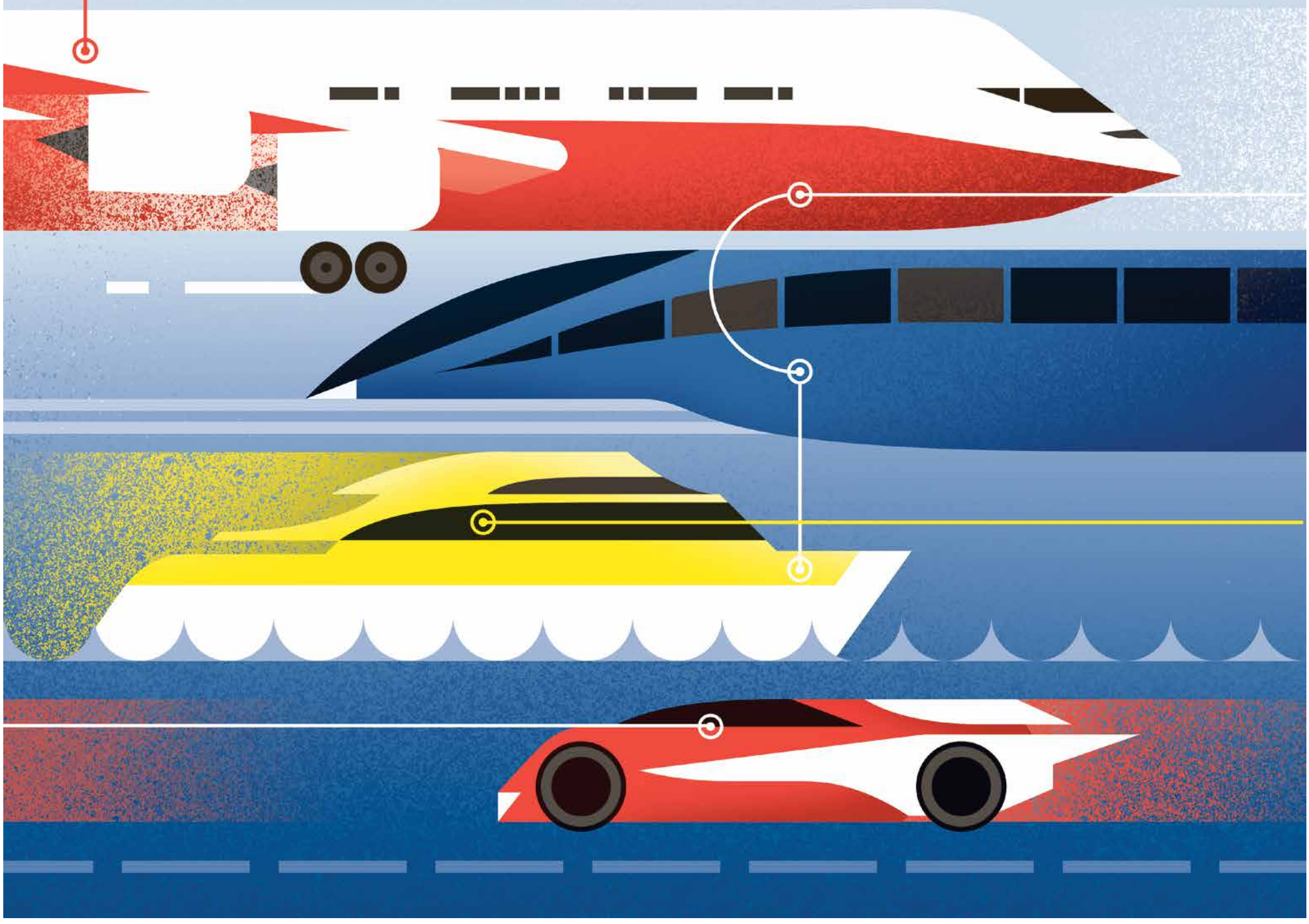
FUTURE OF TRANSPORT



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FUTURE OF TRANSPORT

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OVERVIEW

Innovators must take the customer along for the ride

Momentous change is taking place in transport as governments loosen regulation and encourage major private investment, but innovators risk leaving the public behind on the road to the future

LEO KING

Driverless cars, transport as a service, high-speed rail, supersonic flight and passenger drones. The list of travel innovations goes on. Governments are loosening the law to turn their countries into research hubs, and transport and technology companies are pouring billions into development.

In such circumstances, change is bound to be rapid. But there are serious questions over whether consumers want all this technology.

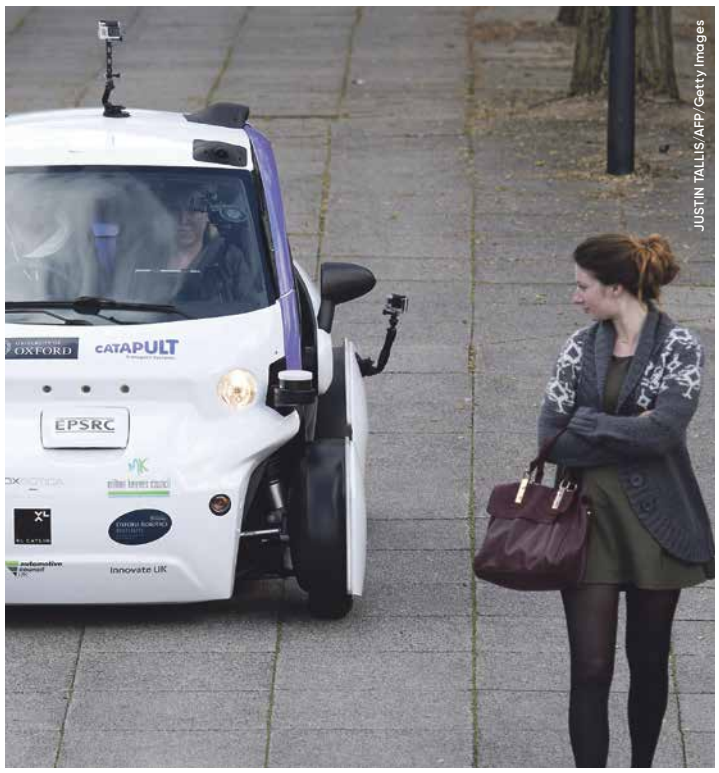
Autonomous vehicles form the perfect example. Enthusiasm is high among car manufacturers and technology firms, most notably Google, and UK tests of driverless vehicles are beginning. The goals are greater convenience, reduced congestion, better environmental health, improved safety and good use of time.

The customer perspective is different. A 2016 study by the University of Michigan found two thirds of Americans are worried about the cars' security. "US motorists have great concerns about the safety of self-driving cars," says Michael Sivak, the university's director of sustainable worldwide transport.

Developers, aware of this issue, are seeking to overcome concerns such as security and resilience, according to Stephen Hart, a senior innovation lead at public body Innovate UK. And there are significant efforts to understand people's needs. He notes: "The UK Catapult [development] networks and Innovate UK are reaching out to the traveller, and involving the user in the development of strategic innovative interventions." Recent studies include a survey of more than 10,000 travellers.

But given the concerns over automated cars, innovation in flying cars – Google co-founder Larry Page is among those investing – poses its own questions. Dr Sivak's research shows that motorists have even greater worries for safety off the ground, with four fifths of respondents expressing concern.

Then there are passenger drones, set to fly people to their destination without a human pilot. "Being a future passenger on a self-piloted commercial aircraft faces the same, if not greater, fear from the public," says Mark Zannoni, a research director at IDC Government Insights. However, the UK's Civil Aviation Authority is clear that passenger drones would have to meet the same safety requirements of piloted aircraft.



