Data opportunities for intelligent mobility
Data opportunities for intelligent mobility
Executive Summary

In July 2016, the Ministry of Transport engaged WSP Opus to lead a focused assessment of current and future opportunities for data-driven intelligent mobility in New Zealand. For the purpose of this work intelligent mobility is defined as:

*The enabling of emerging technologies to improve the movement of people and goods in a smarter, greener and more efficient manner.*

This research is intended to support achieving the New Zealand Government objectives for the transport system, and to complement work undertaken as part of the “Intelligent Transport Systems Technology Action Plan 2014-2018” which states:

“The government’s overall objective for the transport system is for an effective, efficient, safe, secure, accessible and resilient transport system that supports growth of our country’s economy to deliver greater prosperity, security and opportunities for all New Zealanders. The three key areas of government focus for achieving the objectives are: economic growth and productivity, value for money and road safety.”

The OECD International Transport Forum advises that “the acceleration in both the growth and velocity of exploitable and often open data will trigger significant and disruptive change across a number of sectors – including transport”.

By 2020, the digital universe will be approximately 44 zettabytes of data in size, with the mass of data being generated across the world doubling every two months to 2020.

With this influx of data, how then, does New Zealand ensure that it is collecting and analysing the right information, at the right time, in the right way to enable a more intelligent transport system?

To answer this central question, a mixed-methods research approach was undertaken through a combination of a desktop review, key stakeholder meetings and transport sector workshops across New Zealand. The range of groups engaged with included representatives from Central, Local and Regional Government, Universities, research providers, private sector mobility service providers (people and freight movement), data insight providers, and individuals involved with transport system management activities.

In undertaking this work several key questions were investigated, these investigations and findings are set out in chapters 4 through 8. Chapter 9 provides an overall summary of the key stakeholder comments and Chapter 10 outlines the intelligent mobility action plan. The key questions investigated were:

- What intelligent mobility trends are expected in New Zealand? (Chapter 4)
- What data is needed to support future intelligent mobility trends? (Chapter 4)

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1 Based on definition in: https://ts.catapult.org.uk/intelligent-mobility/introduction and the Ministry of Transport’s definition in the Request for Proposal for this research.
4 1 Zettabyte = $10^{24}$ bytes
• How is data being shared and who is using it? (Chapter 5)
• What data related capabilities are needed? (Chapter 6)
• Are there barriers and challenges to creating, opening up and using data in transport (Chapter 7)

**Key research findings**

This research highlights many data opportunities and challenges for realising a more intelligent mobility system for New Zealand. From these opportunities and challenges four key themes emerged:

1. The sector has a continued need and interest for Government to set the strategic vision for intelligent mobility in New Zealand.

2. Once the vision is set and Government led activities within this identified effort should be undertaken to prioritise key datasets that supports this and identify data gaps.

3. There is a need for greater collaboration around transport data in New Zealand.

4. Innovation and development will require educating, training and upskilling people with the right data skills and expertise.

Each of these themes are explored alongside actions from the data action plan in further detail below.

**The transport sector has a continued need and interest for Government to set the strategic vision for intelligent mobility in New Zealand**

A wide range of the private sector, Councils and research organisations engaged with for this project requested that the New Zealand government set a clear strategic vision for future intelligent mobility in New Zealand. A clear vision of the shape and nature of the mobility system was desired along with an indication of who is expected to provide mobility services and technology (for example mass public transport operated on behalf of Regional Councils that is complemented by privately provided services). This vision will allow the private sector to develop their own business cases for development of technology, systems and services, and set a platform for public-private engagement around future mobility service provision.

While our stakeholders expected Central Government to continue to set the strategic vision for intelligent mobility in New Zealand, the direction and rate of data-driven innovation and development that is enabled by the vision will be dictated by other agencies and organisations. In essence, the private sector was keen for challenges to be set for them, so that they could find innovative solutions.

As the private sector increasingly provides transport services to people, those engaged with for this research felt that the need for Government to regulate and set standards becomes an increasingly important role. It was generally believed that if left to the private sector alone the Government’s overall objectives for an: effective, safe, secure and resilient transport system may not emerge in a desirable manner. Those engaged with noted both potential equity and safety issues, with transport offering likely to be limited to geographical areas where the most profit can be made. For example, many taxi companies in New Zealand...
generally provide coverage across a city and include wheelchair accessible vehicles. Newer, on-demand, transport services may be motivated to operate in selective areas on routes that make the most profit, and do not generally offer wheelchair accessible vehicles, thus providing a service that is less equitable for all people and communities. Minimum standards of service may be required to ensure that a transport system that provides equitable access is maintained no matter who the provider is.

**Actions**

- Government (Ministry of Transport, NZ Transport Agency, Regional and Local Authorities) to clearly identify and communicate the desired form and nature of New Zealand’s future transport system. This is done on a regional basis in long-term plans and strategies, but there was demand for a more comprehensive national view of these disparate plans.

- Within this vision there are some key actions and points that the sector engagement in this research identified:
  
  o Questions to be addressed as part of this vision include: what services are best applied where (appropriate mobility service provision will vary from city to city and region to region – for example mass transit is not practical for all locations so needs to be supported by other modes and services), and who is expected to provide these services (public, private, partnership) so that these groups can address challenges and goals through research and innovation.

  o Identify and/or set minimum requirements of quality, accessibility and safety for key services (e.g. total mobility provisions for current taxi services), freight and air that apply to all operators.

  o Local and Regional Authorities currently have the best oversight of their transport network and what gaps exist in terms of service provision, demand, accessibility and equity, safety and customer satisfaction. Many smaller towns and cities in New Zealand will not see the arrival of new mobility services (e.g. ride hailing) for quite some time due to commercial viability. Similarly, these places are not suitable for traditional public transport services and may benefit from more flexible on-demand transport options. If the private sector is unwilling to enter these markets initially can services be delivered by Local Government, or can private providers enter into a contract with Government to provide a subsidised product? New business models and contracts will need to be explored and there is a need for Central Government support in developing these.

**Prioritise collection and analysis of datasets that will enable or inform Government’s ‘key’ activities and identify gaps**

Intelligent mobility trends and next generation transport technologies and services have become intrinsically linked to data trends, and the development of both software and human capability to create innovative products and services using data.

Government will continue to undertake many key transport activities that require data, for example road transport network operations and management continue to be managed by Government agencies, or like many public transport services on behalf of them through contracts. Many of these activities are generators and consumers of data, with information at hand used for real-time decision making and long-term planning. Outside of network
activities, data is used for analysis that provides insight into how the transport system is performing, and where investment is best targeted to meet New Zealand’s objectives. Metrics and indicators supported by quality data will continue to be an important part of Government activity in this space, though the nature of these is likely to change as transport priorities shift, and so the data needs will also evolve.

Much of New Zealand’s transport data is now collected by the private sector as they are increasingly providing transport solutions and services. This is particularly true for data about real-time movements of people, as individuals share their personal location information in return for products and services that are often offered for free. It is inefficient for Government to re-collect data that is already being routinely collected by industry, indicating a need to better engage and work alongside industry.

**Actions**

- Initiatives such as the Transport Domain Plan identify and prioritise a range of transport related datasets in New Zealand. However, feedback from private sector stakeholders in this research is that the Domain Plan does not have the detail required to identify individual datasets, and more clarity is required to link it with the wider transport activities Government expects to undertake (such as those outlined in the ITS Action Plan). From this a better understand of what ‘data gaps’ exist (what do we need to do but cannot because of a lack of data?), and who is best placed to collect and provide this data or data insights can be determined.

- New indicators and metrics will emerge that Government does not currently have comprehensive data to measure. For example, there is an increasing focus on ‘customer experience’ and ‘behaviour change’ with regard to transport, tracking some of these will require access to new datasets. The private sector will be an important supplier of insights based off their data to inform government.

- Government should work with the private sector to collaborate or procure insights from their datasets. For many uses Government does not need access to raw data, and should work with data owners to develop algorithms that process and deliver essential data and insights to enable Government’s activities to proceed. This may be metrics for an element of the transport system provided on a regular basis, or aggregated data provided in real-time to assist with network management activities. In both cases Government is likely to be required to purchase Data as a Service, so a business case for the value (economic and social) of the activity must be established – much like the private sector basing their own data collection around the economic value of the services data enables.

- In some instances, regulation of data sharing may be appropriate, but it is important that this does not stifle commercial opportunities and discourage investment and innovation. Where data sharing is mandated (either through legislation or a contract) standardised contracts for data need to be developed so that local, regional and central government are valuing data in the same way and ensuring that data generated under government contract is shared back in a specified/standardised format.

- Prioritise the release of Government data in standardised formats and consider changes/development required to existing data sharing platforms to encourage reuse of data. For example, data.gov.nz currently holds a lot of Central Government datasets, while individual transport authorities are developing APIs to make large volumes of real-time and dynamic data available. Standards for data and these APIs will be useful to ensure that users of data, such as the private sector, can develop new or improved
mobility services and insights by integrating their own data with public feeds. A present example of this discussed during the research is Auckland Transport’s Public Transport data feed being integrated with electronic transaction records – thus providing some context of ‘why’ people are travelling. How this information is shared back to Government in a way that means they gain value from these insights is something that was not clearly defined by stakeholders in this research and an area requiring further work to build relationships and procure services from the private sector.

Need for greater collaboration around transport data in New Zealand.

Because of the changing role of the private sector in collecting and managing transport data sets, and the rapidly increasing volume of data being collected, it is difficult for any one group (e.g. Government) to get a clear picture of individual datasets. The prioritisation framework in the Transport Domain Plan meets some of this need, but new uses and sources of data are rapidly emerging and evolving that are difficult for such a catalogue to stay abreast of.

For example, a range of organisations hold information about people movements (e.g. mobile phones, patronage data, electronic spending records) and freight movements (e.g. vehicle tracking, electronic road user charges and supply chain logistics). What insights do each of these datasets provide outside of their core use? Are they all the same or do some provide data that can be used for more applications than others? What is the reuse value of these datasets for other uses not yet considered that will arise in the future? A common comment was that there was a lack of communication across the country as to what data enabled transport technologies and services are being trialled in different areas.

Actions

- Facilitate the Transport Knowledge Hub’s Data Hub to becoming a central point of contact for public and private stakeholders across the transport sector. This group can play an important role in bringing collectors and users of transport data together, make datasets more visible and accessible, and build connections between individuals. The Data Hub has the potential to add benefit to both Government and the private sector.

- Central Government to assist Local and Regional Government in developing standardised approaches to accessing, procuring and purchasing data and data insights they need to conduct their core activities. Local and Regional Authorities engaged with on this work stated that there is a need to better connect with each other to learn from initiatives elsewhere, and to partner on new projects and activities. Central Government was discussed as being in the best position to play a lead role in this, and ensure that development is not duplicated and piecemeal across the country with low efficiency.

- Set and communicate national transport data and metadata standards across all of Government that can be taken on by the private sector also. New Zealand will continue to look to international standards in this space as much of the technology and services are being developed offshore.

- Continue to provide Government data openly, and increase the publication of dynamic and real-time data via APIs in New Zealand. The business case for publishing data openly may consider the economic and social value of reuse, even where economic benefits fall within the private sector, a priority over recouping data collection, processing and sharing costs. Sector stakeholders asked the Government to work with them to improve identification of what data is of most value to be shared openly.
• Investigate the feasibility and requirements of a centralised transport data repository and transport API. This would help connect, query, and expose a diverse range of public and private transport data across New Zealand. This centralised repository may build upon the open transport data initiative in data.govt.nz, this platform currently provides links to external transport APIs (e.g. Auckland Transport API) and data sources without having the functionality for users and developers to access and use different datasets for their own needs via the service.

• Regulation of data may be appropriate (as mentioned above), particularly where the private sector is delivering services in an area that is backed by Government legislation. A current example of this is Electronic Road User Charges (ERUC) management systems that are provided to operators for accurate recording of vehicle road usage, and payment to the NZ Transport Agency. Minimum data requirements for ERUC systems are prescribed by the NZ Transport Agency, future requirements may increase or modify the nature of information shared back to Government. This approach can be implemented for other services (not identified here) as appropriate. Regulation will provide clarity to new entrants to New Zealand what their obligations are.

Need to educate, train and retain people with the right skills

There is expected to be an international skill shortage of people with the necessary skills to obtain and transform data into knowledge that can be applied for a more intelligent mobility system. As the complexity of data, data systems and the technology and services using data increases the need for staff who can understand the value of data and its applications increases. While artificial intelligence and machine-learning approaches are improving, there is still a core role for human capability to drive the system and seek out new applications/innovations through data analysis and insights. It is expected that attracting and retaining skilled staff will continue to be a competitive space as all sectors and industries (not just transport) look to leverage data for innovation and development.

New Zealand Universities have been working to develop new courses which industry notes are starting to provide “data industry ready” graduates. As the intelligent mobility industry matures there will be a continual need for Government, industry and universities and other training institutes to work in conjunction to develop training courses and qualifications to meet the needs. The following skills have been identified as essential for realising data opportunities for intelligent mobility:

• Data collection and curation
• Computational, statistical and human analysis
• Software and technology development
• Cyber security and data privacy protections

The three tertiary education providers spoken with were keen to keep an open dialogue with Government and Industry to ensure their courses were meeting the needs of the transport sector.

Actions

• Upskill staff to become more data literate – it is important for individuals who will be engaging with other agencies and organisations around data driven intelligent mobility to understand what is practical and possible to achieve. It was noted that moving forward
it will also be important to upskill decision makers to better understand and be accountable for the data insights that they are presented with. Vocational training is one option to improve the data capability of existing staff across the transport sector.

- Work with industry and universities to ensure the right education programmes continue to be developed to deliver graduates with the right skills. It is important that graduates with an interest in transport be provided appropriate data and analytics training.

- Look at approaches/policies for attracting and retaining staff. Often individuals working in this space will be driven by creative/scientific opportunities.

- Continue to hire or procure data science expertise for transport network management activities, such as the teams involved with the Auckland Motorways Alliance (AMA). Share learning, knowledge and innovation across groups nationally to encourage aligned development and facilitate an environment of collaboration.

- Continuing with transport sector data initiatives such as open data and hackathons is a good opportunity to bring developers and transport staff together in a unique environment to solve problems.

Overall, the engagement undertaken for this report suggests that there is a keen interest from Government, private industry, Councils and Universities to continue the dialogue in how each can play a role in optimising future benefits through data for intelligent mobility.
### Proposed action plan

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<th>Action</th>
<th>Lead stakeholder</th>
<th>Linkages</th>
<th>Priority</th>
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<tbody>
<tr>
<td><strong>Continue to develop detailed actions under the Transport Domain Plan for data opportunities and individual datasets.</strong></td>
<td>Ministry of Transport; NZ Transport Agency</td>
<td>Transport Domain Plan; ITS Action Plan</td>
<td>Medium</td>
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<td>Work towards confirming a roadmap for establishing a tiered suite of transport sector datasets and clarify opportunities for collaboration between public and private sectors. Link this roadmap with the ITS Technology Action Plan 2014-18 which sets out several priorities and actions that relate to data and technology identified in this report, including:</td>
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<td>- Development and application of international transport data standards.</td>
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<td>- Providing a national real-time global navigation satellite system (GNSS).</td>
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<td>- Develop a business case for a coordinated, authoritative national land transport network geospatial dataset.</td>
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<td>- Investigate the merits of, and introduce, and national card-based integrated fare and ticketing system.</td>
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<td><strong>Benefits:</strong> Linking the Transport Domain Plan’s data stocktake with known or planned intelligent mobility services and technologies in New Zealand makes it easier for individual groups to understand the current state of data, and identify areas where there are gaps that will prevent us from meeting our goals. Currently, data stocktakes are generally structured around data typologies, as opposed to their application, including the latter in stocktakes and strategies better identifies the economic and social value individual datasets create, and the groups for whom benefits are realised.</td>
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<td><strong>Central Government to develop standardised approaches to procuring and purchasing data and data insights.</strong></td>
<td>Department of Internal Affairs; Ministry of Business, Innovation and Employment</td>
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<td>Medium</td>
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<td>This may include guidance for public/private business models relating to data collection and data ownership in contracts.</td>
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<td><strong>Benefits:</strong> There are a number of examples, not just for transport, where data has previously been undervalued or future use not considered by Government contracts and so the Agency’s that have paid for, or enabled, the initial collection of data do not have access for further re-use. A standardised all-of-Government contracting approach sets expectations around data procurement and purchasing, and provides clarity to the private sector who will likely be engaged to collect and provide data or data insights. There will be exceptions to standard contracts but this approach establishes a baseline.</td>
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<td><strong>Establish a public sector forum and/or active database of data-driven intelligent mobility activities.</strong></td>
<td>Ministry of Transport; NZ Transport Agency</td>
<td>Transport Knowledge Hub’s Data Hub</td>
<td>Medium</td>
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<td>By focusing on activities taking place across Central, Regional and Local Government level this would identify what innovation is taking place, by whom (public and private), and what data is being used</td>
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and generated. Use this forum as an opportunity for sharing on data-related transport projects and activities (e.g. ticketing systems, journey planning and payment platforms, network management) and to promote partnering that avoids duplicated and piecemeal development across the country.

**Benefits:** Increased cost efficiency through reduced duplication of effort on initiatives and sharing of learnings, contacts and technologies between organisations. Development is more likely to take place in a cohesive manner that ensures data, data systems, and transport technology services can be better integrated at a national level.

Building relationships between subject matter experts to enable the sharing of knowledge and expertise, and fostering opportunities for collaboration among members will: reduce duplication/wasted effort, and promote the sharing and effective use of transport data to drive overall increased efficiency.

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<td>Build on the Transport Knowledge Hub’s Data Hub to become a central point of contact for public and private sectors.</td>
<td>Ministry of Transport</td>
<td>Transport Knowledge Hub’s Data Hub</td>
<td>High</td>
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<tr>
<td>Establish national transport data and metadata standards.</td>
<td>Ministry of Transport; Department of Internal Affairs; Ministry of Business, Innovation and Employment</td>
<td>Transport Knowledge Hub’s Data Hub</td>
<td>Medium</td>
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This would mean that public and private collectors, enrichers and providers of transport data can describe and record data in common ways. This action will likely see the adoption of international data and metadata standards to New Zealand to ensure that we are aligned with overseas data activities and practices. It would also help ensure that contracts reflect the requirement to provide/share data in a specified and standardised format. Provide guidance and support to smaller organisations to develop processes and technology for aligning existing data with new standards, and setting in place systems for newly collected data/datasets.

**Benefits:** For data-driven intelligent mobility activities to work effectively it will be important that all organisations creating, enhancing and using data adopt standards that ensure the widest range of technologies and services can be introduced in New Zealand. Alignment with international standards ensures that overseas innovations can be introduced here, and vice versa. Nationally, transport data standards make it easier for individual organisations to collaborate, share data and insights, and co-create new technologies and services.
metadata, or 'data about data', standards is extremely useful for developers and data scientists. Adopting best practices in this area will reduce barriers that currently exist for open data initiatives and the reusability of transport data across the sector.

### Investigate the feasibility and requirements of a centralised transport data repository and transport API.

This would help connect, query, and expose a diverse range of public and private transport data across New Zealand. This centralised repository may build upon the open transport data initiative in data.govt.nz, this platform currently links to transport APIs (e.g. Auckland Transport API) and data sources without having the functionality for users and developers to access and use different datasets for their own needs via the service.

**Benefits:** A centralised transport data API would serve multiple functions, including:

- Become a 'catalogue' for public and private transport datasets in New Zealand and forgo the need to periodically carry out stocktakes of transport data as this process could be automated (under the expectation that all datasets of interest are in some way connected to or referenced on the platform).
- Allow Government agencies to share and integrate data with the ability to determine who has access to certain pieces of data and information (e.g. team, organisation, cross-organisation, public).
- Link to and integrate data hosted on disparate APIs and data portals across Government and the private sector, without the need for these groups to upload their data directly to both their own platform and a centralised service.
- Increase the usability and functionality of current public facing open data portals for transport in New Zealand and move towards a model that encourages innovation and development to take place and use of data by the public (e.g. London Datastore).

### Improve data literacy across the transport sector.

Data literacy is a well identified need across multiple sectors and in both the public and private realm. It is important that graduates with an interest in transport be provided appropriate data and analytics training. Consideration should also be given to how these graduates could specialise in transport data and analytics. Likewise, existing staff with extensive transport knowledge should be provided opportunities to upskill their data literacy.

Data literacy includes capability to carry out complex analyses, but also staff who more generally understand the value and use of data, can critically interpret data insights, and communicate data outcomes for decision making. Vocational training is one option to improve the data capability of existing staff across the transport sector.

