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Access Economics

Unlocking commercial opportunities from intelligent transport systems

For BusinessNZ on behalf of the Intelligent Transport Advisory Group

January 2018

Contents

This work was commissioned by 16 parties comprising the Intelligent Transport Systems Advisory Group (ITSAG), led by BusinessNZ and the Ministry of Transport. Members are:

Airways

Amazon Web Services

BusinessNZ

Ericsson

Foodstuffs

Fujitsu

Fulton Hogan

HMI Technologies

KiwiRail

Microsoft

Ministry of Business, Innovation & Employment Ministry of Transport

New Zealand Transport Agency

Opus

Spark

Tech Futures Lab

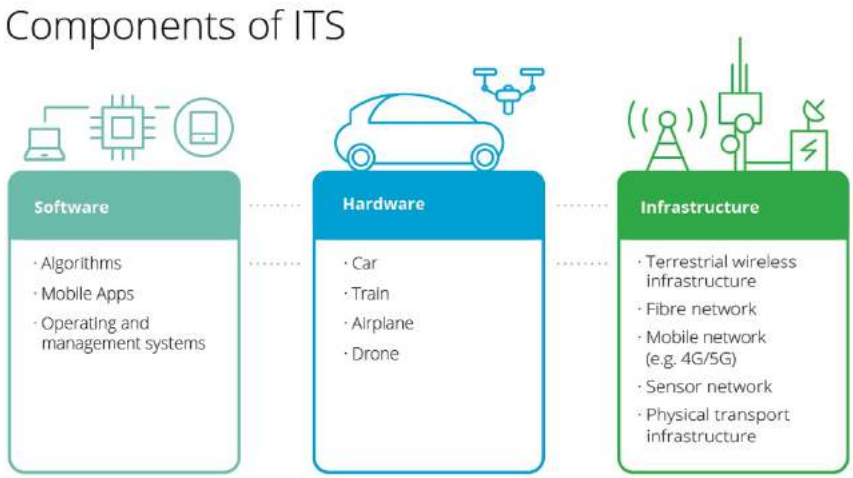
Glossary

ASDV	Autonomous self-driving vehicles
EV	Electric vehicles
FMCG	Fast moving consumer goods
GDP	Gross domestic product
IoT	Internet of things
ITS	Intelligent transport systems
ITSAG	Intelligent transport systems advisory group
MaaS	Mobility as a Service
MoT	Ministry of Transport
NZTA	New Zealand Transport Agency
RPAS	Remotely piloted aircraft systems
R&D	Research and development
SME	Small and medium-sized enterprises
UAS	Unmanned aerial systems
UAV	Unmanned aerial vehicles
WUR	Wageningen University & Research

1. Executive summary

New Zealand has a multibillion dollar opportunity to develop new, high-technology businesses in Intelligent Transport Systems. While there are already some areas of comparative advantage and emerging solutions, these can be accelerated and enhanced through focussed initiatives in key areas.

"Intelligent Transport Systems" or "ITS" refers to new and emerging technologies applied to vehicles, including on land, in the air and at sea, the infrastructure to support the use of vehicles, and the operating systems which make the vehicles genuinely intelligent. ITS technologies are used in a wide variety of industries beyond transportation and logistics, including agriculture, food processing and tourism.



ITS is an increasingly relevant topic both for businesses as a commercial opportunity, since the potential to generate domestic and global revenues is large, and for governments seeking new ways to improve the lives of their citizens and the environment. For example, ITS can contribute to lower emissions, reduced congestion, improved road safety, improved productivity, and increased choices for people mobility.

New Zealand is not the only economy interested in how ITS transforms the lives of citizens and enhances our prosperity. Governments and businesses around the world are discussing how ITS supports improvements to prosperity and wellbeing within individual countries and on a global scale.

This report aims to start the conversation around how:

- New Zealand companies – some already successfully operating – can be established, grow and take advantage of the enormous potential markets for ITS solutions, both domestic and international
- New Zealand can find ways to attract the best international businesses to test, develop and make their ITS technologies in New Zealand, for sale to the world.

The analysis in this report is based on a bespoke new survey of New Zealand-based companies interested in ITS products and services. This is augmented with desktop research and analysis of key data to consider the potential size of the opportunity to local businesses and the New Zealand economy.

The focus of this report is the direct returns from the development of ITS solutions, rather than the additional benefits ITS solutions will create.

Size of the opportunity

To estimate the potential direct returns to New Zealand, three illustrative ITS technologies were considered, namely drones, autonomous self-driving vehicles and smart logistics for land freight. The economic modelling conducted for this report by Deloitte Access Economics estimates these **three ITS products alone** could represent, on average, over the period between now and 2050:

- Nearly **$2 billion dollars a year of turnover within the domestic market** for these three selected products.
- Nearly **$760 million a year of turnover for exports** of these ITS technologies from New Zealand. This represents a potential turnover to New Zealand ITS patent holders, manufacturers, service suppliers and exporters.
- We believe it is reasonable to assume local ITS suppliers might capture 40% domestic sales, plus exports from New Zealand. This amounts to $1.5 billion per year, on average over the period.

Another way of looking at the potential opportunity is to consider what the impact could be of a New Zealand firm developing a "killer app" that will let it dominate its niche globally – for example, precision horticulture drones – and so grab 2%-3% of the total world market for all drones. **Under this scenario, New Zealand could be earning the equivalent of 6% of current GDP just from drones.**

Overall, in considering the potential market size of these three ITS technologies alone, it is clear the potential opportunity for ITS in New Zealand is significant.

New Zealand's comparative advantage

New Zealand provides a great environment for developing and testing ITS solutions.

New Zealand has an established reputation as a clean and green safe country. About 80% of the country's electricity comes from renewable sources and there is further supply available. This means New Zealand is the right environment to develop ITS solutions in light of lowering emissions and, even if, for example, every vehicle in New Zealand were electric, there would be enough capacity to charge them.

New Zealand has a good regulatory system supporting emerging industries. The Government is open to review or change regulations in the right circumstances, and open to solve problems with technologies. New Zealand is also the only country that does not require a driver to be present in an autonomous self-driving vehicle.

New Zealand has a good reputation with international companies wanting to undertake large-scale or long-term testing of technology. This reputation is based on some distinctive aspects of New Zealand, such as the appetite for new technology, our relatively small but well-educated population, and the fact that New Zealand has the only winter testing facility for vehicles in the Southern Hemisphere.

New Zealand is strong in exports within advanced manufacturing, which is currently New Zealand's third-biggest export revenue earner with 9.8% of total exports. This shows New Zealand has the niche capability required to develop and expand ITS.

New Zealand could reap first-mover advantages within the ITS space given it is ranked 3rd in global creativity, 5th in Asia and Oceania for innovation, 6th in the world for contribution to science and technology, and 9th in the world for being prepared for artificial intelligence.

New Zealand's proximity to Asia represents an important source of advantage. The rapid increase in incomes in Asia, especially in China, will lead to increased demand for ITS technologies. As a result of New Zealand's proximity to Asia, it will benefit from this increase in demand for niche high-value manufacturing products and services, such as the design of software templates for componentry.

New Zealand also ranks first in the World Bank's *Ease of Doing Business Index*, which is a source of advantage for the economy. New Zealand has a straightforward, business-friendly, low compliance tax system supporting capital development and international investment.

Industry perspectives

We conducted a new, bespoke survey with 50 large New Zealand businesses in October 2017 on ITS commercial opportunities.

The survey results show the general conditions are there for New Zealand to be successful within ITS products and services. Respondents to the survey indicated the key attractors as:

- New Zealand's ease of conducting business
- New Zealand's innovative culture
- New Zealand's encouraging policies and regulations

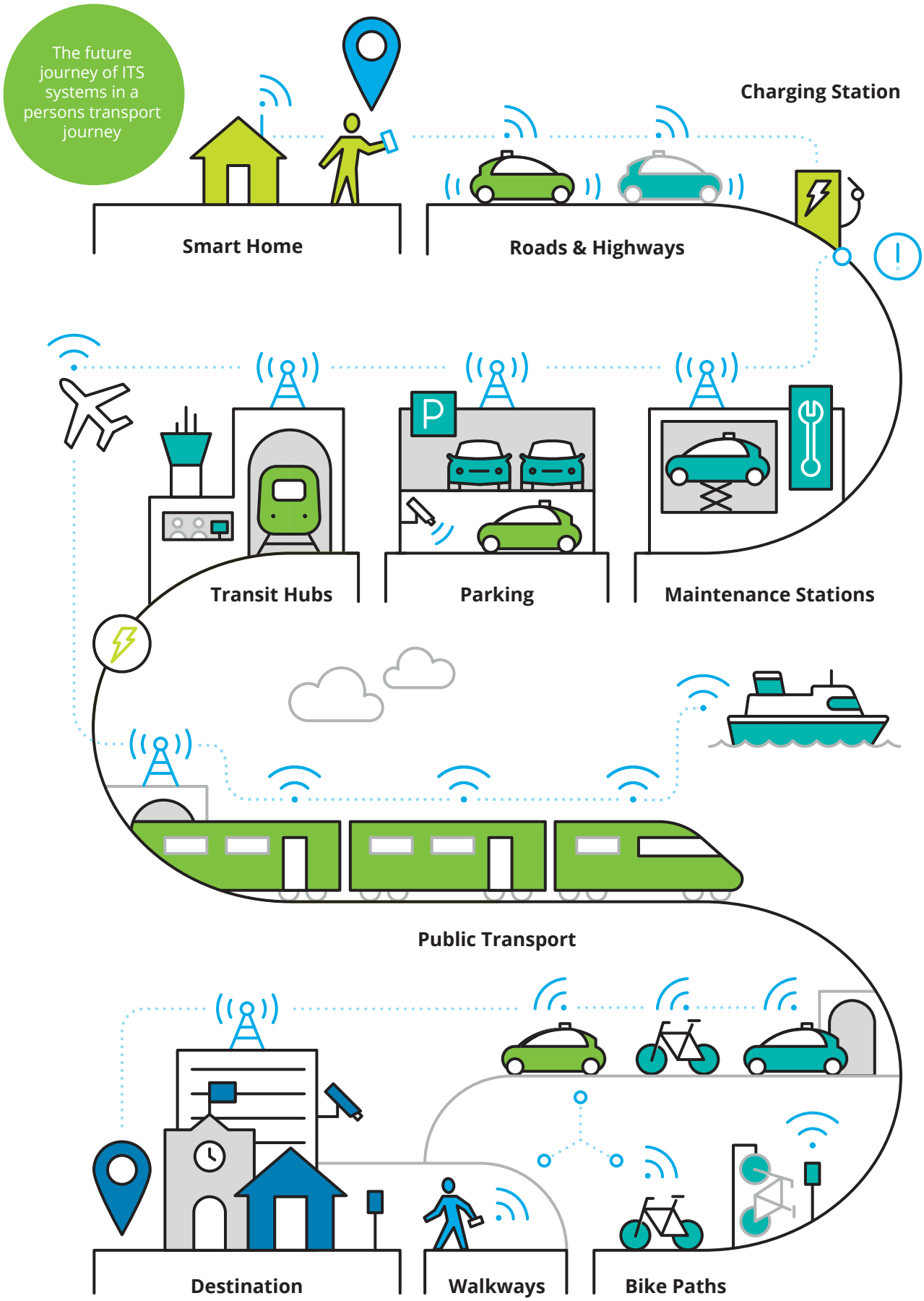
The businesses surveyed identified the following key barriers to growing ITS in New Zealand:

- Slow speed of regulatory change
- Cultural inertia, risk aversion and internal silos
- A lack of vision and goals related to ITS in New Zealand

While survey consensus found an encouraging policy and regulatory environment is a key attractor to growth in New Zealand, slow speed in regulatory change was also identified as the largest barrier. Speed of regulatory change is a challenge faced by most countries globally, and may be perceived as a greater barrier to smaller businesses due to their relative lack of influence.

More needs to be done to further develop and grow ITS within New Zealand to maximise this exciting opportunity.

ITS Ecosystem People and mobility



A plan for action

This report is a call for action on the development and commercialisation of ITS.

The future success of the ITS sector depends on how well businesses, universities, entrepreneurs and the Government can work together. The following recommendations could enable this partnership(s) to realise the successful commercialisation of ITS in New Zealand:

1. **Creating a successful and coordinated commercial environment for ITS. This would require the following:**

    a. **Develop a cohesive government strategy to encourage innovation and export growth around ITS technology products and services**. There is a need for comprehensive cohesive government strategy that actively encourages research, testing and development of new ITS technologies to support innovation and create export growth. This should include a cohesive view on the use of technology in New Zealand's future transport systems.

    b. **Establish a think tank** to engage with innovative ITS companies, identify barriers and act to remove them ahead of time. A good example is the UK organisation, Catapult. This organisation is a technology and innovation centre for intelligent mobility, which aims to foster innovation of new technologies to transport people and goods in a safer, greener and more efficient way.

    c. **Encourage investment in research and development to further develop ITS in New Zealand.** Currently, overall business expenditure on research and development (**R&D**) in New Zealand is only 0.65% of GDP and private sector funding of R&D in New Zealand is one of the lowest in the OECD. Both public and private R&D could be encouraged by establishing of a fund focused on supporting ITS research and development and commercialisation.

2. **Ensure regulators have required resources.** ITS challenges current regulatory models and processes. It is critical to get the right regulation for the issue at hand as soon as feasible. Having open or principles-based regulation supports innovation, but it can transfer the risk from the company to the regulators which have to assess whether something is safe. To ensure regulations remain fit for purpose, regulators must have the required resources to undertake their role.

3. **Invest in education and training for ITS.** ITS development in New Zealand will require new skills**.** This requires investment in education and training which supports the development of the ITS sector. Further, skills within the regulatory environment should also be built on a mode-neutral basis, to serve regulation in land, sea, air or rail. It is unlikely New Zealand has the scale and resources to build capability across all modes.

4. **Provide sufficient support to ensure an environment is in place for ongoing investment in underlying data infrastructure.** ITS will require new Internet of Things (IoT) infrastructure. Strategies to enable the integration of physical and digital elements would also need to be developed.

5. **Encourage access and sharing of data and information systems, particularly from councils.** Access to public data will help New Zealand ITS developers. As part of a strategy to encourage data access, it is also recommended Statistics New Zealand segment industry classification to better recognise emerging technologies to enable calculation of a current baseline estimate of the size of the industry opportunity.

6. **Promote New Zealand as a market for ITS.** ITS is highly competitive internationally, and New Zealand-based ITS suppliers require new strategies to stay ahead of global competitors. It is important to find ways to identify and pursue new markets in a timely manner and to attract talent to New Zealand.

Businesses surveyed also indicated areas of priority are public transport, communication technologies and shared on demand transport. The recommendations could focus on these areas of priority as a first step to develop ITS in New Zealand.

The outcomes of implementing the proposed recommendations to promote ITS are significant. They would enable the Government to address congestion, and provide affordable accessible transport outside centralised urban areas, which could address some of issues in the housing market. Further, they can help New Zealand lower emissions and meet the new targets set, and boost low productivity.

In doing so, they would help New Zealand develop a significant industry for its products and solutions, both domestically and globally.

2. Introduction

Purpose of the report

The report was commissioned by BusinessNZ, in conjunction with a range of organisations from across the public sector and business community (ITSAG), to provide insight into the opportunity for New Zealand to benefit from the growing domestic and international interest in intelligent transport systems.

The focus of this report is on the commercial opportunities to existing New Zealand companies or start-ups, or international companies seeking to invest in New Zealand.

This report aims to start the conversation around how New Zealand companies – some already successfully operating – can be established, grow and take best advantage of the enormous potential markets, both domestic and international.

What are intelligent transport systems?

The concept of intelligent transport systems (**ITS**) is not new in the broadest sense, but there has been an escalation of interest in recent years due to a range of factors. There are a number of components in ITS, and those parts are rapidly morphing in part because the pace of technological change is fast, but also because of the increasingly urgent need for new solutions to long-standing problems.

These problems include emissions, congestion, safety concerns related to transport, and persistently low productivity in certain sectors. Consumer expectations are also rising and changing, with a strong appetite for new services based off technology advances and access to unlimited data.

For the purpose of this report, "Intelligent Transport Systems" or "ITS" refers to new and emerging technologies applied to vehicles, including on land, in the air and at sea, the infrastructure to support the use of vehicles, and the operating systems which make the vehicles genuinely intelligent. ITS technologies are used in a wide variety of industries beyond transportation and logistics, including agriculture, food processing and tourism.

The scope of ITS is broad. It encompasses fully connected cities where public and private transport are connected and coordinated centrally, among other things, through to individual elements such as driver assistance in a vehicle, traveller information or technology-based roadside infrastructure. ITS is also increasingly embedded in supply chains, for example in horticulture, food processing and logistics.

It is not just about the technology, but also about the benefit technology can offer people and businesses, in New Zealand and around the world. **How ITS is used creates the benefit**. Intelligent transport systems are used across a number of industries including:

- Transport and logistics, supporting greater supply chain efficiency, shared and public transport, and private transport improvements.
- Agriculture and automated food processing, supporting improved productivity in food harvesting and processing. For example, ITS related to agriculture includes automated self-driving tractors, or a drone conducting stock checking or pasture cover, or even counting the number of grapes on a bunch before it is picked.
- Information and communications technology, as an enabler of ITS, including back office infrastructure, networks, sensors and other data collection devices.
- A number of other niche areas including design and production of high-tech components and software – docking and charging stations as one example, and investment into scientific research and development; for example, rocket testing.

It is timely to bring the opportunities presented by ITS to the fore

In New Zealand there has long been interest in the possibilities presented by ITS, both within the wider public sector, and across private industry. The Intelligent Transport Systems Technology Action Plan 2014 – 2016 (the "ITS Action Plan"), published under the previous Government, sets out a programme of work to enable the deployment of beneficial ITS in New Zealand.

The ITS Action Plan focusses on the building blocks needed to deploy ITS in New Zealand. These include supportive regulation, data, encouraging research and development, and promoting New Zealand as a place to test and trial new technologies. Although not a key focus of the ITS Action Plan, the programme of work also recognises the potential economic opportunities resulting from promoting New Zealand as a good place to do business.

New Zealand is not alone in being interested in how ITS could transform the lives of citizens and enhance our prosperity more broadly as a nation. Governments and businesses around the world are discussing how ITS could support improvements to prosperity and wellbeing within individual countries and on a global scale. This is particularly apparent, for example, in discussions around emissions reductions and climate change. In other words, ITS is an increasingly relevant topic both for businesses as a commercial opportunity since the potential to generate revenues is large, and for governments seeking to find new ways to meet the needs of their citizens and the environment.

It is timely to give greater attention to ITS and build on the commercial opportunities to research, innovate, design, develop, manufacture and sell ITS technology-based products and services to both domestic consumers and buyers, and to the global market.

Scope of the report

To start the conversation around how New Zealand companies can be established, grow and take best advantage of the enormous potential markets, is by no means easy to achieve.

The factors that make a company successful as it grows and expands into export markets are varied, as indeed are the mechanisms required to encourage international companies to invest in New Zealand. In addition, the opportunities presented by ITS are still emerging, the technology in many cases is still changing rapidly, and many of the traditional support structures may not be applicable.

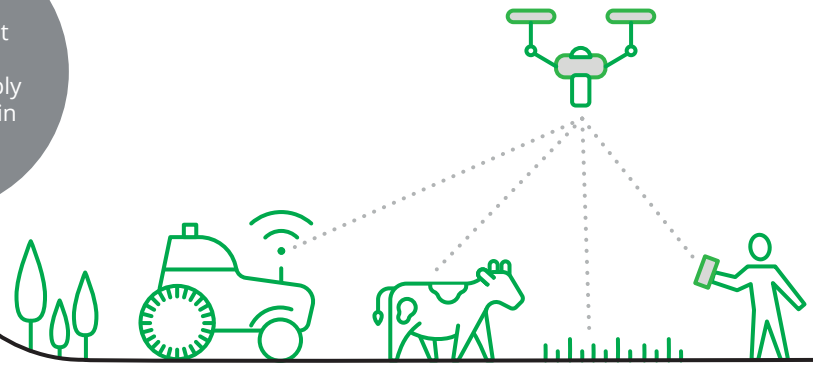
The focus of this report is not on the potential for existing and emerging technologies to transform New Zealand's transport system over the medium- to long-term – although this is clearly relevant both as context for the commercial opportunities, and of interest to New Zealanders.

This report is not intended to be an exhaustive investigation of the possibilities for development and commercialisation (for domestic and export purposes) of ITS technologies, but rather to place an initial stake in the ground around:

- Where the opportunities might sit, and why we should be examining them now
- Finding ways to attract the best international businesses to test, develop and make their technologies in New Zealand
- The potential value of the opportunity for New Zealand businesses and economy
- Our comparative advantages to enable us to drive substantial export revenues over time, as well as broader economic benefits
- The barriers which could constrain growth or hinder our ability to take up the opportunities
- Possible next steps to enable New Zealand to take full advantage of the opportunities and/or overcome factors which could constrain growth.

