



# Scenario Planning to Inform Australia's National Inquiry into Freight and Supply Chain Priorities

**CENTRE FOR SUPPLY  
CHAIN AND LOGISTICS**

**PREPARED FOR THE DEPARTMENT OF INFRASTRUCTURE  
AND REGIONAL DEVELOPMENT, NOVEMBER 2017**

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## About the Centre for Supply Chain and Logistics

The Centre for Supply Chain and Logistics (CSCL) at Deakin University is a specialist research and education centre providing independent, industry-focused study and development. CSCL's goal is to provide robust knowledge to support and deliver value to organisations, businesses and individuals operating in the supply chain industry.

CSCL serves a wide range of private and public sector clients throughout Australia and the Asia Pacific region, providing for traditional logistics disciplines in transportation and warehousing, through to sophisticated supply chain functions, including procurement, process and systems planning, and supply chain strategy.

CSCL provides independent advice and objective tested research in the following domains: contract research; applied academic research education; and specialised education programs for small and medium enterprises, industry and government. All of CSCL's activities are underpinned by the diverse and extensive expertise of its people and partners, including senior academic, government and private sector managers.

# Director's Message

Anyone over the age of 30 will likely know the term “Kodak moment” – a shorthand phrase for a picture-perfect scene just waiting to be photographed. It’s a term soaked in the warm light of a 1950s America; of wholesome families sharing roast dinners in pastel-hued suburban kitchens.

For many decades, Kodak products were in almost every home in Australia and the US. The company, based on a successful foundation of film, positioned itself as being in the business of selling happy memories.

Kodak was an innovator. It first developed a digital camera in 1975, but put the project on ice, lest this newfangled contraption make too much of a dent in its film business. For 20 years it dabbled in digital development, but never really saw it as a viable business model; executives assumed that photography would follow the same predictable path that it had done for a century.

Of course, Kodak filed for bankruptcy in 2012.

Now, “Kodak moment” means something very different in the corporate world; it describes an organisation that failed to see a version of the future in which its very existence was threatened. Smart executives strive to ensure they won’t be the next Kodak, the next Blockbuster, but still we see entire industries fall by the wayside: would a smart investor park their money in newspapers or taxis these days?

Renowned physicist Niels Bohr is famously quoted as saying: "Prediction is very difficult, especially about the future."

None of us can know the future. We may comfort ourselves with the illusion that there are some clever folk among us with a knack of foretelling the path ahead. But history shows us that the march of human existence is far from incremental or predictable; life can turn on a moment. It also shows that the most successful organisations – be they militaries, governments or companies – thrive by preparing for as wide a range of eventualities as possible. One can never know what *will* happen; but knowing what *could* happen is a big step in the right direction.

The Centre for Supply Chain and Logistics is proud to present the results of 17 weeks of intensive research into Australia's future freight and supply chain needs. The scenario planning process has involved researchers traversing Australia, speaking to hundreds of people who play key roles in moving goods into, out of, and around the country. The results are a comprehensive analysis of the issues facing the country, and will help to provide a clear pathway forward – no matter what the future might hold.



Dr Hermione Parsons  
Director, Centre for Supply Chain and Logistics  
November 2017

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# 1. INTRODUCTION

# 1.1 Background

In line with a recommendation made in 2016 by Infrastructure Australia<sup>1</sup>, the Australian Government committed in November 2016 to prepare a National Freight and Supply Chain Strategy. The Strategy was to be pursued in the context of Australia's economic and demographic growth, with the purpose of addressing the need for freight and supply chain systems that can support Australia's prosperity, and meeting the expectations from Australian society for a safe, secure and sustainable future<sup>2</sup>.

Work on the Strategy was initiated with the launch of an Inquiry into National Freight and Supply Chain Priorities. The Inquiry seeks to provide advice and evidence for the development of the Strategy, including – among other things – long-term freight and supply chain priorities for action. The terms of reference for the Inquiry include a requirement for scenario planning, encompassing some of the potential drivers of change in freight and supply chains<sup>2</sup>.

To supplement consultation advice in the Inquiry, a range of independent research was commissioned, including – among other projects – work looking at future supply chain trends<sup>2</sup>. To help address the requirement in the Inquiry's terms of reference for scenario planning, the Department of Infrastructure and Regional Development (DIRD) commissioned a scenario planning project built upon scenario planning tools developed by Massachusetts Institute of Technology's (MIT) Center for Transportation and Logistics.