JUSTIN TALLIS/AFP/Getty Images

Autonomous vehicle testing during a media event in Milton Keynes

It is not just automation where consumer readiness lags behind that of vendors. Big investment is taking place in supersonic flight, yet the expected $5,000 price tag on a one-way journey will exclude most jet setters.

Then there is high-speed rail. Analysing the UK's own HS2, a £56-billion railway connecting London and Birmingham, a study by academics from Leeds, York and other universities suggested a record-breaking 240mph train line was not needed. It would not deliver on promised economic benefit. According to HS2 critics, investment in the North and better support for internet-connected working is required.

Meanwhile, people do not only want a better form of transport, they also want travel that takes into account technological reality and offers a pleasant, helpful experience. Innovate UK's Catapult research found 54 per cent of smartphone users consider their devices essential to travel. Transport is becoming a packaged, on-demand service and companies have seen the chance to serve content in return for cheap travel.

Consumers' needs must be heard in this regard, according to Ross Mason, founder at integration software firm MuleSoft. He says journeys will need to be "highly personalised, providing consumers with choice on whether they want to pay or whether they are willing to consume services in exchange for discounted or free transport".

70%
of British motorists are concerned about the reliability of the computer software driverless cars will use

62%
are scared by the thought of driverless cars on the road

47%
are not excited at the prospect of driverless cars on the road

RAC 2016

In spite of the importance of experience, in the last five years carmakers have spent only 15 per cent of the $50-billion mobility investment by business, advisory firm EY calculates. "There clearly is a disconnect between where consumers are heading and what the [automotive] industry is investing in," warns Kristin Schondorf, executive director of automotive and transport mobility at the company.

"The only way to relate to the consumer of today, and to hear them clearly, is to win their hearts and minds through a digital experience across multiple channels," she explains. Companies need to focus on "trust, control, ease of use and efficiency".

So how can a travel product win consumer confidence? Researchers at the Massachusetts Institute of Technology, whose recent essay found interest in autonomous vehicles was sliding quickly downhill, called for firms to publicly admit to and investigate failures.

Most buyers also need to see affordable and effective options. "Autonomous vehicles, supersonic aviation and flying cars are all ideas in search of workable cost-effective prototypes," says Todd Thibodeaux, president at US IT industry association CompTIA. "Demand for these items is non-existent to scant at this point and that's not likely to change in the next five to eight years."

Companies must also understand and listen to the new demographics of travelers. Mr Thibodeaux maintains: "This creates a dilemma for providing services because it's not a one-size-fits-all model and segmentation is key." Capturing feedback will be essential.

To make innovation work, governments must also support the infrastructure travellers want. Mr Zannoni explains: "Traveller needs deemed to improve or impact the greatest numbers of people, or impact cases of greatest severity, could be supported by governments with research, provision of grants or by passing legislation allowing an innovation to develop."

Whatever travel systems are successfully rolled out in the coming years, people's faith in them will be hard earned. "Consumer trust of these new technologies is not to be minimised; it will take time for them to trust as well as change their current travel behaviour," Ms Schondorf concludes. "Companies must understand this."

Road users on a journey to accepting driverless cars

Autonomous vehicle development is accelerating, but a new report shows many people have concerns about this technology. Eventually, however, they will have to use or share roads with driverless cars, raising questions over risk and liability

The race is on between vehicle manufacturers and technology firms to bring driverless cars to market. But a major new study of 3,000 road users shows drivers are unprepared for the changes this technology will bring.

The report, by insurer Direct Line Group, reveals that only 39 per cent of UK citizens feel confident to embrace driverless technology, while more than a third are sceptical of its benefits. The study categorises UK drivers based on their views of in-car technology.

Seven distinct segments were identified through the research and this found the openness to driverless technology is shaped by attitudes, not demographics. The groups are techno geeks, automation optimists, metropolitan families, middle-laners, next-generation petrol heads, retro petrol heads and risk-averse traditionalists.

The research highlights concerns for safety and a lack of trust in autonomous technology as key barriers to adoption of driverless cars. At the moment, only 18 per cent of UK citizens believe that artificially intelligent machines would make better decisions than humans. Among them, middle-laners, who are more likely to be low-mileage drivers, are particularly unconvinced of the eventual safety or affordability of driverless vehicles.

Meanwhile, experiential benefits such as enjoyment of driving also prevent drivers considering driverless cars. Some 53 per cent say they enjoy driving and would not want this pleasure taken away. They include those classified as petrol heads and risk-averse traditionalists. Furthermore, two-thirds would prefer a vehicle in which they are in control most of the time, with technology only intervening in an emergency.

"Consumers are in the early stages of the journey into autonomous technology. They are getting accustomed to features on new cars such as autonomous emergency braking and lane correction," explains Dan Freedman, director of motor development at Direct Line Group.

Mr Freedman is convinced that the willingness to adopt driverless vehicles will increase as they become used more widely and customers become accustomed to the technology. He adds: "There are a number of groups who already acknowledge some of the likely future benefits of driverless cars, namely convenience and time-saving. However, when more cars with automated driving features are seen safely operating on the road, these technologies will become of greater interest to the majority."

But there are several groups who are more likely to adopt the technology, especially those who find driving dull or see it as a means to an end. These include in-car techies, who love to drive and believe technology enhances their experience.

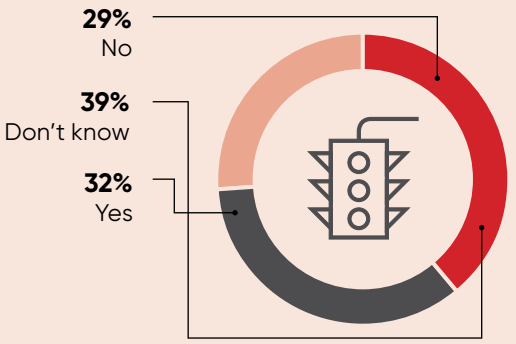
Equally, metropolitan families, who make up 16 per cent of respondents and are likely to be young, live in London and want in-car social media updates, are convinced driving can be improved by the technology, even if they question some of the safety benefits.

> "Consumers are in the early stages of the journey into autonomous technology

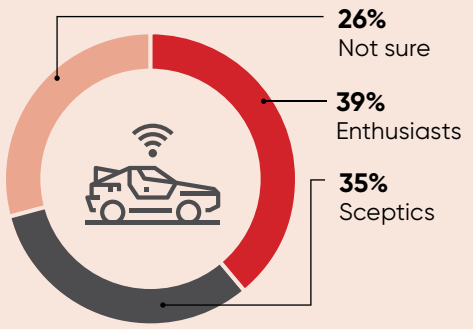
Automated optimists, who make up 12 per cent of respondents, really trust technology and are positive about it being in control. This group, who are typically keen for less stressful and safer journeys, tend to describe driving as being uninteresting.

The people who ultimately use these vehicles will need to know the impact of their choice upon insurance. "Another challenge will be how other road users interact with these autonomous vehicles and, for instance, how accidents involving vehicles with these future technologies are dealt with," says Mr Freedman. "The government's upcoming Auto-

Will driverless cars be safer?



Opinions on driverless cars?

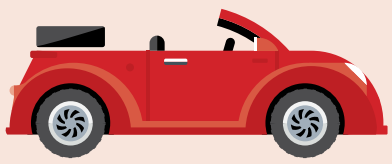


18%
think computers make better decisions than humans

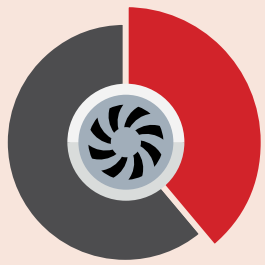
2/3
people would prefer to be in control

53%
think driving is an enjoyable experience

Driverless cars Where do you sit?