ITS Ecosystem Goods and Services

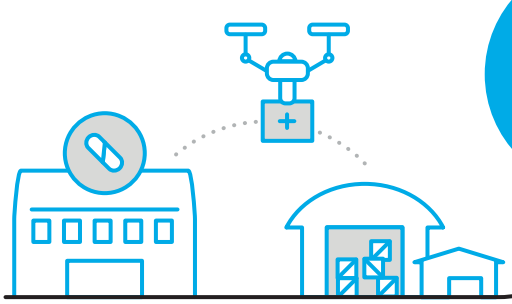
Using ITS across different industries will benefit the supply chain from origin to distribution



Improved productivity

Using initiatives such as precision farming and observing and responding to collected data sets across industries

Streamlined Distribution



Improving efficiency through application of ITS, allowing businesses to raise their competitive advantage

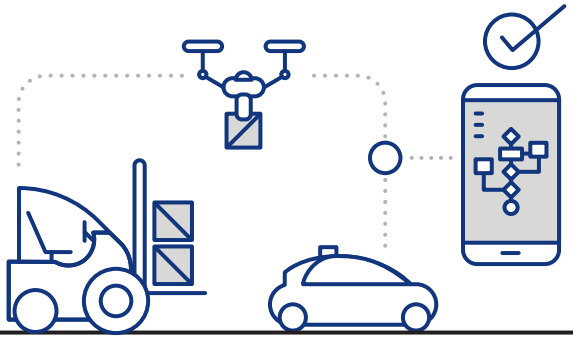
Better Transport Solutions

Finding the best possible route to Improve congestion and delivery times

A Greener New Zealand

ITS creates new demand and business opportunities in industry like retail, with the added benefit of lower emissions

Optimisation of resource allocation to streamline the logistics supply chain through both shared, private and public transport improvements



Efficient Logistics Processes

3. The ITS opportunity for New Zealand companies

New insights

This is an opportunity for New Zealand to solve its own problems related to issues such as congestion, road safety, lowering emissions, and providing access to affordable transport solutions.

New Zealand is in a sweet spot to take full advantage of the opportunities within the global ITS. Global GDP is picking up and the world's economic centre of gravity is shifting towards Asia.

ITS has the potential to be a material contributor to New Zealand's economy. Our economic modelling estimated around $3.5 trillion of benefits globally between now and 2050 from smart logistics alone. It is reasonable to assume New Zealand is in a good position to reap a share of ITS products and services.

There is a desire to use technologies to solve problems

The world is going through a period of exponential change, driven by a range of factors including technological innovations, the rising importance of Asian economies with enormous, wealthier populations, and changing consumer preferences. There is an increasingly urgent focus on the environment and, in particular, the impact of human-induced climate change, and the influence of social media on public sentiment, health and wellbeing.

New Zealand is not immune to these changes, with a number of mega-trends apparent, including increasing population size and diversity, an ageing and larger retired population, and increasing urban density. The consequential impacts are more congestion, environmental pressures and consumer-driven demand for high-value goods and services, and an increasing demand for a shared economy. There is a desire to use technologies, such ITS technologies, to help solve these problems.

One of the areas of greatest potential benefit from technology is transport and mobility systems

Innovation and, more specifically, ITS, helps address some of the problems. For example, it is likely that without changes in the way we travel, congestion will rapidly get worse. Reducing congestion in Auckland could provide journey time savings and reduced emissions of $1.4 to $1.9 billion (NZIER Benefits from Auckland Road Decongestion, 2017).

Opportunities exist for the development and commercialisation of goods and services based on ITS technologies. These range from technologies that could reduce carbon emissions and increase productivity in agriculture, to technologies that reduce logistical costs, stem traffic congestion and save lives.

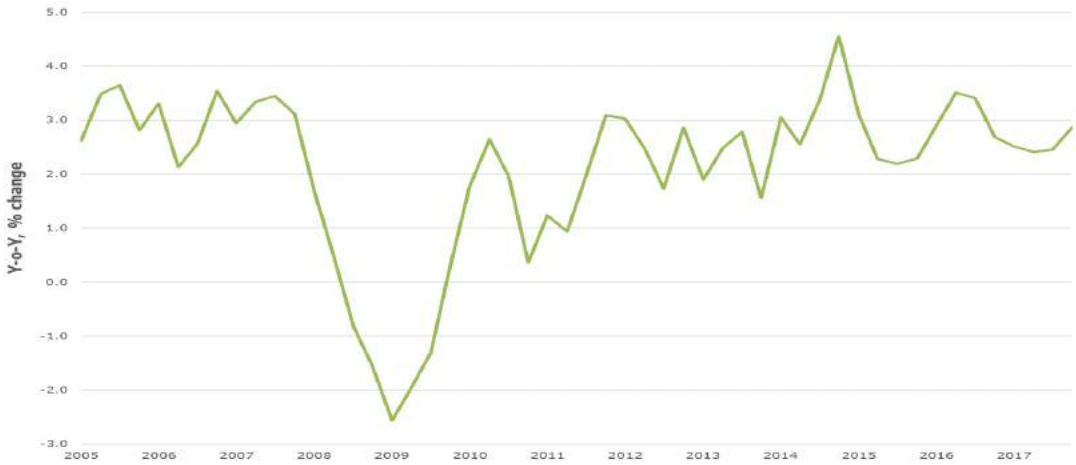
There is a significant opportunity for New Zealand's public sector, through its procurement role, to further support the uptake of new solutions, through mobility solutions or ramping up active transport demand management through mechanisms like road pricing. More generally, other studies have consistently recognised that high uptake of innovation drives stronger than average growth in productivity (Reeson and Rudd 2016; Diaz-Chao et al., 2015).

ITS solutions support an integrated transport network across all modes. If social acceptance allows, high uptake of unmanned aerial vehicles (**UAV**) as a key mode of transport and/or shared on-demand driverless land vehicles could eventually reduce pressure on parts of the road network, and provide access to affordable transport solutions.

New Zealand's economic environment creates a positive commercial environment for ITS development

New Zealand currently ranks fourth on the Global Competitive Index within the Asia-Pacific region (World Economic Forum, 2017). New Zealand's economy has experienced solid economic growth, and is now in its seventh consecutive year of expansion, driven by construction, tourism and strong population increases.

Figure 1: Real economic growth is solid (Real Gross Domestic Product (GDP) growth, year-on-year change, 2005 to 2017)

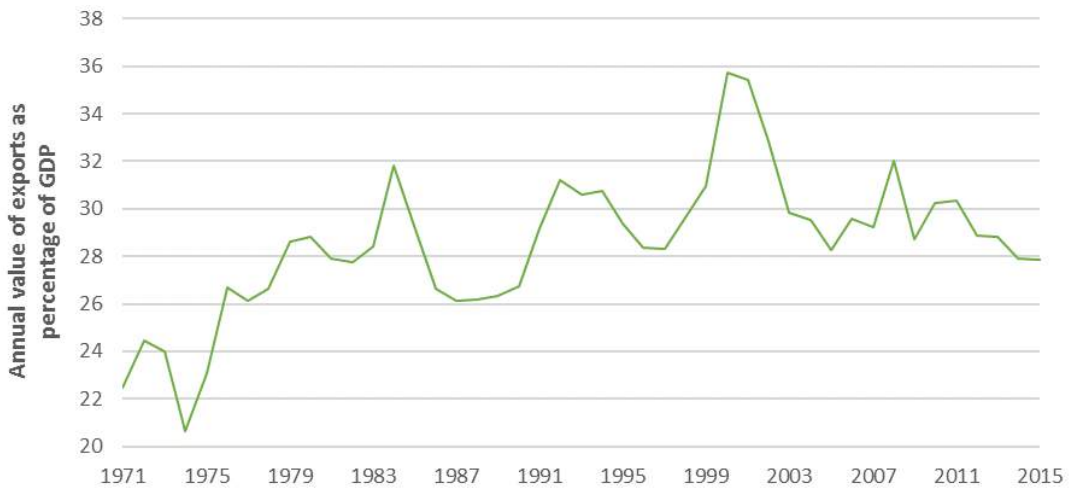


Source: Deloitte Access Economics based on Reserve Bank data

Productivity growth remains low, and an ageing population with reduced retirement incomes will create headwinds in the future. If New Zealand wishes to optimise its future prosperity, it must seriously look to increase exports, and productivity.

Over the past decade, New Zealand's export performance has been lacklustre.[1] Figure 2 shows that not only are exports less than 30% of GDP, which is well below the average for other developed countries, but are trending downwards.[2]

Figure 2: Ratio of the annual value of exports to GDP (percent, 1971-2017)



Source: Deloitte Access Economics based on World Bank data

In light of this trend, any efforts to meaningfully increase export value may seem ambitious. However, some external factors may make this target achievable, as outlined below.

The global economy creates a positive commercial environment for ITS development

Recent global trends may make the development of ITS achievable, and encourage the development of ITS, globally and in New Zealand. The key global trends are:

- Global GDP is picking up
- The world's economic centre of gravity is shifting towards Asia
- It is the era of exponential growth and change.

Global GDP is picking up. The 2008 financial crisis had a lasting negative impact on global trade. The good news is the global economy is normalising. This will have a positive impact on global trade, and New Zealand exports.

The world's economic centre of gravity is shifting towards Asia. Not only is Asian demand rising, but it is increasingly driven by consumption rather than infrastructure, which will benefit New Zealand through spending on higher value-add items. New Zealand will also benefit from second-order effects since Australia will also benefit from growth in Asia, and Australia is New

[1] This may be due to the New Zealand dollar being over-valued for much of the last decade. Briefing Papers, *The Over-Valued New Zealand Dollar – Part Two,* <http://briefingpapers.co.nz/the-over-valued-new-zealand-dollar-part-two/>

[2] The Organisation for Economic Co-operation and Development, Median exports to GDP ratio for OECD nations was 46% in 2016, <https://data.oecd.org/trade/trade-in-goods-and-services.htm>

Zealand's second-largest market. In addition, as part of Asia and sitting on the Pacific Rim, New Zealand is closely linked to its neighbours through an expansive network of FTAs, defence and security dialogue, and co-operation in multilateral and regional organisations.

70% of New Zealand's exports are to countries in the Asia-Pacific, and get preferential treatment with FTAs. With the world's economic centre of gravity shifting towards Asia suggests closer political and economic ties with Asian countries should be a priority for New Zealand.

It is the era of exponential growth and change. This is an era of exponential change, of which ITS technologies are part. The development of autonomous self-driving vehicles illustrates this:

- In June 2015, Google's self-driving vehicles hit one million miles travelled over a seven-year period.
- In October 2015, four months later, Tesla provided auto pilot functionality to over 100,000 vehicles. In June 2016, Tesla recorded over a one million miles through its automated self-driving pilot programme. This was accomplished in under one year, compared to Google's pilot programme over seven.
- By June 2017, Tesla was gathering one million miles of data every 10 hours.

This global trend of exponential growth will change business and the way consumers engage in markets. Exponential growth is also evident in data usage. Contributing factors to the increase in data usage are developments in artificial intelligence, robotics, online platforms, connected cars, utility meters and consumer electronics.

The exponential growth in data is already evident in New Zealand. For example, from June 2014 to June 2015, data consumed by households alone increased 100% to 100GB per month, and reached almost 170GB per month (a further 64% increase) by June 2016.

How can New Zealand companies position themselves to take advantage of the great opportunity?

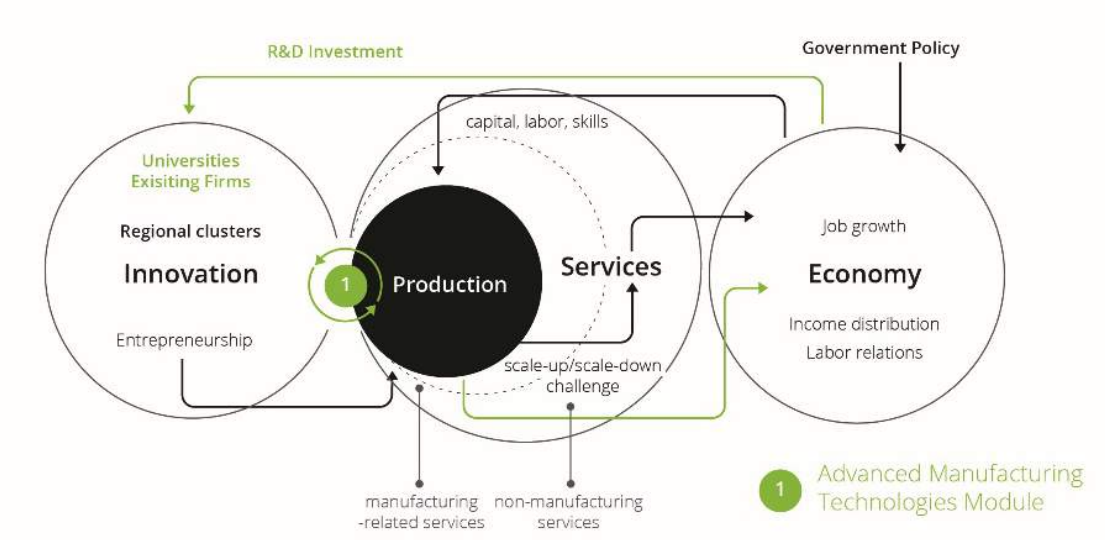
To take advantage of the potential benefits, New Zealand companies must position themselves to understand customer needs and respond effectively.

Companies seeking to take advantage of the ITS opportunity are in many ways no different to companies seeking to sell technology-based products and services in other sectors, such as health and financial services. The fundamentals remain the same – understanding why customers want a product, what they need, and how their needs can be met cost-efficiently.

New Zealand companies hoping to target export sales face the challenge of understanding customer needs in rapidly changing markets while, at the same time, keeping up with changes in technology and competitor offerings.

To be successful, they must tap into clusters of research and development, which may exist some distance from home base (or conversely move to be closer to the R&D cluster), access a skilled labour supply, and be ready to respond to demand in a scalable manner, as Figure 3 shows.

Figure 3: Interfaces between innovation and the rest of the economy



Source: Locke and Wellhausen (eds) (2015) Production in the Innovation Economy, The MIT Press

Predicting outcomes from research investment is uncertain because advanced manufacturing is a complex, fast-changing process. This is a challenging environment to operate in and New Zealand companies may need extra support to be successful. New Zealand has shown ability to apply this in advanced manufacturing in ITS products and services. For example, ITS include systems include data processing, communication, sensor technologies to improve performance in transportation, manufacturing of other electronic equipment, and rockets from Rocket Lab.

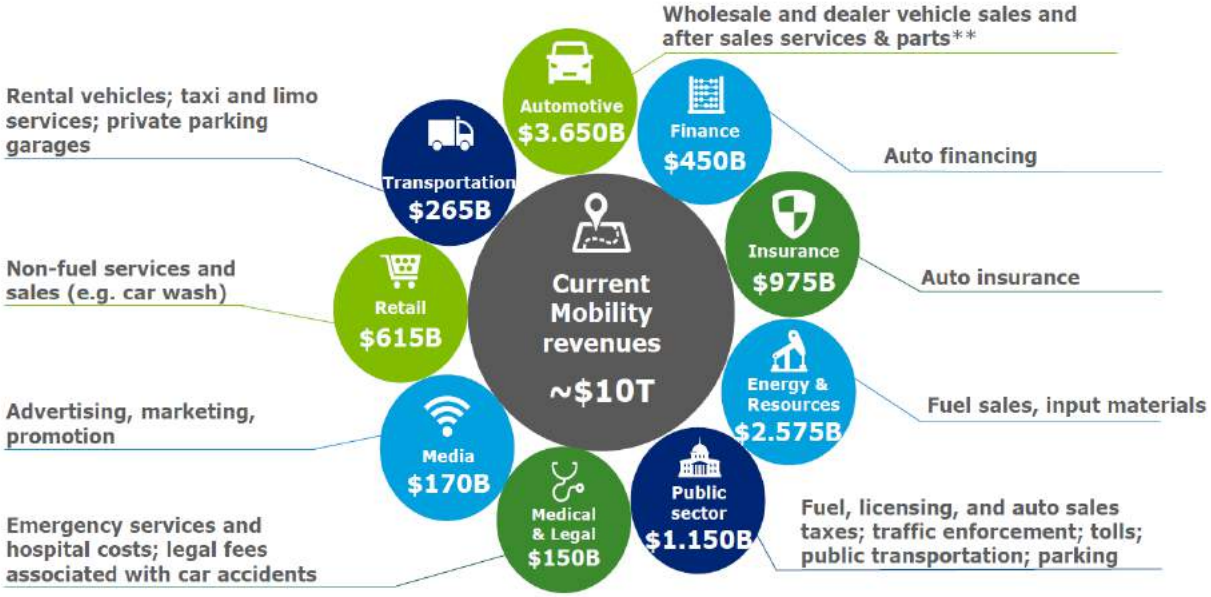
What is the potential size of ITS products and services in New Zealand?

Given the likely influence of ITS on various industries, it is reasonable to suggest ITS:

- Has the potential to be a material contributor to New Zealand's GDP
- May have a strong influence on performance in a range of sectors across the economy, some of which are significant in their own right, including agriculture, food processing, and transport modes
- Is likely to help other sectors to maximise the value in their exports.

The transformation of ITS will impact transport and many other industries. This is illustrated in Figure 4, based on a recent Deloitte study on the global split of mobility revenue by sector.

Figure 4: Global split of mobility revenue (USD, billions)



Mobility is the ability to move freely or be easily moved; Cambridge and Oxford Dictionaries, **72m PV US$1.667B, 23 CV US$833B, Parts US$750B, US$400B services = US$3.65B.

Source: Deloitte analysis based on IBISWorld *Industry Reports, IHS, DOT, US Census, EIA, Auto News, TechCrunch, estimates for 2017 based on historical data and projections.*

Given all of the above it is not easy to precisely estimate the potential benefits of ITS commercialisation for New Zealand. The scope of ITS products and services are broad, and predicting future demand for any of them is problematic. Predicting what research will lead to products that could become part of that market is close to crystal ball gazing.

Notwithstanding the challenges discussed, some estimates of the potential value of ITS commercialisation can be undertaken. The economic modelling undertaken in Section 8 of this report estimates around $3.5 trillion of benefits globally between now and 2050 from smart logistics alone (or $106 billion per year on average between now and 2050).

The size of these benefits gives a proxy for how much customers might be willing to spend on ITS products. Despite – or perhaps because of – the inherent uncertainties in research and development, it is reasonable to assume New Zealand should be able to reap at least a proportional share of these markets.

The size of the benefits estimated in this report do not include the wider economic benefits from ITS solutions but are limited to the size of the prize from commercialisation of ITS solutions for New Zealand-based businesses.

4. New Zealand's intelligent transport system landscape today

Key Insights

New Zealand-based companies are already competing to deliver ITS solutions to the market. In the private sector, there are a number of large businesses with a real market appetite to grow ITS.

The public sector has already begun playing its part, instigating a number of initiatives in the ITS space. NZTA has begun testing Mobility as a Service (**MaaS**), with its transport services app 'Choice', as well as running an innovation hub to grow transport ideas.

There are already a number of New Zealand companies leading the way around developing and selling intelligent transport systems products and services. More international companies are looking at New Zealand as an attractive option to test, develop and sell ITS products and services. This report is not designed to canvass the spectrum of activity already happening in this space in New Zealand; rather, it focuses on the opportunity for growth – although the two are related.

The participation of 50 large New Zealand businesses in our survey on ITS opportunities shows there is a real market appetite to develop and grow ITS in New Zealand. At the highest level, we know advanced manufacturing in New Zealand is currently performing particularly well, with 12% revenue growth (2015-16), over $6.9 billion generated in offshore revenues and nearly 100,000 individuals employed.

New Zealand-based companies are already competing to deliver ITS solutions to the market, developing a number of products and services ranging from network management, integrated transport solutions across all transport modes to autonomous vehicles to wireless charging. Many of these services require research into innovations, or component parts to support technology already in development.

Some examples where New Zealand is already a leader in some areas of ITS include:

Examples of existing ITS in New Zealand

- A world leader in airport baggage handling systems.
- A robot in every port: Ports of Auckland is working on automating its currently manually driven straddle carriers, which shift around the containers at the terminal. Set to be complete in 2019, automating the carriers will increase the sustainability of the port's operations, lower costs by using up to 10% less fuel, and operate more quietly.
- Microsoft New Zealand is in the early stages of developing technologies and their potential to help with congestion monitoring, congestion modelling and congestion alleviation.
- HaloIPT recently developed a wireless charging system for EVs that enables recharging while parking or on the move
- Altus Intelligence, which provides drones to US news giant CNN; Raglan company Aeronavics, which exports precision horticultural drones worldwide; and Asset Insight which provides UAV asset inspection services.
- PoweredbyProxi is already well advanced in developing solutions to support Unmanned Air Vehicle and Drone products.
- Eroad designs and manufactures in-vehicle hardware, while also being the largest provider of road-user charging compliance solutions, exporting to a number of countries, including the USA.
- Rocketlab is a leader in rockets systems and technologies with backing from major investors, including Lockheed Martin, and customers including NASA.
- HMI Technologies recently created a subsidiary company, Ohmio Automation, which intends to manufacture autonomous connected vehicles for New Zealand and global markets.
- Coretex delivers active fleet management services to the New Zealand market, as well as across North America and Australia. It tracks over 40,000 vehicles across the globe for over 1,200 clients.

These are just a few examples of companies already operating in New Zealand. As important as the potential in these companies is the role of the public sector working closely with the private sector. Public sector agencies already have a role as strategist, operator, and catalyst or regulator.