The scenario planning project was conducted by the Centre for Supply Chain and Logistics (CSCL) at Deakin University. It included the identification and validation of potential drivers of change in freight and supply chains in Australia; the development of four scenarios based on these drivers with a time horizon of 20 years; the validation of these scenarios; and finally the facilitation of their application in workshops, to inform the inquiry into Australia's national freight and supply chain priorities.

# 1.2 Methodology

As requested by the Department of Infrastructure and Regional Development, the project's methodology was based on the scenario planning methodology developed by MIT's Center for Transportation and Logistics (CTL) as part of the Future Freight Flows (FFF) Project.

FFF was a US\$1M, three-year-long research project conducted by a small team of MIT researchers for the United States' National Cooperative Highway Research Program, funded by the American Association of State Highway and Transportation Officials, and supervised by the Transportation Research Board and the National Research Council, of the National Academies.

CSCL had a privileged position to adapt and apply this particular methodology of scenario planning, given that Dr Roberto Perez-Franco, a member of the Core Research Team<sup>3</sup> that developed and applied the scenario planning methodology at MIT for the FFF Project, had recently joined Deakin's CSCL after 11 years at MIT CTL. Dr Perez-Franco's area of expertise is supply chain strategy; he led CTL's research initiative on supply chain strategy and established the MIT Supply Chain Strategy Lab<sup>4</sup>.

For the present project with DIRD, Dr Perez-Franco adapted the FFF methodology to fit the much shorter timeline available in this instance, and to strengthen some weak areas in the FFF project. The current project yielded scenarios that were richer than those of MIT FFF in terms of the number of variables explored.

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<sup>1</sup> *Australian Infrastructure Plan*, Infrastructure Australia (2016).

<sup>2</sup> *Inquiry into National Freight and Supply Chain Priorities*, Discussion Paper- May 2017, Commonwealth of Australia (2017)

<sup>3</sup> Future Freight Flows website at MIT CTL (<http://ctl.mit.edu/research/current-projects/future-freight-flows>). Retrieved 12 June 2017.

<sup>4</sup> MIT Supply Chain Strategy Lab (<http://strategy.mit.edu/people>). Retrieved 12 June 2017.

## 1.3 Project Outline

The project started with an examination of potential key drivers of change in freight and supply chains, based on primary data collected expressly for this project from a selected group of experts – through a series of 52 one-on-one interviews – and on relevant literature. Approximately 200 promising future drivers of change were identified, and grouped into 43 categories of driving forces and local factors.

These driving forces and local factors were presented – via an online questionnaire – to a larger group of experts for their validation. Participants were asked about each item's perceived likelihood and expected impact on freight and supply chains. An analysis of the 124 responses received helped CSCL identify the driving forces that were deemed by the experts as most impactful and uncertain.

These were in turn used to create the underlying logic for a set of four divergent and complementary scenarios. A central narrative was prepared for each scenario, describing a vision of the world in 2037, according to each scenario's underlying logic. A series of 16 small vignettes was written as collateral, to help the readers assimilate the salient points of each scenario.

The first draft of the central narrative and the vignettes for each one of the four scenarios was evaluated in terms of their: plausibility; relevance for freight and supply chains; how challenging they are for decision-making; and – as a set of scenarios – in terms of their comprehensiveness, divergence and complementarity. This evaluation was done by means of both feedback on the final draft of the scenarios and later a tailored workshop with members from DIRD and the Inquiry's Expert Panel.

The scenarios were then used in another three workshops, to elicit useful insights on Australia's freight and supply chain future priorities. In these workshops, invited experts and stakeholders applied scenario thinking in a facilitated setting to explore the potential implications that each one of the future scenarios, separately and collectively, could have for Australia, in terms of freight and supply chains.

This final report includes a summary of the key drivers of change, the underlying logic of the four scenarios, the final version of their narratives and companion vignettes, and the implications identified in these workshops.

# 2. INTERVIEWS AND LITERATURE REVIEW

The scenario planning project started by identifying a series of potential future drivers of change. This took place via qualitative interviews with experts, and a review of the relevant literature.

## 2.1 Interviews

A total of 110 experts from different areas relevant to Australia’s freight and supply chains were invited to participate in interviews. In all, 51 interviews were completed. The typical interview was done over the phone, and lasted half an hour. The professional and industry backgrounds of the interview subjects are listed in Tables 2.1 and 2.2.

Summaries of the interviews were analysed qualitatively. This analysis yielded more than 200 potential future drivers of change. To understand the thoroughness of the data analysis process, consider the following example.