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<td>Ministry of Transport; NZ Transport Agency</td>
<td>Transport Information Strategy and Architecture</td>
<td>Medium</td>
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<td>Across Government</td>
<td>Government Analytics Network</td>
<td>High</td>
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Continuing with transport sector data initiatives such as open data and ‘hackathons’ (such as those recently hosted by the NZ Transport Agency) is a good opportunity to bring developers and transport staff together in a unique environment to solve problems.

**Benefits:** Improved data literacy in the sector is essential to achieving the key intelligent mobility trends that are expected to shape the transport system over the coming 10 years and beyond. Ensuring that Government staff, even those who are not performing the analytics, better understand the value, potential use and benefits of data-driven innovation and technology is important for engaging across Government and with the private sector. Improved data literacy takes data out of the ‘black box’ and allows for better communication of data insights both to decision makers and to the public.

Having experienced transport sector staff increase their data literacy also allows for them to better guide graduates who leave university with strong data science and data engineering skillsets, but lack experience applying these skills to transport problems. Over time this increase in capability will spread as more data is made available openly and re-use encouraged for problem solving and innovation.

**Common data management through good data governance**

We can unlock a number of opportunities if we can make better use of transport data, and link key datasets together. Good data governance, the process of managing data based on expert knowledge and defined processes and procedures, will be needed to achieve these goals, part of this is data management planning. Digital.govt.nz provides good advice for creating a data management plan at the planning stage of the data lifecycle to:

- Explain how data will be managed.
- Identify what data will be created.
- Describe how data will be collected, stored, shared, preserved and described.

**Benefits:** Digital.govt.nz state that a data management plan will:

- Provide transparency and assurance to data suppliers.
- Identify policy and legislative requirements.
- Help to anticipate legal, ethical and commercial exceptions around releasing data.

Good data management and governance will make decision making and insights based on transport data more transparent to the public, and datasets will become increasingly reusable. These outcomes will drive greater creativity and innovation using transport data.

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<td>Transport Sector Information Managers Forum</td>
<td>Digital Government</td>
<td>Medium/ High</td>
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1 Introduction

“Data are the lifeblood of decision-making and the raw material for accountability. Without high-quality data providing the right information on the right things at the right time; designing, monitoring and evaluating effective policies becomes almost impossible”


The OECD International Transport Forum advises that “the acceleration in both the growth and velocity of exploitable and often open data will trigger significant and disruptive change across a number of sectors – including transport”. By 2020, the digital universe will be approximately 44 zettabytes of data in size, with the mass of data being generated across the world doubling every two months to 2020.

With this influx of data, how then, does New Zealand ensure that it is collecting and analysing the right information, at the right time, in the right way to enable a more intelligent transport system?

In July 2016, the Ministry of Transport engaged WSP Opus to lead a focused assessment of current and future opportunities for data-driven intelligent mobility in New Zealand. Intelligent mobility is defined as:

The enabling of emerging technologies to improve the movement of people and goods in a smarter, greener and more efficient manner.

This research is intended to support achieving the New Zealand Government objectives for the transport system, and to complement work undertaken as part of the “Intelligent Transport Systems (ITS) Technology Action Plan 2014-18”. It deliberately seeks to utilise existing knowledge and publications across multiple agencies to avoid duplicating effort. To facilitate this approach, and provide a broad knowledge base that guided the research process, a Steering Group was engaged throughout the study to provide input, draw links between ongoing projects, and provide relevant contacts in New Zealand and overseas. This group was made up of the following agencies and organisations:

- Ministry of Transport (Chair)
- New Zealand Transport Agency
- Land Information New Zealand
- Auckland Transport
- Statistics New Zealand
- Local Government New Zealand
- New Southern Sky
- Department of Internal Affairs

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6 Big Data and Transport - Understanding and assessing options; OECD/ITF (2015)
7 1 Zettabyte = 10²¹ bytes
8 Based on definition in: https://ts.catapult.org.uk/intelligent-mobility/introduction and the Ministry of Transport’s definition in the Request for Proposal for this research.
For this report, the Steering Group also obtained independent advice from Deryk Whyte (from DWG Consulting).

WSP Opus and the Ministry of Transport would like to thank the following organisations and groups for their staff and members’ time participating in numerous meetings, interviews and workshops during this research, and for the openness in discussion about their own activities and vision for New Zealand’s data-driven intelligent mobility future:

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1.1 Scope and structure of this report

Use of data to enable Intelligent Transport is one of the 15 key focus areas of the New Zealand Government’s ITS Action Plan 2014-18. Examples of intelligent mobility are provided in Section 3.1.

In the original request for proposals, the Ministry of Transport outlined the context and scope of this work:

Government, business and consumers are already exploiting transport-related datasets to inform policy, to assess benefits delivered, for asset maintenance, traffic

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management and to inform transport users decisions, for example by providing real-time journey information.

New Zealand along with other cities and countries globally are seeking to utilise the current rapid advances and uptake of sensor technologies, access to real-time data, enhanced data processing and analytics frameworks to bring about a more intelligent mobility system. For this report, Intelligent Mobility includes all forms of movement for both people and freight including but not limited to: air, rail and sea, road, and walking and cycling.

The objective of this report is to recommend guidance on the steps required to ensure that the right data is accessible and used to enable intelligent mobility in New Zealand. Where this report discusses the data requirements we have included the process of: the data, data processing and the analytics frameworks being used to gain insights and understanding to inform evidence-based decision making that will enable intelligent mobility.

The outputs of this report are intended for consideration by the transport sector and information technology sectors to inform future action and decision-making around the data needs to enable intelligent mobility. The report is set out to answer questions posed by the Ministry at the beginning of the project and is structured as follows:

- Section 2 – Methodology.
- Section 3 - Setting the scene.
- Section 4 - What intelligent mobility trends are expected in New Zealand, and what data is needed to support these?
- Section 5 - How is data being shared and who is using it?
- Section 6 – What data related capabilities are needed?
- Section 7 - Barriers and challenges to creating, opening-up and using data in transport.
- Section 8 – Major challenges identified by transport sector stakeholders.
- Section 9 - Intelligent mobility data action plan.
2 Methodology

There were three primary phases to this research:

1. **Desktop review** of current, emerging and future data-enabled intelligent mobility trends in New Zealand. A review of government policy, strategy and action plans formed the basis for this review and were a starting point for the research engagement to follow.
   
a. Existing data repositories and catalogues that centralise mobility data in some manner were identified, these are described in Appendix 2.

b. Specific datasets currently being collected and used in New Zealand were also identified, this list was supplemented during the research engagement and is presented as an indicative review in Appendix 3.

2. **Key stakeholder meetings** to build on known themes and identify current and expected uses of data for intelligent mobility innovation in New Zealand.

3. **Sector workshops**, six of these were held in: Wellington (2), Christchurch (1), Auckland (2) and Tauranga (1), which provided an opportunity for discussions focused on key intelligent mobility trends that brought together a wide range of viewpoints, backgrounds, motivations and expectations in the same room. In total, 61 attendees across many public and private organisations participated in this research at the workshops.

The Project Steering Group provided a considerable range of contacts across New Zealand’s transport sector, complementing WSP Opus’ own network and relationships. The WSP Opus research team led the interview and workshop engagement process for this study. Workshop and interview participants represented organisations/groups that generally fell into one or more of the following broad groups:

- **Generators**: Suppliers of data
- **Aggregators**: Organisations that collect and aggregate data (both open and proprietary), may identify correlations, efficiencies or provide visualisation of relationships
- **Users of data for analysis and insights**: local or central government, transport providers who use data to identify demand/market trends, and research and development organisations.

At each workshop participants were split into groups of people with similar roles and backgrounds to discuss specific intelligent mobility questions and themes through a series of tasks:

1. The future of intelligent mobility on New Zealand
   
a. Intelligent mobility services (current and future)

b. Timeframes

   c. What is the value of these services and to who?
2. Data needs, gaps and barriers
   a. Data and data system needs
   b. Gaps in available data and data availability
3. Barriers, roles and actions
   a. Barriers
   b. Roles (who is going to lead and solve?)
4. Actions (for who?)

Following each task, groups discussed their ideas and opinions with the wider group, with a member of the WSP Opus project team joining each group to facilitate and aid recording of the discussion.

3 Setting the Scene

3.1 What is intelligent mobility?

Intelligent mobility is the use of new technologies and data insights to improve the long-established activity of moving of people and goods between places. In a practical sense, intelligent mobility is expected to increase the sustainability and efficiency of all transport modes through innovative ideas and smarter technology.

The planning and delivery of transport infrastructure has traditionally been a government-led activity through regulation and investment. This can be either as part of a Government response to evolving transport needs (both commercial and personal), or as a Government-led initiative to achieve a desired transport goal or vision. Around these decisions commercial operators have developed their own technology (e.g. vehicles) and services (e.g. freight and taxis), while people have made use of available technology and services to meet their personal transport needs.

In New Zealand, there are signs of a shift in this model due to intelligent mobility technology and services that have less direct Government involvement and are led by the private sector instead. Transport users, have increased access to information on which to base their transport decisions, these include real-time mapping for route planning across modes, and online access to a variety of journey planning and payment services. Another emergent trend is the ability for people to connect directly with other people via the internet, opening up opportunities to share resources (e.g. vehicles, parking spaces, electricity charging points) and even share journeys to reduce personal transport costs and increase sustainability.

Mobility service providers are in-turn tailoring their products and services to the needs and preferences of individuals. Data insights about end-users have become as fundamental as the development of new technology and services as companies seek to monetise knowledge gained from data to improve their existing service and develop new ones. This model is aimed at disrupting existing transport models by promoting alternate ways for people to move around, or improving the efficiency of existing modes. Many of these efforts seek to reduce the share of trips made by individuals in personally owned vehicles, such as improved public transport journey planning and payment services via web enabled apps. Private
mobility service providers are also seeking to disrupt existing vehicle ownership models by marketing different, but still car-centric, models such as ride-hailing and shared transit.

People are not the only focus of emerging technology, the freight industry has already benefited from the increased efficiency that software and technology have created for logistics and distribution. Significant future benefits are forecast for the freight sector because of continued data insights, while automation of road, air and sea freight would herald a transport revolution.

The end-user focus of intelligent mobility initiatives has made it necessary for local and central government, traditionally the owners, managers and operators of transport networks and associated infrastructure and services, to become responsive to ‘bottom up’ trends. Existing networks are increasingly catering to an expanding range of modes and trip types, while network managers work to ensure the system functions efficiently in the face of potentially competing demands and rapidly emerging trends. This, again, is achieved by advancements in technology and data insights to aid the movement of people and goods.

New Zealand will experience outcomes of intelligent mobility innovation at both a small and large scale. For example:

- **Individuals already benefit from a range of technology and services that can improve their personal transport experience.** From free to use journey planning tools that advise the best route to drive, or when to catch the next public transport service to reach a destination, people are making use of data-driven services to plan their everyday activities. Private vehicles are now equipped with sensors and software that provide driver assistance. Parking cameras and sensors, lane change warning, adaptive cruise control all make use of real-time data to increase the safety and overall experience of personal driving trips.

- **Communities are better able to engage with each other via internet enabled applications that in turn have enabled individuals to exchange resources and services.** Parking Apps such as Parkable (available in Auckland and Wellington) allow peer-to-peer renting of driveways and parking spaces when they are not being used by the owner. Such apps have implications for transport planning and provision of physical assets by making better use of previously unutilised private space and reducing the burden on public provision of infrastructure such as on-street parking. They also enable individuals and groups to profit from temporarily (or permanently) un-used assets.

- **Cities can better plan and deliver transport infrastructure and services that meets the needs of residents and businesses, while achieving goals such as reduced private vehicle use.** To make travel by means other than private cars as cost effective and convenient as by car, major cities are looking to intelligent mobility innovation to deliver initiatives such as: dynamic bus routes based on real-time demand, use of mobile devices to plan and pay for both public and private transport services, ridesharing and ride hailing services that complement public transport, dynamic pricing of infrastructure (e.g. tolling and parking charges), and traffic management systems that are responsive to the dynamic nature of these modes. In such
an example, a mature level of data insights and integration of information across public and private organisations is necessary to create a cohesive transport system.

Additionally, intelligent mobility services, applications and data-driven decision making can be delivered by both Government and non-Government organisations. These emerging business models are different from the way transport has traditionally been delivered to people. For example,

- **Transport network managers and operators, across land, air and sea, are increasingly using real-time data to monitor the performance of their networks, and respond quickly to events that are likely to cause disruption. The availability of data for these purposes is growing as people and vehicles within the network itself generate increasing volumes of data. The major challenge currently facing our network operators is integrating modern technologies and datasets with historical systems, and identifying what information is required to improve their service.**

- **Data companies who collect information about people and their movements have become major providers of mobility services themselves. International companies like Google provide free services to the public such as multi-modal journey planning and navigation services. The data they receive from people using these services creates a rich data source for mobility within cities, regions, and countries that has immense value to many other organisations and groups.**

The rise of non-Government organisations (e.g. TomTom, Google, Here, Uber and Lyft etc.), as both providers of transport services to the public, and collectors of rich data sets, are having an increasingly significant influence and impact on transport management. The data collected as people and goods move around our towns and cities can provide a real-time understanding of trip demand and current spatial trip patterns. As a result, private organisations are establishing datasets that are of significant value for transport network managers/operators, and likely of better quality than the information currently used for these activities. There is an emerging opportunity for Government transport authorities to engage with the private sector to harness their capability and understanding under new commercial procurement models to achieve local and national intelligent mobility goals.

Potential applications for intelligent mobility are almost endless, but they do require people and data as base ingredients. The development and implementation of intelligent mobility systems are being driven both by industry developing business opportunities, and by Local and Central Government to meet their strategic goals.

### 3.2 New Zealand Government objectives for the transport system

“The government’s overall objective for the transport system is for an effective, efficient, safe, secure, accessible and resilient transport system that supports growth of our country’s economy to deliver greater prosperity, security and opportunities for all New Zealanders.”
The three key areas of government focus for achieving the objectives are: economic growth and productivity, value for money and road safety.10

3.3 New Zealand Government transport related data programmes and strategy

In 2014, the New Zealand Government released the ITS Action Plan 2014-18. The Action Plan sets out the Government’s approach to enabling the testing and deployment of beneficial ITS solutions for New Zealand. The Action Plan makes it clear that data is a core component of ITS, and use of data for ITS is the subject of global discussion.

The Action Plan complements the Government’s objectives by providing the sector with a clear description of how ITS will contribute to meeting these objectives. Private organisations working in this space can take guidance from the Action Plan to identify where their ITS innovation and development aligns with Government’s vision. Government has set for itself an outline of what it must do to enable ITS technologies that will enhance the operation, use and experience of New Zealand’s transport system. Provision of ITS technologies are expected to centre around three key areas:

1. Government provided technologies - these broadly relate to traditional transport network operation and management activities.

2. Private sector provided technologies - Government is expected to have limited direct control over these so documents such as the ITS Action Plan are critical to ensuring emerging technologies and services align with New Zealand’s objectives.

3. Public innovation - an emerging field made possible by better access to data and information and the ability for people to generate their own data as needed.

The Ministry of Transport has several key data-related strategies and projects that are ongoing, these include:

- Domain Strategy: determining the ‘enduring questions’ for the transport sector that could be answered by transport data, and so which justify the collection of that data.

- Developing a common evidence base: for policy development. A long-term project to connect data and research carried out by the Ministry of Transport and NZ Transport Agency.

- Possible Data Council within transport: discussed as an opportunity with the NZ Transport Agency.

- Household Travel Survey: participants will carry GPS trackers for seven days, and a questionnaire with be used to provide an account of their travel.

- Possible ‘Trends in Transport’ publication: opportunity to provide an annual analysis of transport data in New Zealand.

• Future Agenda: the Ministry of Transport is a sponsor of this European-based project to explore future challenges and opportunities. Interests include data privacy, security and sharing.

Government has many other programmes dealing with data privacy, security or sharing that are relevant to transport. These programmes, led by a range of agencies, will set Government’s priorities for investment in data systems and capabilities. Central to most of these programmes are the data standards and practices necessary to ensure security and privacy of information in the digital age.

Government-supported independent forums like the Data Futures Partnership have positioned data as a national strategic asset, and recognise the vast number of economic, social and environmental opportunities that will come from a ‘data-use-system’ that creates value for all New Zealanders.¹¹

Many individual projects have been completed or are underway as part of the Government’s ICT Strategy and Action Plan to 2017 and the Data Futures Forum. Central to these projects is a ‘whole of Government’ approach, with cross agency efforts developing strategic approaches to public sector information management. Government’s policy and legislation frameworks that will be essential to ensuring that individuals privacy is maintained and security risks mitigated are also being developed as part of these forums. An overview of some key projects is presented in Appendix 1.

### 3.4 Key outcomes and benefits of intelligent mobility

New Zealand, like many countries, is seeking opportunities to continue its history of innovation and improvement throughout the transport sector via data driven intelligent mobility services and applications. There are many key outcomes and benefits that are attributed to a more intelligent future transport system in New Zealand. These outcomes and benefits are not inherently ‘intelligent’, they are based around the same objectives we have held for transport in New Zealand for many years: a safe, efficient and effective transport system and sector that meets the needs of people and businesses and enables them to thrive.

Intelligent mobility continues to support these objectives, while enabling an expanded focus on providing a greater volume and diversity of information, and options for how people and goods are moved.

Transport sector stakeholders who attended workshops around New Zealand for this research indicated that they would anticipate the following benefits from data exploitation:

- Better informed transport and land use planning at a regional and national level, including the development of the business cases for undertaking specific transport projects and better use of existing assets by for example, spreading traffic flows over the course of a day instead of going over capacity in the morning and evening peaks, thus reducing congestion.

- A more integrated transport network that includes access and information in real-time with respect to road/path, air, sea and rail.

• Business opportunities to provide intelligent mobility information and options based on data analysis, data collection and analysis.

• Enhanced mobility options and increased ease of movement for individuals and business.

• Network and infrastructure efficiencies and safety improvements.

• Reduced costs for freight (but noted a loss in jobs: driving, roadside cafes, motels etc.).

• Consumer (individuals & commercial) benefits from improved transport system (such as: access, payment, ease of using different modes, trip chaining, reduced travel times, more consistent travel times, better access to options for children and impaired).

• Reduced congestion: (fewer vehicles searching for parks) – improved revenue stream from parking and pricing that is responsive to demand (or changing demand through pricing incentives), and an ability to manage infrastructure in a way to optimise it (e.g. the Smart Motorways project in Wellington uses vehicle numbers and speeds to dynamically respond with speed limits that optimise flows and safety).

• Asset owners have better understanding of real-time demand and improved ability to predict flows.

• Enabled shared mobility (through better carpooling apps, ride hailing and micro transit) reducing the need to own individual private vehicles, providing sustainability benefits and cost savings to individuals.

• Shared freight and passenger trips, so passengers and goods can cost share each other’s travel, lowering costs for each.

• Mobility solutions that are sensibly designed for use in rural and remote locations in New Zealand, where data access and service provision is more challenging.

3.5 Transport data collection in New Zealand

Key to achieving a more intelligent transport system is the collection of the “right data”\textsuperscript{12}, which can then be transformed into information, knowledge and value. This is best driven out of well-founded business and IT processes, and as demonstrated in Figure 3-1, the more aligned those processes are across “use cases” the greater the value that can be generated.

New Zealand’s transport data ecosystem could currently be described as a broad collection of siloed (datasets and data systems that are not integrated with each other) and largely time and location dependent data investments. There are many cases where data is either not available or cannot be combined in a meaningful way.

Transport data collection activities are driven by specific needs, these are often project-specific, and with good reason. Data collection and analysis is necessary to create the evidence needed to form and justify businesses cases, or to monitor trends/outcomes so that an intervention can be planned or the effect of action evaluated. Without these project-level

‘needs’ the rationale for investing in data collection, management and analysis activities does not exist.

Figure 3-1: Transport information cycle (modified from ISACA COBIT 5 Business Framework, 2012, p81)

Bespoke data investment behaviours across New Zealand enable analytics that inform local, regional and national project requirements in isolation, but often without considering the need to verify long-term benefits at national network level. This research found relatively few examples of robust and transparent post-project evaluations being carried out in New Zealand, this is potentially because of the perceived additional cost to collect data once the money to intervene has already been spent. Though, there are emerging examples of intelligent mobility technologies being used for before and after evaluation due to the low cost of capturing data. The NZ Transport Agency is using Bluetooth sensors on current highway projects in Waikato to capture data for long-term evaluation of the project. Sensors have been configured to provide information about journey times and the distribution of traffic across new and old routes.\(^{13}\)

Collecting data at a project level is not a problem in and of itself. The challenge arises where there is a lack of funding, technical ability, or political/organisational will to make data, which has been collected for a purpose, available for problem solving in other areas by different groups. The task of ‘identifying and filling transport data gaps’ is of little value without a consideration of the goals, innovation, needs, or problems the use of data is expected to address. ‘Gaps’ therefore exist where data is not available to achieve a desired outcome.