SEVEN DRIVER TYPES AND WHAT THEY THINK



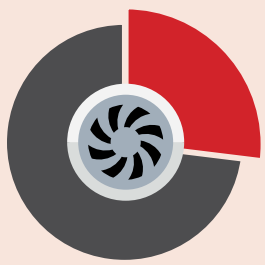
39%

READY FOR DRIVERLESS CARS

In-car techies
- Early adopters
- Love driving
- Tech is about leisure not safety

Automation optimists
- Don't enjoy driving
- High trust in tech

Metro families
- Live in urban areas
- Typically under 45 with children
- Safety is a big issue

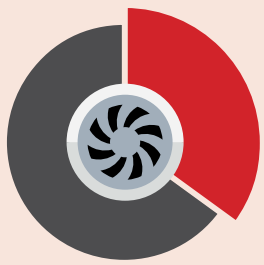


27%

ON THE FENCE

Middle-laners
- Light drivers, mostly female
- Doubts about safety of tech
- Open to tech if it brings benefits

Next-generation petrol heads
- Young, mainly male
- Love driving, like being in control
- Open to tech, but not convinced



35%

NOT READY

Retro petrol heads
- Typically over 55
- Confident drivers
- Don't see a reason for driverless tech

Risk-averse traditionalists
- Older, light road users
- Lowest appetite for tech
- Major safety concerns

COMMERCIAL FEATURE

> Advances in driverless technology will cause seismic shifts for the motoring and insurance industry

mated and Electric Vehicle Bill will likely help address where liability resides and remove one area of uncertainty."

Clearly, there are already potential risk reductions on offer from cars with advanced driver assistance systems, which include features such as autonomous emergency braking. But the risks associated with vehicles crashing and who would be liable when technology is involved in making more of the decisions pose concerns for drivers, insurers and manufacturers.

"Advances in driverless technology will cause seismic shifts for the motoring and insurance industry, and we need to understand what people's attitudes, emotions and behaviours to this new technology will be," says Paul Geddes, chief executive at Direct Line Group. It is essential the potential benefits for road safety are properly communicated and that customers are supported as they move to the new technology.

For insurers, the challenge is to measure risk properly and to be clear about liability. The study reveals that questions over liability are a major challenge for the industry, with 45 per cent of people believing manufacturers of driverless technology should be accountable in an accident. "Direct Line Group and the wider industry have a critical role in the development and adoption of driverless cars on our roads, and how we can better protect the public in the future," adds Mr Geddes.

Direct Line Group is part of two major projects studying automated driving technology in practice. These include MOVE_UK, which is examining how to accelerate the development and validation of automated driving systems, and soon-to-begin Streetwise that will look at development of advanced driver assistance systems and consumer services. Direct Line Group's inclusion in these projects is an indication of the important role of insurers in supporting development.

As these technologies become more complex and sophisticated, insurers will need to evaluate their effectiveness at reducing road risk, and draw this understanding into underwriting and eventually pricing. Mr Freedman says: "The motor insurance industry has a role to play in communicating the potential safety benefits, through our willingness to underwrite such cars, and in driving adoption through lower insurance premiums where we feel they significantly reduce risk."

Direct Line Group is working to bring together car manufacturers and insurers, through dialogue and supporting research into the risk and liability landscape. This will be essential in securing more accurate insurance, protecting customers effectively and supporting the development of safer roads.

To find out more about Direct Line motor insurance please visit directline.com/car-cover

Q&A Understanding autonomous car data to handle risk

The insurance industry has a critical role to play in the development and adoption of in-car technology. As the systems become more sophisticated, insurers will take a new approach to risk, explains **Dan Freedman**, director of motor development at Direct Line Group

Q Direct Line Group wants to help bridge the gap between manufacturers and the insurance industry. How will it do this?

A We are engaging in crucial dialogue with manufacturers to help understand the risk impact of automation and ultimately autonomous cars. These vehicles present insurers with a challenge and an opportunity.

Technology is already helping improve safety and the driving experience, and the value for us is understanding how such cars change the traditional motor risks and liabilities we underwrite. In the long term, with more sophisticated driving technology, humans will effectively be co-driving with robots, and the challenge is unpicking where responsibility and liability lie in any given incident.

Q How will you reassess risk?

A We are a key stakeholder in two major projects. The first is MOVE_UK, which is primarily focused on developing effective methodologies for validating advanced driver assistance systems. We're working on this with Bosch, Jaguar Land Rover, the Royal Borough of Greenwich, telematics firm The Floow and the Transport Research Laboratory (TRL). It is an opportunity to better understand new risks and explore our role.

The second project is Streetwise, which aims to get an autonomous car on to London's roads by 2019, and to demonstrate a viable consumer service using it. The project is in collaboration with organisations including technology firm Five AI, Torr Vision Group from the University of Oxford, and TRL. Our own objective is to build and test new approaches to monitoring and understanding the risk associated with autonomous cars. Both projects are co-funded by UK government through Innovate UK.

DAN FREEDMAN
DIRECTOR OF MOTOR DEVELOPMENT
DIRECT LINE GROUP

Q How do the two projects differ in their methodology?

A MOVE_UK is very focused on one aspect, validation – we are trialling a new, more efficient method. Traditional routes for validation are simply too slow and costly, especially as the technologies become more sophisticated, so we're taking a new approach by testing the systems in "silent mode", in real-world conditions on the road; having a human drive the vehicle, but running the algorithms in the background and comparing what the machine would have done.

Streetwise is focused on delivering a fully working autonomous car service, taking a step back and looking at the whole package. It asks what is needed to put level-four autonomous vehicles on the road, what technology must be on the car, how to develop the algorithms, how to monitor and maintain the technology, and how to deliver relevant services.

Q Given that many of the people involved in these projects come from vehicle and technology manufacturers, what is it like being an insurer on the panels?

A I'm very pleased that we are part of this and it helps show the importance of the technology for our industry. It is essential that we understand the innovation better and we need to know how the technology behaves so we can reward those using safer systems through more accurate pricing. Insurers have a key role to play in helping the transition of this important technology on to the market.

In the longer term, there is a lot still up for grabs. We need to think beyond 2025, and how our role must change, as well as what capabilities we need to develop and what relationships to foster with partners. Also, we must all make clear to customers what the expectation on them is when using more automated vehicles.

Q How can data be better harnessed?

A We believe that new data-sharing arrangements with manufacturers will be necessary to support the development of automated driving technology. Where increasingly sophisticated cars are involved in accidents, the data to show whether or not automation was involved will be essential.

Most of the data needed is already being generated in modern cars, but we will eventually have to have some access to that data. There must be clear minimum standards around data-sharing.

We also believe that the data from vehicles could, with drivers' permission, help insurers better understand and price insurance risk.

TRANSPORT INFRASTRUCTURE

Keeping the planet's megacities moving

With almost ten billion people expected to inhabit Earth by 2050, many of them in megacities, transport planners face mounting problems which challenge mobility, the economy, health and wellbeing

OLIVER PICKUP

There are approximately 7.5 billion people on Earth, yet few realise there were six billion fewer just over a century ago. Between 1900 and 2000 the jump in world population, from 1.5 to 6.1 billion, was three times greater than during the entire previous history of humanity.

Further, the latest United Nations (UN) *World Population Prospects* report, published in June, shows the figure is currently growing by around 83 million people every year, and is projected to reach 8.6 billion in 2030 and 9.8 billion two decades later.