- In an interview, a participant may have mentioned the following: “It is likely that convoys and platooning will become more common in controlling trucks on roads”
- In a separate interview, another participant mentioned: “Platooning, or one semitrailer up front like a convoy, but the vehicles behind would not be manned.”
- Another participant mentioned that, due to technology changes in driverless trucks: “There is no reason why you can't have much longer quasi-trains”

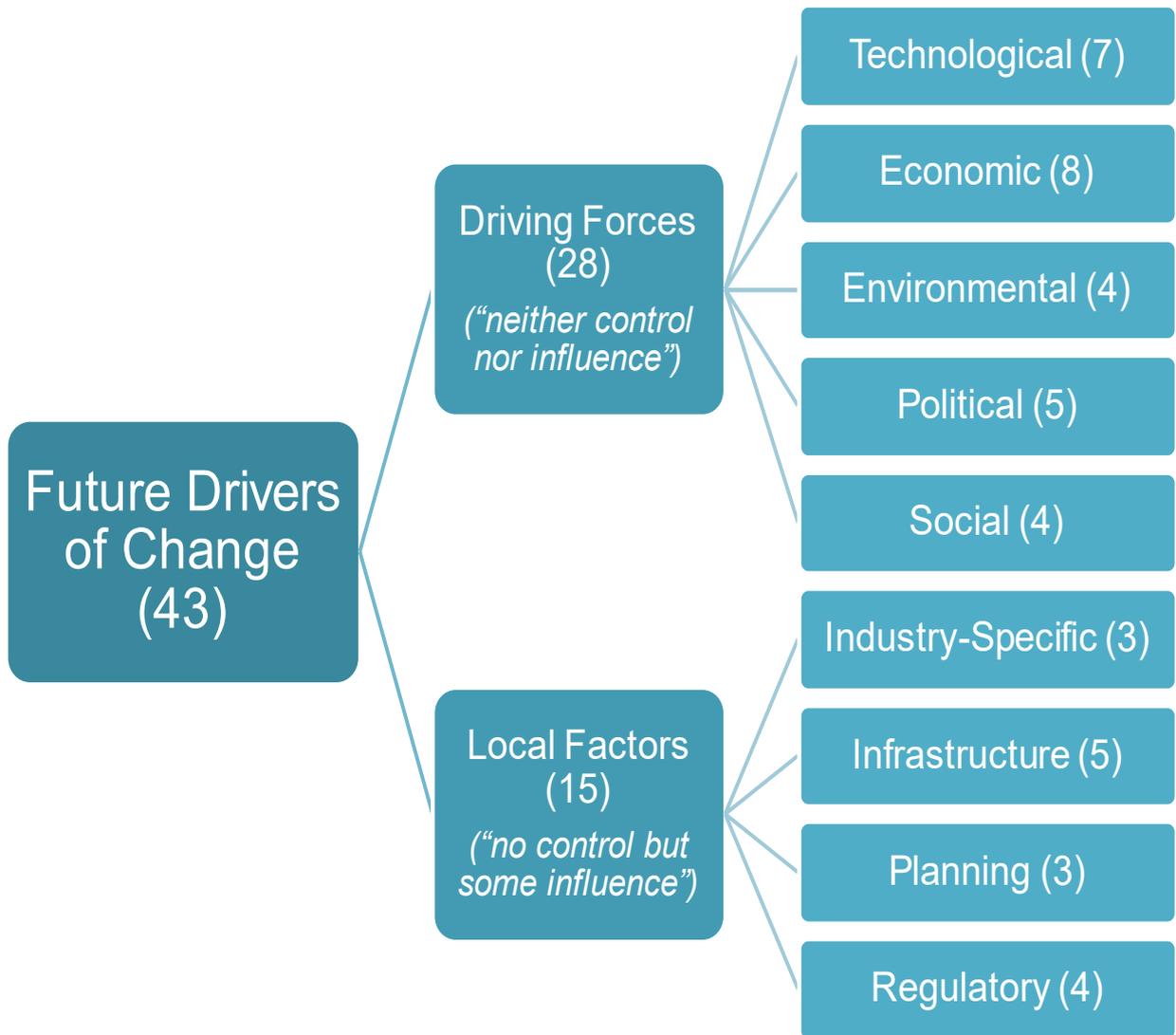
**Table 2.1: Professional Profile of Interview Participants**

- |                              |                              |                         |
|------------------------------|------------------------------|-------------------------|
| • Academic (2)               | • Director                   | • General Manager (4)   |
| • Acting Director            | • Director of Function       | • Head of Division      |
| • CEO (6)                    | • Director of Laboratory (2) | • Head of Function (2)  |
| • Chief Executive            | • Director of Research       | • Managing Director (9) |
| • Chief Executive Director   | • Entrepreneur               | • Maritime Captain      |
| • Chief Supply Chain Officer | • Executive Director (2)     | • President             |
| • Consultant (3)             | • Executive Officer (2)      | • Senior Manager (4)    |
| • COO                        | • Former Federal Minister    |                         |
| • Deputy Secretary           | • General Director           |                         |