These challenges largely stem from a lack of awareness about what data has been captured previously and by who, an issue that will likely grow as the amount of information generated in isolation about very specific elements of the transport system increases. Data sharing is one component of making information available for other uses, another is an awareness on

behalf of organisations collecting and managing data about its wider value. This awareness grows only through strengthening of relationships across the sector.

Raw data by itself is of limited value. Data exploitation is a term used to define the value added through analysis, research, integration and evaluation – the Transport Sector has invested in this space for many years, particularly with regards to Infrastructure Asset Management. However, the use of data for road use, to improve the journeys of people and goods, is a more recent development.

A review of existing transport data catalogues and repositories, and public/private datasets with current and future applications for intelligent mobility in New Zealand are presented in Appendices 2 and 3 respectively. As demonstrated in Appendix 3, ‘Intelligent mobility datasets in New Zealand’, data that has value for intelligent mobility applications in New Zealand is being collected by a wide range of public and private, and local and international agencies and organisations. The list of datasets presented in this report is not exhaustive, rather it represents an overview of the type of data discussed with stakeholders. The research is faced with the same challenges as those working with transport data, that is ‘we don’t know what we don’t know or haven’t been told about’.

Perhaps the greatest transport data ‘gap’ this research, and other similar efforts to document currently available data, identifies is that which exists between each of these individual groups and most particularly between public and private organisations. Without significant government effort to develop and maintain relationships with the private sector, and investment in data systems and technology, this gap will widen and likely stifle government’s ability to encourage innovation in a direction of their choosing.

This research describes the role of the private sector, where organisations are increasingly collecting data that could benefit intelligent mobility in New Zealand. The sharing and re-use of such data makes good sense in that:

- Developing and acquiring the infrastructure, systems and people required for large-scale data collection, management and analysis activities are costly, though the actual cost to store and process data is falling on a per unit basis. So, sharing resources and capability across Local and Central Government, and with the private sector reduces the overall burden on individual agencies and increases the efficiency of investment.
The public are readily adopting mobility services provided by private organisations, and in-turn these organisations have become holders of rich transport datasets.

From government’s perspective, it is preferable to allow competition among the private sector to stimulate innovation and delivery of modern services to customers; this will lead to a wider range of private organisations holding some form of data that has value for application in the wider mobility system.

The model of private organisations being contracted by government agencies to provide professional and technical services will continue; many of these activities generate data and information in some form.

That is not to say that government agencies will play a diminished future role in collecting, managing, analysing and disseminating data, quite the opposite. Rather, it reflects the overall increasing importance and scale of ‘data’ in the intelligent mobility system that is envisioned. This report provides many examples where government is already applying data for increasingly intelligent uses across the transport sector. The short, medium and long-term trends presented in Section 4.4 describe future areas where government should invest in data systems and data-related capabilities ahead of time.

### 3.6 Key findings

- Much of New Zealand’s transport data is now collected by the private sector as they are increasingly providing transport solutions and services. This is particularly true for data about real-time movements of people, as individuals share their personal location information in return for products and services that are often offered for free.

- Because of the changing role of the private sector in collecting and managing transport data sets, and the rapidly increasing volume of data being collected, it is difficult for any one group (e.g. Government) to get a clear picture of individual datasets.

- There is an ongoing need for the identification of Government’s ‘data gaps’ from the sector’s perspective: what data is of use to the wider sector but is not currently made available, or is not available in an appropriate format?

- Government’s primary role in realising value from New Zealand’s data opportunities is an enabling one, in particular:
  
  - Stakeholders engaged with stated that Government should continue to set clear strategic directions for intelligent mobility in New Zealand, and structure its own data needs around these objectives with clear consideration of the goals, innovation, needs or problem that data insights are expected to benefit.
  
  - Identify how Government will address the expanding role of private organisations in the transport sector, and co-operate with them to take mutual advantage of opportunities for delivery intelligent mobility in New Zealand. Leaving the private sector to develop mobility technology and service offerings in isolation is a risk to achieving national strategic transport goals.
  
  - Partner with the private sector through new commercial/business model relationships to harness transport data opportunities in New Zealand. A
Government backed private sector will provide confidence for investment in emerging intelligent mobility data opportunities and technology innovation that meets New Zealand’s transport objectives.

- Data has considerable potential as an essential building block for enabling intelligent mobility for New Zealand.
4 What intelligent mobility trends are expected in New Zealand?

4.1 Overview

A central focus of the transport sector workshops was to identify the current and future intelligent mobility trends that are enabled by data and expected to shape the future of mobility in New Zealand. These trends are summarised in this section, and subsequent sections discuss the data that is needed to support and drive intelligent mobility in New Zealand.

4.2 Rapidly increasing sources and volumes of data

Data trends are becoming intrinsically linked with intelligent mobility trends. The general viewpoint is that intelligent mobility services and activities cannot take place without either consuming or generating some form of data, and most will do both.

The combination of low-cost and prevalent generators of intelligent mobility data, the decreasing per unit cost of storing and processing new datasets, and our ability to analyse data to create insights and value has created a data ecosystem\(^\text{14}\) of unprecedented scale and opportunity. Modern sensing technologies are capable of tracking people, goods, vehicles and objects with precise location information which, when aggregated, enable powerful insights into mobility patterns, relationships between people, the economy and the environment (built and natural).

Traditionally, transport data has been generated by the authorities who build, manage and operate the network. Data was collected manually or from sensors that were installed by, or on behalf of, these controlling authorities. Many of these historic sources of data are in use today, either as static datasets or surveys that are ongoing (e.g. Household Travel Survey). However, in many cases the methods for collecting data have changed, and the use of technology, or new dynamic/real-time datasets may make some existing datasets obsolete.

An example of this is the use of loop-detectors to capture traffic counts on many networks. These sensors would generally be used for a short period of time on a specific corridor before being moved elsewhere to do the same. Large national datasets have been established with annual average daily traffic calculated for key roads among other indicators of interest such as vehicle type. The emergence of location based data via cell phone movements has now made it possible to understand traffic volumes in near to real-time. If this information is supplemented with GPS information of freight movements, then there is a rich dataset being generated with huge value for network management and planning activities with no need for physical sensors on the network. These real-time datasets are non-Government owned, so in New Zealand the NZ Transport Agency are purchasing Google’s traffic data for their needs. For now, there is still much value in historical traffic count data, as modern datasets have not existed for long enough to analyse trends over long periods of time, but this will change.

\(^{14}\) Ecosystem refers to a complex network or interconnected system
Wireless communication and web-enabled devices and applications are largely driving this surge. As more and more of people’s everyday activities are carried out online their transactions, movements and interactions are increasingly recorded.

Much of the information generated by individuals is done so passively, using free/paid services such as online maps; journey planning tools; fleet management applications; online search functions; and social media. In turn, the companies providing these services receive a large amount of detailed information about population-level preferences, trends, activities and transactions.

Mobile phones are central to this new age of personalised data collection, often sharing location-based information relating to their owners back to network and application providers. The value of such precise and detailed information about people’s movements through the transport system, has an incredibly high value for intelligent mobility.

The next major area of growth for intelligent mobility data is likely to come from connected and automated vehicles. As these next-generation vehicles begin to account for a greater proportion of vehicles in the overall fleet the amount of data continually generated and analysed will grow exponentially. The value of this information will be distributed beyond just connected and autonomous vehicle services, for example, information about movements through the road network by certain types of vehicles/users has direct relevance for public transport and land-use planning activities.

4.3 Influence of international decisions and overseas companies

New Zealand’s intelligent mobility innovation and development is largely being driven by major international technology and mobility service companies, original equipment manufacturers (OEMs), and the automotive industry. International decisions about data and technology standards therefore have a direct impact on the availability and adoption of new technologies locally.

The rate of new technology development in the transport sector is forcing private organisations to ‘embrace innovation’. Commercial companies no longer have the option of avoiding adoption of new technologies, else they face being rendered obsolete by their competitors and customers. Disruptive technologies are driving innovation in new products and services for the transport sector, and perhaps more importantly are creating new business models. For example, a logistics company who previously focused on providing a cheap and reliable service, might now be engaged in strategic partnerships with shippers. These partnerships encourage innovation and constant improvement to services, opportunities that can be developed and tested alongside one partner and then rolled out as an organisation-wide service is successful. Such a business model creates potential for substantial ongoing disruption to change how an organisation operates, these disruptions impact the transport sector as new products and services are introduced en masse.

Organisations such as: TomTom; Google; Uber; Microsoft; Mastercard; Visa; and Apple, among others, are becoming influential forces in New Zealand’s, and the global, mobility

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sector. These companies have a varying degree of physical presence in New Zealand, but their ability to draw on significant resources from their wider organisation means they can rapidly deploy new technologies and services into New Zealand’s market and create significant disruption (both positive and negative) to the status quo.

These companies manage large datasets with information collected directly from individuals as they go about their daily activities, the value of this information in-turn gives major overseas companies a growing level of control for data-driven mobility services and activities. International organisations will potentially have a significant influence on the travel behaviour of New Zealanders – what mode they choose to take, the time of day they travel, and how they pay for transport services. This is both a risk, if this influence is at odds with the outcomes we hope to achieve from our transport system, and an opportunity, to create a more efficient multi-modal transport system that encourages a reduction in trips made in private cars, for New Zealand.

The ability of policy and regulation to keep pace with new entrants to the market, and ensuring that existing service providers are not unfairly excluded from the market is a challenge, especially in an environment of high public expectations about the quality and method of service delivery to meet their own preferences and expectations.

4.4 Intelligent mobility services, technologies and actions

Transport sector specialists and stakeholders who engaged with this research were asked to identify and describe the major data enabled intelligent mobility trends they expected to shape the future of mobility in New Zealand. Each of the trends discussed in this section are either wholly or partially dependent on data for their implementation. It is important for Government to clearly identify the activities and vision it has for the transport system, to understand the data that is needed to develop new technologies and services that align with this vision. As this picture becomes more clear data gaps can be pinpointed and filled if necessary.

These trends are summarised in Table 4-1 and described in the following sections. Across all the workshops there was a lot of commonality in the themes described, though with local variations on a theme and some differences in expected time scales depending on who was answering the question.

Attendees from private data, technology and mobility service companies tended to be more optimistic about time frames for some of the following trends compared to participants from local and central government and local organisations who work closely with authorities to manage and operate the national transport system.

These differences, while not significant, were largely borne out of the different data environments in which the two groups are operating. Private companies who are already developing, and in some cases selling data or insights from, large anonymised location-based datasets felt that this information will rapidly lead to the implementation of new technologies and services to the public. The alternate view was that while the data and technology is available, there is much work to be done to build the necessary relationships, integrate data and services, and set policy and legislation to fully realise the benefits. The reality is likely somewhere in the middle.
The time frames discussed in this section are based on a general consensus across each of the workshops. These data services, technologies and actions are well aligned with the ITS Action Plan’s Government actions for 2014-18, with a focus on actions around:

- Data collection, sharing, security and privacy
- Standards
- Active network management
- Positioning systems and geospatial mapping
- Charging and payment systems
- Passenger and cargo facilitation and security
- User interfaces
- Automation

Table 4-1: Major intelligent mobility trends expected to shape the future of New Zealand’s mobility

<table>
<thead>
<tr>
<th>Intelligent mobility services, technologies and actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Short term: now to 5 years out.</strong></td>
</tr>
<tr>
<td>Increasing sensor coverage and volumes of sensor generated data.</td>
</tr>
<tr>
<td>New transport services emerging.</td>
</tr>
<tr>
<td>Enhanced tools for managing and operating networks.</td>
</tr>
<tr>
<td>Enhanced tools for data analysis and data insights.</td>
</tr>
<tr>
<td>Standardisation of data sets and centralised APIs.</td>
</tr>
<tr>
<td>Move toward more open and available data sets.</td>
</tr>
<tr>
<td>Mobility as a Service platforms introduced.</td>
</tr>
<tr>
<td>Data as a Service models growing and adding value.</td>
</tr>
<tr>
<td>Testing of autonomous vehicles in New Zealand and overseas.</td>
</tr>
<tr>
<td><strong>Medium term: 5 to 15 years out.</strong></td>
</tr>
<tr>
<td>Increased intelligence in collaborations.</td>
</tr>
<tr>
<td>Fully autonomous vehicles tested and registered for use in a range of applications.</td>
</tr>
<tr>
<td>New modes of transport available to move people and goods.</td>
</tr>
<tr>
<td>Demand responsive pricing and prioritisation of services, infrastructure and networks.</td>
</tr>
<tr>
<td>Mobility as a Service models become widespread with integration of public and private transport services.</td>
</tr>
<tr>
<td>Optimised journey planning applications.</td>
</tr>
<tr>
<td><strong>Long term: more than 15 years out.</strong></td>
</tr>
<tr>
<td>Increasing number of autonomous vehicles in the land transport fleet, working towards a largely autonomous fleet.</td>
</tr>
<tr>
<td>Shared vehicles become widely adopted creating a ‘city fleet’ of shared assets.</td>
</tr>
<tr>
<td>Adaptive demand-driven public transport services provided by autonomous vehicles.</td>
</tr>
<tr>
<td>Focus on fleet and network level innovation and implementation of new technology.</td>
</tr>
</tbody>
</table>
4.4.1 Short-term trends (now to 5 years out)

Much of the short-term intelligent mobility trends for New Zealand that were discussed at the sector workshops focused on progressing initiatives already underway about collection, management and analysis of data, and setting in place the building blocks needed for anticipated future trends.

The coverage of sensors, on infrastructure, in vehicles, and on people, is expected to continue accelerating, and the proliferation of sensors which have multiple purposes, of which mobility is just one, will become more common. Identifying new sources of data and the value of disparate datasets for mobility will be a significant challenge for both public and private organisations with an interest in the sector.

The volume of data generated will continue to grow exponentially creating demand for continual improvement in the tools and capability of people to manage, analyse, and add-value through insight to intelligent mobility data.

A major focus of enhanced analytical tools and capability is making insights and decision making more accessible and transparent. Visualisation of information for the public is already important and will continue to be as the data literacy of people increases in this digital age. Citizen-led problem solving and communicating the outcomes of investment and projects should be enabled by a general shift in attitude toward more data being available openly, and greater integration and/or collaboration between public and private organisations who generate, manage and use intelligent mobility data.

Mobility as a Service platforms are expected to be introduced with the inclusion of public transport and some private services as a starting point. The NZ Transport Agency has already invested in a pilot MaaS project in Queenstown. This project, unlike some of the early MaaS platforms introduced overseas, has been developed around a Government-led system. For a country the size of New Zealand, with a current population of less than 5 million people, Central Government has decided to pilot investment in new technologies. The rationale for this approach is that the size of our market does not guarantee that it will be attractive for investment of all types, nor is it likely to attract competition between providers that would drive further innovation and improved systems.

This Government-led MaaS platform is being tested with the option to scale it nationally, while the Transport Agency has existing relationships with both public and private transport service providers that will be necessary to create an inclusive platform that works for different parts of the country. It should be noted that these early pilots have been undertaken with an end-user in mind, in Queenstown the Choice app is focused on tourism activities and how people get to and from them while in Auckland the focus is on trips between Auckland Airport and the Central City.

The outcome of these data-focused trends is the onset of new transport services and the emergence of personal mobility solutions that provide highly customised services for individuals. Emerging services discussed included:

- Shared mobility services for vehicles and bikes; new and existing on-demand transportation available via web-enabled platforms (e.g. taxis, ride hailing, car-pooling).
• Data as a Service models being introduced by a range of companies to provide bespoke transport data to commercial end-users.

• Intelligent route guidance systems and journey planning tools – that are integrated with real-time network management activities.

• Increased automation of services through bot/AI interfaces.

4.4.2 Medium term trends (5 to 15 years out)

With a view to the medium term, the expectation is that a culture shift will be taking place among the public with greater acceptance and uptake of new transport technologies, and mobility options. This will drive a period of innovation and development that is heavily focused on services delivered to end users, all underpinned by the robust data systems and data insights that will have been developed in the short-term.

Collaboration, relationships and integration between organisations (public-public, public-private and private-private) how services interact and communicate with people were common themes of discussion at the workshops. It is expected that greater intelligence will be introduced into these collaborations, with computers optimising services and travel via machine learning and automation of decision making and delivery. Bots and AI interfaces will begin to work seamlessly across many facets of mobility, from transport network operations right through to daily planning and booking of travel for an individual based on their calendar entries and personal transport preferences.

A major development in real-time automated decision making will be toward demand responsive pricing and prioritisation of infrastructure and services that is integrated at a network level and across all mobility service providers. This system will enhance the efficiency of the mobility system by incentivising travel by preferred mode and time of day through comparative pricing and travel times where possible. Examples of activities and services that require data to implement included:

• Adaptive pricing for urban vehicle parking spaces based on real-time demand and by time of day and the ability to book and reserve parking online ahead of time.

• Demand responsive congestion charging on commuter routes for private vehicles.

• Freight and public transport priority corridors including beneficial intersection signal phasing to improve the throughput of vehicles based on strategic value by corridor/route.

• Adaptive public transport pricing to encourage travel not just at peak times but throughout the day.

The effectiveness of any initiatives as above will be in their integration within the transport system. For example, decreasing public transport fares during peak periods will be more effective if the price of parking and driving is also increased and priority lanes are made available for buses to improve travel time. Similarly, freight priority is difficult to implement if major arterial routes are so congested that trucks travel with no advantage over other traffic.

The interface of these systems with people will be through optimised journey planning application. Travellers require information about real-time pricing and network conditions
before they begin their journey, and need to be able to evaluate alternate transport options based at least on price and travel time to choose a preferred option. Optimised journey planning applications will incorporate this information across multiple modes and include real-time information about network conditions. Mobility as a Service (MaaS) platforms are an extension of this approach where people can book and pay for transport services across a range of providers within the same platform. It also signals a shift away from personally owned vehicles towards mobility solutions that are accessed on-demand and consumed as a service. MaaS has been flagged by the NZ Transport Agency as a future mobility model with investment in developing the required software and data platform underway in a pilot trial based in Queenstown.

New modes of transport will become available to move people and goods during this stage, drones; small individual user vehicles; increased use of eBikes; robotic delivery vehicles; light rail and even early-stage flying cars were touted as being realistic for trials and in some cases full implementation within the next 15 years.

Top of the list, and a source of much public discussion, however is the onset of fully autonomous vehicles. Within 5-15 years is it expected that these vehicles will have been tested and registered for use in a range of applications in New Zealand. These include operating alongside non-autonomous vehicles on specific public roads (with restrictions), use in agricultural activities, and becoming more widespread in the freight industry as fleets are replaced, though likely limited to key freight routes with sufficient supporting infrastructure.

This medium-term period will still be somewhat of a research and development period for autonomous vehicles with many millions of kilometres needed to be travelled and data analysed to prove their safety and effectiveness on public roads. The point was raised that many millions of kilometres are travelled on Auckland’s motorway network each year with a very low rate of major incidents taking place, any automated system would need to demonstrate the ability to match these outcomes as an absolute minimum.

4.4.3 Long term trends (more than 15 years out)

Visions of New Zealand’s transport system in 15 years’ time are, understandably, aspirational and transformational compared to the present. Government’s window to decide its role in this future transport system is much shorter, and decisions made now will influence that future vision. This role will require a balance between being a controlling influence, and an enabler of the private sector. Controlling by continuing to set the strategic direction for our transport system and as regulator of transport activities. Enabling by supporting and collaborating with the private sector to determine how mobility services and technologies are delivered to meet this vision.

Beyond 15 years, the mobility system is expected to function in a much more integrated fashion compared to the current multi-modal approach where individual services often have little alignment and integration. There will be a focus on fleet and network level innovation and implementation of new technologies, and mobility will be consumed largely as a service through community/privately owned fleets and services.