Considering more than half of us live in urban settlements, there is little wonder that numerous cities across the globe are struggling to handle this speedy and exponential growth. There are currently 37 megacities, which have to have at least ten million inhabitants to qualify for that status, and by 2030 the UN expects there to be four more.

Urban planners would be advised to look at where Delhi, the sprawling metropolitan area surrounding New Delhi, India's capital, with a population of 26.5 million, has got it alarmingly wrong. Decades of poorly managed growth has catalysed overcrowding and culminated in New Delhi receiving the unwanted title of "most polluted city in the world", with off-the-chart smog levels caused largely by congested road traffic.

Quality of life is miserable for Delhi's denizens; disease runs rampant as basic essential services, such as the provision of water, adequate housing, healthcare, education, electricity, public transportation and proper sanitation, have sunk far below the minimum level for a habitable city. Their plight serves as a cautionary example of how dangerous failing to get to grips with urbanisation can be, not just for the city's inhabitants, but for a country as a whole.

India, home to 13 of the top 20 of the world's most populous cities, is paying a significant economic, social and environmental cost for perpetual mismanagement and woeful planning. Indeed, a 2015 study at the Indian Institute of Technology in Bombay revealed that air pollution in Delhi and Mumbai had contributed to 80,665 premature deaths of adults over three decades, twice the number in the same period to 1995. Additionally, in 2015 alone, the air pollution cost the two cities around £8.16 billion, the equivalent of 0.71 per cent of the country's gross domestic product.

At Delhi's Khan Market, enterprising shop owners do a roaring trade in anti-pollution masks and, although there have been "right to breathe" protests outside the government buildings and on social media, there is a fateful sense that any meaningful response will be too little, too late.

"Pollution levels in Delhi have crossed permissible limits long ago," laments Lieutenant General BNBM Prasad, director general of armed forces hospital services and a lung specialist. "The situation is alarming. Children and the elderly pay for it. It is a death sentence for them."

Julie Alexander, director of urban development and smart cities lead at Siemens, says 1,400 new cars clog Delhi's roads every day. "Simply accommodating people in Delhi is a challenge. There are big issues that arise in terms of deprivation," she says.

"To help relieve pressure in and around Delhi, new cities are being constructed, which each with their own industrial concept, to bring new jobs to those cities and to ensure people working in those industries are located close to their workplace, reducing the pressure on transport networks and other services. Worryingly, plans for public transport in some of those new cities are not prioritised to the level it should be."

Martin Powell, head of urban development at Siemens in London, adds: "Jakarta, Mumbai, Delhi, Beijing, Chongqing and most megacities are experiencing growth that is too fast for the traditional investment cycles in energy and transport to cope with, and this is causing immediate impacts on congestion, energy reliability and air pollution."

The complex and critical problems triggered by rapid urbanisation can be alleviated by embracing emerging technologies, experts believe. "Transport infrastructure can play a key part in these solutions or it can become a major blocker," says Rachel Skinner, vice president of the Institution of Civil Engineers. "Against a backdrop of disruptive technological change, including connected vehicles, driverless and electric vehicles, drones, and new shared mobility, we have a once-in-a-century opportunity to shape the future."

CASE STUDY

BOGOTÁ'S TRANSMILENIO

Bogotá, Colombia's sprawling, high-altitude capital, has a population of more than eight million people. Two decades ago it had a reputation for being one of the worst cities in the world, but since revolutionising its transport system, life has never been better.

In the 1990s Bogotá headed world lists for crime, murder and traffic congestion. Pavements were regularly used as parking spaces and drivers would ignore traffic signals. One of the biggest reasons for traffic congestion was the "slugfest" movement of buses, with delays happening at bus stops and because each passenger had to pay the driver before the vehicle could move on.

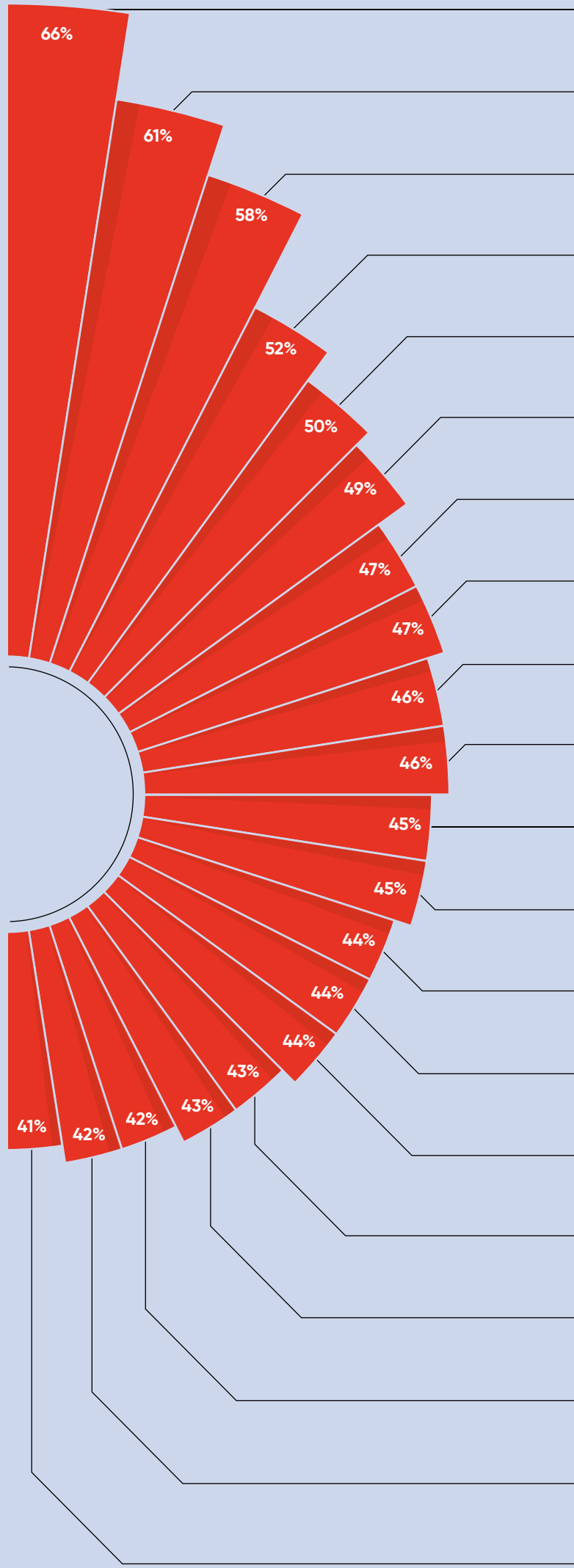
Bogotá's TransMilenio is heralded as the greatest success story in bus rapid transit systems. Established in 2000 as an alternative to a more costly and disruptive subway network, the TransMilenio buses operate in two dedicated lanes on wide boulevards alongside road traffic, and customers can buy tickets before they board.

According to Dr Dario Hidalgo at the World Resources Institute's Ross Center for Sustainable Cities, the system in Bogotá is moving 2.4 million passengers every day over a 112-kilometre (70-mile) network. More routes are being built and the TransMilenio is already viewed as an ideal, relatively low-cost solution for other developing countries.