**Table 2.2: Industry Profile of Interview Participants**

- |                        |                          |                               |
|------------------------|--------------------------|-------------------------------|
| • Business Consulting  | • Freight and Logistics  | • Retail (3)                  |
| • Business Council (2) | • Government (3)         | • SCM Technology (3)          |
| • Consumer Goods       | • Health                 | • Shipping (2)                |
| • Education (3)        | • Imports / Exports      | • Standards                   |
| • Exports              | • Livestock Transport    | • Supply Chain Management (4) |
| • Food                 | • Logistics (5)          | • Transport                   |
| • Food Products        | • Ports and Maritime (4) | • Transport and Logistics (7) |
| • Freight              | • Rail (2)               | • Trucking                    |

Figure 2.1: A Taxonomy of the Future Drivers of Change Categories



These three different references to platooning and quasi-trains were bundled together into one potential future driver of change, labelled 'Platooning and quasi-trains'. More than 200 of these future drivers of change were identified from the interviews.

## 2.2 Literature and Submissions

Parallel to the interviews, separate researchers conducted a review of the relevant literature and of the inquiry submissions, to supplement the findings of the interviews. Concerning the literature, a series of recent publications – published by government organisations, individuals and the private sector – were reviewed for potential future drivers of change. The findings of this literature review are presented in Appendix 1. Additionally, submissions to the inquiry that were publicly available on the DIRD website were examined for recurrent themes concerning future drivers of change. Findings from both the literature and the submissions were used to identify potential future drivers of change, which were added to the list, or served to supplement those derived from the interviews.

## 2.3 Categorising the Drivers

A list with 43 consolidated categories for the future drivers of change was prepared. To provide a sense of the level of detail that went into this data analysis, consider this example.

The category 'Autonomous Transportation (DF3)' included the following potential future drivers of change:

- Platooning and quasi-trains (which we discussed above)
- Autonomous, assisted and driverless trucks
- Autonomous vehicles and auto-pilot
- Autonomous trains
- Autonomous airplanes
- Autonomous ships and container ships
- Connected intelligent transport systems and connected automated vehicles
- Regulatory challenges in preparing for new modalities and technologies
- Workforce challenge on how to manage a fleet of autonomous vehicles

To facilitate their assimilation, these 43 categories can be further classified into two great groups:

- Driving Forces, which are beyond the control and influence of the stakeholders, and
- Local Factors, which – while beyond their control – can be influenced by stakeholders

A total of 28 of these categories of drivers were deemed 'Driving Forces', and the remaining 15 were deemed 'Local Factors'. Within these two groups, it is possible to identify some families for these 43 categories, which are presented in Figure 2.1. The number in parenthesis indicates how many categories of drivers fall within each 'family'. For example, there are seven driving forces that are – roughly speaking – about technological drivers.

## 2.4 Description of Driver Categories

Each one of the 43 categories has been summarised in a few lines of text. The complete list is presented in Table 2.3, on the following pages.

**Table 2.3: Descriptions of Driving Forces and Local Factors**

**DRIVING FORCES**

**Advanced Manufacturing:** Advanced manufacturing technologies become common, including additive manufacturing and 3D printing, nanotechnology, and advanced materials. A wide range of cost-effective and reliable industrial robots, owned or rented on an hourly basis, are used extensively in factories. Human specialists are required to install the robots, and human supervisors keep an eye on production.

**Automated Facilities:** Freight terminals, including intermodal and container terminals, are automated: a container can go from the deck of a ship to the floor of a warehouse without human intervention. Logistics facilities, such as loading docks and warehouses, are also automated. Orders are picked, packed and shipped at unmanned distribution centres. Many supply chain and business processes are also automated.

**Autonomous Delivery:** Several autonomous systems are developed for last-mile delivery of goods, especially in urban and congested areas. Lightweight, high-value parcels are delivered using autonomous aerial vehicles ('drones'). Parcels that are heavier or less valuable are delivered using autonomous 'hubs on wheels', i.e. unmanned vehicles that drive around urban areas delivering packages to customers.

**Autonomous Transportation:** Autonomous and semi-autonomous transportation becomes widely used. People and packages are driven around our cities in autonomous cars. Driverless trucks – often traveling in platoons – carry freight along highways. Freight is often moved in trains without conductors, container ships without captains, and cargo jets without pilots. Autonomous fleets are remotely coordinated and supervised.