The prevalence of electric and autonomous vehicles in the national fleet will be increasing. This will dramatically impact our use of resources and the economics of transport energy demand as New Zealand shifts away from dependence on imported fuel toward locally
generated electricity from renewable sources. As autonomous technologies become more accepted and available the number of these vehicles will rise and the legal scope of their operating environments will broaden to allow them to operate on all public roads. Any transition to a fully autonomous fleet is likely to be many years beyond the 15-year horizon discussed in this study. There was some discussion around the potential for autonomous air transport (freight and people), however given the uncertainty around these technologies no time-frame was reliably proposed.

The major enabler of long-term intelligent mobility services was an expectation that in 15-plus years the mobility preferences and travel behaviours of people are likely to be much different to those of today. Shared ownership, or non-ownership, of vehicles will be a preferred option for many, with alternative public and private transport services being of sufficient quality, flexibility and cost to cater to the same range of trips that private vehicles cater for today.

Public transport services will become adaptive to demand and not fixed to the routes and timetables currently offered. Autonomous vehicles make this flexibility a definite reality when combined with real-time journey planning and booking of services. The integration of public transport services with community/private vehicle fleets and services will create a ‘city fleet’ of assets that wholly cater to our future mobility needs and preferences.

4.5 What data is needed to support these intelligent mobility trends?

Engagement with stakeholder organisations and professionals in the transportation sector further focused on the data needed to support current and future intelligent mobility services in New Zealand (described in Section 6 below). Much of the data system and data needs to support future intelligent mobility trends discussed at the sector workshops for this research had commonality across applications. Data needs were not generally described as ‘gaps’. It was expected that as the sector develops new technologies and services the data required to support progress would naturally emerge. In addition, data gaps are experienced differently depending on who you speak to. Public and private organisations all have access to valuable datasets that are not accessible to others.

The examples provided below in Table 4-2 are used to demonstrate the disparate range of datasets that are required to support selected future intelligent mobility trends, and the range of sources that this information will come from that need integrating within the same data system.

<table>
<thead>
<tr>
<th>Application</th>
<th>Data and data system needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>New transport services emerging:</td>
<td>Integrated information from multiple sources/providers that is accessible to customers from a shared platform. Standard data formats will be required so that information is comparable and usable for planning and provision of individual trips within the network. Where data is dynamic, e.g. demand responsive pricing, these systems must be capable of ingesting and displaying updated information in real-time. Further, changes to one aspect of the system will influence another and change the information presented to customers for journey planning purposes. This process must be automated based on up-to-date information from a range of sources. Real-time data feeds for Public Transport and network flows that are available to a range of public and private organisations.</td>
</tr>
<tr>
<td>- Shared mobility</td>
<td></td>
</tr>
<tr>
<td>- Mobility as a Service</td>
<td></td>
</tr>
<tr>
<td>- Customer journey planning</td>
<td></td>
</tr>
</tbody>
</table>
### Application | Data and data system needs
--- | ---
Public transport patronage, ticketing, and service data. Real-time availability of data on transport services including taxis, on-demand transport, car parking etc. Connectivity between transport service data systems to facilitate multi-modal journeys. Predictive ability for people’s mobility intentions and preferences, and insight into community and population level sentiment regarding mobility services and mobility system levels of service. Position information for travellers/modes (truck, bike, car, bus, pedestrian). - Origin-destination information and the travel intentions and preferences of travellers. A platform for new and existing providers to input details of their services (e.g., bikeshare, rideshare etc.).

Data for managing and operating networks and dynamic prediction of demand | Accurate real-time data for automation of network management activities and decision making. - Area or New Zealand wide comprehensive Real-time hazards, speed and incident mapping in real-time including incident reporting, planned works, and events – shared publicly for journey planning tools. - Origin-destination vehicle locations. - Data on commercial operations. - Predictive ability for people’s mobility intentions and preferences, and insight into community and population level sentiment regarding mobility services and mobility system levels of service. - Real-time understanding of demand for passenger and goods in motion. - Dynamic pricing systems that are demand responsive (or influence demand in response to price).

Connected and autonomous vehicles in New Zealand and overseas | - High resolution mapping data that is supplemented by augmented GNSS and contains a ‘single source of truth’ for key transport infrastructure and transport-related locations. - Vehicle-to-vehicle status data. - Real-time understanding of demand for passenger and goods in motion. - Infrastructure asset data.

### 4.5.1 Augmented GNSS and high-resolution mapping data

Organisations interviewed stated that there will be a pressing need for improved high-resolution mapping data to be produced and maintained. It was considered important that this information is made available across the sector so that there is a ‘single source of truth’ with regard to where things are. With increasing levels of automation, the accuracy required from navigation and positioning systems will also need to improve. Current inaccuracies are compensated by human drivers who determine their position, speed and route through the network.

Current in-vehicle navigation systems make use of real-time global positioning system (GPS) location information. These are accurate enough for route planning and navigation purposes, with accuracy of a few metres adequate for systems to identify which road a vehicle is travelling on. Future vehicle systems will be more reliant on knowing real time positioning with centimetre-level accuracy so there is a need to develop and test augmented systems that utilise space and ground based infrastructure for positioning.

TomTom is already developing an augmented system that makes use of three dimensional LiDAR based maps to map the buildings and road side features along a corridor. As a vehicle
travels along a route it will make use of satellite systems and these known roadside features to accurately determine their position on the road. The raw data has largely been collected in New Zealand but not processed and made into a usable product, this is due to the cost to process and manage the dataset while few to no vehicles are currently on the road that can make use of the information.

4.5.2 Who wants to go where, when, how and why?

Origin-destination needs for all travellers are currently emerging, though data is frequently captured in isolation by different organisations. For example, public transport providers have individual’s tag-on/tag-off information; cell-phone network providers can capture population-level movement between places by time of day though do not necessarily know by which mode people are travelling; while credit card companies can provide insight into what activities/services people access when they arrive at a given destination.

Presently, private companies are predominantly collecting this level of data about people’s movements. This is highly valuable information helping companies to plan long-term investments in products and services, and better understand the personal needs and preferences of a large customer base.

Government transport activities are benefitting from access to these datasets, for example Google’s traffic data as mentioned previously, and it is likely increased access to privately generated data will increase Government’s ability to deliver a smart, sustainable and efficient transport system. Access to Google’s traffic data is one example of new data-related business models, where data is provided as a service, that Government transport authorities will increasingly need to enter with the private sector.

The benefits of increased awareness of people’s mobility behaviours are two-fold, by better understanding the geographic and temporal nature of mobility in a city, region and country network the planning and service delivery can be tailored to best meet the community’s (both people and organisations) needs. Similarly, as people choose to share increasing amounts of personal information about their daily activities with mobility providers and network operators, then the services delivered to them can be tailored to their personal preferences and needs based on past behaviour.

With datasets increasingly relating to people and their daily activities, it is important that a culture of security and privacy is established for the collection, management and use of personal information. Privacy breaches and the release of personal information into the public domain are obvious examples to be avoided, and there have been recent examples of these types of breaches on a large scale from private operators of transport services internationally. Further, how information about people is used and who gains value from it is worth considering. Statistics New Zealand has previously undertaken research that investigated ‘public attitudes to personal data integration’ finding that people were open to integration of personal information for public good, but less accepting of applications with the potential for decisions that stereotype, target or marginalise individuals or groups. Ideally value should be gained by those people who are providing their information, while organisations collecting and using data should avoid targeting individuals and groups in a manner that promotes corporate gains with little social benefit.

16 Opus (2015) Public Attitudes to Data Integration, report prepared for Statistics New Zealand
The Office of the Privacy Commissioner is the lead agency for New Zealand for promoting privacy principles, codes of practice, and enacting legislation. All organisations making use of data related to individuals will be expected to comply with current New Zealand legislation, some overseas-based organisations spoken to stated that they seek to comply with the ‘highest standard’ of privacy legislation in any of the countries they operate in and apply this across their international business.

4.5.3 Vehicle locations, routes and trip purposes

Vehicle types, by mode or classification, are already captured to some degree though not at a system level and our understanding of where specific vehicles are travelling to and from, and for what purpose is not comprehensively understood. Individual companies, such as taxi providers, public transport operators, and freight companies are likely to have detailed information about individual vehicles in their fleet including attributes such as location, speed, people/goods on-board, and the end destination of a journey or linked trips.

Personal location information, such as from cell phone GPS, are currently a proxy for vehicle movements and are supplemented by information collected by ITS infrastructure such as loop and Bluetooth traffic counters on selected corridors. With a future vision of autonomous fleets of vehicles efficiently moving people and goods around without the need for individuals to own a vehicle themselves, fleet operators will need a flow of data to track and reposition vehicles across the network and respond to current and predicted demand for different trip types.

4.5.4 Real-time demand and availability of infrastructure (corridor capacity, parking availability)

The potential for infrastructure itself to be provided in new, and more effective, ways is increasing as our understanding of how it is used grows through use of data. Information such as who is using a corridor, by time of day and for what purpose, or demand for inner city parking based on historical and real-time data allow network operators to be more adaptive in infrastructure provision.

In urban areas opportunities to provide new transport infrastructure is limited or very costly. More efficient management and use of existing infrastructure is therefore a priority for future transport networks that will need to accommodate population growth and competing demand for space. Real time data is essential to create more efficiencies, from understanding current and forecasting immediate demands, and for automated responses to real-world conditions.

Data is necessary to create feedback loops for identifying where intervention/action may be necessary, such as tolling of corridors for certain vehicle types (charges for private vehicles on major arterials but not public transport and freight) or demand responsive pricing for on- and off-street parking in city centres. Such levers are aimed at incentivising travel behaviours toward improving overall efficiency, at an individual level cost, or perceived cost, of mobility may be greater but the productivity of the system rises.

Workshop participants envisaged an eventual data ecosystem where a high level of automation would be possible for real-time decision making about infrastructure availability and delivery. A theorised implementation of such an approach was sketched out as: preferred types of mobility (e.g. people, goods, mass transit) being identified at a given time...
of day by network corridor (e.g. during the morning commuter peak), intersection signals adapting to prioritise certain vehicles on a corridor (e.g. emergency vehicles, public transport and freight), other modes being charged to travel on the same corridor (private vehicles or those that do not meet an occupancy threshold), and subsequently central city parking prices increasing while public transport fares are decreased to incentivise a change in behaviour.

There are two fundamental enablers of such a system:

- genuine options for mobility - increasing the cost of travelling by car only serves as a penalty if people do not have convenient alternatives such as mass transit to complete the same journey or flexibility to undertake the trip at a different time; and

- communication ahead of time about impending changes - if travellers leave home when no congestion charging is in place and parking fees are low only for them to increase substantially during their trip then the system has not discouraged travel and been a failure from the user's viewpoint.

4.5.5 Journey costs by mode across public, private and personal providers

Journey planning platforms are beginning to incorporate some detail about trip costs into their service, though historically private mobility providers like taxis and internet enabled ride hailing services have been largely absent from platforms that include public transport journey planning. In addition, the cost of making the same journey by private car (fuel, running costs and environmental impact) are currently not included in mainstream platforms for users in New Zealand to make a fully informed comparison when planning their trip.

Future online MaaS products will require pricing data from all operators whose services are made available on the platform. Because users may be able to plan and pay for their use of mobility infrastructure, services and information within an integrated platform MaaS will require standardisation of certain datasets across many providers. These might include: dynamic cost/fares; static and dynamic service schedules; real-time availability of vehicles and their current capacity; estimated travel time based on real-world conditions etc. Where pricing and scheduling of services/infrastructure is dynamic, data being presented to people for journey planning services must communicate not just the current cost of travel, but the likely future cost at a certain point in time with a high degree of reliability.

4.5.6 Network performance and management data

Data generated for insights about network performance and network management will continue to increase along with the applications of this information. Much of the information needed to create an intelligent system in this space exists in some form, such as: real-time and/or historical traffic information, hazards, events, traffic management activities, incidents on the network, weather, and temporary speed limits. Future datasets will be integrated into a single interface so that decision making is based upon up-to-date information across a wide range of factors.

In New Zealand, Nextspace have already been working with Auckland Council to integrate multiple layers of data into their ‘BRUCE’ platform. This 3D visualisation of information makes it easy for Council staff to navigate the city via a map-based web viewer. Overlaid onto
satellite imagery are geolocated representations of assets including pipes, roads, buildings (including full BIM visualisations), power networks and telecommunications. Attribute information can be brought up by clicking on any asset shown in the viewer and users can edit data as needed.\textsuperscript{17} Any layer with spatial attributes, including social and economic information, can be included in these systems also. Incorporating real-time data from transport APIs into systems like this will enable automated decision making based upon data from many different sources.

Historically, detailed network performance insights have generally been generated only for the most significant parts of the network or infrastructure as these have made most sense for investment in sensors and ITS technologies. As such, network performance insights across the transport system is currently a relatively immature area of analysis. Though, the reduced cost of sensors, and generation of data from objects and people as they move through the network now make it possible to collect information across virtually the entire network if needed. Increasing our capability to manage and analyse these vast repositories of data is the next significant challenge.

4.6 Key findings

- Intelligent mobility trends and next generation transport technologies and services have become intrinsically linked to data trends, and the development of both software and human capability to create innovative products and services using data.

- The volume of data is growing exponentially and the sources of transport data are becoming much more diverse, particularly across the private sector. Government does not need access to all data, nor to be aware of it, but will require insights from both public and privately collected data that supports key Government activities.

- International organisations already exert a significant influence on New Zealand’s transport system. The introduction of new vehicle technologies is led by international markets, while overseas based companies engage directly with travellers to direct them on their journeys or help them to plan for a trip. This influence is likely to grow as more and more technologies developed and tested overseas are introduced locally. Government needs to consider how to access the data these organisations generate where it is useful.

- Government is, and will continue to be, responsible for setting the future vision for New Zealand’s transport system. Government will become increasingly outward facing, developing relationships across the private sector to foster collaboration and confidence for innovation and investment. This is important to ensure that data related activities match the short, medium and long-term vision Government sets forth for transport in New Zealand.

- Strengthening relationships between Government and the private sector will lead to new business models for how data generated and used for transport infrastructure and services is made available.

5 How is data being shared and who is using it?

5.1 Types of data service providers

Combining and analysing different datasets provides insights that can lead to, and support, intelligent mobility solutions. In terms of types of involvement different groups have with data, Catapult defined five different use categories\(^\text{18}\) (Table 5-1). However, after discussion in the interviews and at the workshops it was felt that many of New Zealand’s organisations fit within many of the categories, partly due to New Zealand’s relatively small size which has resulted in many businesses and agencies combing both being a data supplier with some form of one or more of: aggregators, developers, enrichers and enablers.

\(^{18}\) Catapult modified the categories originally created by Deloitte and ODI

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>New Zealand Examples</th>
<th>Data example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suppliers</td>
<td>Organisations that publish their raw data so that others can (re)use it</td>
<td>NZ Transport Agency, Google, Road Controlling Authorities (e.g., Auckland Transport)</td>
<td>Auckland Transport provide a wide range of API’s and transport data from both Auckland Transport and the NZ Transport Agency via the Auckland Transport API platform.</td>
</tr>
<tr>
<td>Aggregators</td>
<td>Organisations that collect and aggregate data (both open and proprietary), find correlations, identify efficiencies or visualise complex relationships</td>
<td>Qrious, Private industry, Universities, FigureNZ</td>
<td>Qrious aggregate location-based-information triangulated from cell phones on Spark’s network to develop a real-time origin-destination dataset.</td>
</tr>
<tr>
<td>Developers</td>
<td>Organisations and software entrepreneurs that design, build and sell web, tablet or smartphone applications for individual consumption</td>
<td>Thundermaps, Media Suite, TomTom</td>
<td>TomTom build applications and hardware for navigation, and work with vehicle manufacturers to develop next-generation in-vehicle navigation systems.</td>
</tr>
<tr>
<td>Enrichers</td>
<td>Organisations that use data to enhance existing products and services, and/or deliver operational efficiencies, through better insight</td>
<td>EROAD, Cortex, Fleetpin, CCS logistics, H.R.L Morrison and Co, Tera-data</td>
<td>EROAD use GPS and logistics data sourced from their clients to deliver services in return that are focused on safe and efficient fleet management activities.</td>
</tr>
<tr>
<td>Enablers</td>
<td>Organisations that facilitate the supply, publication, sharing and use of data</td>
<td>Ministry of Transport, NZ Transport Agency, FigureNZ</td>
<td>The NZ Transport Agency are a key enabler of intelligent mobility trends and will provide guidance to the public and private sector on emerging technologies that benefit New Zealand.</td>
</tr>
</tbody>
</table>
Data and insight sharing in New Zealand occurs under three different models in New Zealand.

1. Data and insights are shared as a requirement of a contract or under a Government regulation.
2. Data is made available for free.
3. Data is shared at a cost.

Each of these models is further discussed below:

5.2 Data and insights shared under a contract or Government regulation

Government has routinely contracted the private sector to undertake data collection and provide services that generate data on their behalf. The nature of data ownership and sharing under these contracts have varied over time. However, increasing importance is being placed on ensuring that Government has access to data under newly signed contracts, and are actively seeking to identify opportunities to make data collected under ongoing historical contracts available for their needs.

An example of mandatory data collection occurs through the contracts for the NZ Transport Agency funded urban cycleways. Government regulations require public transport agencies to provide certain operational data to them. In contrast, some public transport contracts for provision of ticketing platforms have not previously mandated adequate sharing of information and data back to the regional authority. As potential uses for this information subsequently arise, modifying existing contracts and accessing data/insights in a cost-effective manner has proved challenging.

There is potential for the New Zealand Government to require more data sharing, however, comments from those consulted with for this project suggested that this should only be undertaken where there was a clearly defined benefit for requesting the information, time and expense should be compensated for and consideration should be given to protect intellectual property and commercial enterprise.

An example of regulatory requirements for data sharing might be for some data collected by connected and autonomous vehicles to be shared with network managers. It is yet unclear if the automotive industry will adopt the ‘Vehicle to Infrastructure’ system that has been forecasted, a situation where vehicles and infrastructure are in communication with each other and sharing data back and forth. Security concerns are the primary reason for not adopting this approach, with some manufacturers, including Google, appearing to prefer a closed system approach where each vehicle operates independently of each other. The risk of malicious interference in a closed system is much reduced while the ability of a vehicle to run autonomously remains.

If Government were to regulate sharing of information from these vehicles it is likely to be in aggregated form, and may not be delivered from the vehicle itself. The nature of information sharing between vehicle manufacturers and Government will be an issue discussed globally. In this instance New Zealand will follow overseas decisions/trends given that vehicles will be developed and manufactured offshore.
5.3 Data shared for free

A substantial amount of information/insights created from transport data is shared freely. It is likely that the largest supplier of free transport data to the public¹⁹ in New Zealand is Google. Google’s traffic data is widely used by people and businesses every day to plan their journeys through the road network. Data is turned into near-real time estimates of journey times along all segments in the road network, users can identify congested areas and those using Google maps for navigation can be re-routed during their trip to decrease travel time.

Underlying these free data insights is a large international dataset capturing information about the movement of people (via their cell phones installed with Google applications). This data can be accessed by Governments and businesses through Enterprise APIs, though this more detailed data is not always available for free.

Free sharing of data insights is becoming a more common model than the sharing of raw or aggregated data for reuse by the private sector.

Many Government Agencies also share data, for example the NZ Transport Agency and Auckland Transport (See Appendix 2 for lists of the types of data available).

5.4 Data for a fee

This often occurs where there is some post-processing and/or data-analysis occurring. Increasingly business models are specifically developed whereby the provision of data is intended to create an income stream. New Zealand company Qrious provides an example of one such business set up to generate an income stream. Qrious is a venture of mobile phone network operator Spark. It processes and sells analytical services based on aggregated personal location information to multiple end-users in the public and private sector. Qrious enrich these services by integrating their own data with external datasets, that they in turn pay to access, to meet a broad range of bespoke needs.

Purchasers of data commented that the fee for obtaining both data and insights appears to be rapidly changing with new vendors regularly coming onto the market and advances in data technology techniques and business practices, plus economies of scale, affecting the price monthly. It was noted that purchase of static data is much cheaper relative to dynamic data.

5.5 Participant’s comments on data sharing

Participant comments from both the workshops and the interviews on data sharing are summarised below:

- Participants noted that there is a general lack of: standards and formats for collected data; and protocols for their exchange. In one case, it was noted that the data exchange between a Regional Council and the NZ Transport Agency required data being completely re-typed (there was no copy and paste function) into an online form as the system had no other way of uploading data.

¹⁹ Google’s traffic data is purchased by both public (NZ Transport Agency) and some private organisations in New Zealand.
Participants, particularly developers, noted that many of the existing data sets were not saved in formats that could be readily downloaded or understood so would require work to understand them before they could decide if they were useful.