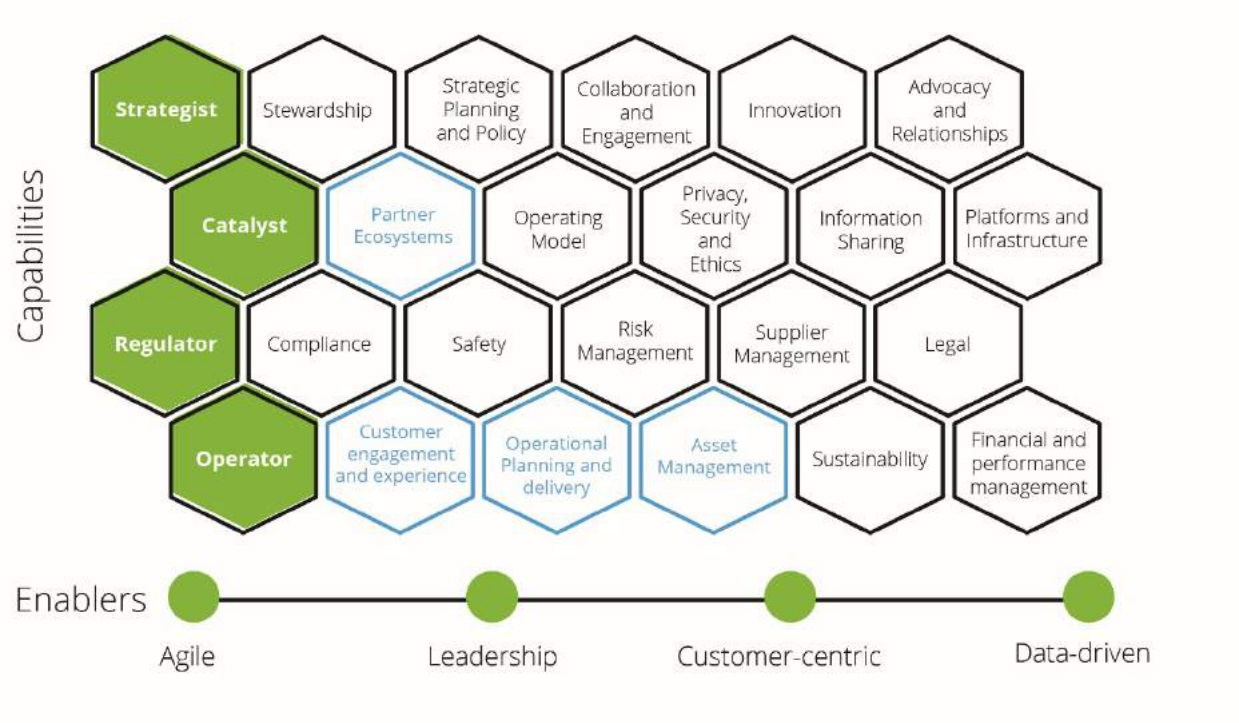
Examples of public sector ITS initiatives

- The New Zealand Transport Agency (**NZTA**) has begun testing MaaS using the concept of an 'open marketplace' with the launch of the Choice app. Choice, piloted in Queenstown, connects users with transport services through an online marketplace. The app uses live transport information so users cam book a journey and get to their destination. Using the live, cloud-based, data platform Satori, Choice combines all journey options from all available transport operators, so the user can determine the best travel option for them. Choice aims to improve transport options for residents and tourists in order to create a better travel experience, resulting in reduced congestion and enhanced road safety.
- Following Choice, another pilot will focus on facilitating seamless ground transport planning for travel to and from Auckland International Airport. The pilot will feature an integrated, network-wide mobility service airport users will access via a journey planning app or dedicated website.
- NZTA has created a hub to foster transport innovation. The innovation hub is a place where people can share their ideas with the public and receive feedback on them, promoting continued growth of the idea.
- The NZTA is undertaking a pilot of a national mobility marketplace. This marketplace will provide a digital platform where public, private and active mobility services can be integrated in real-time with multi-modal journey planning and payment services and made available to customers via apps or other means.

However, in a time of rapid disruptive change, the public sector needs to modernise its approach to working with industry. New skills and capabilities will be needed to maximise the benefits of the future of mobility.

Figure 5 illustrates the extent of the public sector's possible roles within the ITS space, spanning partner ecosystems, platform and infrastructure, asset management, operational planning and delivery, and customer engagement and experience.

Figure 5: Future of Mobility Capabilities



Source: Deloitte Access Economics

Given the public sector's interest to procure and apply ITS to improve transport outcomes, and New Zealand companies' desire to commercialise ITS, we believe there is a case for government agencies and the private sector to work closely together from research through to production. Working together to optimise the potential for greatest economic benefit may challenge traditional models of partnering and procurement. We believe the potential size of the prize is big enough to justify developing new approaches in the ITS space.

5. New Zealand's comparative advantage

New insights

New Zealand has some areas of natural advantage, and this creates a great opportunity for ITS services and products, both from a domestic and global market perspectives. New Zealand has:

- An established reputation as a clean and green safe country- creating an excellent environment for ITS solutions
- A good regulatory system supporting emerging industries
- A good reputation with international companies wanting to undertake testing of technology
- The only winter testing facility for vehicles in the Sothern Hemisphere
- The niche capability to develop ITS solutions in advanced manufacturing, which is currently New Zealand's third-biggest export revenue earner (9.8% of total exports)
- Proximity to Asia, representing an important source of advantage due to increase demand for ITS solutions
- Top placing in the World Bank's *Ease of Doing Business Index*, which is a source of advantage for the economy.

As shown by Team New Zealand winning the America's Cup, which is as much a technology race as a sports event, it is beneficial for New Zealand to have an edge – a source of comparative advantage difficult for other countries to match. Fortunately, New Zealand has some comparative advantages relative to the global opportunity to commercialise ITS technologies.

Because ITS is not one industry but rather a cluster of sub-sets of other industries, it is not possible to model comparative advantage in the same way as, for example, tourism. However, it is possible to make some observations on specific areas of comparative advantage:

- Innovation - New Zealanders have a culture of creative self-sufficiency and resilience leading to the design of clever, pragmatic innovations
- The right environment for the development of ITS
- New Zealand has well-designed and agile regulation encouraging sustainable growth, and job and wealth creation
- Focusing on niche markets, New Zealand's advanced manufacturing industry has earned a reputation for being flexible, resilient, adaptable and entrepreneurial

Innovation – a culture of creative self-sufficiency and resilience leading to the design of clever, pragmatic innovations

Increasingly sophisticated technological innovation has led to significant improvements in quality of life. Innovation plays a crucial role in driving improvements in the wealth and prosperity of nations as a whole and their populations. At its core, innovation is the act of developing or using a new method to create a product or service in an improved or different way.

Relative to the rest of the world, New Zealand is in a good position to promote and harness innovative solutions. Overall New Zealand ranks 3rd in global creativity, 5th in Asia and Oceania for innovation, 21st in the world for innovation, and 6th in the world for contribution to science and technology. New Zealand has the highest tertiary graduation rate of any advanced country (OECD, 2016). Also, New Zealanders are well connected, thrive on doing more with less to meet global challenges, and thinking differently with an innovative "can do" culture (Ministry of Business, Innovation & Employment, 2017a).

New Zealand provides the right environment to develop ITS technologies

New Zealand has an established reputation as a clean and green country. ITS technologies can ensure that New Zealand is maintaining this image, given the recent publicity on whether that questions whether this image still holds.

New Zealand generates 80% of its electricity from renewable sources. This means New Zealand has the right environment to develop ITS solutions in light of lowering emissions. If every vehicle in New Zealand were electric, there would be enough capacity to charge them (Ministry of Transport, 2017b).

Transport is typically associated with a negative impact of the environment. The transport sector in New Zealand is the second-biggest source of emissions**. ITS technologies can help to reduce emissions** by, for example, smoothing traffic flow or promoting modal shift. In this way, ITS can ensure New Zealand maintain its clean and green reputation in the future and contribute to meeting the target of carbon neutrality by 2050.

New Zealand has solid supporting infrastructure in place for ITS to flourish, and to enable data connectivity. This provides a good basis for both overseas and New Zealand companies to enter the ITS space. This infrastructure include telecommunications networks and sensor networks. ITS also requires multiple network types to support the necessary plethora of sensor and vehicle data at the right price points.

New Zealand has a good reputation with international companies wanting to undertake large-scale or long-term testing of technology, and research and development. This reputation is based on some distinctive aspects, such as the appetite for new technology, a relatively small but well-educated population, and a diverse landscape and climate.

New Zealand has the only winter testing facility for vehicles in the Southern Hemisphere, the Southern Hemisphere Proving Grounds in the South Island. This provides an opportunity for companies to test technology such as autonomous self-driving vehicles (**ASDV**) in New Zealand.

For exports generally New Zealand's proximity to Asia, in particular, Australia and Southeast Asia, combined with its natural resources represents an important source of advantage. The rapid increase in incomes in Asia, especially from China, will lead to increased demand for ITS technologies. New Zealand's proximity to Asia and preferential access means it will benefit from this increase in demand, especially for niche high-value manufacturing products and design of software templates for componentry.

New Zealand also ranks first in the World Bank's *Ease of Doing Business Index*, which is a source of advantage for the economy, particularly for those sectors that have a greater weighting for this component. New Zealand has a straightforward, business-friendly, low compliance tax system supporting capital development and international investment.

New Zealand has well-designed and agile regulation encouraging sustainable growth, and job and wealth creation

The Government's regulatory approach supports emerging industries

Having adaptable regulatory practices is important in unlocking technological change.

Generally, the Government is willing to review or change regulations in the right circumstances. For example, the Government has taken an agile and pragmatic approach to attracting and retaining investment in digital innovation, in visual effects and imagery processing. Another example is the speedy development of legislation governing outer space and high-altitudes activities in 2017, which enabled Rocket Lab to begin its launches in Mahia.

New Zealand's regulatory environment is committed to ITS
Ministers and government agencies have critical roles to play in leading, facilitating and supporting the further development and deployment of ITS technologies. This is to ensure the benefits are realised for New Zealanders as quickly as possible, where they support improved transport outcomes and it is cost-effective to do so.

Government agencies can do this by providing strategic leadership, direction setting and collaboration, providing a supportive regulatory environment, funding and procuring infrastructure or services and using the information and opportunities provided by ITS.[3]

The Government already creates a supportive regulatory environment by:

- Removing unnecessary regulatory barriers, to enable the deployment of ITS technologies, ensuring open markets and accelerating the uptake of ITS technologies where there is a clear public benefit, while maintaining the safety of users and the public
- Encouraging sector-led ITS development, investment and trialling
- Leadership in the technology and transport sectors, working with all relevant parties to develop a clear strategic direction for ITS as an integrated part of New Zealand's transport system
- Operating in a coordinated way across different government departments, government agencies and local government, recognising many of the issues relevant to ITS also apply in, and have benefit for, other sectors

New Zealand already has a supportive regulatory framework and has shown a willingness to make necessary changes.

In general, New Zealand's transport legislation is already well suited to enable the trialling of ITS technologies. In aviation and maritime legislation, there are existing provisions for the testing of experimental or novel aircraft and vessels. The NZTA already has broad powers to allow testing under controlled circumstances on land.

Two key examples to consider are around regulations on unmanned aircrafts and automated vehicles:

Unmanned aircrafts (including drones)
The growth in testing and deploying different applications for unmanned aircraft is creating regulatory challenges around the world.
In 2015, New Zealand introduced Civil Aviation Rules for unmanned aircraft, including UAS, remotely piloted aircraft systems (**RPAS**) and drones. These rules have introduced one of the most accommodating regulatory frameworks for unmanned aircraft innovation in the world.

This has enabled a range of new commercial and recreational applications, such as using unmanned aircraft for courier deliveries, asset management and search and rescue.

[3] The central government participants include the Ministry of Transport, the NZ Transport Agency, KiwiRail, Maritime New Zealand, the Civil Aviation Authority, the Aviation Security Service, Airways New Zealand, Land Information New Zealand, and MetService. Other government departments and agencies, such as the New Zealand Police and the New Zealand Customs Service, are involved in specific aspects of ITS.

International developments will also be monitored to ensure New Zealand's approach is consistent with these when they are developed. A key milestone is the expected release of Standards and Recommended Practice for regulating unmanned aircraft by the International Civil Aviation Organization in 2020. Air traffic management for unmanned aircraft is another area that will likely require both technological and regulatory interventions.

Autonomous vehicles

Unlike some other markets, testing semi and fully autonomous vehicles, as well as other ITS technologies, is encouraged on New Zealand roads (Ministry of Transport, 2016b). Most US States have introduced specific ASDV legislation. For example, under Californian law, an ASDV is "any vehicle equipped with autonomous technology that has been integrated into that vehicle and is operated without the active physical control or monitoring by a human operator" (Bonta 2017).

There is no legal definition of an ASDV in New Zealand because New Zealand law already does not require a driver to be present (Ministry of Transport, 2016a). This means that, so long as a vehicle meets relevant safety standards, or is exempt from these requirements, the testing is carried out safely, and the vehicle complies with all relevant transport legislation, a truly driverless vehicle may be tested today on New Zealand roads.

To date, no formal requests to test autonomous vehicles on public roads have been received. Testing could occur on private property, such as farms, forestry roads or racetracks, without requiring any formal consent from the government. NZTA is considering establishing a connected and automated vehicle test-site in New Zealand, and is planning to review the vehicle classification system to provide for emerging vehicle types.

Focusing on niche markets, New Zealand's advanced manufacturing industry has earned a reputation for being flexible, resilient, adaptable and entrepreneurial

New Zealand is strong in advanced manufacturing and has the niche capability to expand. Advanced manufacturing is currently New Zealand's third-biggest export revenue earner (9.8% of total exports), and communication equipment is the third-largest revenue earner within advanced manufacturing.[4]

ITS falls at least partially under this category as a defined export sector, which includes both high-tech manufacturing and ICT services. Particular services relevant to ITS include systems that apply data processing, communication, sensor technologies to improve performance in transportation, including the manufacturing of communication, and other electronic equipment (Ministry of Business, Innovation and Employment, 2014). Considering the advanced manufacturing component of ITS alone provides an indication of the significant opportunity in ITS to New Zealand.

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[4] This percentage is calculated based on the total of 2017 exports and the value of $6.9 billion. Source for $6.9 billion: Ministry of Business, Innovation and Employment, The investor's guide to the New Zealand technology sector, <http://www.mbie.govt.nz/ publications-research/publications/telecommunications/investor-guide-to-the-nz-techsector.pdf>

6. Making the most of New Zealand's comparative advantage

New insights

For ITS, New Zealand's level of innovation, quality of products and services, relatively permissive regulatory environment and ease of doing business are all significant advantages. But there are big challenges to address to make the most of the global opportunities.

To enhance New Zealand's comparative advantage in ITS, it needs to:

Be globally connected. New Zealand needs to be internationally connected through trade and investment, and the flow of people and ideas. New Zealand firms in ITS need to be innovative and create international appeal from the start to get a first-mover advantage on a global basis. It is important to find ways to identify and pursue new markets in a timely manner and to attract talent to New Zealand.

Attract more foreign direct investment (FDI). In the past five years, a growing number of high-profile and respected international investors have invested in New Zealand companies. In the past year FDI increased by 239% within the overall advanced manufacturing industry. A future challenge is going to be maintaining this level of FDI for ITS.

Spend more on R&D. Overall business expenditure on R&D in New Zealand is only 0.65% of GDP and private sector funding of R&D in New Zealand is one of the lowest in the OECD.

Create new employment opportunities to mitigate the potential impact of ITS on the workforce. ITS solutions could have a significant impact on the workforce due to automated fleet vehicles, for example

These challenges are discussed below, with suggested strategies to address them.

Be globally connected

Embedding digital technology in the fabric of the business model makes businesses more likely to trade. For example, digitally advanced small and medium-sized businesses are seven times more likely to be exporting, compared to those relying on traditional means of marketing, and product and service distribution.

If New Zealand is to take full advantage of ITS as an opportunity for accelerating trade growth, it is important public officials and others at the forefront of trade negotiations understand both the nature of the opportunities and where impediments might lie.

Encouraging entities working with New Zealand companies, to fully embed digital technology in their business models from the outset could be a powerful means of encouraging export growth – particularly given the synergies between ITS as a technology-rich industry and digital technology more generally.

Attract more foreign direct investment

New Zealand needs to attract foreign direct investment to invest in ITS.

One way to do this is for New Zealand to target technology start-ups that are "born global". It is technology in the broadest sense that has developed the possibility for businesses to be born global, exporting from their inception. These firms are different from domestic small firms and conventional international firms, in that born global firms selectively invest in projects designed to use resources and produce goods and services on a large scale in multiple countries. For example, Orca NZ, Skype and Cochlear are all born global companies.

The number of born global companies is growing, and studies show firms originating in industries with higher levels of international competition and high levels of global integration are more likely to be born global. This is true for the technology sector, where digital technology has streamlined geographical markets and enabled the development of an international market. As a result, more than 80% of technology start-ups worldwide are born global.

One option is for the New Zealand government to develop a strategy around "born global" businesses more through marketing the potential for New Zealand to be in the first wave of countries where born global entities seek to operate. New Zealand is already seen as a good testing ground for new ideas by companies such as Google, but this is a concept that could be promoted much more extensively.

Example of a born global business

Startupbootcamp was founded to support the world's best entrepreneurs, through all stages of their growth.

Melbourne has attracted Startupbootcamp, so Australian start-ups have the opportunity to access an already established and highly successful global network of mentors and investors. Startupbootcamp received $600,000 from the LaunchVIC innovation fund, and will be using the funding to launch its accelerator programme in Australia from 2017.

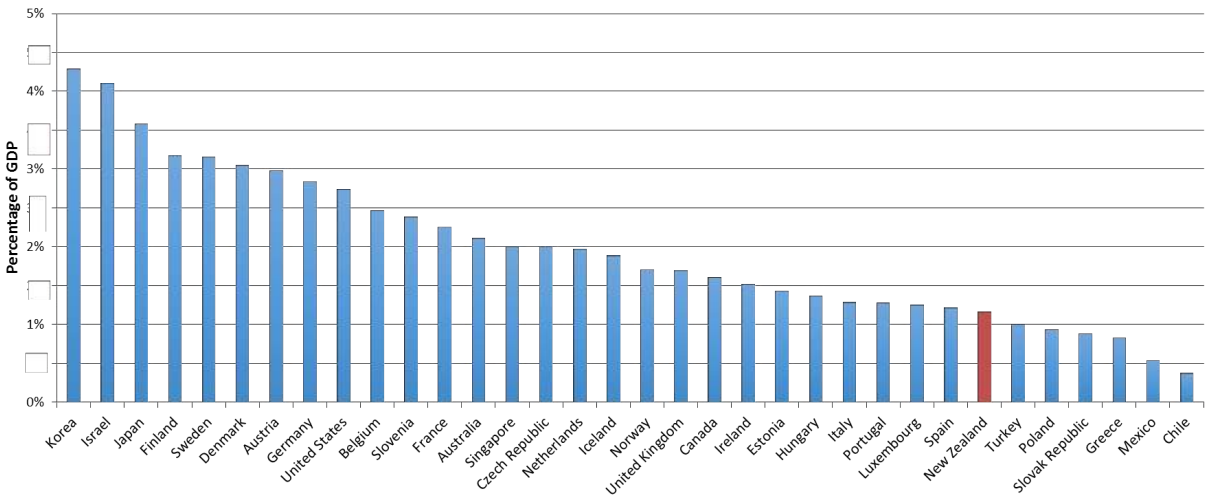
Startupbootcamp was founded in Copenhagen in 2010 and now runs 13 accelerator programmes in 10 countries. Nearly 350 start-ups have passed through its doors, with 71% of these going on to raise an average of $1 million.

Spend more on R&D

The Government has recently reintroduced tax credits for R&D, committing to a 12.5% tax credit for research and development.

Overall, private sector funding of R&D in New Zealand is one of the lowest in the OECD, as shown in Figure 6. Being small is not an excuse. Other small advanced economies like Israel, and Finland all spend between 2.0% to 3.5% of their GDP on R&D in terms of business expenditure, and these countries all have higher productivity than New Zealand.

Figure 6: Private sector funding of R&D as Percentage of GDP



Source: Deloitte Access Economics

New Zealand's low rate of expenditure on R&D appears to be a product of a number of systemic factors, making resolution difficult. The Prime Minister's Chief Science Advisor, Sir Peter Gluckman believes it is a combination of the following factors:

- New Zealand's culture does not encourage risk-taking, but rather emphasises "making do" and ingenuity, and isolation means the country is not subject to very obvious competitive forces.
- The vision of New Zealand as a 'smart nation' has not really been adopted.
- The development of research focused universities has been relatively recent compared to other countries.
- A lack of large companies, the small domestic market size, and the nature of the sectors naturally strong in New Zealand appear to have resulted in a limited private sector and public advocacy for public sector R&D and upstream research.

One answer to these long-standing issues is for the Government to develop and promote a "within New Zealand" view in the same way there is a "brand New Zealand" marketed externally. The aim would be to identify the comparative advantages of New Zealand's cities and regions so these could be built up over time with the end goal of encouraging much greater R&D in centres of excellence.

Create new employment opportunities

There is a view some jobs could soon be extinct due to the rise of autonomous vehicles, so opportunities for people to retrain may need to be made available.