**Blockchain:** Distributed ledger technologies – such as blockchain – become widely used in freight, supply chains and daily life, to track many physical and financial transactions. These technologies replace paper-based documents and regular databases in those cases, providing a permanent and immutable record that allows end-to-end visibility to interested and authorized parties.

**Data:** Global data standards for freight and supply chains are widely adopted. Huge amounts of high-quality data, about all relevant aspects of freight and supply chains, are collected by companies and governments. These data – about goods, vehicles, people, transactions – are then shared extensively and safely, and used productively, in a way that protects privacy and commercial confidentiality.

**Loss of Low-Skilled Jobs:** Low-skilled jobs, both manual and intellectual, are automated or offshored. Certain low-skill business tasks, previously conducted by junior workers, are now outsourced to offshore providers in lower-cost countries, while others are replaced by automation, software and artificial intelligence. There are fewer jobs, which go to people with higher skill-sets, capable of conducting more complex tasks.

**Food and Agricultural Exports:** Exports of Australia's food and agricultural products – particularly to Asia – continue to grow: not only staples (wheat, wool, meat), but also fruits and vegetables and more boutique products, like fish, high-priced lobsters and crustaceans, among others. Australia's reputation as a 'clean and green' producer allows high-quality products to be sold at a premium price in niche markets.

**Less Manufacturing, More Imports:** Australia's international and domestic trade has grown significantly. Australian firms face more competition than ever in a global marketplace. Local manufacturing has continued to decline. Australia relies more than ever on imported goods. Supply chains that were previously domestic now originate offshore, delivering directly to Australian ports. Products then travel less than 100km to the point of consumption. Domestic and international freight flows mix routinely.

**Middle Class Grows Globally:** The world's middle-class population doubles over two decades, in a massive and unprecedented expansion in purchasing power worldwide. Most of this growth occurs in Asia. Hundreds of millions of people around the world can now afford more, and expect to live better lives. Demand for Australian goods increases from both domestic consumers and international trading partners. Work standards increase globally, and so do the cost of goods made abroad, along with their value density.

**Minerals and Batteries:** The widespread adoption of lithium batteries for devices, vehicles, and buildings increases demand for many minerals and metals. Australia – seen as environmentally and socially responsible – becomes one of the world's largest suppliers of these and other commodities. Australian-made batteries, based on lithium and other technologies, are manufactured in giga-factories for export.

**Online Retail, Direct Delivery:** Although bricks-and-mortar stores remain, most consumer demand now goes through online retail channels. For most goods – including groceries, and heavy or bulky

items – consumers in urban areas have come to expect 24/7, same-day delivery of their orders, directly to their homes or to nearby pick-up sites. Hybrid click-and-mortar models are used, along with multichannel and omnichannel.

**The Rise of China:** China – a global superpower – is the dominant player in the Asia-Pacific region. Through its *One Belt, One Road* plan, and other initiatives, China develops strong land and maritime routes with South-East Asia, the Middle East and Europe, improving passenger and freight infrastructure and boosting its trade. China asserts its authority over the South China Sea, which is now the world's most important waterway.

**The Uber Economy:** The 'Uberisation' of the economy (i.e. the shift from full ownership of assets to the renting or leasing of assets) has continued unabated and expanded to areas other than cars and houses. The sharing economy has become the norm. The Uber model is now commonly applied to trucks, freight and distribution systems, while the Airbnb model is now applied to warehouses and other facilities.

**Visibility and Traceability:** Visibility and traceability have become paramount in many supply chains. Due to security issues, countries and some institutions demand complete visibility within certain supply chains, and require answers on chain of custody and ownership. Customers – concerned with fraud, substitution or adulteration – demand a guarantee of provenance, and end-to-end traceability of their products.

**Climate Change:** Signs of climate change are thoroughly documented in thousands of scientific studies. Evidence demonstrates that human activities – especially emissions of greenhouse gases – are primarily responsible. The emerging scientific understanding suggests the speed and impact of global warming will be worse than previously anticipated. Immense public pressure mounts on governments and companies to take decisive action to counter its progression and effects.

**Energy and Carbon Footprint:** The price of fossil fuels increases. Carbon and other greenhouse gas emissions are taxed, capped and traded in global and local markets. Most supply chains and freight lanes are expected to achieve a carbon footprint of zero, by either reducing or offsetting their emissions. Hybrid, electric, fuel-cell and other alternative fuel engines are widely adopted in cars, trucks, trains and ships. Their utilisation is maximised: futile, empty and half-empty trips are reduced or altogether eliminated.