There were numerous examples where data sets were not shared. For example, except for real-time flight arrival and departure information, ports, airports and rail collect data for their own purposes and don’t generally share information, unless they are contractually or legally required to do so. For example:

• Under the Commerce Act 1986, suppliers of specified airport services in Auckland, Christchurch and Wellington at the Commission’s determination may be required to:

“disclose certain specified information relevant to their performance (such as financial statements, prices and quality performance measures), including forward-looking information (such as forecasts and asset management plans).”

• Road controlling authorities share data with developers, but also purchase data from third parties. One issue with the way that the system currently works is the existence of a contract through which road controlling authorities pay a commercial company for data to be collected and then pay to receive each set of data on an ongoing basis. The data is then received is post-processed to provide the answer to specific pre-set questions rather than to allow for further in-depth analysis. There appears to be two reasons for this 1) this provides a business opportunity for industry providing the data and 2) industry note that the post processing requires a level of sophistication and/or knowledge of the data set that only they have the skills to provide. It was noted that improvements in writing contracts with third parties is resolving this issue.

• There is a further issue where data is taken from a road controlling authority for further analysis, but then when the information is shared back with the road controlling authority a further fee is charged. It was noted that the Trucking industry and Google are happy to share back the data whereas other 3rd parties are not without an additional fee being charged

• Several of the larger International companies such as Conduent (formerly part of Xerox), HERE, Mastercard and Microsoft have put substantial efforts into data analytics. These companies work as a partner to understand existing data sets to provide insights to enhance understanding of people and freight, travel patterns, needs and requirements. A common theme from the companies is the need to ensure that the trust is not lost of individuals whose data is being integrated. They note that most people will give their consent for their data to be used if they get something in return.

• Requests for data sharing to both the public and the private sector frequently cited privacy concerns as a reason for not sharing data. For example, the NZ Transport Agency has removed access to information on individual vehicle crashes in recent times.

• Participants could more easily discuss the insights that they have gained from data than talk about how data sharing occurred in New Zealand. Developers in particular commented that the current data is either inaccessible requiring the user to spend time

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on it before knowing if it is useful, which they cannot make a business case for doing unless they know what benefit they may get from it.

5.6 Future requirements of the intelligent mobility data ecosystem

Data integration and enabling integrated mobility service delivery from singular or linked processing platforms is central to New Zealand’s future intelligent mobility vision as described by stakeholders engaged throughout this research. Integration as a data theme was used to describe a system where disparate sources of information that have value to intelligent mobility uses could be connected or shared.

The system did not need to be open, and there are many intelligent mobility datasets that are unlikely to never be made ‘open’. It was agreed that it should be possible to develop a system that allows high value data to be integrated without individual companies losing commercial value or individual’s privacy being threatened. Platforms such as Nextspace’s BRUCE are already demonstrating how multiple sources of information can be integrated in the same platform for visualisation while underlying data is stored on the servers of the owner. Development in this space is expected to lead to systems that allow for greater sharing of aggregated information in a secure environment for selected analytics, while maintaining confidentiality of individuals and the commercial interests of owners.

As important as investing in the technology itself are the relationships necessary to create a system of willingness to collaborate and share across public and private interests, and contribute data to the system. Current examples of open-data portals in New Zealand have limited input even from public organisations and virtually no presence from private companies, so it cannot be expected that developing an intelligent data system capable of ingesting disparate sources of information is the complete solution. This is likely due to a lack of incentives to do so. Simply contributing data to a system where the purpose is largely driven only by having data available lacks purpose. As stated previously, most examples of data sharing and integration take place within a defined project, where the use and value of data is clearly defined.

It is expected that in the short-term these relationships will be largely project-based, as government and private companies seek out opportunities to create value. The development of integrated data platforms should be much broader in focus and be adaptable to empower future innovation.

Given that multiple integrated platforms will be developed, and not a single centralised national/international system, the data systems themselves must facilitate seamless data sharing between them. Similarly, systems developed within the mobility sector must be compatible with integrated data platforms in other sectors.

Data ‘Platform as a Service’ models are expected to rapidly emerge across the sector disrupting traditional methods transport modelling, planning and delivery. The Nextspace example described in this section is one example of this, the integrated data platform is developed by a private provider that does not own the data. It is up to organisations such as local authorities, utilities providers and private companies to make their information accessible via the service.
5.7 Machine-led processing and automated decision making

Automation of data processing, analysis, insights and decision making is a necessary shift that must be made to maximise the value of the large volumes of data being collected and stored for intelligent mobility. Traditional analytics that may have taken days or weeks to perform will need to be completed in hours or minutes requiring advanced algorithms and modelling to be trained and applied within machine-led systems.

The behavioural component of decision making in response to certain conditions is a critical element of a successfully automated system and will require a significant amount of analysis of historical data before automation can be fully implemented. Wellington’s Smart Motorway is an example of this approach where a long period of manual operation was planned following construction of the physical infrastructure. During this period the system learns from human operators and data flowing into the system so that over time decision-making control can eventually be handed over to the computer system with some confidence.

The flow of communication into and out of the system will be a high priority. As automation expands into many elements of the mobility system, each individual component (adaptive speed restrictions, priority vehicles, demand responsive pricing, autonomous vehicles) must be aligned and fully ‘aware’ of each other. Further, the system must be capable of sharing learnings and not just data. This will require a considerable investment in relationship management between different organisations to breakdown silos and deliver toward agreed common goals for mobility delivery.

5.8 Key findings

- Whilst data is already shared between organisations in New Zealand, and within some projects and services a high level of collaboration is already taking place, the importance of this will grow exponentially as more and more intelligence is sought for activities across the transport sector.

- It is important to recognise that ‘data sharing’ and ‘open data’ are distinct concepts, for the most part the value of data will need to be realised in terms of commercial gain for private collectors, aggregators and suppliers of data. In contrast, Government needs to get better at quantifying the value their investment in data (either primary collection or paid for via third parties) has for social and economic vitality.

- There was a general consensus between this research’s participants that there is a need for greater collaboration around data in New Zealand to identify commercial opportunities for sharing and reuse of data.

- Government will continue in its role as central provider of transport infrastructure and services, so is well placed to lead the development of relationships with the private sector. Business models are already being established between Government and private organisations to purchase transport data and insights, while Government-led platforms such as with the current MaaS pilot will be enablers of public-private collaboration in the sector.

- Government should further investigate regulation of data sharing. Any regulation should be undertaken for good reason, and the use of data standards implemented by strong relationships with the private sector would be preferable. Regulation does however have
the advantage of making it clear to new entrants to the market what the expectations are of them, though further work is required to identify what data would benefit from regulation to ensure that it does not discourage innovation and development.
6 What data-related capabilities are needed?

6.1 Skill sets needed across the transport sector

Internationally it is expected that there is and will be a shortage of people with the necessary skills to obtain and transform data into knowledge that can be applied for a more intelligent mobility system. These skills/capabilities include:

- Data collection and curation.
- Computational, statistical and human analysis.
- Software and technology development.
- Cyber security and data privacy protections.
- Increase data literacy of decision makers.

New Zealand universities have been working to develop courses which industry note are making the graduates in the last couple of years are more “data industry ready” than ever before. Meanwhile, some international companies are bringing experts from one country to another on an as needed basis. Key challenges are in working with some of these international companies to ensure that New Zealand gets the benefits of these experts who come to work here.

Catapult composed the following table of the data-related capabilities and example activities for intelligent mobility (Table 6-1).

Table 6-1: Table reprinted from: The Transport Data Revolution21

<table>
<thead>
<tr>
<th>Capability grouping</th>
<th>Common Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw data creation, collection and curation</td>
<td>Exposing feeds of data currently collected/stored in silos so they become linked open data</td>
</tr>
<tr>
<td></td>
<td>Collaborative definition and maintenance of national / regional / global standards for data</td>
</tr>
<tr>
<td></td>
<td>Cataloguing transport-related datasets to improve discoverability</td>
</tr>
<tr>
<td></td>
<td>Sensor design and deployment to create new datasets</td>
</tr>
<tr>
<td></td>
<td>Archiving and storing data collected in real-time for future analyses</td>
</tr>
<tr>
<td>Dataset handling and manipulation</td>
<td>Data mining, cleaning, and aggregation</td>
</tr>
<tr>
<td></td>
<td>API creation and consumption</td>
</tr>
<tr>
<td></td>
<td>Design and maintain standardised/bespoke data services</td>
</tr>
<tr>
<td></td>
<td>Cloud-hosting and stream processing</td>
</tr>
<tr>
<td>Computational and statistical analyses</td>
<td>Algorithm design and application to multi-source datasets</td>
</tr>
<tr>
<td></td>
<td>Geospatial analyses using relational and non-relational databases</td>
</tr>
<tr>
<td></td>
<td>Predictive modelling, sampling and inferential analyses (statistical probabilities) using real-time and historic datasets</td>
</tr>
<tr>
<td>Human intelligence and use of data insights</td>
<td>Transport service scheduling based on deeper understanding of partially connected networks and services (road/rail/air/sea).</td>
</tr>
</tbody>
</table>

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In addition to the items in the above table, there is also a need for people with skills in cyber security and data privacy protections as well as increasing levels of data literacy for decision makers. Figure.NZ notes:

“Data is a language in which few are literate, and the resulting constraints at an individual and societal level are similar to those experienced when the proportion of the population able to read was small. When people require intermediaries before digesting information, the capacity for generating insights is reduced.

To democratise data we need to put users at the centre of our models, we need to design our systems and processes for users of data, and we need to realise that everyone can be a user. We will all win when everyone can make evidence-based decisions.”

6.2 Tertiary education

Discussion from the engagement on the data related capabilities needed noted that New Zealand Universities have recently introduced specialist data analysis programs such as:

- Master of Analytics (Massey University, AUT).
- Master of Applied Data Science (Canterbury University).
- Masters of Professional Studies in Data Science (Auckland University).
- Master of Business Data Science (University of Otago).

A common theme of these programs is for students to come from a range of different undergraduate backgrounds, with students often being involved in other types of research. For example, the Canterbury University programme is also connected with Canterbury University’s research centres: The Geospatial Research Institute, HIT Lab NZ, High Performance Computing, Wireless Research Centre, Digital Arts, Social Science and Humanities.

As this is a rapidly growing field, it is anticipated that as data sets continue to grow there is expected to be a shortage of suitably trained people. Some engagement participants noted

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22 Figure.NZ. 'Why Figure.NZ?'. Available at: https://figure.nz/learn-about-us/why-figure-nz, accessed 10/05/2017
that they felt that the students coming out of these courses had a far greater understanding of data analysis and evidence-based research than students from two or more years previous. There was agreement from two of those engaged with that the students were “industry ready”, of high quality and able to start providing valuable inputs when give data. The Universities spoken with were keen to keep an open dialogue with Government and Industry to ensure their courses were meeting the needs of the transport sector.

There were comments from developers that many of the existing data sets in New Zealand were not sufficiently clean or accurate enough to enable them to be used to develop intelligent mobility applications. This identified the need to upskill and ensure a level standard of accuracy was achieved when data is made available.

One area that engagement participants felt that New Zealand had less knowledge about (but that was also just starting to be investigated internationally) was the use of human sentiment and human intent information in conjunction with other data. Knowing what someone is trying to achieve provides greater scope for pushing-out information at the right time.

In addition, there is a need to incorporate an understanding of how human behaviour (including use of social media) might be affecting the accuracy of our data collection. For example, in 2015 the community-based traffic and navigation app WAZE was flooded with incorrect traffic information (including false reports police presence at particular locations) by Miami Police Officers because the officers felt that drivers would drive more carefully if there were police around23. Whilst in 2016 residents of Takoma Park Maryland (along with residents in many other United States locations) entered fake car crashes into the WAZE to deter people from using their quiet streets. WAZE

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23 BGR.com ‘Miami cops are sending fake data to Waze to stop people from knowing speed trap locations’. Available at: http://bgr.com/2015/02/11/cops-fight-back-against-waze/, accessed 9/07/2017

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**Council Collaboration for Better Quality Transport RAMM Data**

The RAMM database and the Bridge Data System (BDS) are nationwide databases containing data on the location and conditions of road pavements and structures (including bridges, and culverts, and roadside infrastructure such as signs and barriers). The data contained within these databases has potential to be used for a wide range of intelligent mobility projects such as: they could provide location, loading and height restrictions of structures to freight companies for routing-loads in real-time. There is a caveat though for using this data for intelligent mobility projects in that it must be accurate.

In October, 2014 a four-way Memorandum of Understanding (MoU) collaboration was signed between the District Councils of: Timaru, Mackenzie, Waimate and Ashburton. Whilst this collaboration was primarily set-up to address roading issues between the Districts it also has a specific objective of “sharing resources and skills” and “joining procurement of physical works contracts”.

This collaboration is leading to better data management and use of the data, including a greater level of consistency and accuracy in the RAMM data collected. The Councils have also noted benefits from the overall increased skill level available within the group has been a means of combating the issue of attracting and retaining appropriate staff with the right technical skills who collect and analyse the data. Cost savings have included getting lower priced work due to increased size of contracts (economies of scale).

Costs of this collaboration have been limited to staff time for collaborating plus the cost of an external facilitator/project manager working across the 4 councils.
now suspends the rights of users who enter false information24. Within New Zealand it has been noted that when Police set-up alcohol and speed check-points, the location of these is now quickly spread by social media, which results in a large change in driving behaviour, making any data from these points not indicative of normally occurring behaviour.

Whilst it is felt that the University programs will address in part the skills shortage it is important to note that these students will also be sought after by other industries. In addition, as is noted by Catapult that it is estimate that by 2017, as many as 3000 data specialists will be need by the UK transport industry. They expect that the demand for skills will outstrip the supply within the next 5 to 10 years. We expect that this timeframe will be further pushed out in New Zealand due to the slower uptake of Intelligent Mobility currently occurring.

### PricewaterhouseCoopers 2017 New Zealand CEO Survey

“*When we asked our CEOs what’s the biggest change they’ve seen over the last 20 years, the answer was just one word: technology. Forty one per cent of our CEOs felt their industry has been completely reshaped by technology in the last five years alone and 38 per cent think their industry will be completely reshaped again in the next five years. None of our CEOs thought their industry would emerge from the next five years unchanged by technology.*

“We asked CEOs which areas they most want to strengthen and three shone through: innovation, digital and human capital. The path that our CEOs are taking is to pursue new thinking, with the right staff and the right technology to back it up.” pp 8-9

6.3 Key findings

A shortage of skilled people in the workforce who have the necessary experience to create value out of data is a concern for both New Zealand and overseas countries. Transport is one of many sectors undergoing a ‘data revolution’ where data driven research and innovation are forecast to yield significantly positive outcomes. Each of these sectors has a need for skilled people and are competing for limited resources. Like any finite resource, the price (salary) to attract people with necessary skills will increase, and place pressure on some organisations to attract and retain staff.

The following skills have been identified as essential for realising data opportunities for intelligent mobility:

- Data collection and curation.
- Computational, statistical and human analysis.
- Software and technology development.
- Cyber security and data privacy protections.

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24 Wired.com 'There are better ways to kill traffic than lying to Waze'. Available at: https://www.wired.com/2016/07/better-ways-kill-traffic-lying-waze/, accessed 9/07/2017
New Zealand Universities have been working to develop new courses which industry notes are starting to provide “data industry ready” graduates. As the intelligent mobility industry matures there will be a continual need for Government, industry and universities and other training institutes to work in conjunction to develop training courses and qualifications to meet the needs.

The authors note that a recently published NZ Transport Agency Research Report titled ‘Technology related transport skill requirements and availability’ covers this content in more depth.25

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7 Barriers and challenges to creating, opening-up and using data in transport

7.1 Incentivising the sharing of public and private data

The vision described in this report of future intelligent mobility opportunities and innovation enabled by data systems that are built upon integrated datasets, is a much-developed scenario from the present. It should not be expected that data will be made freely available by the private sector in the interests of ‘public good’ only, Government must therefore look for opportunities to incentivise making data available (e.g. paying for data or creating future commercial opportunities).

‘Data sharing’ as highlighted by this research is not just the sharing of raw/aggregated datasets via open platforms, or the sale of data from one entity to another for reuse. Data sharing already takes place via commercial relationships and partnerships that are structured around mutually beneficial goals and actions. Public-private and private-private business models will continue to see data, or data insights, shared between organisations. Government’s collaboration with the private sector will likely play an increasingly important role in its access to data.

There are many examples of relationships being built and data sharing/collaboration taking place at small scales, often on a project basis. However, there is much work to be done (including agreeing who is responsible for which aspects) to develop both the data platforms and the public-private relationships that are necessary to facilitate such widespread sharing of information at a national, and perhaps international, scale.

It is therefore critical that sharing and supplying data to integrated data platforms is incentivised, and the commercial value of sharing is proven for organisations sharing their data, not just for NZ Inc. Incentives might be as simple as creating standards that mean ‘plugging into’ a centralised data platform is relatively easy. In some cases, such as MaaS platforms, the expected commercial value of being included and exposed to many consumers will likely outweigh any decision to not share information with the system.

Government has the opportunity also to mandate that any data collected via public funding should be shared back with government in a pre-agreed format. This approach is becoming more common. However, there are legacy contracts in place around key datasets that do not make such provisions and currently keep valuable information out of the system.

7.2 Standardisation of data and data systems

Data standards are needed that are common across the sector and enable generators, managers and users of data to ‘speak’ a common language of intelligent mobility data. Standards will also be needed for the data platforms which will be developed, be it MaaS; transport models; machine-led automation; APIs; or open data portals. These standards will ensure a consistent approach for integrating data into these platforms, and that the platforms themselves are interoperable to form a wider connected system.

Adoption of common standards, systems and approaches to sharing/integrating data is essential to ensure the different organisations can share real-time information across the network. International standards are being developed and will provide some guidance.
However, in some cases a New Zealand approach will be necessary and the challenge of the disparate nature of data already held by different companies is great. Austroads is undertaking a project to establish a harmonised road asset data standard for use in Australia and New Zealand, the NZ Transport Agency has been involved in this work.\textsuperscript{26}

Internationally, the non-Governmental International Organization for Standardization has developed ISO/TC 204, the programme of standards responsible for ‘the overall system aspects and infrastructure aspects of intelligent transport systems’ (in-vehicle transport information and control systems are excluded from this standard).\textsuperscript{27} Private organisations have also developed approaches that have led to international standards. Google developed the ‘Google Transit Feed Specification’, now known as the ‘General Transit Feed Specification’, a common format for public transport schedules and related geographic information.\textsuperscript{28}

### 7.3 Government funding of data and technology development

There are structural and organisational barriers for access to funding. In general, each agency and central/local authority is working toward the same thing but have different funding mechanisms and sources, while still having their own organisational or local priorities. A more efficient way of making cross agency/authority business cases for investing in data and technology related projects would encourage collaboration and reduce development within silos.

This is particularly important at the local level where funding is more limited, but organisations are in a good position already to cooperate as public/private organisations often know each other and are potentially more agile than larger national or international organisations.

Governments’ data budgets will need to be reprioritised and be allocated to specific projects and development to provide confidence to invest in capability. Competing with the private sector in terms of attracting and retaining people with the necessary data skills and capabilities will also require resource, so efficient use of resources across agencies will likely be required. Where possible researchers and commercial organisations should be partnered with to solve problems to leverage off their knowledge and expertise, and avoid over investing in in-house data and technology development.

### 7.4 Legacy systems

Current data platforms and integrated systems, most of which are internal to an organisation, will pave the way for future platforms and models, however they will themselves become out of date and in need of replacement. Owners and users of such systems will face challenges in the timing of replacing such system: at what point is ‘fit-for-purpose’ no longer sufficient, when do the benefits of redesigning or replacing the system outweigh the costs, and what can be done with historical data that may need to be converted


to a new format? New Zealand Government’s open data programme should assist to reduce the legacy issues associated with access to some datasets.

Legacy data platforms often run on in-house hardware, while some modern systems are generally accessed via cloud-based servers where the actual hardware costs and capability is outsourced to specialist providers. Legacy systems that have been developed for specific purposes are difficult to shift over to new software that uses completely different technologies that may not be compatible with older data processing and modelling software requiring these elements of the system to be recreated also.

Budgetary constraints are a major barrier, particularly for small local authorities in New Zealand though even cities such as Christchurch will face major challenges if required to develop a system in isolation. Therefore, a nationally centralised approach is a preferred model for future data systems where possible, to leverage off resources across multiple groups and avoid duplication of effort. Competing demands and requirements of the system will be a challenge to gain agreement on a base system’s capabilities.