This is particularly the case for New Zealand in the agriculture and food processing sectors. A case in point is the Netherlands, where scarcity of land forces a sharp focus on productivity. The September 2017 issue of *National Geographic* magazine reported a nice story that illustrates this point:

> *"From his perch 10 feet above the ground, he's monitoring two drones—a driverless tractor roaming the fields and a quadcopter in the air—that provide detailed readings on soil chemistry, water content, nutrients, and growth, measuring the progress of every plant down to the individual potato. Van den Borne's production numbers testify to the power of this "precision farming," as it's known. The global average yield of potatoes per acre is about nine tons. Van den Borne's fields reliably produce more than 20."*

The Netherlands is a small, densely populated country, and yet it's the globe's number two exporter of food as measured by value, second only to the United States, which has 270 times its landmass. New Zealand has a population of around 5 million, but produces enough food to feed around 50 million by some estimates – not bad, but the Netherlands is doing much better again. So how can we be more like the Netherlands without creating mass unemployment?

How can our agri-focused universities, already world leaders in some respects become more like the Wageningen University & Research (**WUR**), near Amsterdam? WUR is at the centre of Food Valley, a cluster of agricultural technology start-ups and experimental farms, developed to emulate the role of Stanford University in bringing together academia and entrepreneurship.

7. Attractors and barriers: industry perspectives

Key Insights

In October 2017, we surveyed 50 national and international businesses operating in New Zealand.

The results of our survey indicated the top three attractors to ITS growth in New Zealand are the ease of conducting business, New Zealand's innovative culture and its encouraging policies and regulations.

The results of our survey shows the top three barriers to growth were identified as slow speed of regulatory change, cultural inertia/risk aversion/internal silos and a lack of vision/goals.

The survey results indicated the areas we should prioritise for ITS growth in New Zealand are Communication Technologies, Shared On-Demand Transport, Public Transport and Physical Infrastructure.

As part of the analysis, a new, bespoke survey was used to consider what businesses perspectives are about New Zealand's attractors and barriers in the development of ITS in New Zealand.

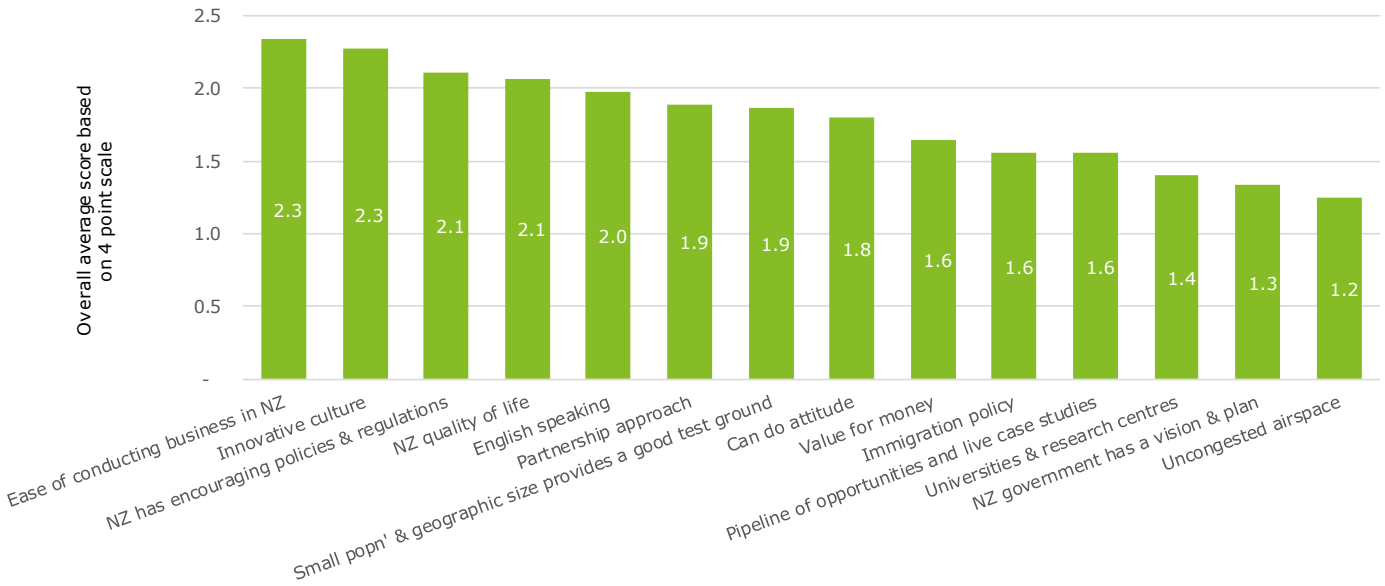
The survey was conducted with 50 large New Zealand businesses who have a strong interest in developing ITS within New Zealand. These businesses operate in the Transport industry, Information Media and Telecommunication industry and Manufacturing were the other major industries represented by the survey participants. Over two-thirds (65%) of respondents had international operations, and 88% of responses were received from large organisations.

The results shown in this section are based on scale, with the number assigned to each attractor being an average score. Each response was assigned a number between -1 (not an attractor) to +4 (critically positive attractor) and the results were averaged for each attractor to get a total average score.

Attractors

Participants confirmed New Zealand is an easy place to do business, has an innovative culture and supports commercialisation of ITS technologies by an encouraging policy and regulatory environment. As shown in Figure 7, ease of conducting business in New Zealand received the highest average score and therefore is ranked as the overall top attractor to ITS. For more information on the methodology behind the survey results interpretation, **refer to Appendix 1**.

Figure 7: Overall Attractors



Source: Deloitte Access Economics survey

Other positive attractors to business growth in ITS included quality of life, and being an English speaking country.

Top attractors by industry

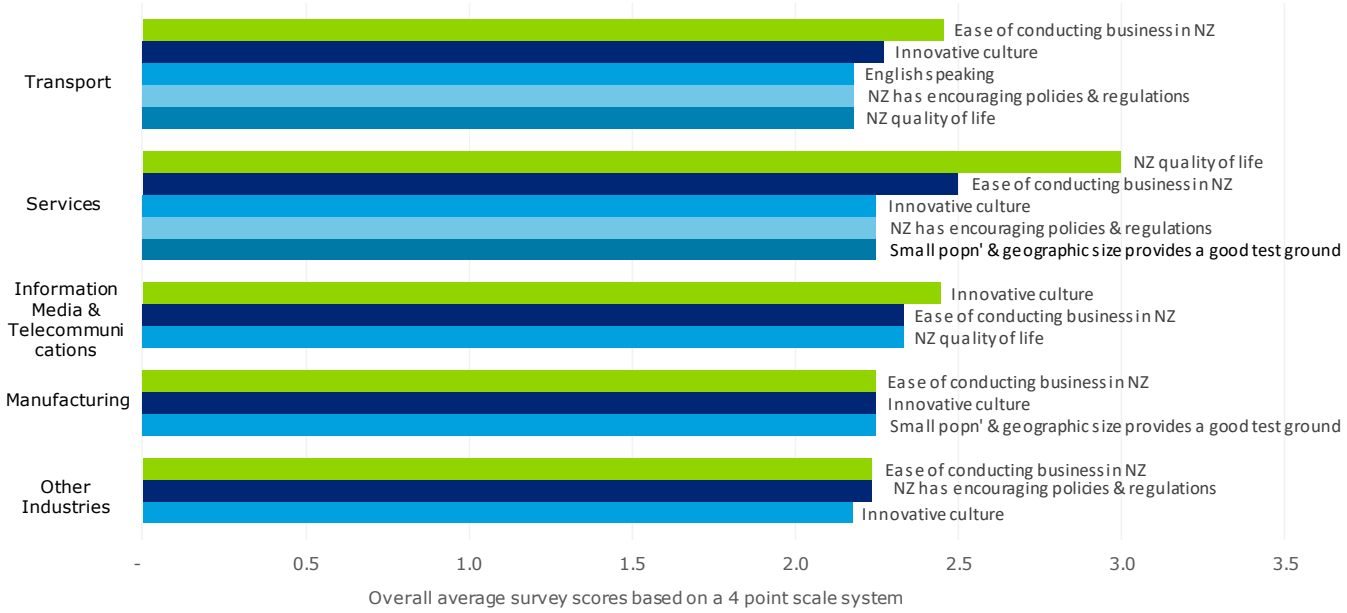
As shown in Figure 8, these results were largely the same between respondents across industry sectors, with all industries surveyed identifying at least two of these attractors in their top three.

Figure 8 shows the top three attractors by industry. In some cases, there was no clear top three, in which case all top three results are shown. For example, transport identified English speaking, New Zealand has encouraging policies and regulations, and quality of life as third-equal attractors to ITS in New Zealand.

Key results illustrated in Figure 8 are:

- All industries identified ease of conducting business in New Zealand and an innovative culture as one of the top three attractors
- A small population and geographic size providing a good testing ground was identified as a top attractor for the services and manufacturing industries
- Quality of life was identified as the number one attractor in the services industry and the third attractor by the transport and information, media and telecommunications industries.

Figure 8: Top attractors by industry



Source: Deloitte Access Economics Survey

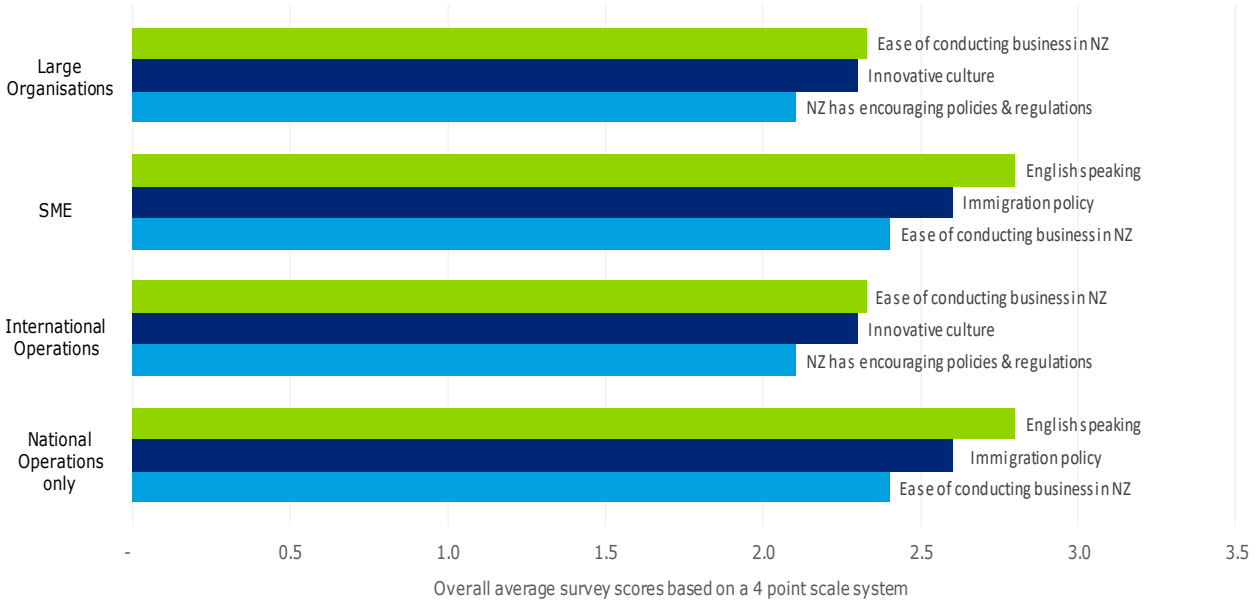
Note some industries have more than three attractors because respondents ranked some attractors on an equal basis

Top attractors by organisation type

There were different views on attractors and barriers, depending on the size of the respondents' businesses.

The majority of survey respondents were large and international businesses, resulting in their top attractors also being the overall top attractors shown in Figure 7 above. Smaller sized businesses, on the other hand, identified the top three attractors as New Zealand being Englishs-peaking, immigration policy settings, and ease of doing business.

Figure 9: Top attractors by organisation type

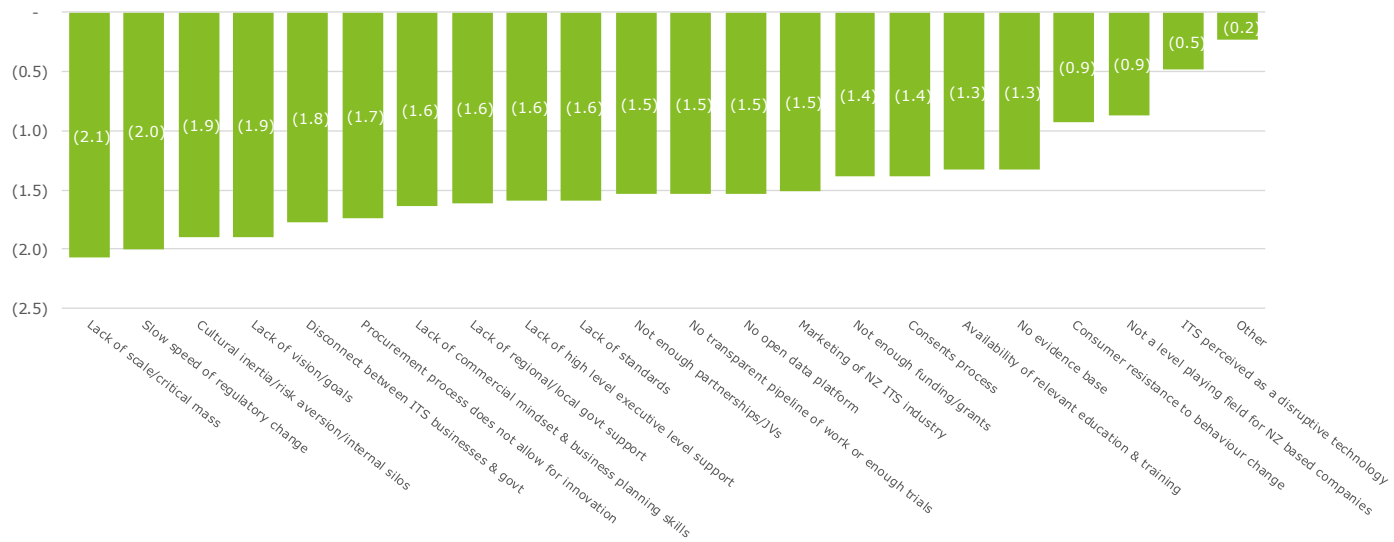


Source: Deloitte Access Economics survey

Barriers

Figure 10 provides a breakdown of results. The scale follows a similar methodology to the attractors scale, however, the scale ranges from -4 (positively strong barrier) to +1 (not a barrier). The scores were averaged, and the largest negative score is identified to be the overall largest barrier to ITS growth in New Zealand.

Figure 10: Overall barriers



Source: Deloitte Access Economics survey

The top five barriers to growth, with almost a third of respondents identifying these as critical barriers, were:

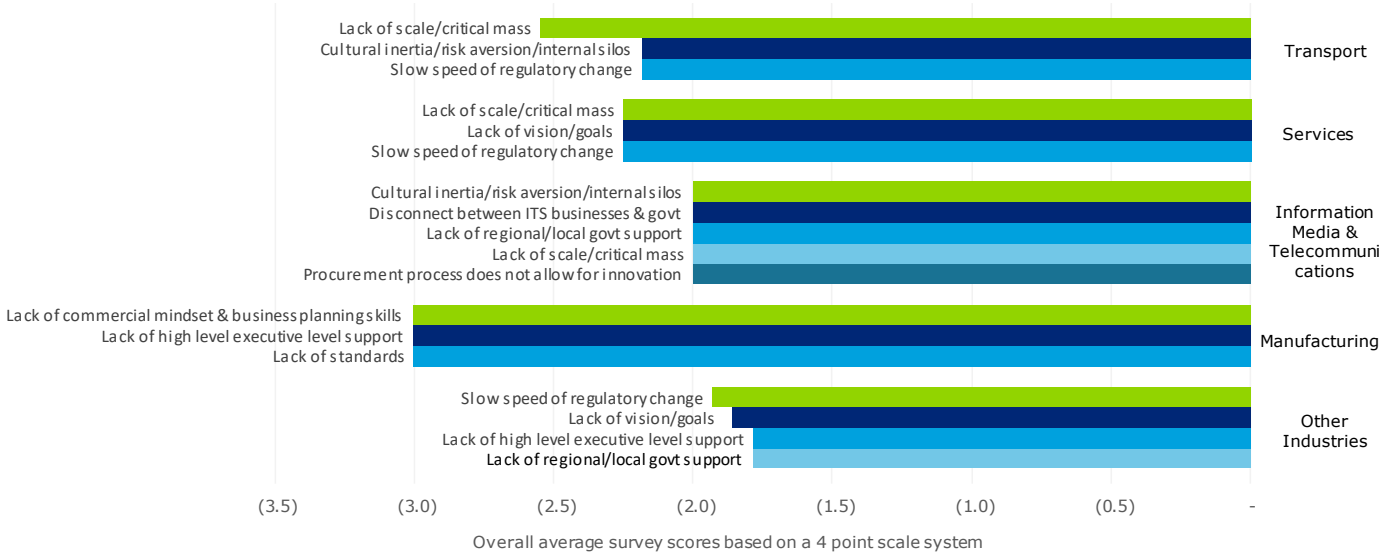
- Slow speed of regulatory change
- Cultural inertia, risk aversion and internal silos
- A lack of vision and goals
- A disconnect between ITS businesses and government agencies
- Procurement process does not allow for innovation.

We recognise there are limitations of the survey, as the questions are not providing explanation or context behind the response. For example, one of the barriers identified was slow speed of regulatory change, but the response in the survey does not describe a particular piece of legislation which requires change. It is also not immediately apparent what the disconnect is; whether it relates to vision and strategy or to who should lead ITS in the public sector.

Top barriers by industry

Similar to the attractors, these top barriers were fairly consistent between industries and many of the barriers were seen as equal in magnitude, for example the Services; Manufacturing and Information Media; and Telecommunications industries, as shown in Figure 11.

Figure 11: Top barriers by industry



Source: Deloitte Access Economics survey

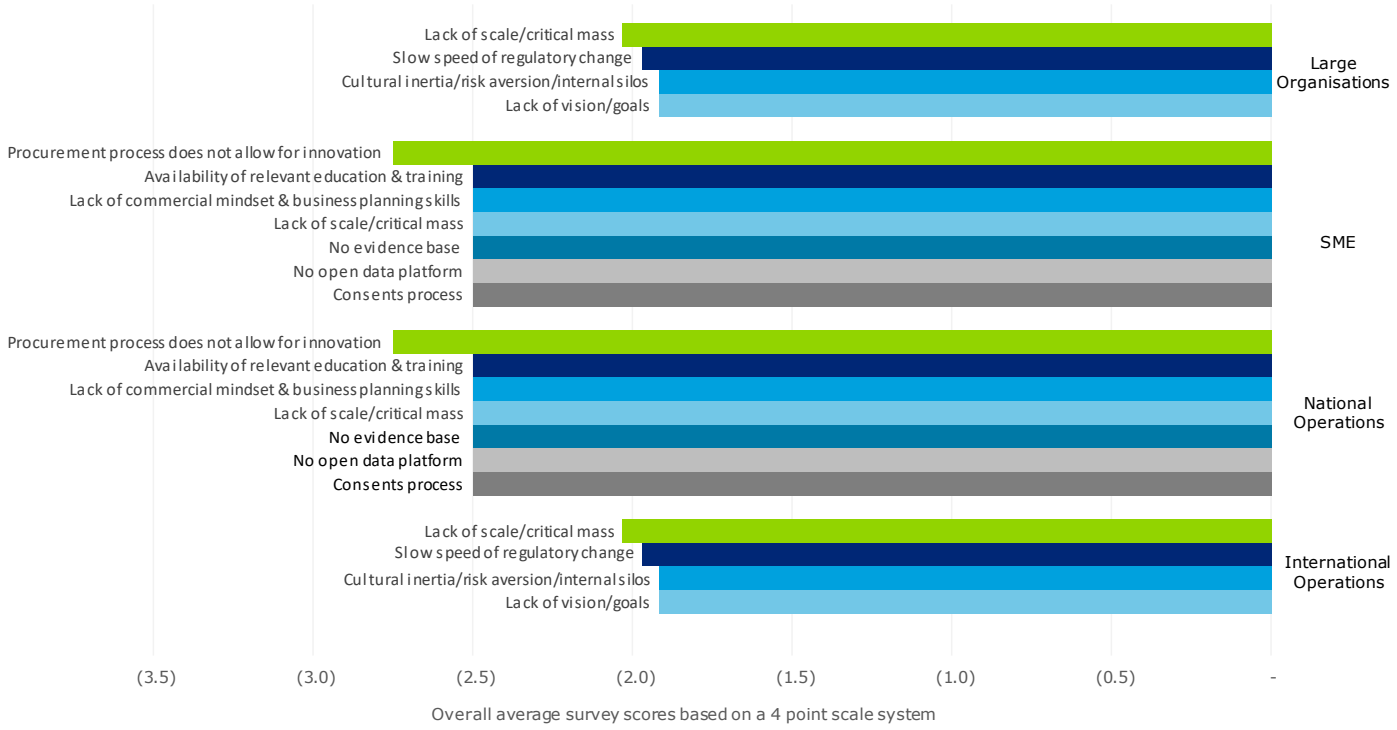
While survey consensus found an encouraging policy and regulatory environment is a key attractor to growth in New Zealand, slow speed in regulatory change was identified as the largest barrier. This may indicate that while active regulation in New Zealand is a comparative advantage, there is a perception that changes in regulation is slow. The speed of regulatory change is a challenge faced by most countries globally, and more of a significant barrier to smaller businesses in New Zealand due to their lack of influence relative to large businesses.