URBAN CON

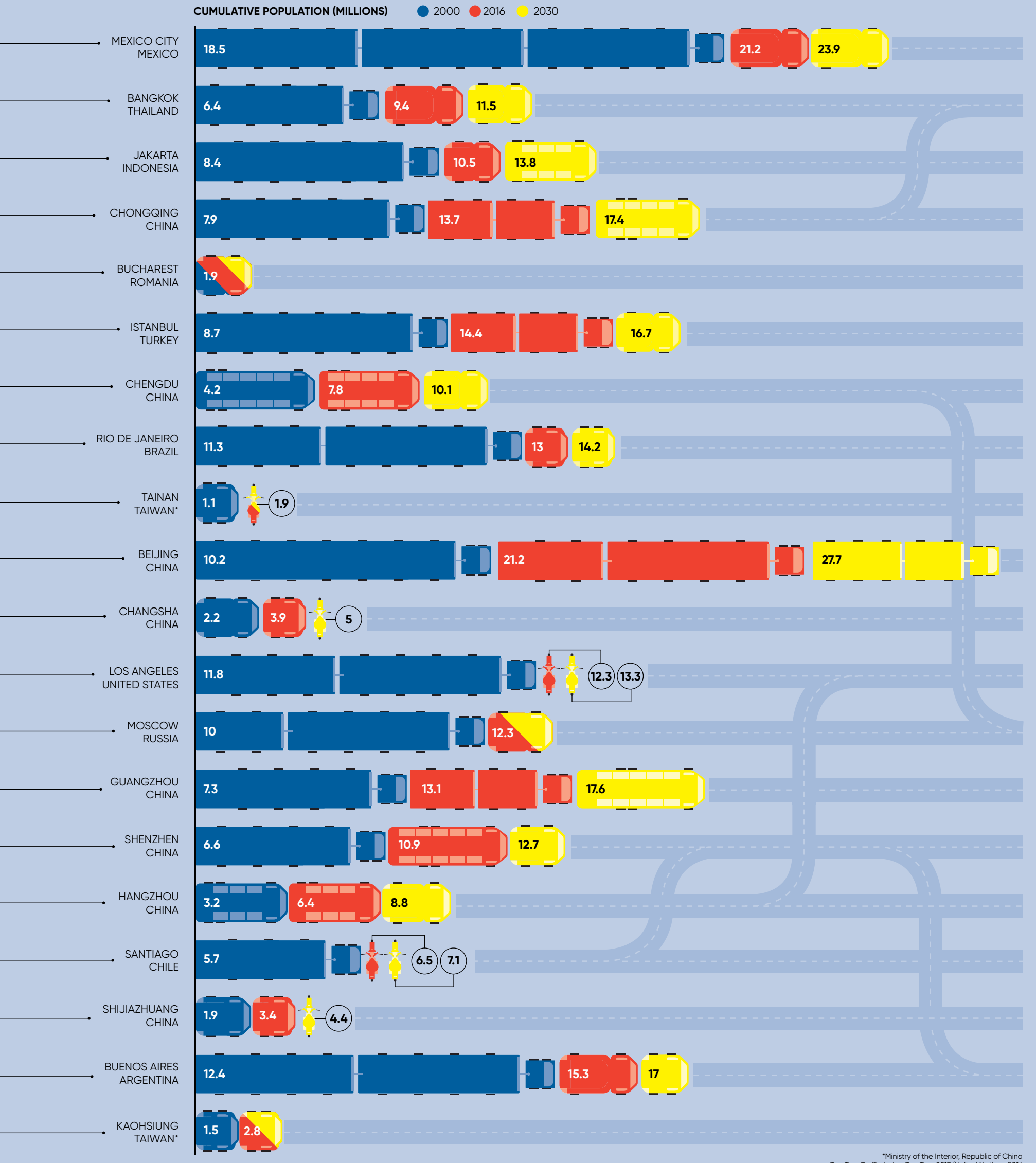
CONGESTION LEVEL IN 2017

Congestion is measured by the increase in travel times when compared with free-flow traffic



GESTION

With urbanisation set to soar over the next few decades, this infographic charts the busiest cities worldwide and accompanying population forecasts to identify potential problem areas for congestion in the future



*Ministry of the Interior, Republic of China
TomTom Traffic Index, TomTom 2017/United Nations 2016

COMMERCIAL FEATURE

One hundred and eighty decisions

That's what the average driver makes every minute. That's three decisions every second. It's impressive, especially because most of us never even realise we're doing all that

ANALOG DEVICES
AHEAD OF WHAT'S POSSIBLE™

Imagine you're driving and an oncoming vehicle drifts into your lane. At the same time, a man is walking his dog on the pavement. Do you brake hoping to minimise a collision? Do you swerve and possibly hit the man and dog? Do you veer the other way and into oncoming traffic? Whichever you choose, it's unlikely you escape without causing substantial harm or damage.

Even with the ability to make three decisions in a split second, this still becomes a no-win situation for just about all of us.

The only way to have a successful outcome in a no-win situation is to avoid it completely. That's one of the main goals of autonomous driving. What is being imagined today are vehicles where sensing, communication, actuation and artificial intelligence (AI) work together to gather information, analyse it, and make decisions faster and sooner than even the best human drivers.

Most of the information we get while driving comes from what we see. And that can be limited and impacted by numerous variables, such as weather, distance and distraction. As a result, many of the decisions we make behind the wheel are reactive. Autonomous vehicles offer the promise of predictive driving. To realise this they need sensing capabilities far greater than ours.

Three technologies that are central to sensing the external environment of autonomous vehicles are RADAR, LiDAR and High-Performance Inertial Measurement Units (IMUs).

RADAR is currently being used extensively in Advanced Driver Assistance Systems (ADAS) applications such as collision warning and mitigation, blind-spot monitoring, and lane-change assistance.

Approximately 50 per cent of all recently produced RADAR modules contain technology from Analog Devices, Inc (ADI). With a 15-year track record in automotive RADAR, Analog Devices is now developing the innovative Drive360™ RADAR technology platform to deliver the highest level of performance and distance resolution available. The Drive360™ RADAR platform is engineered to support the full 76GHz to 81GHz frequency band and provide for platform longevity.

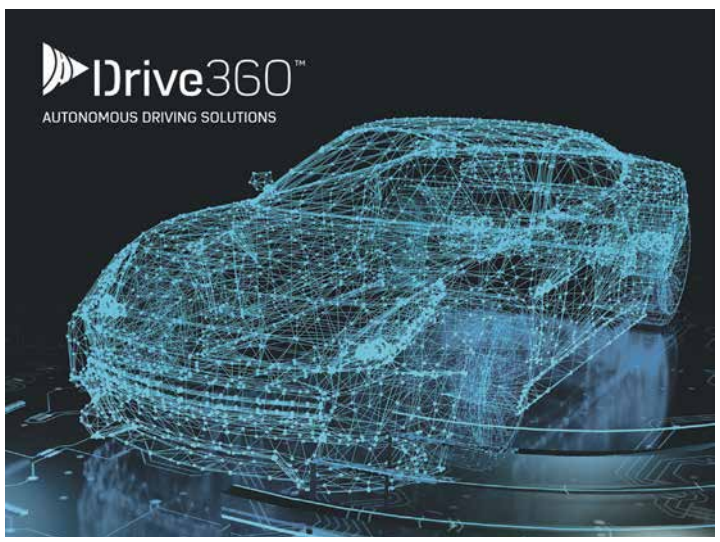
Built around 28nm CMOS technology, this fundamentally different innovation can provide the highest degree of digital signal processing integration flexibility, while built-in ADI RF IP allows for highly differentiated waveform and algorithm implementations. Drive360 RADAR-enabled products will reliably detect smaller, faster-moving objects at longer distances, providing the critical time to avoid injuries or fatalities.

While RADAR is central in the future of all-weather autonomous driving, for full-confidence decision-making other sensors are needed, such as cameras and LiDAR. LiDAR (light detection and ranging), with its range and accuracy, will be key in solving the most difficult ADAS challenges, and is an area of rapid and intense development.