7.5 Commercial sensitivity

Commercial sensitivity was a commonly cited barrier to sharing of data and information in New Zealand and overseas during the engagement process of this research. Corporates were generally supportive of collaboration within the sector and seeking opportunities to push the development of mobility services and technology forward with their own investment in data. However, any sharing of data that gave away their commercial value or reduced their own opportunities to develop new products and services is a risk most are unwilling to take.

Data systems that allow for integration of aggregated data sets without the need for raw data was seen as a positive step. However future ownership of data within the system and products or services developed using commercial datasets is currently unclear. Private organisations were particularly open to working with the government on identified opportunities as it was expected that government’s benefits would be experienced via economic growth and achievement of strategic mobility goals, while the benefit to the company would be the monetary gain through use of their datasets.

Given that this is a hotly contested space it is understandable that private organisations are hesitant to enter widespread sharing of data into a system accessible by potential competitors. However, government and the sector have no need for all transportation data to be made available, with specific key datasets of more use than others, identification and access to these is a major focus of government’s efforts in this space at present.

7.6 Confidence in new technologies and services

Where data is being used to automate decision making and operate the mobility system in place of people or traditional processes, there must be confidence in these technologies and services that they provide at least the same level of service as the currently available system. For the mobility system, this will often be thought of in terms of safety for people within the system, and the efficiency of moving people and goods around New Zealand.

As mentioned previously, the fatal and severe injury crash rate per million kilometres is relatively low in New Zealand, particularly on major roads such as Auckland’s motorways. Future generation vehicles will need to achieve at least the same level of safety before
confidence can be had about their inclusion in the fleet, and these vehicles will be under very high scrutiny with autonomous vehicle incidents already making international headlines when they occur.

Data systems will also face similar scrutiny, with major outages of international cloud-based data platforms causing widespread disruption in 2017. The March outage of Amazon’s Web Service caused widespread disruption both online and in the real-world. Websites and services relying on Amazon’s systems were unavailable globally during the outage, while people who use networked Amazon systems to run many functions in their homes, such as lighting and media systems, could not operate them.

If connected autonomous transport systems are operated on a system that is knocked off-line, even for a matter of hours, the implications for a city and country are potentially catastrophic. Users of these systems must be confident in their robustness and redundancy, while the security of a system to external threats is a very real concern. A data system that controls national transport systems and individual vehicles within them will be a major target for cyber-attacks.

### 7.7 Rapidly increasing rate of development

The rate of development in data collection, data-related technologies and the intelligent mobility services and products that these enable is accelerating. While private companies work within their interests and capability, government is placed in the centre of the system in an almost overwhelming position of trying to stay aware of all developments, and leverage or respond to these as they emerge.

Even a document such as this research report, based on engagement with key sector stakeholders throughout the latter half of 2016 and subsequently written in early 2017, is at risk of not being up-to-date by the time it is published, and could easily continue in a cycle of identifying new data, technologies and services with no defined end-point.

Government’s relationships with the private sector will therefore be a key enabler of data-led intelligent mobility in New Zealand, setting a strong agenda and policy platform that is developed and agreed in tandem with the sector to ensure that efforts are relatively aligned and avoid conflict. Through these relationships central and local government can facilitate and enable data innovation for mobility services, without necessarily needing to become involved in the data processing and modelling itself.

### 7.8 Security and privacy of information about people

As people share more and more personal information with a range of public and private organisations there are valid concerns about the security and privacy of this information once it is collected. The use of this information is also an often-cited concern, the public are generally accepting of data use for purposes that aim to directly benefit them, while commercial exploitation or targeting of communities without a benefit to people is much less accepted.

Privacy is also a common reason given for companies being unwilling to share data in a centralised system, though New Zealand’s Privacy Act (1993) is an enabling piece of legislation which supports the sharing of personal information so long as it is done lawfully and positions the privacy of individuals central to any decisions.
Representatives from the New Zealand Office of the Privacy Commissioner attended many of the workshops for this project in addition to being engaged with separately. They noted the following:

*The Privacy Act is principles based, technology neutral framework for the use, collection, storage and disclosure of personal information. The Act enables agencies to use and share personal information in accordance with their policies and lawful purpose. Many of the principles contain exceptions that provide flexibility and enable reasonable and proportionate use and disclosure of information while protecting the privacy of individuals. In addition, Part 9A of the Act deals with information sharing agreements for inter-agency sharing that falls outside the exceptions (also known as AISAs). The Act provides a framework for sharing in a necessary and proportionate manner.*

A new Privacy Act has been in the pipeline for a number of years, and the office is keeping an eye on law reforms internationally. Recent changes of significance include the revision of the EU’s General Data Protection Regulations and the Australian prohibition on re-identifying de-identified data, and the introduction of mandatory data breach reporting.

*In a technology saturated environment the concept of ‘ownership’ of information is not a helpful point of reference. Rather, the legal framework supports multiple and competing rights to information. A pivotal factor is the purpose (or purposes) for which the agency has identified for collecting and using personal information. Provided that purpose is communicated with customers or clients, an agency has a great deal of freedom to use and share information accordingly.*

*The more information there is about us and the more that information or data is centralised (e.g. in a transport data hub) the greater the risks around theft and accidental or malicious breach. As a society we need to have an open debate about the potential benefits, our risk tolerance and the security protection and training that are necessary.*

New Zealanders have the right to request their personal information held by almost any person, group or organisation. As overseas companies begin to hold a large share of personal information about our people, how any requests for release of information are handled remain to be seen. Major multi-national organisations openly discussed their approaches to privacy during this research, many have their own in-house policies that are aimed at complying internationally with any local regulations they face while being able to apply a standard approach internally. If companies, both New Zealand and overseas based, are found to be non-compliant or non-responsive to privacy breaches then the public’s trust in the entire system is diminished and penalties will be difficult to apply across national borders.

*The Office of the Privacy Commissioner can be reached through their website www.privacy.org.nz. There you can find several online resources including AskUs (an interactive search tool for any privacy related questions you may have), Priv-o-matic, that assists agencies in developing their own privacy statement, as well as case notes, blog posts and much more. OPC’s 0800 enquiry line runs Monday-Friday 10am-3pm and can field any other privacy concerns or questions.*
7.9 Data-related capabilities

Multi-national companies spoke of having dedicated teams located around the world that collaborate, share innovation and can be relocated if necessary to solve specific data issues in New Zealand. These are resources beyond the means of many local companies who are primarily focused on the transport sector, though teams within organisations here are growing. In response to the drive for data-related capabilities Universities are offering a wide range of data-science and data-engineering programmes with many new graduates entering the workforce.

Local and central government each spoke of challenges in competing with private companies to attract and retain talent, especially experienced staff who are needed to mentor new graduates but can potentially earn much higher salaries working in the private sector.

Increasingly government will look to the private sector to provide data-related services meaning that the cost of contractors is expected to rapidly grow. Local authorities are already collaborating amongst themselves and with the sector to upskill staff, however the need for pure data science expertise means that upskilling alone is not a long-term solution.

7.10 Key findings

The volume of data being generated by the transport sector is itself a major challenge. While data may be relatively low cost to generate, there remain costs associated with storing data, and investing in systems, artificial intelligence and human capital capable of transforming data into knowledge, insights and subsequently value.

There are inter- and intra-organisational barriers to realising data opportunities for intelligent mobility. Legacy data systems that have previously been developed as fit-for-purpose no longer are, organisations across the sector are investing heavily in modernising their IT systems and their data handling capabilities.

Commercial sensitivity will continue to be a key consideration for any private organisation who controls access to valuable data. Many companies already treat transport data as a commercial asset and have monetised this product by making it available to the market for a fee. In this way, they can maintain control of how their data is used, while external organisations who see value in this information for their own needs can invest in existing datasets. There are also companies who do not make their data accessible at all, preferring to seek opportunities for innovation and growth for themselves. There are still opportunities for Government to engage with these organisations in a non-competitive manner. Uber’s tool ‘Movement’, anonymised trip data that tracks patterns of driving times between locations by time of day and day of the week, is an example of a private company providing information that can aid in transport planning.

The rate of development of new technology is a challenge for Government to keep pace with, though competition in development will also lead to improved products and services being delivered to New Zealanders. Government therefore must decide what parts of the technology and data system should be left to the market, and which, such as MaaS, make sense for Government to lead local development of itself.

We are experiencing similar disruption to our transport sector as countries overseas, with the same challenges of public-private collaboration and integration; historical systems,
processes and legislation; and the ability for Government to predict and respond to rapidly emerging trends and technologies. This last point is especially important, as provision of new technology and services by developers and uptake of these by the public is already taking place at a faster rate than which policy and strategies can be developed.

Specific barriers include:

- Lack of incentivising the sharing of public and private data.
- Standardisation of data and data systems.
- Government funding of data and technology development.
- Legacy systems.
- Commercial sensitivity.
- Confidence in new technologies and services.
- Lack of comprehensive internet coverage.
- Rapidly increasing rate of development.
- Security and privacy of information about people.
- Data-related capabilities.
8 Major challenges identified by transport sector stakeholders

Through the extensive transport sector engagement undertaken for this research, a number of individuals and organisations provided key insights and learnings that add value to an ongoing conversation about data opportunities for intelligent mobility in New Zealand. These statements are highlighted here, many serving as subjects for further investigation on behalf of Government, or as general views on the state of transport data opportunities in New Zealand.

- **Need for clarity on the problem you are trying to solve or the system you are trying to create before embarking on an intelligent mobility project.** This includes understanding how the project will be evaluated. Where there is this clarity, the data requirements both to run the system as well as to evaluate it are much easier to define and collect. It was noted a tendency to get systems in place quickly can lead to the ongoing data needs and collection process not being well thought through. In addition, it was considered important to consider how scalable solutions were.

- **When looking at data requirements it is important to remain at the what is the information needed level, rather than the data level, to avoid a system not becoming technology dependent.** For example, one company suggested that just as smart phones have replaced mobile phones which replaced landlines there will be a replacement for smart phones, so our solutions (such as accessing personalised location information via cell phones) needs to take this into consideration.

- **There is an issue in New Zealand with the completeness of data sets.** For example, the national mobile coverage is quite patchy, which is problematic in terms of providing information to/from rural and remote locations. It is also noted that even within cities the quality of data that a network can yield varies, with the accuracy of cell phone GPS/triangulation traces varying according to the location of the transmission towers.

- **When any work is undertaken for a local, regional or national government, collecting data on that project and provision of it should be mandatory.** Frustration was expressed by commercial entities, and local and central government about instances where they had to pay to get data that they had already paid for another organisation to collect.

- **There needs to be a comprehensive plan for spending transport innovation money that involves all road controlling authorities.** There was a general consensus that innovation funding was needed to ensure that value for money was being achieved. The following ways were suggested:
  
  » This should ensure that solutions are applied on a “one network” system basis and not just on State Highways or Councils roads and that there is not duplication of development costs whilst individual Councils/road controlling authorities develop solutions in parallel. It was noted that at present there is little transparency of what
innovative projects local and central governments are undertaking. The SCATS™ system was given as an example by which each Council pays for development, maintenance and analysis and it was suggested that this could be combined for a more cost-effective system.

» It was noted that whilst larger Councils might be able to undertake innovation smaller Councils with tight budgets cannot as they need to account for every project in their Long-Term Council Community Plan (LTCCP).

» Making better use of leveraging of Universities and innovation funds.

» Industry would like to see more partnering on projects, it was noted that that the “best value for transport money” would be achieved where you have public-private partnerships.

• **There should be more open and free data sharing between Government Agencies.** For example, why do Councils have to pay for MetService data (while understanding that MetService is a State Owned Enterprise expected to operate on a commercial basis) when they are both Government agencies? One Council noted that this has led to them investigating gathering their own weather data or getting it from another cheaper source.

• **When trialling data collection systems it must be ensured that they are scalable.** There is little point in trialling a system to find that the system is not scalable. It was suggested that bigger and smaller road controlling authorities undertake trials together.

• **Building and maintaining trust with the people or businesses you collect data from or about is key to having ongoing access to their data.** International commercial entities noted their use of incentives (rewards for providing information or feedback) for individuals for providing their data and ensuring that data is only used in accordance with agreements you already have.

• **Data silos are holding a move to intelligent mobility back.** Data silos prevent private industry and other agencies from creating seamless transport system.

• **Need to invest in data standards for the country.** International commercial entities noted that data standards ensured that data could be used and was reliable when it was shared. Without having access to useful reliable data commercial companies are unlikely to use data even if it is open and free.

Lastly, companies with an international presence were asked if they intended to increase their commercial activities in New Zealand, and if so what they saw as the advantages and disadvantages of working in New Zealand as compared with other international locations? The advantages and disadvantages are summarised below:

**Advantages of undertaking work in New Zealand**

The business case for companies undertaking work in New Zealand include:

• New Zealand’s political structure is stable

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29 SCATS® (Sydney Coordinated Adaptive Traffic System) is an adaptive urban traffic management system that synchronises traffic signals to optimise traffic flow across a whole city, region or corridor
• Infrastructure is in good shape (e.g., traffic lights, highways) which makes data collection easier

• Tax laws are advantageous and it is relatively straightforward to bring in your “international experts” for projects

• If implementing/trialling physical system you don’t need to get as many approvals as you would in Australia (due to the large number of Shires that you might operate through)

• Culture is receptive to trials, in that they are generally keen to try new things and understand that not all aspects of trials will be successful.

Disadvantages to operating in New Zealand

• Budgetary constraints mean it’s not always possible to keep recruited talent

• When looking for data for the “Internet of Things” (IoT) the quality of data available is an issue. There are problems with legacy data not having all the data points and there being proprietary data platforms.
## Appendix 1: Government data programmes with relevance to transport

<table>
<thead>
<tr>
<th>Programme/project</th>
<th>Who is involved?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Government ICT Strategy and Action Plan to 2017</strong></td>
<td></td>
</tr>
<tr>
<td>Govt.nz (July 2014).</td>
<td>Whole of Government.</td>
</tr>
<tr>
<td>Information Privacy and Security Programme.</td>
<td>Government Chief Information Officer Team.</td>
</tr>
<tr>
<td>Strategic Information Policy/Programme (SIMP).</td>
<td>Reports to Information Privacy &amp; Security Governance Group (IPSGG). Cross-agency group chaired by Government Chief Information Officer.</td>
</tr>
<tr>
<td>ICT common capabilities panel for Security and Related Services (SRS Panel).</td>
<td>Led by the Department of Internal Affairs.</td>
</tr>
<tr>
<td>Confirmation Service.</td>
<td>Set up by the Department of Internal Affairs, many private companies are authorised to access this.</td>
</tr>
<tr>
<td>Shared Workspace.</td>
<td>Led by the Department of Internal Affairs, used by many Agencies including the NZ Transport Agency, NZ Police, and NZ Customs Services.</td>
</tr>
<tr>
<td><strong>Data Futures Forum</strong></td>
<td></td>
</tr>
<tr>
<td>Data Futures Forum (set up in December 2013).</td>
<td>Set up by the Ministers of Finance and Statistics, comprised of eight members from the Public and Private sector.</td>
</tr>
<tr>
<td>Policy and Legislation workstream.</td>
<td>Department of Internal Affairs.</td>
</tr>
<tr>
<td>Business case for Independent Data Council (reporting to lead Ministers in April 2015 and Cabinet in May 2015).</td>
<td>StatsNZ.</td>
</tr>
<tr>
<td>Independent Data Council.</td>
<td>StatsNZ.</td>
</tr>
<tr>
<td>Open Government Data Programme.</td>
<td>Land Information New Zealand.</td>
</tr>
<tr>
<td>Catalyst projects.</td>
<td>StatsNZ.</td>
</tr>
<tr>
<td>Developing a plan for implementing social sector data integration including common standards.</td>
<td>Commissioned by the Social Sector Board.</td>
</tr>
</tbody>
</table>
Appendix 2: Government catalogues and repositories containing transport data

What is apparent is the abundance of historical data. A major challenge that needs to be addressed is an understanding of what information is and will be captured by private organisations. However, this should not be at the expense of discounting the value of existing transport datasets data already held by a wide range of organisations in New Zealand. The need to understand what we already have is reflected by central government’s focus on data, and the current and future value of information and knowledge for New Zealand’s communities and economy across all sectors. Both the Ministry of Transport and NZ Transport Agency are undertaking data ‘stocktakes’ to understand what data is already at hand within government. Alongside this work is data.govt.nz, a directory of publicly available government datasets.

8.1 Transport Domain Plan

New Zealand’s Transport Domain Plan is a central government collaboration focused on ensuring the transport sector has the right data and information. The significant programme of work produced to date includes a data stocktake for New Zealand, and aims to help the sector better align and coordinate their data collection and data sharing efforts.30 Figure 12-1 outlines the 12 categories of the transport data stocktake:

The datasets identified to date in the Transport Domain Plan Stocktake are largely historical or current static datasets, calculated performance metrics or indicators, and survey-based data. No real-time datasets derived from sensors, network operations and web-based platforms are currently listed.

8.2 New Zealand Transport Agency’s Asset Register

The NZ Transport Agency has been cataloguing transport datasets within their Information Asset Catalogue. This Catalogue includes many of the datasets and categories described in the Transport Domain Plan Stocktake, and identifies many internal information sources.

Much like the Stocktake, the Agency’s Asset Catalogue is focused on a range of: performance indicators and metrics; static datasets; finance; legislation; and company processes. We understand that this work is ongoing and is not publicly available. It is expected that some of this data may be useful to incorporate into intelligent mobility in conjunction with other data. For example, bridge heights and loading limits data provides useful information for freight companies to incorporate into their route planning.

8.3 data.govt.nz

As New Zealand’s directory of publicly available government datasets, data.govt.nz provides access to a range of transport-specific and transport-related datasets and data sources. As at early 2017 the ‘Transport’ sub-category of data.govt.nz housed 175 individual sources of information, though it should be noted that this number has remained static from a prior check in September 2016. A keyword search for ‘transport’ returns 228 results. Transport has more datasets stored on data.govt.nz than most other sectors, though the overall involvement remains low across all groups. data.govt.nz provides metadata for each dataset listed including information about the source agency; data format; re-use rights and cost of use; creation date and update frequency; and keywords.

Nine individual agencies are listed as providers of these datasets with 151 attributed to the Ministry of Transport and 15 to the NZ Transport Agency. As the most well publicised central repository of open government data in New Zealand these figures suggest that there is significant ground to be made in efforts to make mobility-related information and data publicly available. This is particularly true for local and regional councils where only Christchurch City Council (two links) and Auckland Transport (one link) have any information present on the website. Auckland Transport and the NZ Transport Agency’s Transport and Traffic APIs are linked via data.govt.nz.

8.4 Land Information New Zealand and Statistics New Zealand

Public service departments Land Information New Zealand (LINZ) and Statistics New Zealand (StatsNZ) provide information management services that are relevant to mobility in New Zealand. LINZ is responsible for geographic, surveying and property information while StatsNZ is the government’s statistical department and maintains New Zealand’s geographic administrative boundaries.

While neither department are specifically focused on transport, both hold data about property, the environment, people, communities, and business that are all associated with transportation. In addition, both LINZ and StatsNZ are well advanced in their delivery of data for public and private use in New Zealand. Each have their own data portals where information can be directly accessed for a range of purposes along with information services for bespoke requests.
LINZ and StatsNZ both provide working models of online data repositories delivered by central government, and importantly are recognised as the ‘face’ for much of government’s data. As their relationships across government and the private sector continue to grow it is expected that the role of both LINZ and StatsNZ in data driven intelligent mobility will do so too.

### 8.5 Data Futures

The New Zealand Data Futures Forum, set up by the Ministers of Finance and Statistics, is tasked with providing independent advice on how the country can harness opportunities to deliver improved social and economic benefits from the use of data.

Three core areas are being looked at for enabling data innovation and use in New Zealand:

1. **Social license** – the public’s acceptance for personal information to be used in public good and commercial applications.
2. **Catalysts** – what problems or opportunities exist that we can ‘solve’ by intelligent use of data?
3. **Diagnose and fix** – what are the issues in sharing data and how can we remove barriers?

Given a mandate to engage with citizens, private sector, and non-government organisations, the Data Futures Partnership is a key figure for driving change in how data is used and turned into knowledge and value for New Zealand. A lack of data integration and alignment of purpose/interests across organisations is not unique to the transport sector. Data Futures and initiatives like this will be vital to establishing relationships and creating a data ecosystem that benefits innovation, social capital and economic vitality.

### 8.6 Review

These catalogues and repositories of transport data are very much in early development in New Zealand and provide a starting point for the scope of transport data only. Because these platforms and forums act as an intermediary between users and suppliers of data they do not facilitate integrating data from different sources and provide little insight into how data is being used once exported.