Top barriers by organisation type

Views also differed between national and international businesses in relation to the barriers. Businesses with national operations did not believe slow speed of regulatory change was a primary barrier to growth, whereas businesses with international operations did.

Small and medium enterprises (**SMEs**) and large organisations also had different perspectives on barriers. There was only an agreement on a lack of scale/critical mass as primary barrier, with otherwise differing views on the remaining primary barriers as shown in Figure 12 below.

Figure 12: Top barriers by organisation type



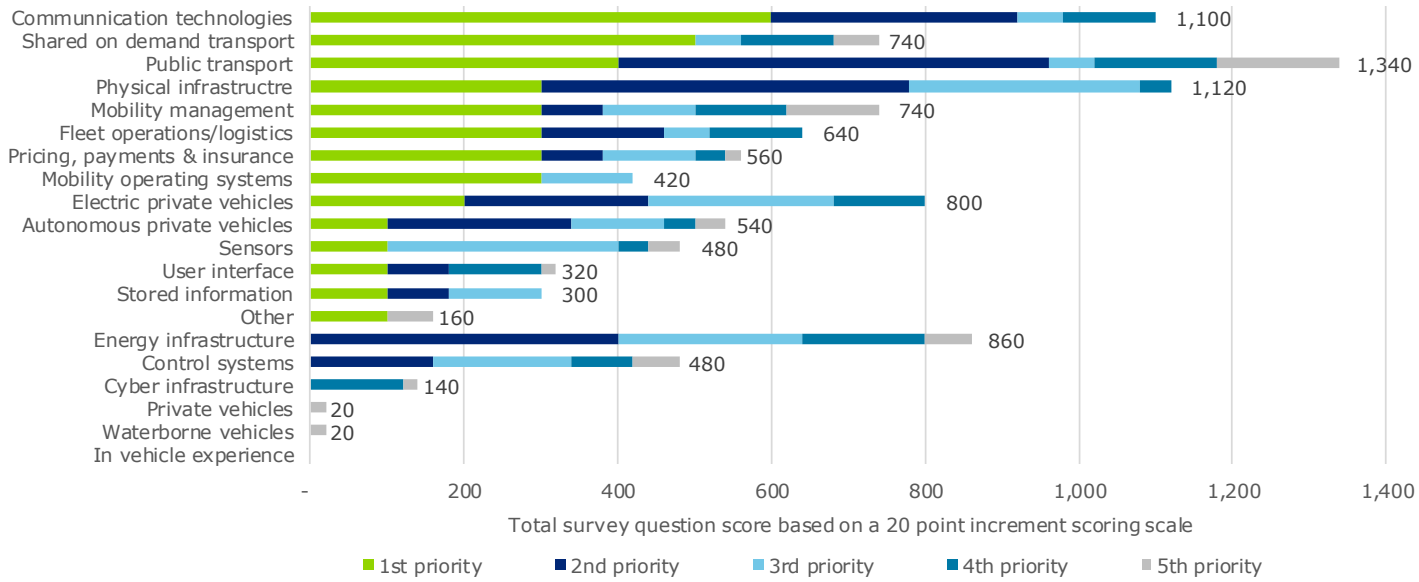
Source: Deloitte Access Economics Survey

Where should we prioritise?

We asked our survey respondents to rank New Zealand's top five priorities to commercialise and grow ITS. The top three first-choice picks were Communication Technologies, Shared On-Demand Transport and Public Transport, with no clear distinction in fourth and fifth place. Once second, third, fourth and fifth place choices were included, Public Transport and Physical Infrastructure edged out Communication Technologies – possibly because these are easier to understand as they are known consumer needs – while other opportunities are still emerging.

Figure 13 outlines the top priority areas for New Zealand as indicated by survey participants. Each priority was given a score, with 1st priority receiving 100 points down to 5th priority receiving 20 points. Points for each priority were then multiplied by the number of respondents per priority, with the overall points aggregated up to a total number. This resulted in two different interpretations of the results; the overall priority with the highest total number of points, and the priority which received '1st priority' the most. Public Transport received the largest number of points (1,340); however, as a first priority it was selected as third-highest. The graph below ranks the priorities by the scores for '1st priority'. For more information on the methodology behind the survey results interpretation, **refer to Appendix 1**.

Figure 13: Top ITS priority areas for New Zealand



Source: Deloitte Access Economics Survey

Except for in-vehicle experience, which was not selected by any respondent, the other 19 areas were selected as a priority at least once. Given the range of companies surveyed, this suggests each has its own idea of what should be a priority, which probably relates to the industry it operates in. For example, waterborne vehicles was selected once as a 5th priority from one respondent.

The top priority areas identified by survey participants is a relatively small sample of opinions across a wide range of industries, each with its own idea about what is important in the ITS space in the future.

8. Case studies

New insights

To estimate New Zealand's potential share, Deloitte Access Economics has considered three ITS technologies: drones, ASDVs and smart logistics for road freight.

Our reports find that, on average, over the period from now to 2050, potential benefits to New Zealand from the three ITS products and services could be worth almost $2 billion dollars a year in domestic sales and about $750 million in exports. This assumes New Zealand achieves a competitive share of the global market based on ITS technologies under consideration.

Under a breakthrough scenario, New Zealand could be earning the equivalent of 6% of current GDP just from drones.

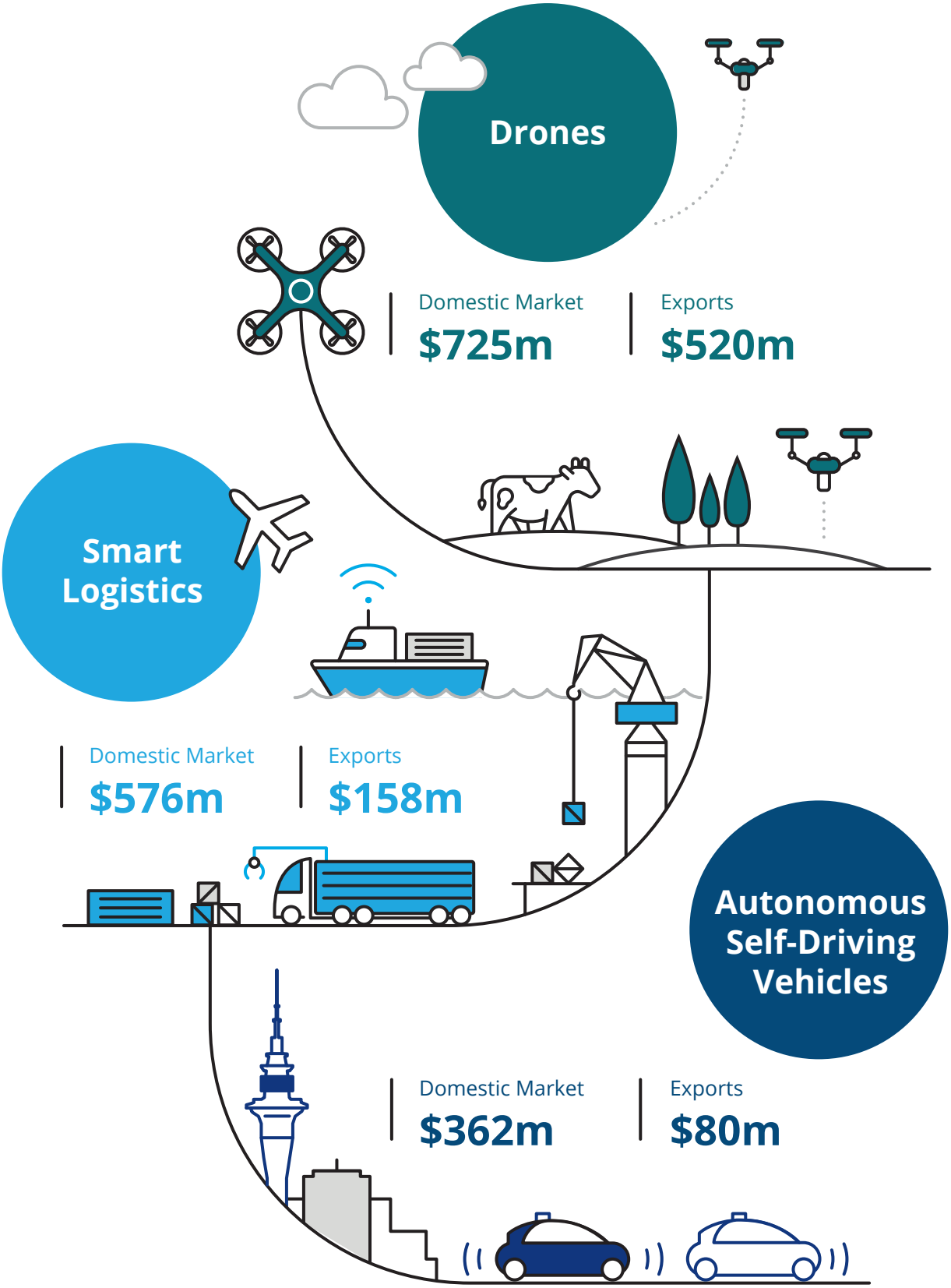
There is significant potential economic value to New Zealand from the commercialisation of ITS. Markets are emerging globally for many different technologies in this space, including autonomous, electric and shared vehicles, intelligent freight movements and drones.

To consider the potential benefits for New Zealand, we have looked at three case study technologies that could represent large, medium and small opportunities within New Zealand. These ITS technologies are:

- Autonomous Self Driving Vehicles (**small or emerging opportunity**)
- Intelligent logistics or freight movements (**current, medium opportunity**)
- Drones (**large, rapidly accelerating opportunity**).

Potential market size for the supply of three illustrative ITS technologies

(Average $, millions per year, between now and 2050)



The selection of the case studies was based on the quality and availability of data. They are all specific opportunities where it was feasible to narrow down the scope of ITS to an area amenable to modelling. **Appendix 2** expands on these case studies.

For each of these technologies, we researched the following values at 10-year intervals from 2020 to 2050:

- Total size of the domestic market
- Total size of the international market
- New Zealand suppliers' potential share of the domestic market
- New Zealand suppliers' potential share of the international market (specifically Australia, the US, the EU and Japan)[5].

The economic modelling conducted for this report by Deloitte Access Economics estimates these three ITS products alone could represent, on average, over the period between now and 2050:

- Nearly $2 billion dollars a year of turnover within the domestic market for these three selected products.[6]
- Nearly $760 million a year of turnover for exports of these ITS technologies from New Zealand. This represents a potential turnover to New Zealand ITS patent holders, manufacturers, service suppliers and exporters.
- To develop these estimates, Deloitte Access Economics has assumed New Zealand ITS suppliers will capture the same share of the international market for these three products as it has of global GDP (0.15%).[7] This is a conservative assumption given New Zealand's benefit of an increase in demand from Asian markets.
- We believe it is reasonable to assume local ITS suppliers might capture 40% domestic sales, plus exports from New Zealand. This amounts to $1.5 billion per year, on average over the period.

Table 1: Average potential revenue between 2020 and 2050 from case studies ($m pa)

Case study	Total local market size	Total exports from New Zealand	Local ITS supplier's share of local market and exports
ASDVs	362	81	136
Drones	725	520	882
Smart Logistics	576	158	446
Total	**1,663**	**759**	**1,464**

Source: Deloitte Access Economics

[6] Because of the rapid pace of technological change and inherent uncertainties over such a long period, the detailed numbers in the models may give a false sense of accuracy. Accordingly high level rounding is employed in the text.

[7] Alternative measures, such as New Zealand's share of world trade, or world advanced manufacturing trade are discussed in Appendix 2.

To estimate the benefit, we look at forecasts for the domestic market, and four other markets globally:

- Australia
- United States
- European Union
- Japan

The export figures above are based on 0.15% share of the potential global market.

If New Zealand was able to capture up to 0.21% of the global market, which is based New Zealand's current share of world trade (World Bank, 2017) the figure would be higher. **Based on this target of 0.21% of the global market, average exports over the period 2020 to 2050 for New Zealand could be $1 billion.**

Another way of looking at the potential opportunity is to consider the impact of a New Zealand firm developing a "killer app" that will let it dominate its niche – for example precision horticulture drones – and so grab 2%-3% of the total world market for all drones. **Under this scenario, New Zealand could be earning the equivalent of 6% of current GDP just from drones.**

Overall, in considering the potential market size of these three ITS technologies alone, it is clear that the potential opportunity for ITS in New Zealand is significant. Our key assumptions in deriving these estimates include:

- Most ASDVs in the future will be electric. Projections for electric vehicle (**EV**) take-up are a consensus of forecast ranges from previous Deloitte Access Economics reports, with a range from 30% to 40%. This range is slightly lower than the Ministry of Tranport's (**MoT**) recent projection of the uptake of EVs (MoT's range is 40% to 50%).
- Modelling is based on the reduction of freight costs due to enhanced efficiencies in planning and logistics, and our charging price for electricity is assumed to be cost-competitive with fuel. The potential for freight-cost savings provided by ITS technology indicates the potential market size for ITS suppliers. Take-up of smart logistics is based on a mixture of population and GDP growth, to derive total heavy freight kilometres and total running costs.
- By 2050 total sales will be considerably larger than this average figure. Conversely, current sales for ITS products are far smaller. However, most new industries show a pattern of rapid take-up in the first 10 to 15 years, followed by steady growth thereafter. For example, smartphones were taken up by 40% of the US population within 10 years of being introduced (Harvard Business Review, 2013). So it is reasonable to expect the benefits would be front-loaded, rather than growing incrementally over this time. We also expect the growth in benefits to be exponential.

To achieve these benefits, money will need to be spent developing successful ITS products in New Zealand, and on developing products that do not ultimately make it to market. This expenditure would be a direct economic benefit to New Zealand, but no attempt to calculate this has been made, due to Rumsfeldian unknowns.

Small or emerging opportunity autonomous self-driving vehicles (ASDVs)

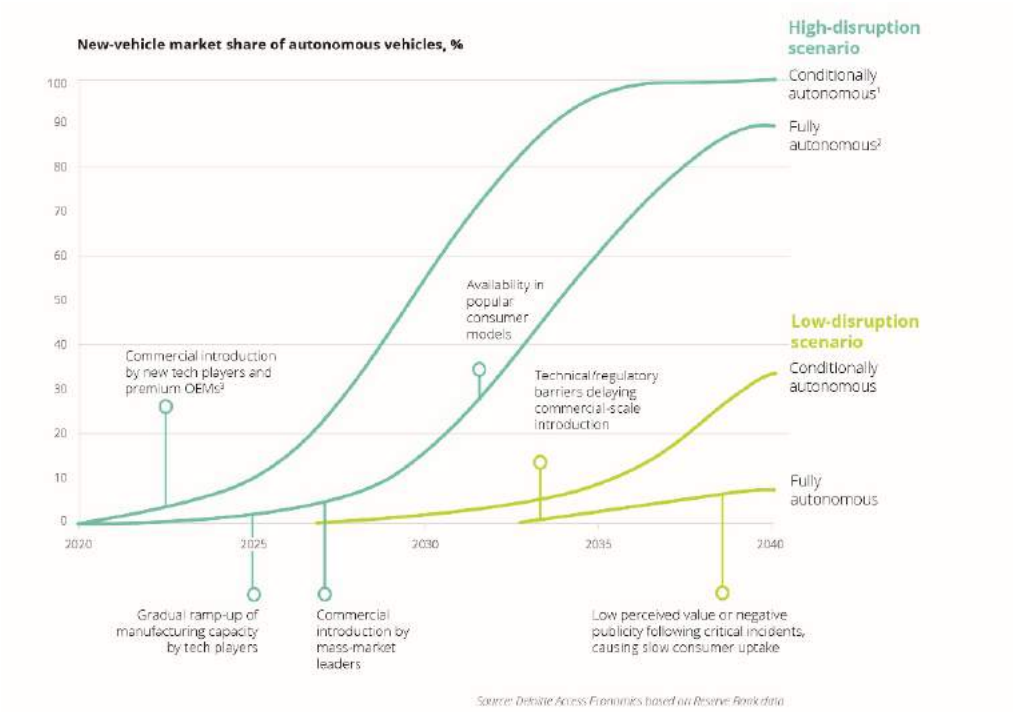
The way both passengers and freight are moved is being disrupted through a combination of technological changes. Three of the most significant are the rise in electric vehicles, the creation of autonomous vehicles and the emergence of the sharing economy.

The combination of these trends is creating a new global market, and we estimate this market will grow significantly over the coming decades. New Zealand is well placed to realise the benefits of this, with a high proportion of renewable electricity generation and a government that actively encourages the testing of new ITS technology.

Fully autonomous vehicles have the potential to transform the way transport is used. Predicted benefits of autonomous fleets include enhanced road safety, increased vehicle utilisation, greater access to transport services, more efficient use of urban land (less need for parking) and transport infrastructure, and improved environmental outcomes.

There is currently a race between traditional vehicle manufacturers and computer companies to produce automated vehicles. Many companies plan to have automated vehicles for sale to the public by 2020, or even earlier. While there are a great many forecasts about future take-up of ASDVs, McKinsey & Company forecast most cars being ASDVs within 15 years.

Figure 14: ASDVs as a share of new vehicles sold, 2020 to 2040



Notes: OEM = original-equipment manufacturers. Conditionally autonomous = driver may take control. Fully autonomous = vehicle is in full control.
Source: McKinsey & Company (2016) A Road Map to the Future of the Auto Industry.

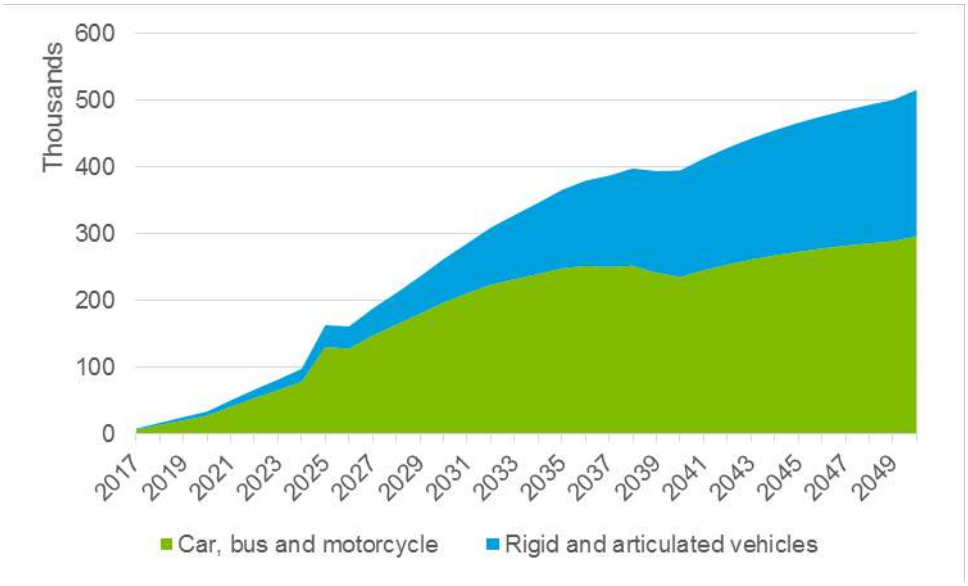
We expect global participants in the market, such as Google and Tesla, to have a large volume share in the supply of ASDVs worldwide and within the domestic market. For this reason, we assumed the local suppliers' volume share to be relatively small.

Electric vehicles

A closely related technology trend to ASDVs is electric vehicles. Stanford University economists James Abib and Tony Seba use a system dynamics methodology to forecast energy and transport trends. This has successfully predicted changes in solar energy cost efficiency and the cost-effectiveness of electric vehicle motors. Their latest publication claims that in the US oil demand from light vehicles will have decreased eight-fold from today's levels by 2030 (Arbib, J. & Seba, T. 2017).

Figure 15 shows, it is projected that there will be approximately 515,000 electric vehicles in New Zealand by 2050, comprising just under 300,000 car, bus and motorcycles, and almost 220,000 rigid and articulated vehicles.