**Green as a Requirement:** Being 'green' is a requirement to stay in business. Sustainability criteria in the design and operation of supply chains and freight networks are a key element for business success. Products are expected to last a long time, and to be repairable, reusable, and recyclable. All packaging supplies are also expected to be reusable and recyclable. Water and waste footprints of manufacturing and other industrial operations are expected to be minimal.

**Urban Congestion:** Population growth concentrates in major cities. Additional housing is built in already settled areas: new houses on the fringes, and large apartment blocks in the city centres. As more people live in them than ever before, city centres become much denser and more congested. Movement of people and goods into and around these urban centres becomes difficult. Ensuring that these new consumers have access to the products and services they require becomes a challenge.

**Exports as Strategic:** Since exports contribute to the GDP of the nation, they are now considered a matter of national importance. Because of this, Australia has made it a strategic imperative to facilitate the timely and cost-effective movement of exports, by sea and air. Federal and state governments work together to ensure that Australia has in place the infrastructure and mechanisms necessary to make Australian exports competitive in global markets.

**Federal v State:** A fundamental problem has become clear, concerning the distribution of power between the federal and state governments. Both levels of government determine policy, yet have political goals and objectives that are often at conflict or in competition with each other. Balancing these competing federal and state interests has proven a roadblock for long-term planning. A lack of coordination between federal, state and municipal governments has worked against long-term planning.

**Fragmentation:** The politics of nationalism and populism make a comeback in many countries around the world. Scepticism about the benefits of globalisation and international collaboration gains traction. Protectionism and thicker borders follow. Many governments implement tougher tariff regimes and higher duties. Several nations implement self-serving policies, that adversely affect other nations.

**Intentional Disruptions:** There is a constant risk of intentional disruptions. This risk may take the form

of terrorism attacks, domestic and international, with communities, companies, facilities or supply chains as their targets. Risks may also take the form of sabotage activities, such as deliberate disinformation campaigns against brands or companies, cyber-attacks on their networks, and sabotage on their products. Cars, trucks, planes, trains and ships, as well as logistics facilities, may be the means or targets for these.

**Short Political Cycle:** The Australian population is increasingly apathetic towards government and distrustful of politicians. Their decisions are often perceived as pursuing political gains. Reaching bipartisan agreement for important decisions proves difficult. The short-term political cycle results in an equally short-term outlook and mindset, with little stability or ongoing ownership of the issues. There is uncertainty around long term planning, because – it seems – “every four years there is a flip flop”.

**Great Expectations:** The generation born in the first two decades of the new millennium has different values, lifestyles and priorities, which are reflected in the type of products and services they decide to consume. These new consumers have more power, because they are better informed and have more choice. Consumer expectations are higher than ever before, in terms of service, quality and corporate responsibility. Consumers will bring their business only to those who meet their expectations.

**Growing Inequality:** Around the world there is increasingly more economic disparity. The percentage of the world’s population that falls into what could be called the ‘middle class’ is greatly reduced. Poverty levels – including extreme poverty – increase dramatically. The inability of hundreds of millions to satisfy their basic needs creates political instability and social tensions, and triggers massive migrations.

**Population Growth:** By 2030, the population of Australia exceeds 30 million. Most Australians reside in urban areas, particularly in capital cities, which are now densely populated. As life expectancy improves, Australia has experienced a significant ageing of its population and workforce. The populations of South-East Asia, Latin America and Africa have grown at even higher rates. Australia remains an attractive destination for skilled immigrants seeking residency.

**Workforce Issues:** Diversity and inclusion are fundamental values: the new workforce is more diverse in terms of ethnicity and gender. Not

enough young people come into freight and supply chains to replace existing workers, contributing to the ageing profile of workers in the industry, and to skill shortages. Labour costs continue to increase. Casual employment increases. It becomes more common for desk workers to work remotely. Driver work hours are now logged automatically by electronic means.

## LOCAL FACTORS

**Complexity & Collaboration:** End-to-end supply chains become much more complex. As their complexity increases, managing these supply chains will require a different skill set from employees, including soft skills (i.e. strategic thinking) and hard skills (i.e. optimisation). Algorithms are used extensively for optimisation. Many opportunities for improved productivity will be possible with industry leadership and genuine collaboration across the supply chain.

**Consolidation:** The consolidation of the shipping industry continues. Container ships and other vessels are larger than ever before. Significant consolidation also takes place in the logistics industry. The remaining logistics players are on average larger and more powerful. They are willing to take on more and more roles within supply chains, to invest more on their facilities, technology and personnel.