There are significant challenges faced by these platforms, one of which is the speed at which new sources of data are emerging (and disappearing or changing), and the effort that is therefore required to ensure any catalogue or repository remains up-to-date and relevant. Because these platforms and catalogues do not provide a service other than pointing to datasets there is no incentive for users to upload their own data, even if it is already openly available.

Additionally, the sheer volume of ‘intelligent mobility datasets’ in existence make the task of cataloguing them challenging and time consuming. As we begin to discuss the value of data being generated from an increasingly wide range of sources the value of documenting each one arguably diminishes. What is valuable however is understanding the parts of the sector that we have and need information for, and where new sources of information will better inform us in the future – the Transport Domain Plan Stocktake does this quite effectively.
The immediate gap that exists in the work being undertaken across government is the identification of privately held data, and the value that this may have for intelligent mobility. Over time the list of private datasets with perceived value will grow, however it is not important to list each of these as they emerge. Rather, developing centralised systems, such as data warehouses and APIs that are accessible to both public and private organisations and encourage use by adding value, is a priority for aligning New Zealand’s intelligent mobility datasets.
Appendix 3: Intelligent mobility datasets in New Zealand

Tables (13-1) below describes examples of data currently being collected and used to support intelligent mobility applications in New Zealand. These datasets, and the insights derived from them, relate to several themes, or parts, of the intelligent mobility system, with the collection, analysis and application of data carried out by many different organisations. The datasets themselves are also distinct, with many real-time sources of information entering the data ecosystem alongside numerous static and dynamic datasets, similarly there is a mix of spatial and non-spatial information used for intelligent mobility in New Zealand.

As such, the datasets and their relevance to intelligent mobility presented in Table 13-1 are a snapshot of the current availability and use of information in New Zealand and is not a complete overview of all data and uses of data. As evidenced by numerous uses of the same dataset, repurposing of data and information for multiple applications is common and capturing these uses in a ‘single source of truth’ difficult and perhaps not entirely beneficial in a static document given the rapidly evolving nature of this space.

What Table 13-1 does provide is a detailed overview of the most common ‘types’ of data being used for intelligent mobility in New Zealand. While specific providers and/or users of these datasets are mentioned here, it is to be expected that a similar set of tables created in one years’ time would name many new organisations related to intelligent mobility datasets.

The example datasets and their relevance to intelligent mobility are grouped by theme in the following tables.

Table 13-1 Place and Space – anything tangible that can be seen, touched or found.

<table>
<thead>
<tr>
<th>Example datasets and data services</th>
<th>Description</th>
<th>Intelligent mobility benefit/relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>3D road network dataset (TomTom)</td>
<td>Original 3D capture carried out by vehicle with scanning technology. There is a high cost to process this data which has not yet been done. Over time this data will be added to by in-vehicle sensors that feed data back to TomTom about live traffic conditions and the physical environment. Access to data is provided to TomTom’s public customers for free as part of their service (e.g. via in-vehicle navigation and journey planning systems).</td>
<td>Support next-generation vehicles, real-time journey planning and vehicle routing decisions and optimise movement across modes at a network level. Better informed transport and land use planning.</td>
</tr>
<tr>
<td>One Network Road Classification (NZ Transport Agency)</td>
<td>The Transport Agency provides spatial information for the national road network hierarchy which is openly available online.</td>
<td>Provides a functional hierarchy for the network, this describes what vehicle/people/freight movements should be prioritised on a particular corridor – important for future journey planning tools and automated routing for vehicles.</td>
</tr>
<tr>
<td>Example datasets and data services</td>
<td>Description</td>
<td>Intelligent mobility benefit/relevance</td>
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<tr>
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</tr>
<tr>
<td>Walking Access Mapping (NZ Walking Access Commission)</td>
<td>Maps are made available online for free use in a spatial viewer, underlying data not available for extraction. Some of this information is crowd-sourced from the public and organisations who want to contribute.</td>
<td>Support door-to-door trip planning by providing walking navigation, predicted travel time, walkability information such as: difficulty of the terrain, surface, safety concerns</td>
</tr>
<tr>
<td>Transit hub locations (local and regional authorities/providers, journey planners)</td>
<td>Transit network maps and routes are generally held by relevant operating authorities (e.g. GWRC for PT in the Wellington Region), though this information is shared with other organisations and provided to the public in online mapping and journey planning tools (e.g. Google Maps, Metlink).</td>
<td>Data supports MaaS and door-to-door planning by allowing individuals to plan trips.</td>
</tr>
<tr>
<td>Virtual and interactive 3d city models (NEC)</td>
<td>Data updated as changes are made to the physical environment, metadata for places and features of the environment including the ontology information and relationships is updated as an ongoing process.</td>
<td>Adds a placemaking component to the city, the transport network carries people and goods between places, including information about these locations of interest is essential to understanding spatial and temporal patterns of transport demand and predicting future demand in near real-time.</td>
</tr>
<tr>
<td>On- and off-street parking locations, stock, and current availability (local authorities, private providers – Wilsons, Parkable, PayMyPark (<a href="https://paymypark.com/">https://paymypark.com/</a>))</td>
<td>Parking stock information is improving as payment and enforcement systems become automated. There is little integration of public-private information in this space. In Wellington for example the off-street commercial supply of parking (leased and casual parking) is largely an unknown. Information about available spaces is improving but this is not used in NZ as is the case overseas for dynamic demand-responsive pricing etc. Parkable provides access to many parking spaces via an app with available spaces displayed alongside fixed rates. Users can park and pay via the app. Parkables dataset provides real-time availability of parking spaces which capturing information about usage. PayMyPark is a mobile-based app that lets users find an available park and pay for it online. Parkers can extend their parking time remotely if running late, or if they return early unused time is refunded. PayMyPark is currently available in Wellington, New Plymouth and Tauranga.</td>
<td>Supports the next generation parking systems and demand responsive pricing of parking systems are reliant on data about stock, and availability of parks in real time in order to communicate availability of parking to end users and adjust pricing in response to real-time demand.</td>
</tr>
<tr>
<td>Street maps (e.g. Open Street Map (<a href="https://www.openstreetmap.org">https://www.openstreetmap.org</a>), TomTom, Google, Bing, Apple)</td>
<td>Street maps available to the public come from a range of open and closed datasets. Google, Bing, TomTom and Apple’s mapping data are commercially held and have restrictions on their use – though they are available for commercial applications. Open Street Map is an open service that makes use of crowd-sourced information for updates and improved information.</td>
<td>Essential spatial component of any data collected from people/vehicles/assets on the network – most intelligent mobility applications have some sense of place which is provided by network maps and associated data.</td>
</tr>
<tr>
<td>Example datasets and data services</td>
<td>Description</td>
<td>Intelligent mobility benefit/relevance</td>
</tr>
<tr>
<td>------------------------------------</td>
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</tr>
<tr>
<td>Road network datasets (LINZ Data Service, Critchlow)</td>
<td>New Zealand’s road network datasets are provided in a range of open (e.g. LINZ) and paid for (e.g. Critchlow) formats. There is no ‘single source of truth’ for road network data in New Zealand that is used consistently across all organisations and platforms.</td>
<td>Essential spatial component of any data collected from people/vehicles/assets on the network – most intelligent mobility applications have some sense of place which is provided by network maps and associated data.</td>
</tr>
<tr>
<td>RAMM database and the Bridge Data System (BDS) database. Data services created from these by the Auckland Motorway Alliance include MobileRoad <a href="https://mobileroad.org/desktop.html">https://mobileroad.org/desktop.html</a> and Highway Information Sheets. <a href="http://his.aucklandmotorways.net/amahis/ListPDF.aspx">http://his.aucklandmotorways.net/amahis/ListPDF.aspx</a></td>
<td>These databases contain data on the location and condition of road pavements, structures including bridges and culverts, and roadside infrastructure such as signs and barriers. They use the 'Route Position' system to locate infrastructure on state highways.</td>
<td>Intelligent mobility includes intelligent asset management of infrastructure, RAMM provides a historical and current view of the state of the network and in some places the demand for types of infrastructure by mode. Machine learning applications for this data have demonstrated opportunity for optimised maintenance and renewal schedules for assets based on information about deterioration of asset types given certain conditions around the country.</td>
</tr>
<tr>
<td>Argonaut Roadrunner state highway videos at <a href="https://www.argonautltd.co.nz/roadrunner/">https://www.argonautltd.co.nz/roadrunner/</a></td>
<td>Roadrunner software developed for the NZ Transport Agency makes use of video captured by NZ Transport Agency on the state highway network. This data service provides an alternative street view of state highways instead of Google. The travel speed along state highways can be adjusted according to user preferences. The 'Route Position' system is used to locate the videos and photos on state highways. New videos are available on an annual basis at a cost from Argonaut.</td>
<td>Currently used for incident and emergency management planning, and when planning Temporary Traffic Management operations. As more assets are geolocated with this data the video inventory can be linked to other datasets related to these assets.</td>
</tr>
<tr>
<td>Aeronautical Information Publication (AIP) New Zealand <a href="http://www.aip.net.nz/Home.aspx">http://www.aip.net.nz/Home.aspx</a></td>
<td>The AIP provides a range of information online including details about aerodromes, and airspace zones under the Air Navigation Register.</td>
<td>Unmanned aircraft carrying passengers and goods will require detailed information about landing sites and airspace across New Zealand. Information held by AIP will become part of the ‘one-network’ transport dataset as automated systems across land, air and sea manage movements through the system.</td>
</tr>
<tr>
<td>LINZ Nautical Almanac, marine charts and hydrographic assessments <a href="http://www.linz.govt.nz/sea/nautical-information/new-zealand-nautical-almanac-nz-204">http://www.linz.govt.nz/sea/nautical-information/new-zealand-nautical-almanac-nz-204</a> <a href="http://www.linz.govt.nz/sea/charts/annual-work-">http://www.linz.govt.nz/sea/charts/annual-work-</a></td>
<td>LINZ provide national charts and navigation publications needed for vessel passage in New Zealand waters.</td>
<td>Much like land and air travel, any automated marine systems will require a detailed hydrographic dataset to facilitate the safe navigation of vessel traffic in New Zealand waters. LINZ hydrographic risk assessment has identified where improvements are needed for charts and navigation information. There is also a large amount of existing information available from private navigation providers in this space as many ships already operate with some level of auto-pilot functionality.</td>
</tr>
</tbody>
</table>
### Example datasets and data services

<table>
<thead>
<tr>
<th>Description</th>
<th>Intelligent mobility benefit/relevance</th>
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<tbody>
<tr>
<td><a href="#">Environment – data relating to environmental trends and natural occurrences.</a></td>
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</tbody>
</table>

### Environment – data relating to environmental trends and natural occurrences.

<table>
<thead>
<tr>
<th>Example datasets and data services</th>
<th>Description</th>
<th>Intelligent mobility benefit/relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metservice weather forecasts, LINZ tidal information</td>
<td>Metservice provides a free-to-use public service via their weather forecasting and warnings online. For commercial uses the underlying data including historical meteorological information can be obtained from Metservice for a fee.</td>
<td>Environmental information is currently used in advanced warning alerts to road, marine and aviation users. These are not always communicated via transport-related channels with the Metservice being a primary source of publicly available information. There are a range of other providers of meteorological information that is used to planning and management of operations. The NZ Transport Agency provides frequent updates to travellers via social media and other forums to inform people of real-time conditions and events that are impacting the transport system. Future applications of this information will see more bespoke communications provided to people and organisations based on their transport behaviour and needs. Automated uptake of environmental information into incident management systems can be used to determine priority for checking transport infrastructure in an area after a significant event. The design of infrastructure considers historical and modelled environmental information, including the level of design required to be resilient to a given level of disruption or impact from and environmental event (e.g. earthquakes and flooding). Data which supports better predictability/identification of what environmental impacts the transport system is exposed to and where, is important for managing the system and improving the resilience of infrastructure on behalf of the community.</td>
</tr>
<tr>
<td>NIWA climate data</td>
<td>NIWA makes some climate information available online via the National Climate Database. Bespoke data requests can also be processed via NIWA for a fee.</td>
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<tr>
<td>GNS earthquake data (GeoNet)</td>
<td>All New Zealand earthquake data collected by GNS’s GeoNet are made freely available via their website.</td>
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<tr>
<td>Air quality monitoring data (local authorities)</td>
<td>Fixed position air quality monitoring stations are common in many New Zealand cities, raw data is generally not made available publicly however aggregated information is reported e.g. number of exceedance days per year.</td>
<td>Automated uptake of environmental information into incident management systems can be used to determine priority for checking transport infrastructure in an area after a significant event. The design of infrastructure considers historical and modelled environmental information, including the level of design required to be resilient to a given level of disruption or impact from and environmental event (e.g. earthquakes and flooding). Data which supports better predictability/identification of what environmental impacts the transport system is exposed to and where, is important for managing the system and improving the resilience of infrastructure on behalf of the community.</td>
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<tr>
<td>Noise and vibration monitoring (WSP Opus)</td>
<td>Noise modelling and vibration monitoring for new and existing infrastructure to understand and manage the impact on communities</td>
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<tr>
<td>River flow information (Regional Councils)</td>
<td>River flow data is used to inform the design of adjacent infrastructure, namely bridges, and during times of flood or increased flow influences the operational ability of the network. Flooding is a regular cause of disruption to the network and has significant implications for people’s movements as seen in recent years on the Wellington network where flooding at key points have had a network wide impact.</td>
<td>Data which supports better predictability/identification of what environmental impacts the transport system is exposed to, and where, is important for managing the system and improving the resilience of infrastructure on behalf of the community.</td>
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<tr>
<td>Example datasets and data services</td>
<td>Description</td>
<td>Intelligent mobility benefit/relevance</td>
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<td>for the Environment</td>
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<tr>
<td><a href="https://data.mfe.govt.nz/search/?q=transport+emissions">https://data.mfe.govt.nz/search/?q=transport+emissions</a></td>
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<tr>
<td>Marine Oil Spills (Maritime New Zealand)</td>
<td>Maritime New Zealand’s challenge is to foster economic activity around New Zealand’s shores by minimising compliance costs, while continuing to safeguard the marine environment. MNZ monitors their contribution to this outcome by producing statistics on the number of oil spills and volume of oil spilled into the environment.</td>
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<tr>
<td><a href="http://www.transport.govt.nz/ourwork/tmil/environmental/ei011/">www.transport.govt.nz/ourwork/tmil/environmental/ei011/</a></td>
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<tr>
<td>Grams of CO₂ (KiwiRail)</td>
<td>To measure progress towards reducing carbon emissions for its customers and to embed sustainability practices into the business.</td>
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<tr>
<td>Sea Levels (National Institute of Water and Atmospheric Research)</td>
<td>To help New Zealanders plan for weather dependent activities and prepare for extreme events. Direct measurement of geo-referenced sea level data at 1 or 5 minute intervals for New Zealand’s Open Coast and Chatham Islands and Scott Base Antarctica.</td>
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</tr>
<tr>
<td><a href="http://www.niwa.co.nz/our-services/online-services/sea-levels">www.niwa.co.nz/our-services/online-services/sea-levels</a></td>
<td></td>
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<tr>
<td>Auckland Airport Noise Monitor</td>
<td>Auckland Airport’s Flight Monitor uses information from air traffic control radar and the airport’s noise and operations monitoring system to provide information about air traffic movements. Information for individual noise monitoring sites can be viewed in real-time along with tracking from aircraft as the approach and leave the airport.</td>
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### People, Things and Movement – data generated by individuals and things as they move around.

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<tr>
<th>Example datasets and data services</th>
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<tbody>
<tr>
<td>Auckland Transport Hop Card.</td>
<td>Auckland’s tag-on tag-off public transport system is operated via the AT Hop Card payment system. This system allows users to register cards to their personal profile to manage spending and through its use generates data about individual’s use of public transport, and real-time patronage of services by route segment. This information is held and managed by Auckland Transport with some information</td>
<td>Future intelligent systems will seek to make use of real-time demand for public transport, and other mobility services, to provide responsive services rather than the fixed schedules and routes that are currently adhered to. This will require greater use of PT tag-on and tag-off data along with data from private companies in a usable format.</td>
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## Example datasets and data services

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<tr>
<td>Made available publicly but individualised and raw patronage data not generally shared.</td>
<td>Future intelligent systems will seek to make use of real-time demand for public transport, and other mobility services, to provide responsive services rather than the fixed schedules and routes that are currently adhered to. This will require greater use of PT tag-on and tag-off data along with data from private companies in a usable format.</td>
</tr>
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</table>

- **Wellington Snapper card.** Wellington also operates a tag-on tag-off public transport card based system, however in contrast to AT Hop this system is contracted to a third party making the data structure and process for accessing information (even for the regional public transport authority itself) different to Auckland. Snapper cards do not need to be registered to a user and there is no online account so individualised information is limited however the quality of information about service patronage remains highly detailed. At present Snapper is not used for Wellington’s train network creating a gap in data about use between bus and rail services. |

- **Christchurch Metro card.** Christchurch operates a tag-on public transport system using the Metro card payment system. Users register cards to their personal profile and through its use generated data about individual’s use of public transport and real-time patronage of services. |

- **Population, households, and estimates of future growth (StatsNZ).** StatsNZ manages all of New Zealand’s Census information and generates population estimates based on existing datasets for relatively small (neighbourhood/suburb) geographic areas in New Zealand. This information is made freely available via StatsNZ online data portal: nz.stat. |

- **Automated pedestrian, cyclist, vehicle tracking through fixed spaces (NEC).** Innovation in the space of automated pedestrian, cyclist and vehicle capture using video footage is being trialled by NEC in central Wellington. These feeds categorise road user types, paths/trajectories through space, and potential conflicts in real time as well as providing overall counts of users by mode. Currently video technologies that identify people and vehicles by mode and track their movements and interaction through space are mostly used for monitoring or are in the development phases. Future applications are important for urban environments where many different users occupy the same space and have the potential to feed into signal phasing and prediction of disruption/conflicts before they occur. |

- **Domestic and International Air Passengers (CAA, AirNZ, Jetstar, Avsec).** The Civil Aviation Authority has some information about domestic air passengers, however detailed information of passenger numbers by route and flight is held by carriers themselves and not made available due to commercial sensitivity. Integrating air travel information with the wider transport system supports ‘door to door’ travel planning – for example the frequency and number of buses and taxis required to transport passengers to and from the airport at any given time. |