Figure 15: Projection trends in New Zealand's Electric Vehicle fleet size



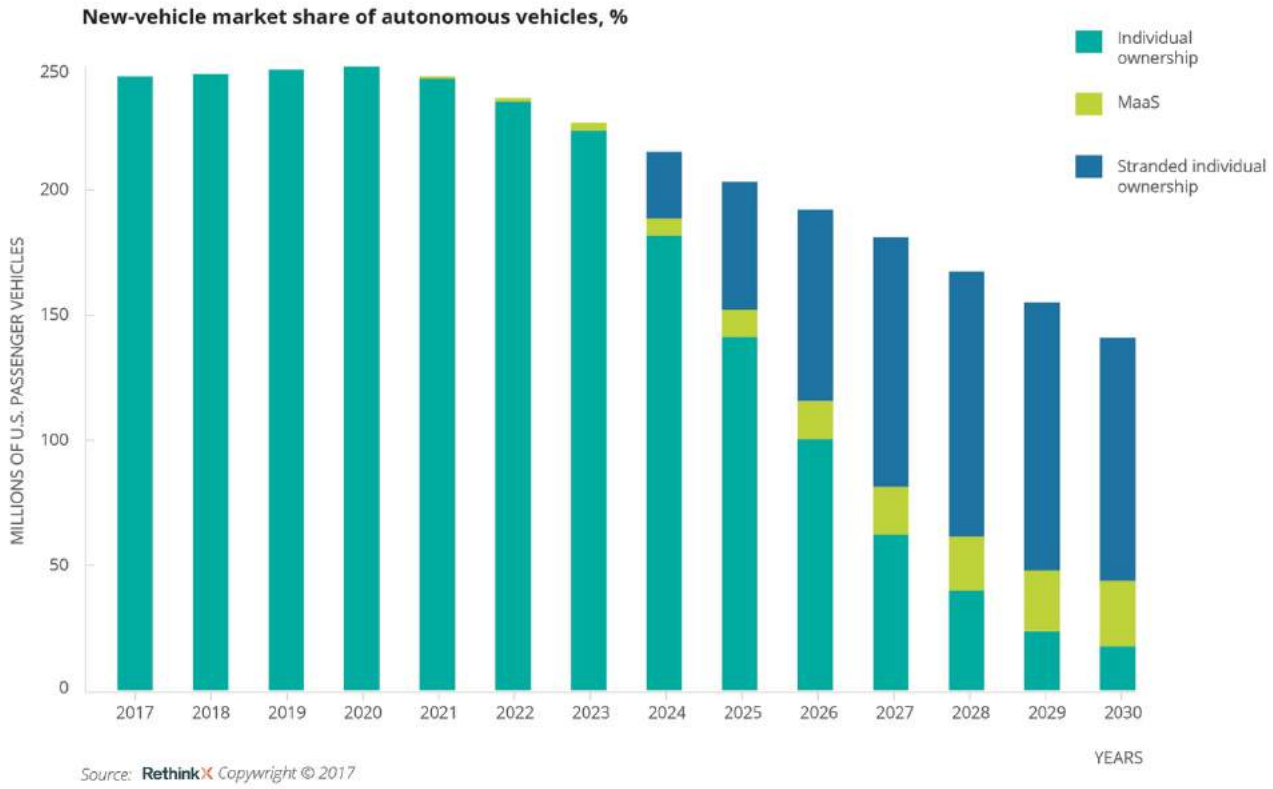
Source: Deloitte Access Economics

Vehicle Sharing

Along with the rise of EVs and autonomous vehicle technology, the sharing economy is a growing part of the transport sector globally. Enhanced collaboration and connection is allowing consumers to lease vehicles they may have been using only intermittently, or rent them as needed rather than owning them.

MaaS is one of the elements of the shared economy with the potential to widely disrupt existing transport and energy use. MaaS describes the shift away from private vehicle ownership towards transport services.

Figure 16: Projection trends in fleet size and composition



Size of the opportunity

Collectively, the global opportunity from ASDVs is estimated to be around $55 billion on average between now and 2050. If New Zealand could capture even a small portion of this market; for instance, by developing and exporting components or software to support home charging stations, the commercial benefits would be significant.

Table 2: Average potential revenue between 2020 and 2050 from ASDVs for New Zealand ITS suppliers ($m pa)

ASDVs	Total market size	NZ supplier share
New Zealand	362	55
Other countries	54,254	81
World total	54,616	**136**

Source: Deloitte Access Economics

In total, Deloitte Access Economics estimates the commercial opportunity from autonomous, electric, shared vehicle technology in New Zealand would be around **$362 million** on average between 2020 and 2050.

However, not all of this opportunity is likely to be captured by New Zealand companies, because New Zealand does not currently manufacture vehicles. We think it likely that New Zealand based suppliers may be able to capture around 15% of the local market.

New Zealand's potential share of the domestic and global market for ASDVs could be around $136 million a year on average between 2020 to 2050.

This comprises sales and installation of public and private vehicle stations or other component parts of ASDVs, or software to operate ASDVs, and assumes New Zealand achieves a competitive share of the global market based on existing technological exports.

This may not seem like a large amount, but as Callaghan Innovation observes, "niche guys finish first" – it could be quite lucrative if most of this were in the form of royalties to New Zealand patent holders.

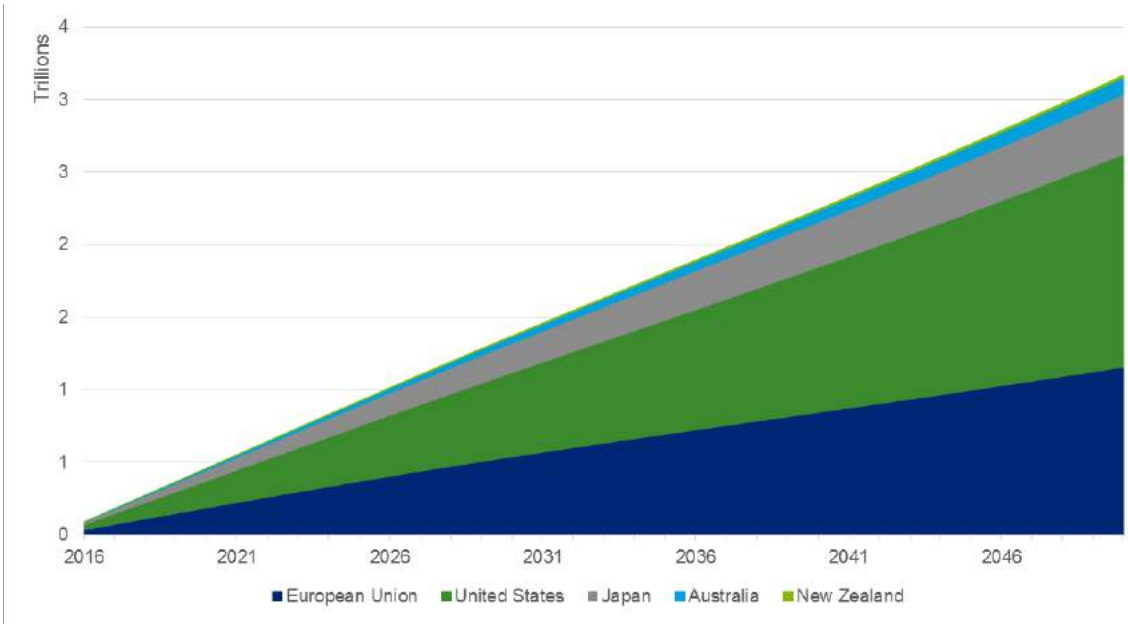
Current, medium opportunity- intelligent logistics

There is significant potential for the application of intelligent freight movements in supply chain logistics. Currently, the focus is on applying the software to better plan, optimise and adjust logistics and supply chain movements – particularly in fast moving consumer goods (**FMCG**). The FMCG supply chain involves two discrete tasks: linehaul and distribution. Linehaul involves transporting goods from the manufacturer to a distribution centre, while distribution involves transporting goods from a distribution centre to a destination.

ITS is only in its starting stages, and has been applied in small scale trials. We estimate improvements through ITS, such as an algorithm to optimise freight movements in the supply chain, have the potential to improve freight efficiency between 7% to 10%. This translates into a potential cost saving for businesses in New Zealand.

Our calculations on cost savings and profit increases that ITS could bring are based on data from road freight businesses, specifically cost information broken down into their components such as labour and fuel. We recognise this benefit would occur in all modes of transport and is not limited to road freight. To provide an indication of the extent of this opportunity for New Zealand, we focused on road transport.

Figure 17: Projection trends in efficiency gains for trucks from autonomous technology



Source: Deloitte Access Economics

Considering the size of the freight task undertaken each year, we estimate these efficiency improvements within **New Zealand would be worth around $19 billion collectively over the period to 2050. That is, $576 million per year on average between now and then**.

As explained above, the potential for freight-cost savings provided by ITS technology indicates the potential market size for ITS suppliers. Assuming **New Zealand suppliers capture 50% of the local market, Deloitte Access Economics' modelling estimate that average revenue between now and 2050 is $290 million annually within the domestic market**.

Further, global sales of ITS into land freight industry could total to $3.5 trillion between now and 2050 which, divided by 33 years, is $106 billion per year, as shown in Table 3 below. Of this, local ITS suppliers could capture $446 million.

In total, the **potential benefits to New Zealand domestic freighters and New Zealand exporters of ITS products could be $446 million per year**.

Table 3: Average potential revenue between 2020 and 2050 from smart logistics for New Zealand ITS suppliers ($m pa)

Intelligent logistics	Total market size	NZ supplier share
New Zealand	576	288
Other countries	105,485	158
World total	106,061	**446**

Source: Deloitte Access Economics

Large, rapidly accelerating opportunity - Drones

The drone revolution is disrupting industries, ranging from agriculture to photography, and its impact is set to exponentially expand as time passes. Drones, also known as unmanned aerial vehicles, are aircrafts without a pilot on board, controlled remotely either by an individual or autonomous computers.

There are three primary uses for drones: military, commercial/industrial and consumer. While initially being used by the military as early as World War I, drone use is rapidly expanding and is being adopted for commercial purposes beyond recreational or experimental applications. This wave of drone technology is supported by rapid technological development in this field, growing awareness and readiness by businesses to adopt drones in their operations, as well as improvements in the regulatory environment.

Drones will become a vital technology in business operations of the future, so it's important New Zealand positions at the leading edge of this innovation wave. As an emerging technology, New Zealand is able to support its growth, innovation and adoption with a good regulatory environment and an active user base.

Drones are bringing farming closer to an exact science. Already used heavily in Japan, other developed nations are catching on and using drones for stock management, land surveying, mapping, spraying and crop health, and other data-gathering activities.

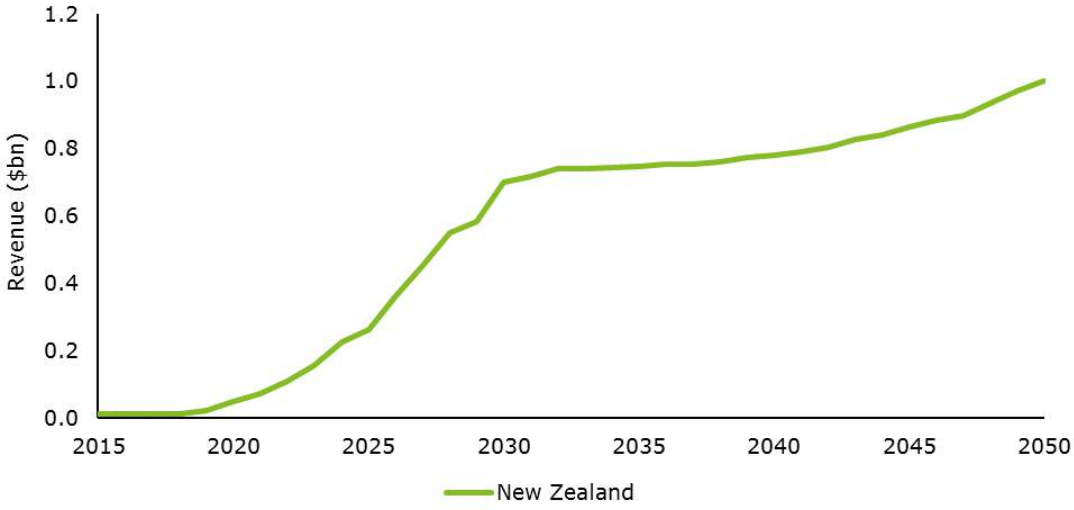
A report by PWC (2016) values the **current market for drones in agribusiness at $46.3 billion globally**.

In the future, drones can be used to support precision farming, to increase crop yields and reduce the use of costly inputs. Within US itself, the market is estimated to **grow as high as $117 billion between 2015 and 2025**, Lawson, K., 2017).

The demand for such products is immense, as it reflects the fundamental shift in consumer preferences for instantaneous access to goods and services. According to McKinsey & Company, the expected growth of this service is between 5% per annum in and 17% per annum for China over the next few years (McKinsey & Company, 2016).

Deloitte Access Economics estimates drones currently **represent a $7.7 million a year market in New Zealand,** which is expected to grow at a compounded annual growth rate of 28.5% until 2030 and around 2% thereafter (Figure 18). **By 2050, drones will represent a domestic market worth over $1 billion.**

Figure 18: Total market value revenue of drones in New Zealand (NZ$, billions, now till 2050)



Source: Deloitte Access Economics

Between now and 2050, drone revenue globally is projected to be around $350 billion. Table 4 illustrates the average annual potential revenue to local ITS suppliers from drone and related technology sales could be close to $1 billion per year between 2020 and 2050.

Table 4: Average potential revenue between 2020 and 2050 from drones for New Zealand ITS suppliers ($m pa)

Drones	Total market size	NZ supplier share
New Zealand	725	363
Other countries	346,600	520
World total	347,325	**882**

Source: Deloitte Access Economics

9. Recommendations

The following actions would be beneficial if New Zealand is to actively target development and commercialisation of an ITS industry:

1. **Creating a successful and coordinated commercial environment for ITS.** This will require a number of government agencies and businesses to take action together**.** As indicated by our survey results, there is a need to create a targeted vision and strategy for ITS. This suggests that while there are a number of policy documents that direct the future state of transport in New Zealand it is not immediately clear where the lead for ITS sits. This poses a number of risks to businesses. For example, increased clarity over the strategic vision for cities such as Auckland would allow companies to invest time and money in developing products and solutions that align with the vision. Policy uncertainty has been shown to negatively affect innovative activities. Dubai, for instance, aims to have 25% of local passenger trips taken in a driverless vehicles in 2030.

   Deloitte Access Economics recommends this strategy involve a partnership between government and businesses. Key points are outlined below:

   a. **Develop a cohesive government strategy to encourage innovation and export growth around ITS technology products and services**. There is a need for a comprehensive cohesive government strategy that actively encourages research, testing and development of new ITS technologies to support innovation and create export growth around ITS technology products and services.

   b. **Establish a think tank** to proactively engage with innovative ITS companies, identify barriers and act to remove them ahead of time. A good example is the UK organisation, Catapult. This organisation is a technology and innovation centre for intelligent mobility. Catapult aims to foster innovation of new technologies to transport people and goods in a safer, greener and more efficient way. Its innovations focus on human-centric design, intelligent mobility data and many other segments across all major forms of transport.

   c. **Encourage investment in research and development to further develop ITS in New Zealand.** Currently, overall business expenditure on R&D in New Zealand is 0.65% of GDP and private sector funding of R&D in New Zealand is one of the lowest in the OECD. We recognise some agencies already provide support, for example Callaghan Innovation supports R&D, New Zealand Trade and Enterprise supports companies to expand their offshore operations, and the Venture Investment Fund supports early stage investments, and MBIE is also providing support.

      There is a need for proactive government recognition of the potential for ITS as a commercial opportunity and nor active encouragement of research, testing and development of new

ITS technologies to support innovation and export growth. To support the ITS industry, **the Government can create a new funding agency or use NZTE or Callaghan Innovation to be the owner of funding ITS R&D.** The benefits of Catapult in the UK illustrates the impact a focal point for ITS could have in New Zealand.

d. **To successfully attract overseas businesses to invest in ITS it is advised that New Zealand** leverage off the New Zealand Story's Investment Attraction Narrative to promote New Zealand's competitive advantage in ITS at events such as Global ITS Forums.

2. **Ensure regulators have required resources.** ITS challenges current regulatory models and processes. ITS involves evolving technologies, and regulations need to be adaptable to a changing environment. It is critical to get the right regulation for the issue at hand as soon as feasible. Having open or principles-based regulation supports innovation, but it can transfer the risk from the company to the regulators which have to assess whether something is safe. For regulations to remain fit for purpose, regulators must have the required resources to undertake their role.

   a. Communication of the Government's priorities for future investment is essential for the private sector so it can plan accordingly, and research and develop new products.

   b. Simplify the processes required in the Resource Management Act to attract ITS businesses to invest in New Zealand.

3. **Invest in education and training for ITS.** ITS development in New Zealand will require new skills developed. This requires investment in education and training which supports the development of the ITS sector. A key plank for this industry must be to encourage a more collaborative relationship between academic institutions and companies and entrepreneurs.

   a. This could be achieved through greater promotion of apprenticeships or "dual education" at dedicated learning institutions, similar to schemes operating in countries like Switzerland, where time is spent in almost equal measure between theory and practice – and both theory and practice are acquired in parallel.

   b. Further, skills within the regulatory environment should also be built on a mode neutral basis, to serve regulation in land, sea, air or rail. It is unlikely that we have the scale and resources in New Zealand to build capability across all modes.

   c. At its heart such a skills strategy must recognise the importance of collaborative research and innovation which leads to job creation. It is also critical to recognise such a strategy should be focused across all modes for the best outcomes for New Zealand.

4. **Provide sufficient support to ensure an environment is in place for ongoing investment in underlying data infrastructure.** ITS will require new IOT infrastructure. Strategies to enable the integration of physical and digital elements would also need to be developed.

5. **Encourage access and sharing of data and information systems, particularly from councils**. Access to public data will help New Zealand ITS developers. This will enable innovation within ITS services. As part of a strategy to encourage access of data, it is also recommended Statistics New Zealand segment industry classification to better recognise emerging technologies. This will enable calculation of a current baseline estimate of the size of the industry.

6. **Promote New Zealand as a market for ITS.** ITS is highly competitive internationally, and New Zealand-based ITS suppliers require new strategies to stay ahead of global competitors. New Zealand firms in ITS need to be innovative and create international appeal from the start to get a first-mover advantage on a global basis. It is important to find ways to identify and pursue new markets in a timely manner and to attract talent to New Zealand.

Businesses surveyed indicated areas of priority are **public transport, communication technologies and shared on demand transport**. The recommendations could focus on these areas of priority as a first step to develop ITS in New Zealand.

Unlocking the barriers within the ITS space will have major benefits to New Zealand. It is now time to start the conversation around how New Zealand companies – some already successfully operating – can be established, grow and take best advantage of the enormous potential market, both domestic and international.

10. Looking ahead

This report provides insight into the opportunity for New Zealand to benefit from the growing domestic and international interest in intelligent transport systems across all transport modes. The focus of this report is on the potential commercial opportunities to New Zealand existing companies or start-ups, or international companies which may seek to invest in New Zealand.

The pace of change in ITS technologies is likely only to accelerate. The players pouring into the field consumer electronics, mobile communications, app makers, smart infrastructure and smart entrepreneurs, forward thinkers in the ITS space are transforming it and creating opportunities for even newer players. Others arriving with experience in solving problems in other fields bring fresh insights with them and, in turn, strike new sparks among existing players.

The challenge, especially for businesses and the Government, is to find its footing in this environment. This means asking hard questions:

- Are there existing laws that need to be changed or updated to meeting tomorrow's reality?
- How can the public sector best get out of the way of innovation, yet also provide the required legislation on privacy and cyber security?
- How can we promote New Zealand globally to make overseas business want to invest in New Zealand's ITS space?
- How can we get the Government to use NZTE or Callaghan Innovation, or create a new funding agency, to support ITS R&D?
- How can New Zealand stay ahead of megatrends to be competitive as a country and as providers of ITS products and services?

What is most exciting about this is the opportunities for both New Zealand companies and overseas businesses have unlimited possibilities to contribute to lowering emissions providing affordable access to transport, more efficient processes, and safer roads.

Appendix 1: Methodology

Qualitative data

Utilising the results of our desktop research and the feedback gathered from our stakeholder interviews we designed an online survey to gather primary research data. The survey was disseminated to 350 selected New Zealand businesses that interact with the wider transport industry. The final response rate was 15%.

We used Research.net to design and deliver our survey. This enabled us to easily collate and extract the survey data into excel. Once in excel, we had to clean the data in order for it to be able to be used in Tableau. For each unique question, this data cleansing and analysis required different analysis.

Barriers and attractors responses are ranked using a 4-point scale. For all 'critically positive' responses assigned to an answer, the question is assigned +3 points. The scale goes down to -1 for 'not an attractor', with other answers receiving either 2 points, 1 point, 0 points for 'N/A' depending on how strong or not the attractor response is. The results for each question were then averaged for each question, with the strongest attractor having the highest average score (2.4 in this case for ease of conducting business in New Zealand).

Similarly, the barriers question follow the same 4-point ranking scale, however the data is inverted with the scale ranging from -3 (critical barrier) to +1 (not a barrier), with the larger the negative score, the higher the barrier.

The responses are also analysed based on the percentage of respondents selecting the same option per question. For example, for the question ease of conducting business in New Zealand, 60% of respondents selected 'critically positive attractor'.

The priority ITS areas survey data was cleansed by assigning a relative scale to each of the priority responses. Where a question receives a '1st priority' it is assigned 100 points, with each successive priority response receiving 20 fewer points (for example the 5th priority is assigned 20 points). To get total points per question, we multiplied the number of responses for each priority by the number of respondents for that priority (effectively a sum product of responses and priority scores). This provides a ranking of the top priority areas for New Zealand.

Modelling the potential economic benefit to New Zealand

Due to data limitations, and the crystal ball gazing nature of trying to forecast developments in such a rapidly changing technology over a period as long as thirty years, the Deloitte Access Economics modelling in this report is only high level. While there is some qualitative discussion of domestic drivers, for the most demand in New Zealand markets is expected to follow forecasts for other advanced economies, which have been developed from a literature study of reports written by industry experts in those countries.

Stakeholder interviews

These interviews were held in person or over the phone with the ITS Advisory Group members, who represent companies currently interacting or planning to interact with the ITS industry. These helped to shape the attractors and barriers and give us an understanding of the current position.

Focus group

We invited leaders of businesses that interact with the transport innovation industry and were not part of the ITSAG to discuss the emerging results of survey findings and research to date and the emerging action plan.

Appendix 2: Detailed ITS economic case studies

This Appendix looks in more detail at the data sources and assumptions underlying future projected ITS sales in the ASDV, drone and smart logistics markets.