**End-to-end Freight:** As opposed to the disconnected freight services of the past, there is now a coordinated freight supply chain that includes road, rail, sea and air. From the point of view of users, freight has become an integrated end-to-end service, one that is simple to use, with a single point of contact and great traceability and reliability.

**Congestion and Bottlenecks:** Australia faces a catastrophic congestion problem. Significant infrastructure bottlenecks slow down the flow of freight and the movement of passengers. An abundance of choke points makes supply chains slower and less productive. Traffic gets worse every year, especially in and around major cities. Roads are full of passenger cars and heavy vehicles. When moving cargo, “there is always a bottleneck somewhere”.

**Improved Ports:** Rail access into ports is improved. New port capacity is built to keep up with demand. A Port Community System is established, to handle electronic communication in ports between the private transport operators (shipping lines, agents, freight forwarders, stevedores, terminals, depots), the private hinterland (pre- and on-carriage by

road, rail and inland waterways), the importers and exporters, the port authorities, customs and other authorities.

**Improved Rail:** Seeking to move freight away from roads and into rails, Government intervenes to make rail more competitive and achieve critical mass. Plans are made, funds are allocated and land is secured for new rail corridors – capable of higher speeds – and intermodal facilities. The inland rail project, a north-to-south corridor moving freight along the east coast, is completed. Passenger and freight rail lines in the city are separated, to improve liveability.

**Intermodal Hubs and Interfaces:** Better coordination between transportation modes is achieved. Intermodal hubs are created to take advantage of higher-efficiency vehicles and rail interfaces. Rail networks, doing the bulk of long distance transport, connect into intermodal hubs, where freight is moved to road transport for the last kilometres to the customer. These intermodal hubs are integrated into the strategies of ports.

**Road Pricing:** As a response to road congestion, a policy of road pricing is implemented. Road users pay an amount calculated as a function of the distance travelled and the capacity of the vehicle. These funds are then used directly to invest in new road capacity. Road pricing is seen as a way to create a more level and transparent playing field, where road and rail freight can compete more equitably.

**Encroachment:** Faced with rising population growth, Australia failed to protect enough land for freight corridors and logistics facilities from urban encroachment. Where infrastructure like roads, rail, ports, airports and intermodal hubs were needed, nearby land was encroached by residential areas and other incompatible activities. This resulted in many areas with curfews and bans of trucks, trains and airplanes. Industrial activities that generate smoke or similar hazards constrain the use of airports. High efficiency heavy vehicles cannot access the consumption centres where goods are needed.

**Freight in Urban Planning:** Awareness of the importance of freight and supply chains for their communities has resulted in a more sympathetic attitude, and improved planning, from city councils. Municipalities now include freight and supply chain considerations in their plans for the design and management of cities and suburbs. These seek to reduce congestion and cost, and to increase safety. Shared warehouse space is available closer to city centres, and intermodal sites are built on the city edges to receive freight

from trucks that is then loaded into smaller vehicles better suited for the urban areas.

**Masterplan:** A holistic masterplan for freight and supply chains in Australia is developed, in coordination with all branches of government – local, state and federal – and in close collaboration with industry. Guided by an apolitical vision, this masterplan identifies future freight and supply chain needs, and provides a blueprint for long term investment in major infrastructure, as well as laws and regulation. Funding is put aside, unaffected by political changes, for a range of projects and programs around this masterplan.

**Coastal Shipping:** The Australian Government amends coastal shipping laws, to remove barriers to accessing coastal shipping. This allows domestic shippers to integrate with international shippers, in using the substantial spare capacity travelling between Australia's coastal ports for carrying domestic cargo.

**Driver Skills:** More attention is given to skill development of truck drivers. In the past, many people driving trucks below 12 tonnes were not properly trained as truck drivers, and generally had a low level of driving skills. Skill development, licensing, and accreditation of all drivers receive more attention as an industry issue. The minimum training required to get a truck licence is now better, and regulatory requirements have been tightened, will less paperwork and greater emphasis on safety.

**Regulatory Burden:** Efforts to reduce the layers of regulation across levels of government have failed. Regulation keeps piling up, and is perceived by industry as rigid, excessive and outdated, neither sufficiently smart nor flexible to keep up with technological developments. The regulatory burden – and regulatory cost – in Australia continues to be very heavy, in terms of both time and money. Businesses strive to keep up with ever more complex regulation, while continuing to be competitive internationally.

**Truck Regulation:** Regulation of the trucking industry is thoroughly rethought and revised. Outdated and duplicated rules are eliminated. Smarter rules are developed to address current issues, including safety concerns. These rules include mandatory minimum safety standards, including for trucks under 12 tonnes that carry local freight. Larger and heavier high-productivity freight vehicles are mostly limited to specific routes that are identified and engineered to fit their weight and other requirements.