Analog Devices is currently focused on solid-state LiDAR designs based on the same material found in computer monitors to scan light. The cost-effective design overcomes the current prohibitive cost and improves reliability by eliminating the moving parts found in conventional offerings. It also offers improvement in key performance metrics such as range, resolution, frame rate and power consumption.

Along with seeing the surrounding environment, autonomous vehicles also need to feel and respond to the road in all weather conditions. Analog Devices IMUs combine multi-axis accelerometers and gyroscopes with processing and calibration in a single package. IMUs, in conjunction with on-board ADAS and satellite localisation inputs, provide an accurate picture of a vehicle's position and heading, while rejecting shocks and vibrations from normal driving.

Much as RADAR, LiDAR, and High-Performance IMUs can extend the sensing capabilities of autonomous vehicles beyond what we can see, Analog Devices is looking beyond how those technologies are used today.



Drive360 from Analog Devices are platform solutions focusing on RADAR, LiDAR and High-Performance IMUs for autonomous and automated driving

> The bottom line is an organisational culture with an acute awareness of the vital impact its work can have on human lives

"Think about cell phones in the 1990s," says Chris Jacobs, vice president of autonomous transportation and safety at Analog Devices. "When a new model came out, it may have had a better battery or a thinner profile. Then came the smartphone, which fundamentally and permanently transformed and improved how we live. That's how we're looking at the technology we are about to introduce for RADAR, LiDAR, and High-Performance IMUs. These transformational technologies will be foundational to the future of advanced safety and autonomous-driving applications."

Whether designing vehicles to comply with today's ADAS regulations or the fully automated models to come, electronics manufacturers must be proficient in a variety of sensing technologies such as, RADAR, LiDAR, High-Performance IMUs and imaging. And that knowledge must include an ability to leverage the strengths of one sensing modality to compensate for the limitations of another, a snow-covered LiDAR sensor, for example.

Experience across a breadth of industries is also important. For example, the ability of phased-array RADAR to provide military tracking systems with unparalleled velocity and range resolution could be adapted for pedestrian detection in autonomous-driving systems in the future.

Competencies need to extend beyond the technological. Trust, familiarity, and a proven history of success with automotive partners are essential in an industry with long product development timelines and even longer product life cycles. In addition, flexibility, innovation and foresight allow for the development of solutions that meet the requirements of a rapidly transforming industry.

Of no lesser importance is a commitment to functional safety. There should be intrinsic knowledge and a cultural philosophy that augment processes and procedures. Carmakers should look for partners that see the significance of quality through a refined lens, from critical ISO 26262 compliance to virtually every other touchpoint.

A legacy of successful achievement in automotive safety systems is a prerequisite, but the bottom line is to promote an organisational culture with an acute awareness of the vital impact its work can have on human lives.

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CHINA AND RUSSIA

Qilai Shen/Bloomberg via Getty Images

China and Russia are taking off

Chinese and Russian commercial aircraft manufacturers have forged an alliance to take on the lucrative wide-body airliner market

PAUL SILLERS

Le Bourget, aka the Paris Air Show, is the biennial aerospace show-and-tell where manufacturers reveal snazzy new aircraft prototypes, jets zoom overhead with gravity-defying manoeuvres and, most importantly, monumental airliner orders are signed off.

This June's show, attended by 322,000 visitors, delivered the anticipated mix of aeronautical showmanship, aerobatic pyrotechnics and telephone-number deals, with $150-billion worth of orders announced for 934 commercial aircraft.

But beyond all that there was another dimension, something that transcends commerce and technology. It's to do with national aspirations, for there were two conspicuous blips on Le Bourget's radar – Russia and China. 2017 is the year in which these two countries individually and collaboratively assert a new stance in the aerospace arena as they kick-start their transition from consumers to contenders.

China has been an avid customer of Western-built airliners for decades. At Paris, Xiamen Airlines, a regional subsidiary of China Southern Airlines, signed a memorandum of understanding for ten Boeing 737 MAX 10 airliners, valued at $1.2 billion. These will top up Xiamen's all-Boeing fleet comprising nine 787 Dreamliners, 149 Next-Generation 737s and four 757s. The carrier plans to grow its fleet to 280 airliners by 2020; impressive statistics for a domestic airline, dwarfing the fleet numbers of most national carriers.

Airbus is also a beneficiary of China's predilection for Western planes with the announcement earlier this month that China Aviation Supplies Holding Company (CAS) had contracted to purchase 140 aircraft from the Toulouse-headquartered manufacturer. That's in addition to the 1,440 Airbuses currently in service with various Chinese airlines.

The Xiamen and CAS orders are emblematic of the scale of growth in Chinese regional aviation which is expected to quadruple over the next 20 years. Boeing calculates that by 2036 China will be the largest domestic airline market in the world. And to put the significance of this into context, in its *2017-2036 Global Forecast*, Boeing identifies that over the next 20 years there will be a global market requirement for 41,030 new aircraft, worth $6.1 trillion.

This slices up into 7,530 planes in Europe, 8,640 in North America, 3,350 in the Middle East, 3,010 in Latin America, but the lion's share will be headed to the Asia-Pacific region where 16,050 will be delivered. That's a lot of business in China's backyard, which brings us to those radar blips as Le Bourget signalled what could be a disruption of the equilibrium of global civil airliner manufacturing held by Airbus and Boeing.

> 2017 is the year in which these two countries individually and collaboratively assert a new stance in the aerospace arena

Challenging Boeing's 737 MAX 10 and its European rival the Airbus A321neo, the Commercial Aircraft Corporation of China (COMAC) stand at Le Bourget promoted its C919 airliner, while Russia's United Aircraft Corporation (UAC) plugged its MC-21 medium-haul jet. These Chinese and Russian contenders made their maiden flights on May 5 and 28 respectively this year; both offer similar configurations to their American and European counterparts.

In their domestic markets, order books are filling up as 285 MC-21s have been ordered, 50 slated for Aeroflot with deliveries starting in 2019, and COMAC has already sold 600 C919s to 24 airlines in China.

But even more intriguing on the COMAC stand was a model of a Sino-Russian long-range wide-body aircraft sporting a three-class cabin layout with 280 passenger seats. The plane's 12,000km range aligns with the market segment presently served by Boeing's 787 Dreamliner and Airbus's A350.

Underpinning this Sino-Russian collaboration is a COMAC-UAC partnership, endorsed by Chinese President Xi Jinping and Russian President Vladimir Putin who signed a joint venture as part of a "major strategic co-operation programme against the background of further developing the comprehensive strategic partnership between China and Russia". The joint entity is known as the China-Russia Commercial Aircraft International Corporation (CRAIC), based in Shanghai.

Unsurprisingly, elements of the media have been rubbing their hands together, quickly characterising this emerging story as a classic East-West showdown, threatening the status quo of civil aerospace. But the reality is more nuanced, for in the short and medium term the MC-21 and C919 rely on key Western components: Russia's airliner is powered by US-built Pratt & Whitney PW1000G-JM engines; likewise, COMAC's jet has CFM International LEAP-1C engines beneath its wings. CFM International is a joint venture between America's General Electric and France's Safran Aircraft Engines.

Of course, Western engines could in the future become merely optional if indigenous ones become available: Russia's United Engine Corporation (UEC) displayed its PD-14 engine at Le Bourget, designed specifically for the MC-21 and presently in its testing phases.

"We are going to base our further work not only on exporting the end products, but firstly on taking part in the export-oriented projects; in other words, co-operation with foreign companies in the field of developing engines and components," says Alexander Artyukhov, UEC's director general.

And that mirrors CRAIC's objectives. It recently announced that it's on a quest to procure international partners to ensure that what is brought to market is compliant with global industry norms.