New Zealand ITS supplier share of domestic and global markets

There are two components to this modelling exercise. The first is to estimate domestic and global total demand for each of the selected ITS products. The second is to estimate what potential share of each could be captured by New Zealand firms.

As the global market is several hundred times larger than the domestic market, capturing even a tiny sliver of this market could be worth more to a local firm than getting a complete monopoly of the domestic market.

There are three potential proxies for New Zealand's share of global markets.

- The high end proxy is New Zealand's share of world trade of 0.21% (World Bank, 2017). New Zealand punches above its weight when it comes to trade. Our share of world trade is about 50% larger than our share of world GDP. Further, New Zealand's third largest export sector is advanced manufacturing, which is directly relevant to ITS.
- The middle proxy is New Zealand's share of world GDP of 0.15% (International Monetary Fund, 2017). New Zealand's share of global GDP is more than double its share of population, because it is an advanced economy with a well-educated, high income population. These fundamental comparative advantages will be important in the competition to produce new ITS products.
- The low proxy is New Zealand's share of global advanced manufacturing trade of 0.03% (World Trade Organization, 2016). While New Zealand ranks in the top third of OECD countries in the Global Innovation Index, this has historically not translated into high-tech exports due to the twin tyrannies of distance (expensive to export) and size (too small to capture economies of scale in production). However, as the world moves to a weightless economy – the cars of the future will probably be made by software companies - these barriers will matter less.

On balance, we have selected the middle ground of GDP share (0.15%) as the proxy for New Zealand suppliers' potential share of global ITS markets.

Sensitivity testing is applied in at the end of this appendix. Conversely, there is always a chance that a New Zealand firm will develop a "killer app" that will let it dominate its niche – for example precision horticulture drones – and so grab 2% to 3% of the total world market for all drones. Under this scenario, New Zealand could be earning the equivalent of 6% of current GDP just from drones.

Regarding domestic markets, the same considerations that will make it easier for New Zealand to compete in the global markets will also make it easier for foreign firms to compete in our domestic market. When it comes to ITS services, local knowledge will be important. For both drones and smart logistics, understanding how to deal with New Zealand's unique combination of treacherous terrain, island hopping, earthquake damage to infrastructure and myriad tiny farms will lead to locals providing a substantial majority of ITS services. Accordingly, for both case studies on drones and smart logistics, we have assumed locals will garner a 50% share of the total markets (goods and services).

It assumed that most ASDVs will be imported, and thus that New Zealand's share of the domestic ASDV market will be same as its share of the global market (15%). That is, if your future Googlemobile does have New Zealand ITS components, they will be the same ones that are found in that brand of ASDV worldwide. There may be some local data used by ASDVs, but these would probably be general location / navigation services, which is a separate market.

Autonomous self-driving vehicles

Between now and 2050, autonomous, electric, shared vehicle technology could present an opportunity of: $362 million in a domestic market, $81 million in exports and $136 million per year for local ITS suppliers. This is made up of electric vehicle sales and installation of public and private vehicle stations, and assumes that New Zealand achieves a competitive share of the global market based on existing technological exports.

Transport is undergoing significant transformation around the world. The way that both passengers and freight are moved is being disrupted through a combination of technological changes. Three of the most significant are the rise in electric vehicles, the creation of autonomous vehicles and the emergence of the sharing economy.

The combination of these trends is creating a new global market, and we estimate this market to grow significantly over the coming decades. New Zealand is well placed to realise the benefits of this emerging market, with a high proportion of renewable electricity generation and a government that actively encourages the testing of new ITS technology.

An Autonomous Self Driving Vehicles, or ASDV, is a vehicle that is capable of sensing its environment and navigating without human input. Different countries and different companies use different terms to describe ASDVs, including 'driverless', 'self-driving', 'automated' and 'autonomous' vehicles. It is also necessary to distinguish different levels of vehicle

autonomy. In particular, we can distinguish systems by their degree of autonomy and by the functions that are autonomous.

Elements of vehicle autonomy are already part of the existing fleet. Several auto manufacturers offer parking assist, reversing sensors, automatic parallel parking and collision avoidance. These features are seeming to be expanded and enhanced in the near future to include functions for automated highway and city driving. Overtime, automation technologies will likely improve to cover more complex and difficult road environments.

Several established auto manufacturers have announced that they will be releasing completely autonomous vehicles into the market by 2020-2021. Audi is expected to introduce a self-driving car by 2020, Volkswagen by 2019, BMW by 2021 and Ford by 2021. Ford is aiming to introduce a fully-autonomous vehicle for ride sharing by 2021.

Other software companies, fleet operators and auxiliary businesses have announced similar timeframes. NuTonomy plans to deploy a self-driving taxi service in Singapore by 2018 and ten other cities globally by 2020. Uber's former CEO has indicated that he anticipates Uber's fleet to be driverless by 2030. Further, Delphi and MobilEye are slated to provide off-the-self self-driving systems to market by 2019.

Electric vehicles
Most of the cars of the future – and thus most ASDVs – will be electric.

Globally there has been a clear shift away from the use of petrol and diesel fuelled vehicles and a movement towards electric vehicles. According to the International Energy Agency (2017) in 2016, new registrations of electric vehicles (EVs) reached over 750,000 sales worldwide, a new record. These sales mean that, after reaching one million EVs in 2016, there are now over two million EVs on the road worldwide. Correspondingly, the number of public charging stations globally increased by 72% from 2015 to 2016.

New Zealand is well placed to benefit from electric vehicles and also to become involved in the Global Supply Chain. About 80% of the country's electricity comes from renewable sources, and there is excess supply – even if every vehicle in New Zealand were electric, there would be enough capacity to charge them (Ministry of Transport, 2017b*)*. More than 85% of New Zealand homes have off-street parking, meaning overnight home charging would be simple, and, on average, New Zealanders have a commute of only 22km, well within the range of an EV (Ministry of Transport, 2017b*)*.

In May 2016, the Government announced an Electric Vehicles Program which should help ensure uptake of more EVs. The program set a goal of doubling the number of EVs on the roads every year, to reach 64,000 electric vehicles by 2021, and contains a number of incentives programs such as allowing EVs to travel in bus lanes and road user charge exemptions (Ministry of Transport, 2017b*)*.

Vehicle Sharing
The impacts of MaaS are accelerated and multiplied when coupled with other emerging technologies, particularly electric and autonomous vehicles. Autonomous vehicle technology will make MaaS very cheap

because of the absence of a driver – currently, drivers account for three quarters of the cost of an Uber. A sharp decline in cost will likely increase the total kilometres households want to travel, increasing the burden on the transport network. MaaS vehicles will also increase the speed with which these vehicles can transition between serving one customer and another, further reducing the necessary size of the vehicle fleet.

Given the likely spike in vehicle travel that would be anticipated with cheap, autonomous, MaaS vehicles, this technology alone could create a spike in vehicle emissions. However an electric fleet could overcome this challenge, while also proving to be cheaper and easier to maintain.

Size of the opportunity

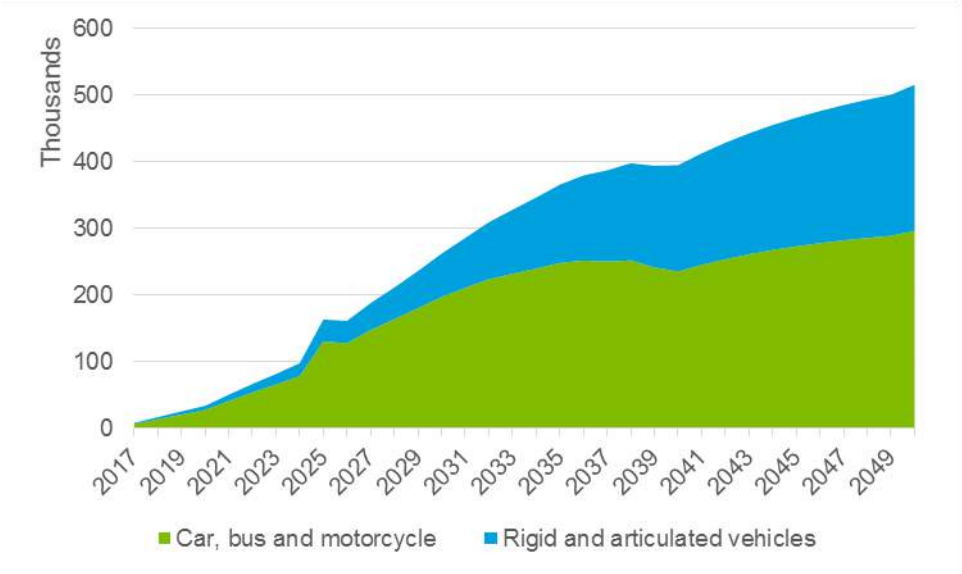
These three emerging technologies will reinforce each other and compound their effects on the global transport market.

There are significant opportunities for New Zealand domestically, but also as part of the global market through exports.

The New Zealand market

As Figure 20 shows, there will be approximately 515,000 electric vehicles in New Zealand by 2050, made up of just under 300,000 car, bus and motorcycles, and almost 220,000 rigid and articulated vehicles.

Figure 20: Projection trends in New Zealand Electric Vehicle fleet size

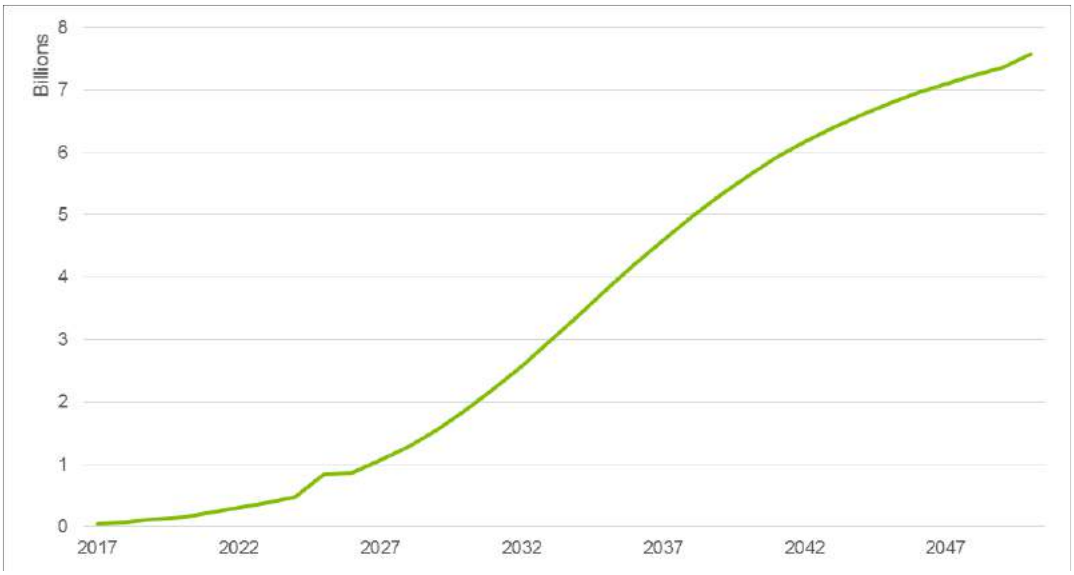


Source: Deloitte Access Economics

The commercial opportunity in providing this fleet is significant. Isolating just the passenger vehicles (not the rigid and articulated vehicles), revenue from sales are predicted to be worth around **$313 million** (assuming a cost of $43,600 per vehicle) annually by 2050. This revenue will not be uniformly distributed, in fact annual revenue will be higher in the short run as demand for EVs grows, but over the longer term (out to 2050) this growth will not be sustained. This is because total demand for vehicles is predicted to fall with the rise of ride sharing services. As such, the largest revenue opportunities are in the next decade.

This fleet of over half a million EVs will require large volumes of energy to run. Figure 21 shows the forecast demand for electricity as a result of this growing EV fleet. While demand from the EV fleet in 2017 is low, by 2030 an additional 1.9 billion kWh will be needed annually to keep the EV fleet operational, and by 2050 this will have grown to **7.6 billion kWh**. Assuming a rate of 33 cents per kWh for electricity, by 2050 this will mean the electricity market sees an additional $2.5 billion in demand annually.

Figure 21: Projection trends in energy needs to operate the New Zealand fleet (kWh needed annually)



Source: Deloitte Access Economics

New Zealand is well equipped to cope with this increased demand, with current electricity supply regularly outstripping demand (Ministry of Business, Innovation and Employment, 2017b). However, there will be a need for both public and private EV charging stations to be installed around the country to deliver this electricity to the fleet.

We estimate that there will need to be around 2,200 public chargers installed in New Zealand by 2050. Taking just the cost of the charger (ignoring the cost of establishing a site for the charger), this installation exercise represents an $85 million commercial opportunity over the coming decades to 2050, worth **$2.4 million** annually by 2050. In addition, if every EV owner were to install a private charging station at their home, this would represent an additional **$7.8 million** in revenue annually.

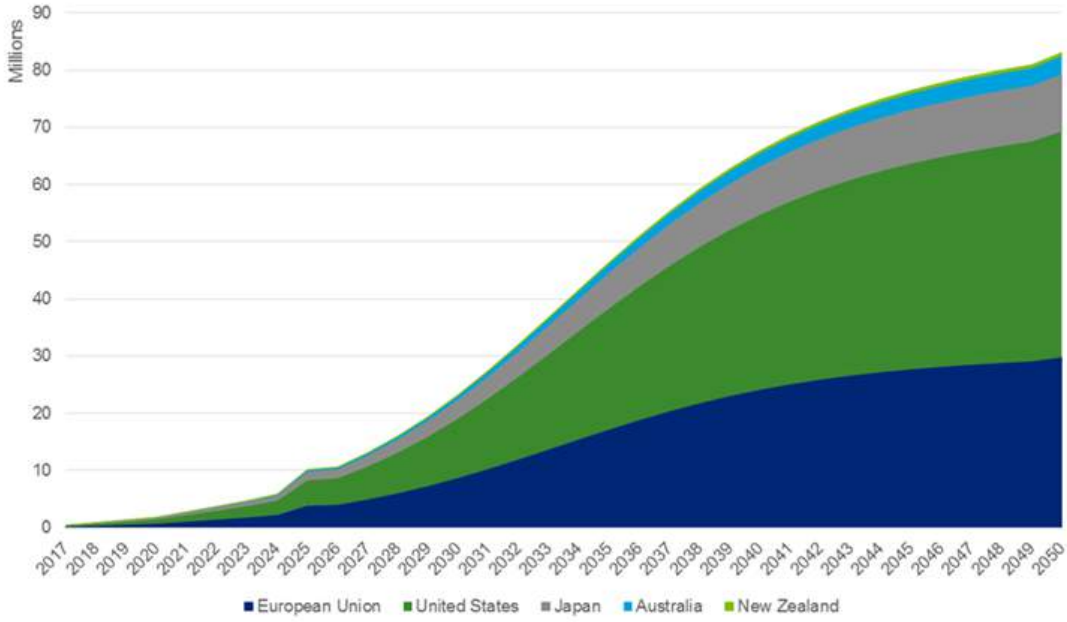
In total, we estimate that the commercial opportunity from autonomous, electric, shared vehicle technology in New Zealand would be around **$323.50 million** annually by 2050.

The global market

The domestic market represents a significant opportunity, however if New Zealand can become a player globally, the possible benefits are even larger.

While New Zealand's EV fleet is expected to be 515,000 by 2050, the global[8] fleet is set to top 80 million. By 2050, sales of EVs will be worth **$42.6 billion**.

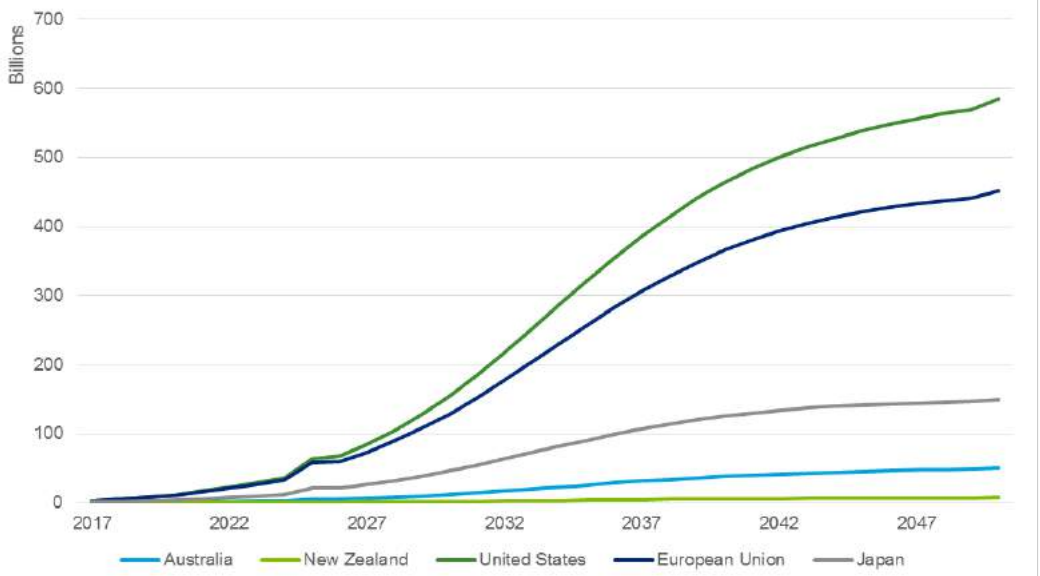
Figure 22: Projection trends in electric fleet stock, globally



Source: Deloitte Access Economics

This fleet will require significant volumes of energy to charge. By 2050, **1.2 trillion kWh** will be needed annually to keep the electric vehicle fleet running – representing an annual economic opportunity of $406.8 billion in providing this energy by 2050.

Figure 23: Projection trends in energy needed to power the electric fleet (kWh)



Source: Deloitte Access Economics

[8] 'Global' in this report refers to the aggregated demand of New Zealand, Australia, Japan, the United States and the European Union. This is because these are large markets for these ITS improvements, and the parameters used in the modelling are not applicable to all countries.

EV charging stations will need to be installed both in private residences and publicly around the world. We forecast that by 2050, there will be around 350,000 public chargers and over 45 million private chargers, cumulatively worth **$1.4 billion** annually.

Collectively, the global opportunity from these technologies is estimated to be **$44.0 billion** annually. If New Zealand could capture even a small portion of this market, for instance by exporting components or software that supports home charging stations, the commercial benefits would be large.

Summary

The table below shows a summary of the ASDV global opportunity.

Table 5: Summary of the annual size ASDV represent to 2050

	2020 ($bn)	2030 ($bn)	2040 ($bn)	2050 ($bn)
New Zealand				
EV Sales	0.07	0.58	0.47	0.31
Home charging stations	0.00	0.01	0.01	0.01
Public charging stations	0.00	0.00	0.00	0.00
Total	0.07	0.59	0.49	0.32
Australia				
EV Sales	0.37	3.17	2.83	2.10
Home charging stations	0.01	0.08	0.07	0.05
Public charging stations	0.00	0.02	0.02	0.01
Total	0.38	3.27	2.92	2.17
United States				
EV Sales	4.70	39.16	32.20	21.91
Home charging stations	0.12	0.98	0.81	0.55
Public charging stations	0.03	0.29	0.25	0.14
Total	4.85	40.43	33.25	22.60
European Union				
EV Sales	4.66	35.88	25.65	14.41
Home charging stations	0.12	0.90	0.64	0.36
Public charging stations	0.03	0.23	0.21	0.10
Total	4.81	37.02	26.50	14.88
Japan				
EV Sales	1.74	12.67	7.87	3.93
Home charging stations	0.04	0.32	0.20	0.10
Public charging stations	0.01	0.08	0.07	0.03
Total	1.80	13.07	8.13	4.06
World				
EV Sales	11.54	91.47	69.02	42.67
Home charging stations	0.07	0.63	0.55	0.29
Public charging stations	0.29	2.29	1.73	1.07
Total	11.90	94.38	71.30	44.03

Source: Deloitte Access Economics

The benefits modelled here are for electric vehicles, which have substantial overlaps with, but are not identical to, ASDVs. In the near future, there will continue to be both electric vehicles that are not self-driving, and self-driving vehicles that are not electric.

In the mid-range McKinsey & Company scenario discussed above, at the beginning of our analysis (2020) self-driving cars will still be a small minority, but by the middle of the period covered in this report (2035) they will overtake human driven cars, and by the end point (2050) all new vehicles will be self-driving. Assuming these trends apply to both electric and fossil fuel cars, then over the period 2020 to 2050 around half the benefits in **Table 5** will accrue to self-driving electric cars and half to human-driven electric cars.

Equally, while RethinkX (Abib and Sab, 2017) predict the rapid demise of the internal combustion engine in advanced economies, they also forecast that it will not be until around 2035 that electric vehicles will account for the majority of global vehicle sales. So, again making the assumption that this trend will apply equally to self-driving and human-driven cars, then over the period from 2020 to 2030, **around half the total self-driven cars produced will still be powered by fossil fuels**.

We think half the vehicle sales, which are electric, but not self-driving, should be removed. However, the vehicle sales should be replaced by an equivalent number of vehicles, which are self-driving but not electric. For this reason, the results represented in the table above are a good proxy for the opportunity for ASDVs.