- **Location based dataset from cell phone movements (Qrious, Vodafone, Strava).** Qrious, a venture of mobile phone network operator Spark, is tasked with processing personalised location information into aggregated datasets. This data contains highly detailed origin-destination information that is geolocated and real-time. The data capture is Provides a rich perspective of cellphone (and by association people) movements around NZ, not just locally by domestic travel by air also. This information is not able to be captured at such a scale by any other method currently so is likely to be a key input to intelligent mobility applications. |
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<td>now several years old providing a rich source of personal mobility data for all New Zealand. A commercial dataset, Qrious location based data is sold to customers for a fee with insights generally produced by in-house data scientists themselves.</td>
<td>that require a high degree of understanding of movements at fine temporal and spatial scales – network planning and transport modelling approaches may incorporate aggregations of this data.</td>
<td></td>
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<tr>
<td>Fleet tracking (Snitch, EROAD, Teletrac Navman …)</td>
<td>Fleet tracking via GPS is an increasingly common source of vehicle information, though this is generally held by private vendors and not shared to maintain the privacy of customers.</td>
<td>The data can be used to determine issues on the network and to identify points where issues are frequently faced by commercial operators – such as. bottlenecks, delays, heavy braking.</td>
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<tr>
<td>Historical traffic counts (local authorities and NZ Transport Agency)</td>
<td>Traffic counts sourced from loop detectors in state highway and local roads have been stored across a significant period. Some sites have loop detectors active 24/7 but most are deployed for short periods of time annually to captured AADT. This information is held by the relevant road controlling authority and can be sourced for specific purposes on request. NZ Transport Agency also host this information on the TMS database: <a href="https://tms.nzta.govt.nz/">https://tms.nzta.govt.nz/</a>. Information includes traffic volumes, vehicle types and in some cases vehicle speeds. Some road controlling authorities use Miovision’s online service to record, store and use traffic count data.</td>
<td>Can be analysed to determine traffic patterns, for example when and where peak travel occurs over holiday weekends and what actions could be implemented to reduce the overall impact on the network. This historical information becomes powerful when integrated with other datasets e.g. weather data, to explore drivers of patterns. Historical traffic counts also provide valuable context to emerging real time traffic datasets.</td>
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<tr>
<td>Sensor derived traffic information (Bluetooth, WiFi, Optasense, TomTom, acoustic sensor fibreoptics on Harbour Bridge through to Johnstone Hill tunnels). Services such as <a href="http://www.trafficcounts.co.nz/">http://www.trafficcounts.co.nz/</a> created by Abley Transportation Consultants</td>
<td>Detects and measures vehicle movements and traffic patterns (congestions, queuing) in real-time. SCATS (Sydney coordinated adaptive traffic system) data includes traffic volume and turning counts from loop detectors to automatically phase lights depending on traffic flows, some lights are equipped with ‘emergency vehicle’ sensors to allow for rapid phase changes when an emergency vehicle approaches an intersection – improves emergency response time. Some areas (Christchurch, Wellington, Auckland) have bluetooth/wifi monitoring systems which can track routes and speeds at which vehicles, cyclists and pedestrians move around the network.</td>
<td>Essential for intelligent network management and a shift toward automated processes/controls of network operations.</td>
</tr>
<tr>
<td>Road safety data, in the NZ Transport Agency Crash Analysis System (CAS) [<a href="https://securecas.nzta.govt.nz/Citrix/AccessPlatform/auth/login.aspx?NFuse_FandSafetyNET">https://securecas.nzta.govt.nz/Citrix/AccessPlatform/auth/login.aspx?NFuse_FandSafetyNET</a> <a href="https://nzta.abley.com/SafetyNET_2016/">https://nzta.abley.com/SafetyNET_2016/</a></td>
<td>CAS is a database of all reported crashes on public roads in New Zealand, which is updated on a continual basis from traffic crash reports that Police complete. The wait time for reliable data to become available on CAS is around 6-8 months. SafetyNET is a data service where crash data is processed into information for safety-focused network management within a GIS platform.</td>
<td>Is analysed to determine patterns in traffic crashes that can be addressed to create a safer transport system.</td>
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<tr>
<td>Example datasets and data services</td>
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<tr>
<td>Complaints forums</td>
<td>People use official (snap send solve app) and unofficial (facebook, twitter, Greater Auckland blog, Generation Zero better buses campaign) to give feedback about transport services. Many of these are in the public domain, but are in a variety of locations.</td>
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</tr>
<tr>
<td>Household Travel Survey (Ministry of Transport) <a href="http://www.transport.govt.nz/research/TravelSurvey/">www.transport.govt.nz/research/TravelSurvey/</a></td>
<td>This ongoing survey extends to all private dwellings in New Zealand, excluding some in sparsely populated areas. Household: Region, urbanisation, household type, vehicles (car, motorcycle, van, bicycle), make, model, age, engine capacity, ownership. For each person gender, age, employment, income, driving experience, no. of road crashes, no. of trips, ethnicity, marital status, whether drank alcohol on travel days, and location of workplace/school is captured. For each trip made on the travel days: purpose, distance, mode: driver/passenger/cyclist/walking (excludes walking on private property e.g. farms, trips under 100 metres, and tramping tracks), date, time of day, time spent on journey, origin and destination, age and gender of people in the vehicle, and which household vehicle was used.</td>
<td>To measure household travel; to improve road safety; to produce estimates of cycling and walking activity; to provide a basis for monitoring trends in mode share; to provide estimates of vehicle occupancy.</td>
</tr>
<tr>
<td>Domestic Travel Survey (Ministry of Business, Innovation and Employment) <a href="http://www.mbie.govt.nz/info-services/sectors-industries/tourism/tourism-research-data/domestic-travel-survey">www.mbie.govt.nz/info-services/sectors-industries/tourism/tourism-research-data/domestic-travel-survey</a></td>
<td>• Total expenditure of domestic travellers and type of expenditure (accommodation, transport, food and alcohol, gifts, recreation, gambling) • Purpose of visit (holiday, visiting friends and relatives, business, other) • Accommodation types used • Transport types used (aeroplane, car/van, campervan/motorhome/RV, scheduled coach service, coach tour/tour coach, taxi/limousine/car tour, train, commercial ferry/boat, private yacht/boat, bicycle, motorbike, hitchhiking, walking/tramping, other) • Activities and attractions (includes walking and trekking, cycle sports, horse trekking/riding, motor sports, boating, canoeing/kayaking/rafting) • Region (Regional Tourism Organisation region) • Travel companions • Day trip or overnight trip • Length of stay</td>
<td>Survey is to measure the expenditure and travel patterns of domestic tourists within New Zealand. Domestic travel data collected includes day trips (where 40km has been travelled one way from home) and overnight trips.</td>
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### Example datasets and data services

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**Public transport performance measures by region**

**Raw data:**
- Passenger kilometres
- Boardings
- Farebox
- Subsidy information
- Survey data
- Population data from SNZ

**Derived data:**
- Contracted fare revenue per boarding
- Trips per person
- Farebox recovery rate
- Commercial revenue
- Investment is the sum of the NZTA investment, Local Investment, and Crown investment
- Investment per trip
- Investment per passenger kilometre.

**Aeropath** [https://www.aeropath.aero/](http://www.aeropath.aero/) | Organisations like Aeropath will play a critical role in the safe management of air travel (people and goods), and as personal air travel becomes a reality the expected rise in small aircraft over cities and rural areas will need to be managed in real-time with a high degree of accuracy. |

Aeropath is an international Aeronautical Information Management (AIM) and Navigation services provider. Aeropath provide both navigation charting and instrumentation services, and navigation services to track flight paths and plot regional and national airspace movements.

### Disruption and event-related data – dynamic datasets related to physical events that impact transport networks.

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<tr>
<th>Description</th>
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<tr>
<td><strong>Real-time video footage/images of the network</strong> (NZ Transport Agency)</td>
<td>Provide road users with a visual indication of traffic congestion and conditions, which allows them to make informed decisions about their travel. Can be used to detect issues: e.g., wrong-way drivers, traffic incidents</td>
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</table>

There are many cameras on the state highway network that stream live footage online for the public to view. These images/videos provide information to road users of current conditions, and can be monitored during a disruption event to see the effect on the network.

Many local authorities also have networks of cameras on local roads, often for use in optimising signal timings, incident management and enforcement. The HP management system VidSys has recently been
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<tr>
<th>Example datasets and data services</th>
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<tr>
<td>Forward works planning (network managers)</td>
<td>Forward works programmes are mainly for operational use by network management and operation’s authorities/organisations and not shared in a format that is used for journey planning and real-time network status.</td>
<td>Information could be pushed out to other road users and incorporated into their travel plans. For example, knowledge of when and where heavy loads are being moved can alert other commercial drivers to avoid that areas at that time.</td>
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<tr>
<td>Network incidents (traffic operation centres)</td>
<td>Network incident information is communicated to travellers via roadside VMS signage and online alerts, there is currently no formal integration of this information with journey planning apps (public and private) though there is recognised value in doing so. NZ Transport Agency uses the TREIS (Traffic road event information system) to manage road and traffic information on the state highway network, information is communicated to staff and road users.</td>
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<tr>
<td>Temporary Traffic Management records (network management authority)</td>
<td>Temporary traffic management often represent planned works in the road corridor that are likely to impact mobility in some way. These records are largely used for administration and network operations and not used for other uses such as journey planning. Road work closures and disruptions are most commonly communicated to the public via online channels such as NZ Transport Agency’s Twitter account and by VMS signage once travellers are already on the road. Transport for Christchurch was set up post-earthquake to amalgamate data on the unprecedented quantity of road closures/disruptions and communicate them to the public via a dedicated website.</td>
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<tr>
<td>Incident, accident and closures reporting (Thundermaps, Datacom’s Atenno, AA, Waze)</td>
<td>Crowd-sourced reports of road network closures and incidents are commonly utilised by a range of private organisations in New Zealand in lieu of formal datasets shared in real-time from network operation centres. In platforms such as Waze this information is incorporated into Google’s journey planning tools for travellers.</td>
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Public Transport Services – scheduled and real-time data relating to the movement of public transport vehicles, and their characteristics.

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<tr>
<td>Auckland Transport public transport API</td>
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<td>High quality multi-modal public transport route, schedule and pricing information is an essential component for including public transport services in any national or regional MaaS platforms.</td>
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<tr>
<td>Local/regional PT routes and schedules</td>
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<td>Real-time bus, train and ferry information (Metlink, Auckland Transport, Metroinfo)</td>
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<tr>
<td>Auckland Transport API</td>
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<tr>
<td>Aviation schedules and tracking</td>
<td>Airline schedules are available from websites such as Hipmunk (<a href="https://www.hipmunk.com/">https://www.hipmunk.com/</a>), while real time tracking and delays are also provided via Flightradar24 (<a href="https://flightradar24.com/">https://flightradar24.com/</a>) and FlightStats (<a href="http://www.flightstats.com/">http://www.flightstats.com/</a>).</td>
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<tr>
<td>Ship tracking</td>
<td>ShipFinder (<a href="https://shipfinder.co/">https://shipfinder.co/</a>) provides real-time tracking information for vessels internationally. The location of a vessel can be viewed and additional information about the vessel and journey brought up.</td>
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Personal Automobility – the spatial movement of powered personal vehicles (e.g. cars, motorcycles, taxis).

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<tr>
<td>Ride hailing and ride sharing location based datasets (Uber, Trip Convergence, Mevo, CityHop)</td>
<td>As the use of these services rises data is generated about individual’s personal movement. Uber is currently generating most information in this space, though it is confined largely to the urban areas of Auckland, Wellington and Christchurch where they operate. This information is currently not shared openly though discussions with local transport authorities are looking for opportunities to collaborate.</td>
<td>These services provide transportation choice to travellers, and have an important role to play in reducing inefficient point-to-point trips being made in private vehicles. As a result patterns of transport demand may change dramatically and have an effect on the management of the wider network so information about use of these services has high value for local network managers and planners.</td>
</tr>
<tr>
<td>Taxi movements (individual organisations)</td>
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</table>
Example datasets and data services | Description | Intelligent mobility benefit/relevance
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Journey planning tools (Auckland Transport, Metlink) | | Provide people with clear information about transport options. These services should eventually become integrated into MaaS.
Google Traffic, TomTom real-time, Here Maps | Google, TomTom and Here all derive traffic data from in-vehicle or on-person devices. This information is used for journey planning purposes while also building a comprehensive dataset of historical and real-time mobility patterns. | Google, TomTom and Here all derive traffic data from in-vehicle or on-person devices. This information is used for journey planning purposes while also building a comprehensive dataset of historical and real-time mobility patterns.
Car/bike share schemes | Car share (cityhop, your drive) and bike share (next bike) schemes collect data on origins and destinations of trips around various cities. This data is privately held. | Can be used to inform further investment in this emerging area and evaluate uptake and subsequent effect on transport demand and use.
Freight movements through ports (local) | | Can be used to understand freight movements, to better plan areas that would benefit from Freight Priority or where longer signal phases might be needed.
Rail movements (KiwiRail) | | Could help in identifying and preparing for periods of high freight movements to and from ports.
Inter-island freight via ferries (KiwiRail, Bluebridge) | | Could assist with traffic signals being optimised to freight movements, or provide freight priority. There are examples emerging of companies sharing this data with road controlling authorities to inform maintenance programmes, identify high-risk areas and for use in incident management.
Courier track-and-trace data (individual companies) | | Many freight companies use GPS tracking to monitor their fleets. This data is often held privately, either by the freight company or the technology provider.
GPS truck movements (e.g. EROAD, Cortex, Navman, Xcelerate) | Many freight companies use GPS tracking to monitor their fleets. This data is often held privately, either by the freight company or the technology provider. | Could assist with traffic signals being optimised to freight movements, or provide freight priority. There are examples emerging of companies sharing this data with road controlling authorities to inform maintenance programmes, identify high-risk areas and for use in incident management.
Electronic Road User Charges (EROAD, Cortex) | EROAD provide electronic road user charges payments on behalf of commercial operators and has built a dataset of this information including vehicle kms travelled etc. | Data has previously been used to indicate road transport movements to/from sea ports, and average speeds on the State Highway network.
Vehicle weigh stations | | Data has previously been used to indicate road transport movements to/from sea ports, and average speeds on the State Highway network.

Freight connections – data related to the movement of goods by road, rail, sea and air.
**Example datasets and data services**  
**Description**  
**Intelligent mobility benefit/relevance**

| **Weigh-In-Motion (WiM) Reports**  
www.nzta.govt.nz/resources/weigh-in-motion/ | Weigh-in-motion data is collected by NZ Transport Agency at a small number of locations on the state highway network (6 sites in the most recently available annual report). The cost of current technologies are prohibitive for widespread rollout of this technology. Cheaper solutions that can be placed on the road surface rather than built into it are currently being developed and trialled by a range of private companies. | The WiM data is intended to be used as an approximate indication of traffic loading and vehicle weights and data feeds into State Highway Traffic Volumes Data. |

| **Freight Information Gathering System (FIGS)**  
(Ministry of Transport)  
www.transport.govt.nz/sea/figs/ | An overview of freight movements around New Zealand, including containerised freight, rail freight, and bulk coastal freight. Nationwide freight movements by region and by commodity, in both tonnes and tonne-kilometres. This data extends to coastal, rail, and import and export movements. Across modes, the information available extends to commodity type, movement type (e.g. import, transhipment, domestic movement), and origin-destination data by region. | To provide data for modelling potential changes in freight movements, to feed into the National Freight Demand Study; to support central and local government policy and planning decisions. |

**International connections – international travel and cargo to and from New Zealand by air and sea.**

| **Example datasets and data services**  
Airline routes and passenger data (AirNZ, Jetstar, etc) | As for domestic travel, individual airlines hold detailed information relating to passenger numbers, routes and fares which is not widely shared for commercial reasons. Incoming and outgoing passenger numbers through airports are available but not with final destination information. | Integrated planning of inward and outward movements of people and goods, and the required infrastructure/services that support these within the country.  
High quality information about freight movements in particular enables real-time planning for these movements by time of day and route that optimises efficiency for commercial providers and reduces conflict with other road users and congestion. |

| **Flight Radar 24** | International aviation database, information about specific flights by airport, aircraft and flight number can be searched for in historical datasets. |  |

| **Port schedules**  
NZ Register of Ships (Maritime NZ)  
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<td>International Aircraft Movements (Airways NZ) <a href="http://www.airways.co.nz/airways_Services/movement-statistics.asp">www.airways.co.nz/airways_Services/movement-statistics.asp</a></td>
<td>Movement statistics referring to any takeoff, landing or missed approach or oceanic over flights handled by Airways New Zealand. International airport slots data (arrival/departure times and airliner seat capacity) is available from <a href="https://www.acl-uk.org/airport-info/">https://www.acl-uk.org/airport-info/</a>.</td>
<td>To record the number of aircraft movements handled by Airways NZ, the sole Airport Traffic Management provider in New Zealand.</td>
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<tr>
<td>International Maritime Cargo Operators (Maritime NZ)</td>
<td>The number of ships and oil tankers, number of voyages, number of port visits, and tonnes of oil</td>
<td>Measure and monitor maritime cargo trade</td>
</tr>
<tr>
<td>International Visitors’ Survey (IVS) (Ministry of Business, Innovation and Employment) <a href="http://www.med.govt.nz/sectors-industries/tourism/tourism-research-data/international-visitor-survey">www.med.govt.nz/sectors-industries/tourism/tourism-research-data/international-visitor-survey</a></td>
<td>A survey about overseas visitors that collects: Expenditure, places/regions visited, purpose of travel, activities undertaken (water and land based), transport and accommodation used, flight and road travel distances, visitor demographics including origin and length of stay</td>
<td>To measure expenditure and travel pattern trends of international visitors in New Zealand</td>
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<tr>
<td>International Trade Statistics by Port and Tonnage <a href="http://www.stats.govt.nz/browse_for_stats/industry_sectors/imports_and_exports.aspx">http://www.stats.govt.nz/browse_for_stats/industry_sectors/imports_and_exports.aspx</a></td>
<td>Overseas trade statistics providing information about: the value and quantity of imports, exports and overseas cargo; quarterly and annual changes in import and export volumes and prices; and trade surpluses and deficits.</td>
<td>Long-term indicators of changes to overseas trade through New Zealand ports. Planning of transport infrastructure around these ports to support seasonal changes and trends over time can be made based on this information. Imports and exports by tonnage via individual ports provides insights to the road, rail and air services required to support overseas trade. Some of these movements can be tracked in real time to better understand the linkage between domestic goods movements and our overseas links.</td>
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</table>
Consumption and transaction data – individual preferences and retail choices that are both directly and indirectly related to transport.

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<thead>
<tr>
<th>Example datasets and data services</th>
<th>Description</th>
<th>Intelligent mobility benefit/relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic card transaction data (Paymark, Mastercard)</td>
<td>Paymark provides most of New Zealand’s EFTPOS network processing 75% of all electronic transactions. For a fee this information can be obtained by location, industry classification, and transaction values and counts by temporal period. Mastercard and Visa, among other providers of credit cards, hold detailed individual information of spending by customers which is anonymised internally and not shared to maintain the privacy of customers.</td>
<td>Provide trip ‘context’ – why people make certain trips and how trip making could be influenced to take place at certain times of day or by a particular mode. Wider economic benefits currently form the wider business case for transport investment decision making, but the actual impacts are relatively unknown at an accurate/relevant scale. Better understanding of how the transport system promotes/inhibits economic activity is an important component of investing for widespread benefit.</td>
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<tr>
<td>Energy End Use Data (EECA, StatsNZ)</td>
<td>EECA provides an online energy end use database, there is regional information available for 2012 and national data available for 2013 and 2014.</td>
<td>Planning wider infrastructure and resource demands that result from transport activities. As we shift away from imported fossil fuels to NZ generated electric power for the fleet a significant amount of new infrastructure will be required. This will have a major impact on existing businesses and be a shift away from business as usual, information about this transition will be vital for planning investment.</td>
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<tr>
<td>Energy consumption (EV charging stations at commercial and domestic premises)</td>
<td>Shows how transport-related prices, including fuel and construction price, are trending. This covers Regular petrol pump prices, Diesel pump prices, International oil prices, Bunker fuel prices, Jet fuel prices and Road user charges prices.</td>
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<tr>
<td>Fuel pricing (Price Transport Indicators, MBIE, Ministry of Transport)</td>
<td>Economic indicators derived from traffic volume information around NZ, traffic flows are used as a proxy for real-time and real-world economic activity. This uses data from the NZ Transport Agency and StatsNZ.</td>
<td>“The ANZ Heavy Traffic Index shows a strong contemporaneous relationship to GDP, while the ANZ Light Traffic Index has a sixth month lead on activity as measured by GDP”31</td>
</tr>
<tr>
<td>Truckometer (ANZ)</td>
<td>Economic indicators derived from traffic volume information around NZ, traffic flows are used as a proxy for real-time and real-world economic activity. This uses data from the NZ Transport Agency and StatsNZ.</td>
<td>“The ANZ Heavy Traffic Index shows a strong contemporaneous relationship to GDP, while the ANZ Light Traffic Index has a sixth month lead on activity as measured by GDP”31</td>
</tr>
<tr>
<td>Consumer Price Index (CPI): Transport Group (Statistics New Zealand)</td>
<td>The Transport Group and its Subgroups: • Passenger Transport Services: Classes are: • domestic air • international air • rail • road</td>
<td>The CPI is a measure of inflation used to set and monitor monetary policy.</td>
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</tbody>
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<thead>
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<tbody>
<tr>
<td>• sea</td>
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<td>• Private transport supplies and services: Classes are:</td>
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<td>• vehicle servicing and repairs</td>
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<td>• vehicle parts and accessories</td>
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<td>• petrol</td>
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<td>• vehicle fuels and lubricants</td>
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<td>• other private transport services</td>
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<td>• Purchase of Vehicles: Classes are:</td>
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<td>o bicycles</td>
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<td>o motorcycles</td>
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<td>o new cars</td>
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<td>o second-hand cars</td>
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<tr>
<td>Household Economic Survey (HES) (Statistics New Zealand)</td>
<td>Household expenditure on transport.</td>
<td>The survey is an input into the Consumers Price Index, National Accounts, living standards indicators, affordability and socio-economic statistics.</td>
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<td></td>
<td>• Private transport supplies and services</td>
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<td></td>
<td>• Passenger transport services (including domestic and international air transport)</td>
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<td>Data on transport costs can be analysed by:</td>
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<tr>
<td>• Household and individual income by source and asset ownership and</td>
<td></td>
<td></td>
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<tr>
<td>• Household and individual demographic characteristics</td>
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