"We will follow the latest international mainstream airworthiness standards and build more competitive long-range wide-body aircraft," says Jin Zhuanglong, chairman of COMAC, while his Russian counterpart Yury Slyusar, president of UAC, says the wide-body programme "is testimony to China and Russia's determination to engage in long-term co-operation".

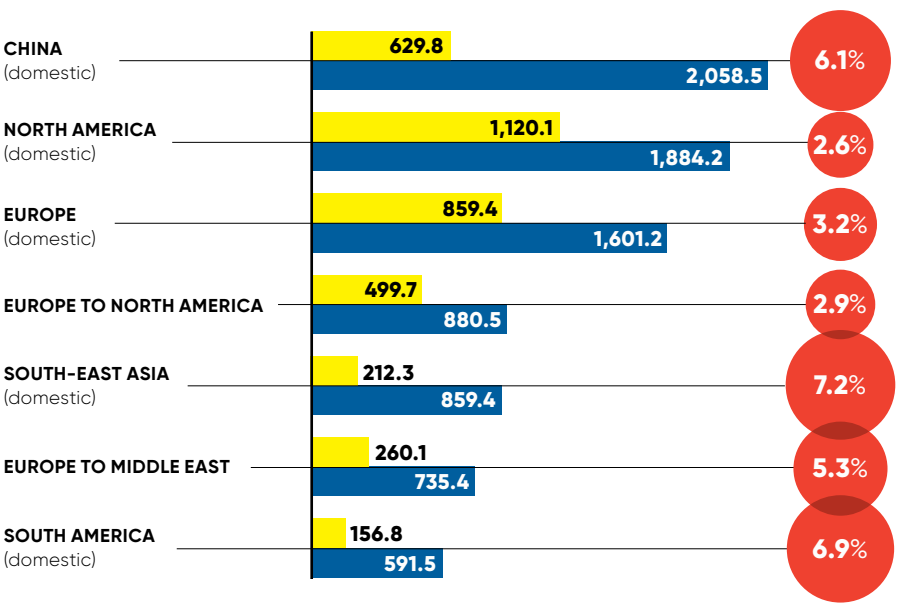
Commercial Aircraft Corporation of China's C919 airliner under assembly at the group's facility in Shanghai

CRAIC says it will carry out global bidding based on market-oriented and standardised principles, and provide priority to suppliers that are more experienced, can provide competitive products and are willing to share the risk during development through local investment or joint ventures.

Becoming technologically self-sufficient might be a long-term objective, but for now Russia and China appear intent on collaborating beyond borders with partners that have the competence to raise the quality and competitiveness of their airliners. And that has to mean greater choice for passengers worldwide.

PASSENGER TRAFFIC FORECASTS BY REGIONAL ROUTE

SELECTED MARKETS IN BILLION REVENUE PASSENGER KILOMETRES



Boeing 2017

INNOVATIVE STARTUPS

Getting the innovators on board

Whether it is planes, trains or automobiles, tech startups and smaller businesses have the dexterity to originate and flex ideas efficiently and cost effectively for tomorrow's journey

PAUL SILLERS

Never before have consumers in the transport sector been so empowered. Whether it is purchasing a car, booking a flight or a train ticket, digitalisation and technological innovation are accelerating consumers' ability to make informed choices from an improving and more personalised set of vehicle and transport experience options.

On the flipside, aviation, rail and auto industries face unprecedented pressures to up their game to deliver a better product and bolster consumer engagement. But adapting to a fast-changing market requires a level of agility and responsiveness that's not naturally inherent in the cautious, process-driven, large-scale culture of transport industries, where traditionally big players call the shots and networks of small and medium-sized enterprises (SMEs) fulfil the supply chain.

What if this was turned on its head and it was the smaller players in the ecosystem driving the response to customer expectations, and even pre-empting the travellers' needs?

Recently the transport sector has had an epiphany whereby the fast-track DNA of tech startups, and their knack for catalysing innovation, are being harnessed by those big players striving to deliver personalisation, value and improved user experience.

Aviation has had an affinity with the startup mindset since its inception. You could even say that the Wright Brothers, Orville and Wilbur were the godfathers of aviation's first startup, operating on a shoestring, entrepreneurial, iterating and reiterating a completely new concept – their Wright Flyer, the world's first aeroplane – until it actually got off the ground. Over a century later, air travel hasn't lost its innovative spirit.

An example of how a tech startup can bring logistical benefit to aviation is evident in a recent initiative in airport operations. KLM Royal Dutch Airlines partnered with Amsterdam Airport Schiphol, Rabobank and the Delft University of Technology to create the Mainport Innovation Fund, which invested in August 2015 in Dutch startup Undagrid. Its GSETrack internet of things technology tracks the whereabouts of non-motorised vehicles at the airport – GSE is an airport acronym for ground support equipment – everything from baggage carts to aircraft stairs and cargo trailers can be monitored at all times, enabling airport personnel to locate and deploy equipment around the airport rapidly. Two years after the successful pilot at Schiphol, Undagrid's technology is now implemented in nine of the world's busiest airports, including Heathrow, Paris CDG and Frankfurt, with Dubai coming soon.

On a more customer-facing level, in February easyJet announced that it had selected two startups, FLIO and LuckyTrip, for the airline's Travel Tech accelerator programme, following its strategic investment in Founders Factory, the corporate-backed incubator and accelerator founded by Brent Hoberman and Henry Lane Fox.

FLIO is an app for frequent travellers, complete with maps, shopping deals, airport tips and departure information to help passengers navigate the airport and make their journey less stressful. LuckyTrip enables travellers to set their budget and find a unique holiday in just one tap. Each trip gives you somewhere to go and the cheapest flight to get there, somewhere to stay and something to do.

"Connecting the talented easyJet team with the next generation of disruptive entrepreneurs will only continue to drive fresh thinking and uncover new opportunities," says easyJet's chief executive Dame Carolyn McCall, since appointed chief executive designate of ITV. "Working with Founders Factory to explore opportunities for advanced Travel Tech services will help us to keep making travel easy and affordable."

In the rail sector, passenger needs may be similar to those in air travel, however there's a different set of constraints for UK operators.

"The rail industry is steeped in history and regulation, and the tricky thing about the franchise model is that every six to eight years you're up for rebid, so it's very hard to invest in innovation when you know that you might not actually be there to see the fruits of your labour," says Jonathon Spanos, head of commercial and innovation at Virgin Startup, the entrepreneurial hub of the Virgin Group which provides business advice, funding and mentoring to UK startups.

Founders Factory

Brothers Tiff and Alex Burns, founders of LuckyTrip, a travel startup selected for easyJet's accelerator programme with Founders Factory

Hence, to devise and implement innovation when you're working against the clock, Virgin Startup has facilitated a new business accelerator programme called Platform-X with Virgin Trains East Coast (VTEC) offering startups the opportunity to scale-up their business and fast track procurement, through access to Virgin Trains' £25-million innovation fund to address four predefined challenges.

These are improving the end-to-end travelling experience of passengers by providing solutions that transform the rail journeys of Virgin Trains' customers; getting passengers "all on board" the digital grid, providing solutions that help Virgin Trains grow its passenger database and improve online customer experience and engagement; improving behind-the-scenes decision-making processes, including the way Virgin Trains manages disruption and communications with staff and customers; and innovating wildcard concepts that transform customer experience.

"We feel there are definitely some amazing smaller companies out there just waiting for that right opportunity to partner with the larger player to bring their products to market, and at the same time to scale it – it's a really symbiotic relationship," says Mr Spanos.