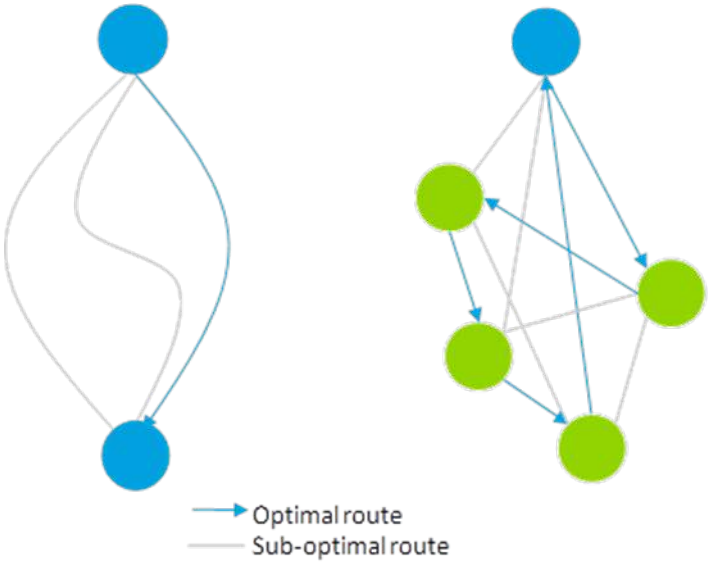
Intelligent freight movements

Between now and 2050, the value of intelligent freight movements in New Zealand could be worth $576 million in the domestic market, $158 million in exports and a turnover opportunity for local ITS suppliers of $446 million annually. This assumes that New Zealand achieves a competitive share of the global market based on existing technological exports.

There is significant potential for the application of intelligent freight movements in supply chain logistics. Currently, the focus is on applying the software to better plan, optimise and adjust logistics and supply chain movements – particularly in FMCG. The FMCG supply chain involves two discrete tasks: linehaul and distribution. Linehaul involves transporting goods from the manufacturer to a distribution centre while distribution involves transporting goods from a distribution centre to a destination.

As a result of the difference between them, linehaul and distribution involve different decision making problems. Linehaul is generally restricted to transport along main roads and focuses on selecting an optimal point to point route. Distribution must take into account the distances between retailers, the roads joining retailers and their restocking needs in order to select a route which optimises the full distribution run. A stylised example of the different decision making situations is shown in the following diagram.

Figure 24: Example of linehaul and distribution decision making problems



Source: Deloitte Access Economics

Both FMCG and trucking are highly competitive industries with low profit margins and high costs. Fluctuating demands, changes to delivery and various operational constraints place further strain on the profit margin. This is compounded by the fact that firms may be forced to decrease prices, at a cost to themselves, if their competition reduces prices and costs.

As such, improvements in efficiency are an important part of the competitive strategy of firms in these industries. Any opportunity to reduce costs and improve efficiency means that the firm can raise their competitive advantage. For this reason, FMCG companies have already been using computer algorithms to optimise their logistics supply chain.

However, there is opportunity to further improve efficiency through the application of ITS. In logistics supply chains, ITS could be used to develop optimisation algorithms and establish a transportation systems model to ensure the optimum allocation of resources – specifically, ITS can be used to find the best possible route in both linehaul and distribution, in order to reduce costs. An extension of this includes cost-to-serve analysis, which allows logistics companies to calculate the cost of each route to make better informed business decisions about pricing and operation.

ITS is only in its starting stages, and has thus been applied in small scale trials. We estimate that improvements through ITS, such as an algorithm to optimise freight movements in the supply chain, have the potential to improve freight efficiency between 7% to 10%. This would mean that businesses in New Zealand could increase freight volumes by the same amount without increasing costs.

Our calculations on cost-savings and profit increases that ITS could bring are based on data from road freight businesses, specifically cost information broken down into their components (such as labour and fuel). Autonomous logistics technology affects each of these cost components differently, which we aggregated to estimate an overall cost savings for freight. For example, it was found that the application of this logistics technology reduced costs by 9.0% in linehaul. For distribution, the data shows that cost reduction was around 9.9% but could be as high as 25% in some cases.

These cost savings represent a potential revenue stream for ITS businesses. Having applied the cost savings to the standard cost per km rates seen for different vehicle classes, a total cost savings for linehaul and distribution freight activities was determined.

Considering the size of the freight task undertaken each year, we estimate that these efficiency improvements would be worth around **$19.0 billion** collectively over the period to 2050 and globally they would be worth **$3.5 trillion**.

The **potential benefits to New Zealand domestic freighters and New Zealand exporters of ITS products is $446 million per year**.

Drones

Between now and 2050, the annual opportunity for the domestic market from drone technology will be $725 million, $880 million for local ITS suppliers and this includes $520 million of exports.

The drone revolution is disrupting industries ranging from agriculture to photography, and its impact is set to exponentially expand as time passes. Drones, also known as UAVs, are aircrafts without a pilot on board that is controlled remotely either by an individual or autonomous computers.

There are three primary uses for drones: military, commercial and consumer. While initially being used by the military as early as World War I, their use is now rapidly expanding and is now only being adopted for commercial purposes beyond recreational or experimental applications. This wave of drone technology is supported by rapid technological development in this field, growing awareness and readiness by businesses to adopt drones in their operations as well as improvements in the regulatory environment.

Drones will become a vital technology in business operations of the future, so it's important that New Zealand positions themselves at the leading edge of this innovation wave. As an emerging technology, New Zealand is well able to support its growth, innovation and adoption with a good regulatory environment and an active user base.

The technological potential of drones is immense, and one such purpose is using drones to deliver packages, particularly 'deliveries of the last mile'. Currently in its prototype stage, drones can potentially act as substitutes for postal delivery services, ensuring deliveries are faster, more environmentally friendly, cost less and that there is greater control over where and when a package is delivered.

Drone delivery can be particularly cost-effective and fast for parcel deliveries weighing less than 5kg, same day or time-window parcels, and even deliveries to rural areas. McKinsey & Company (2016) estimate that **roughly 13% of parcels could be delivered this way, which represents a sizeable market.** In New Zealand, this could affect 344 businesses, based on 2015 postal delivery and courier figures (Statistics New Zealand, 2015).

The demand for such products is immense, as it reflects the fundamental shift in consumer preferences for instantaneous access to goods and services. According to McKinsey & Company, **the expected growth of this service is between 5% per annum in Germany** – a comparable economy to New Zealand – while 17% per annum for China over the next few years (McKinsey & Company, 2016).

Different companies and governments have been trialling the profitability and feasibility of drones in countries around the world, including Australia, United States of America, Switzerland, Germany and even New Zealand. Giant global retailers, like Amazon, Walmart and Target have used drones to deliver packages to their customers, which is estimated to slash delivery costs to less than $1 a package by eliminating fuel and labour costs. In New Zealand, a pizza franchise, Dominos, used a drone to deliver a pizza to a customer. This represented the first commercial delivery of food to a customer globally.

However, according to a report by Mckinsey & Company (2016), **the vision of drone deliveries will become a reality within 10 years.** This is subject to public acceptance of drones, government regulation and labour/capital costs. Currently, the main barrier to drone delivery is cost and flight regulation, and either are not expected to fall within the next five years according to a Deloitte report on Technology, Media and Telecommunications Predictions (2015*).* Drone delivery is estimated to cost between $8 and $12 per delivery of up to 10 kilometres**,** and this does not account for operational costs.

As capital costs decline with technology development, the future last mile offers tremendous opportunity for drones for existing and new service providers in the field of delivery. There is immense opportunity for return of investment if the right regulatory environment is created and technology evolves.

Drones in New Zealand

Drones are bringing farming closer to an exact science. Already used heavily by Japan, other developed nations are catching on and using drones for stock management, land surveying and mapping, spraying and crop health activities, and other data gathering activities. A report by PwC (2016) values the **current market for drones in agribusiness at $46.3 billion globally**.

In the future, drones can be used to support precision farming, to increase crop yields and reduce the use of costly inputs. Within US itself, the market is estimated to **grow as high as $117.3 billion between 2015 and 2025**, which makes farming as three-quarters of commercial drone use Lawson, K., 2017).

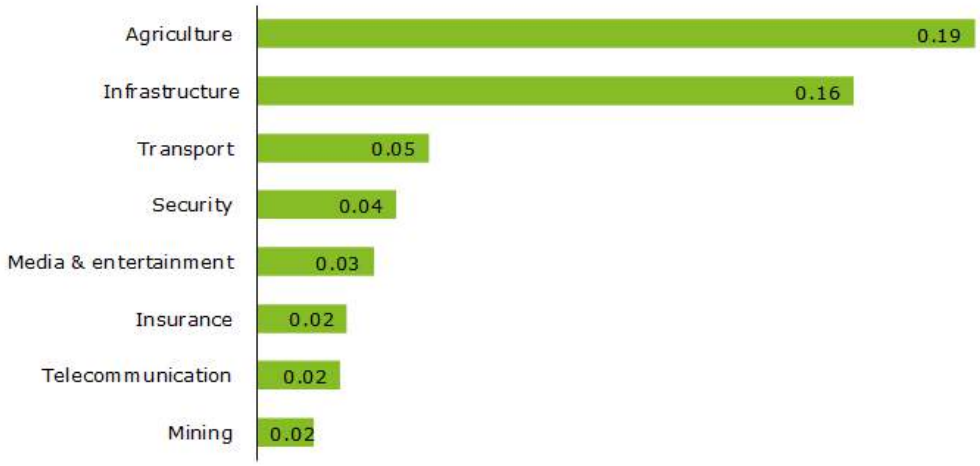
Some benefits of precision farming include relying on data to:

- manage irrigation and pesticide use,
- round up cattle,
- crop irrigation,
- detect crops stress before humans and
- monitor breeding habits.

For New Zealand, the biggest potential use of drones is wrapped in agribusiness, which in itself is key future industry, **globally projected to grow by 3.83% in the next 20 years** (*Shaping our slice of heaven*, Deloitte Access Economics New Zealand, 2017). New Zealand's agricultural business is large, with a growing dairy cattle, sheep, and beef industry.

While currently 70% of commercial drones are used for aerial photography and surveying, and 2% for agricultural work, this is expected to change significantly in the future. **Within New Zealand, drones can positively impact the agriculture industry by more than $185 million, representing products and services in farming that are replaceable by drones** (Figure 25). The agriculture segment is expected to witness the highest growth with a CAGR of 19.6% till 2025**.**

Figure 25: Current Demand for drones in New Zealand, by industry (NZD, billions)



Source: Deloitte Access Economics

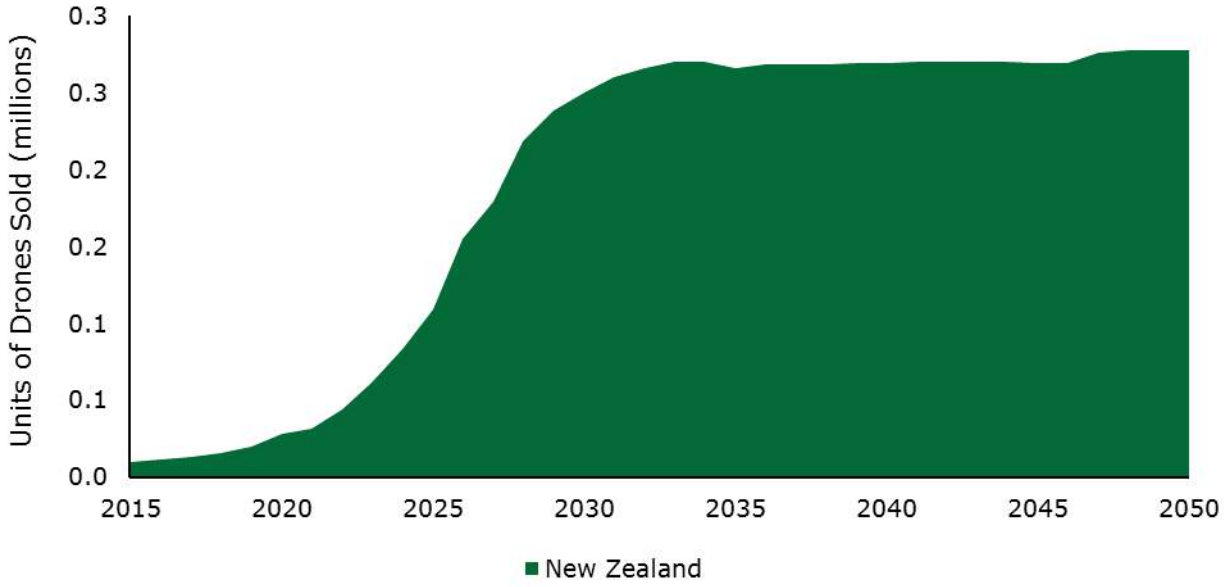
As drones continue to evolve, it's likely that they will play an increasingly important role in helping boost New Zealand's farming productivity. However, despite benefits in yield management, adoption may be a challenge. For example, **only 5% of farmers in Australia have been able to afford this technology, usually in high yield crops.** Depending on the software used, the type of camera and its coverage, drones can range in price from $3,000 to $15,000 or beyond.

Nearly 4 million units of commercial drones were sold globally in 2015 (Boston Consulting Group, 2017). The number of sold units is anticipated to expand exponentially over the forecast period, to support the forecast revenue growth, reaching more than 113 million units a year by 2050 the adoption of drones will be growing most rapidly in USA and in Europe, with an expected compounded annual growth of around 21.3% till 2030

where production peaks; thereafter, units sold will taper due to product maturity.

Deloitte Access Economics estimates that drones currently **represent a $7.7 million a year market in New Zealand.** More than **9,700 commercial drones have been bought in 2017,** according to comparative study between Australian and New Zealand markets (Figure 26). Like other advanced nations, drone units will follow a similar path of rapid expansion until 2030 to around 250,000 drones, and then grow stably thereafter.

Figure 26: Units sold in New Zealand and Australia (till 2050)



Source: Deloitte Access Economics

Global Market for Drones

Thus far, drones' primary commercial use has involved capturing images and gathering data for analysis, which is currently estimated to have generated revenue of $3.1 billion globally. According to Goldman Sachs, the **estimated global market for commercial drones will grow to $30 billion by 2021** (Goldman Sachs, 2017), growing at a compounded annual growth rate of 37% over the forecasted period. This is driven by realisation of the potential applications of drones – thus widening industry applications and generating greater business opportunities.

The manufacturing component of the drones industry will only create 14.3% of the total global revenue in 2030**,** according to analysis by BCG (2017). This includes the production of drones, design, manufacturing and assembly, which will become cheaper as countries specialise in their production and achieve economies of scale.

The biggest value will be derived from drone-related services, accounting for 71% of total global revenue, which will expand as drone adoption accelerates. This iIllustrates that as the distances that drones travel widens and the data collected increases in both sophistication and capabilities, there will be opportunities for services in piloting, operations, maintenance and insurance.

Summary
The table below shows a summary of the global drone opportunity

Table 6: New Zealand and global drone sales to 2050

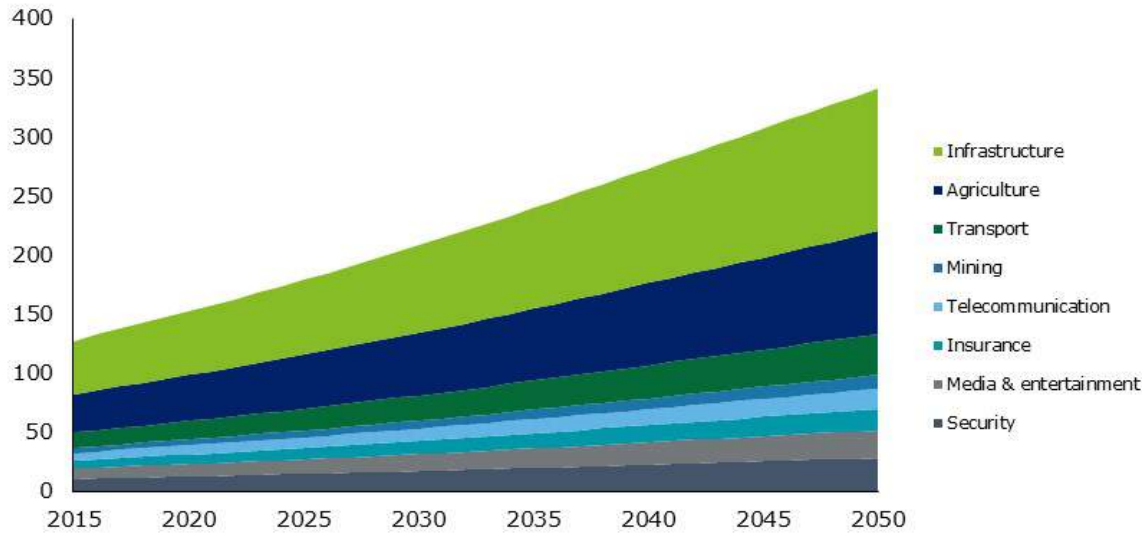
	2020	2030	2040	2050
New Zealand				
Units sold (million)	0.03	0.25	0.27	0.28
Product Revenue ($bn)	0.004	0.063	0.070	0.089
Service Revenue ($bn)	0.02	0.31	0.35	0.45
Total Revenue ($bn)	0.0	0.4	0.5	0.6
Market Demand ($bn)	0.5	0.6	0.8	1.0
Australia				
Units sold (million)	0.18	1.63	1.75	1.81
Product Revenue ($bn)	0.028	0.407	0.454	0.582
Service Revenue ($bn)	0.14	2.04	2.27	2.91
Total Revenue ($bn)	0.2	2.8	3.2	4.1
Market Demand ($bn)	3.5	4.8	6.3	7.9
United States				
Units sold (million)	3	25	27	28
Product Revenue ($bn)	0.436	6.276	7.004	8.975
Service Revenue ($bn)	2.18	31.38	35.02	44.87
Total Revenue ($bn)	3.0	43.9	49.0	62.8
Market Demand ($bn)	51.3	65.0	79.4	93.5
European Union				
Units sold (million)	3.94	13.56	14.36	15.26
Product Revenue ($bn)	0.823	3.103	3.505	4.792
Service Revenue ($bn)	4.12	15.51	17.53	23.96
Total Revenue ($bn)	5.8	21.7	24.5	33.5
Market Demand ($bn)	26.5	32.0	37.8	43.6
Japan				
Units sold (million)	0.74	6.69	7.19	7.43
Product Revenue ($bn)	0.116	1.669	1.863	2.387
Service Revenue ($bn)	0.58	8.35	9.32	11.94
Total Revenue ($bn)	0.8	11.7	13.0	16.7
Market Demand ($bn)	12.3	13.9	15.7	17.4
World				
Units sold (million)	11.37	102.38	110.09	113.75
Product Revenue ($bn)	3.582	41.328	46.125	59.101
Service Revenue ($bn)	17.91	206.64	230.62	295.51
Total Revenue ($bn)	25.1	289.3	322.9	413.7
Market Demand ($bn)	217.3	296.3	389.4	486.3

Source: Deloitte Access Economics

Future of Drones
The application of drone technologies to existing business processes is allowing companies to create new business and operating models. There's not only opportunity to improve existing products through drones but also the opportunity to create new drone-related services.

According to a PwC Report, **the addressable market value of drone powered solutions is over $181.6 billion** (PWC, 2016). This is the value of current business services and labour that are likely to be replaced in the very near future by drone powered solutions. Globally, drones can have the highest impact in infrastructure, with potential to add value of approximately $64.6 billion (Figure 26), followed by agriculture at $46.3 billion (PWC, 2016). The growth demonstrated in each of the sectors is expected to grow in line with global GDP, at a compounded annual rate of 2.8%.

Figure 26: Drone demand by industry (till 2050)



Source: Deloitte Access Economics

Sensitivity testing
The base case scenario assumes that New Zealand will be able to garner the same share of ITS exports as it has of world GDP. As this is a share five times larger than New Zealand's current share of advanced manufacturing trade, this base case will not be achieved easily. However, Deloitte Access Economics considers it to a plausible outcome should some of the recommendations in this report be implemented. On the other hand, there is always a chance that a local firm will develop a "killer app" that will result in local firms as a whole holding 2% to 3% of the entire world market for drones or ASDVs or intelligent logistics.

Breakthrough scenario

This section also looks at a scenario where a New Zealand firm comes to totally dominate its particular niche – for example precision horticultural drones – and gathers 3% of the total world drone market for itself. However again, this product breakthrough is not assumed to affect service provision, so local firms' share of the domestic market only increases by 3% also. These results are also not summed, as such breakthroughs are rare. In this scenario, New Zealand could make over a billion dollars a year just from ASDV components. Or nearly $15 billion from drones – which to put it in perspective is around 6% of current GDP.

Table 7: Total potential revenue 2050 from ASDVs for New Zealand ITS suppliers, breakthrough scenario ($m pa)

ASDVs	Total market size	NZ supplier share	%
New Zealand	315	9	3.0%
Other countries	43,090	1,293	3.0%
World total	43,405	1,302	3.0%

Source: Deloitte Access Economics

Table 8: Total potential revenue 2050 from intelligent logistics for New Zealand ITS suppliers, breakthrough scenario ($m pa)

Intelligent logistics	Total market size	NZ supplier share	%
New Zealand	576	305	53.0%
Other countries	105,485	3,165	3.0%
World total	**106,601**	**3,470**	**3.3%**

Source: Deloitte Access Economics

Table 9: Total potential revenue 2050 from drones for New Zealand ITS suppliers, breakthrough scenario ($m pa)

Drones	Total market size	NZ supplier share	%
New Zealand	1,000	530	53.0%
Other countries	485,300	14,559	3.0%
World total	**486,300**	**15,089**	**3.1%**

Source: Deloitte Access Economics

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