More than 280 entries from across the world applied for the Platform-X programme, which after a rigorous selection process was whittled down to eight that qualified for a five-week programme of one-on-one access to Virgin Trains' senior management team, Department for Transport specialists and experts across the Virgin Group throughout July.

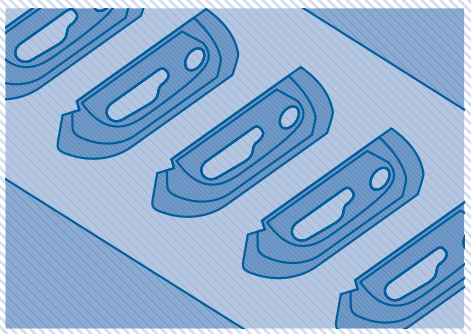
Platform-X follows on from an initiative earlier this year which culminated in the rollout of Virgin Trains Explorer, Virgin Trains' wayfinding app create by Pointr Labs.

Indoor navigation at stations is one element VTEC identified as a method of reducing travel anxiety. Virgin Trains' innovation team had investigated indoor station navigation with some larger technology businesses, but were told it was impossible to get enough accuracy for customers to confidently navigate stations.

"When we were introduced to Pointr Labs, a startup specialising in navigation for retail outlets and airports, we knew they had something that could benefit our customers," says Nicola McGuiness-Brown, VTEC's head of innovation and business excellence. "From early discussions and demonstrations, it was clear that Pointr's technology would be able to provide accuracy to within one metre – more accurate than other providers."

Virgin Trains' innovation team worked with Pointr and in less than two months the collaboration had delivered a multi-platform standalone app at both King's Cross and Peterborough stations. "The solution provides a mixture of indoor navigation, augmented reality and sign translation for international customers, and would have been impossible for a large company to deliver in such a short period of time," says Ms McGuiness-Brown.

The technology also lets Virgin Trains understand how customers move around and produces live heat-maps that help to deploy staff to where they're most needed. In a way this encapsulates the much broader macrocosm of the transport sector as an ecosystem embracing nimble solutions from smaller players to track that most important asset in the future of transport – the passenger on the lookout for a smoother journey.



CASE STUDY 01

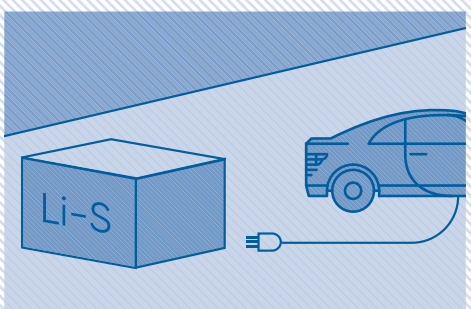
IMPRESSION TECHNOLOGIES

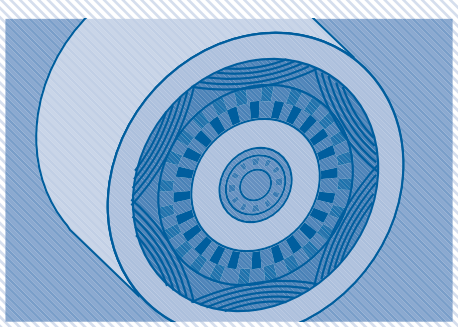
Impression Technologies Ltd (ITL) developed a patented aluminium weight-saving pressing process called hot form quench (HFQ) with support from the Engineering and Physical Sciences Research Council, Innovate UK and the Office for Low Emission Vehicles. ITL secured £6 million in funding and HFQ is now used on Aston Martin's DB11, but its potential application in volume manufacture could bring cost and environmental benefits to the wider automotive market.

CASE STUDY 02

OXIS ENERGY

Oxfordshire-based OXIS Energy won investment of £850,00 from Innovate UK to develop its revolutionary electric vehicle battery, employing the company's lithium-sulfur battery technology which, says OXIS, is lighter, more efficient, cheaper to produce and has less environmental impact because the active materials do not include rare Earth metals. OXIS recently raised an additional £7 million from private British investors.





CASE STUDY 03

MAGNOMATICS

With £4.5 million of venture-capital investment and support from Innovate UK, Magnomatics went from Sheffield University spin-out in 2006 to a high-tech small business with 28 staff. Its hybrid drive systems for vehicles include the innovative Magsplit contactless, frictionless gearbox. Magnomatics developed the device during a two-year research-and-development project with Ford Motor Company, and then further collaboration with Volvo Group.

OPINION COLUMN

'The future of transport depends on space and in space there lies the future of transport'

DR CHIARA MANFLETTI
Programme adviser to the director general
European Space Agency

Space activities are no longer driven by the single aspiration of nation states to establish their predominance and space is now an integral part of people's lives.

Maximising the integration of space into society and economy, ensuring a globally competitive space sector, for itself and for all sectors it serves, and autonomy in accessing and using the space environment are the three pillars of European space activities underpinned by advances in science and technology.

The future of transport is based on the future of air, land, water and space transport. These share the needs of being economically profitable and environmentally friendly, as well the need for secure and resilient infrastructure, vehicles and operation.

Today, satnav guides us to our daily destinations using a vast infrastructure that extends into space: constellations of navigation satellites that serve to pinpoint our position and monitor our progress continuously. All modes of moving about on Earth need evermore precise positioning, bolstered by data, information and services delivered from space.

The vision is not optional: a truly integrated transport system, combining data from many sources to enable speed control, lane management, flow control and tolling where applicable, maximising efficiency while minimising environmental impact. Highly autonomous mobility systems will support self-driving cars and trucks, all enabled through a continuous, seamless rain of satellite signals. A variety of space-based systems are set to bring this vision to fruition.

Satellite-based augmentation systems, such as the European Geostationary Navigation Overlay Service (EGNOS), Europe's first satellite navigation system, improve the precision of global navigation satellite systems.

More than 130 European airports are already making use of EGNOS to guide airliners down to within 60 metres of landing, boosting safety and airport capacity while cutting costs and excessive noise over populated areas.

Galileo, Europe's satellite navigation system, will provide sub-metre precision, sufficient to pinpoint road users down to a single driving lane, and necessary for autonomous shipping and land transport in remote areas.

Satellite positioning is being combined with monitoring – micro-satellites have demonstrated the capability to track global air and sea traffic – and also communications. Supporting air traffic management, through innovations such as Europe's single-sky Iris programme for space-based air traffic management, is just one example of how space assets can secure the needs of a growing sector.

Earth-observing satellites, such as Europe's Sentinels, will allow the optimising of maritime transport routes, the single most energy efficient means of transport, even as climate change alters the environment, through events such as the Larsen C ice-shelf collapse, or to open up safely new routes such as the Arctic north-west passage.

Future transport necessitates resilience against attacks, accidents and major disasters. Secure communication, through for example quantum cryptography, is a necessity against spoofing, hacking and hijacking. Through optical communication, using laser terminals, such as those implemented in the European Data Relay System, larger data volumes and rates are possible to guide interventions.

But space too is transport: orbital, sub-orbital, transfer from one orbit to the next or the travel to destinations beyond Earth's orbit. The future of space transport lies in the reduction of cost, in flexible launch rates, in environmental friendliness, in space traffic management and in the safety of space assets.

New design and more autonomous manufacturing methods, which are seeing an increased use, will become commonplace. Clever use of reflow hardware to balance non-recurring costs and guarantee the necessary production and launch rates depending on market demand, both institutional as well as private, both orbital as well as sub-orbital, is leading and will continue to lead to different types of expendability and reusability.

The future of transport is autonomy, lies in user-friendliness, and is efficient and resilient for both civil and for defence peacekeeping purposes and will continue to require space assets whether for use on Earth, in orbit or at the Moon Village.

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