# 3. VALIDATION AND SCENARIO LOGIC

**The next step in the scenario planning project was to assess the impact and uncertainty of the different driving forces and local factors. This was done through a survey administered to experts in relevant areas.**

## 3.1 The Survey

A questionnaire was prepared for administration via an online survey. For each one of the 43 driving forces and local factors identified, there was a question in the questionnaire, asking the respondent to assess – using a simple scale – the expected impact that such a development could have on Australia’s freight and supply chains, if it were to become a reality. There was also a second question for each one of the 43 driving forces and local factors, asking the respondent about the perceived likelihood of such a driving force or local factor becoming a reality.

The survey was sent to about 130 contacts, including more than 50 organisations. One of these organisations, the Supply Chain and Logistics Association of Australia, sent it to almost 2800 members. This means the survey reached in the vicinity of 2930 people. We received a total of 124 responses, including 82 complete and 42 partial responses. The average number of responses for each one of the 86 question was 75 responses. The absolute minimum number of responses for any question was 68. Since the survey was anonymous, there is no way to know the exact profile of the respondents.

## 3.2 Survey Findings

Based on the answers to the survey, we calculated three scores: first, a score for the expected impact of the drivers in each category, assuming the drivers in that category were to materialise in the future; second, a score for the perceived likelihood of the drivers in each category; and third, a score for the uncertainty of the drivers in each category. Whereas the first two scores (on impact and likelihood) are just averages of the answers provided by the respondents in the survey, the last score (on uncertainty) required a more sophisticated approach: it was calculated as a combination of two metrics, one on variation on the likelihood answers, and the other on distance of the answer from the 'certain' extremes in the scale.

The tables in Figure 3.1 summarise the impact, likelihood and uncertainty scores for each one of the 28 driving forces and 15 local factors. For the first two, on impact and likelihood, the scores run from 0 to 3, where 0 is extremely unlikely and 3 is extremely likely. For the third, regarding uncertainty, the score is given as a percentage, where scores smaller than 70% represent little uncertainty, and scores closer to 100% indicate a higher level of uncertainty. To assist in their interpretation, next to each numerical score in the table below we provide a verbal interpretation of the score.

# Figure 3.1: Impact, Likelihood and Uncertainty

Driving Forces		Impact		Likelihood		Uncertainty	
		Avg	Interpretation	Avg	Interpretation	Ind.	Interpretation
<b>Technology</b>							
DF01	Data	1.98	Considerable impact	2.24	Moderately likely	79%	Significant uncertainty
DF02	Blockchain	2.06	Considerable impact	2.33	Very likely	76%	Significant uncertainty
DF03	Autonomous Transportation	2.41	Great impact	1.96	Moderately likely	92%	Huge uncertainty
DF04	Automated Facilities	2.37	Great impact	2.16	Moderately likely	87%	Great uncertainty
DF05	Advanced Manufacturing	2.11	Considerable impact	2.05	Moderately likely	87%	Great uncertainty
DF06	Loss of Low-skill Jobs	2.07	Considerable impact	2.36	Very likely	74%	Some uncertainty
DF07	Autonomous Delivery	2.14	Considerable impact	1.83	Moderately likely	90%	Great uncertainty
<b>Economy</b>							
DF08	Food and Agro Exports	1.82	Considerable impact	2.36	Very likely	72%	Some uncertainty
DF09	Minerals and Batteries	1.70	Some impact	1.54	Somewhat likely	82%	Significant uncertainty
DF10	Less Manufacture, More Imports	2.13	Considerable impact	2.34	Very likely	78%	Significant uncertainty
DF11	Middle Class Grows Globally	2.09	Considerable impact	2.17	Moderately likely	85%	Significant uncertainty
DF12	The Rise of China	2.15	Considerable impact	2.26	Very likely	77%	Significant uncertainty
DF13	The Uber Economy	2.14	Considerable impact	2.15	Moderately likely	83%	Significant uncertainty
DF14	Online Retail, Direct Delivery	2.36	Great impact	2.56	Very likely	64%	Very little uncertainty
DF15	Visibility and Traceability	1.87	Considerable impact	2.61	Very likely	61%	Very little uncertainty
<b>Environment</b>							
DF16	Climate Change	2.03	Considerable impact	2.09	Moderately likely	89%	Great uncertainty
DF17	Energy and Carbon Footprint	2.31	Great impact	1.95	Moderately likely	92%	Huge uncertainty
DF18	Green as a Requirement	2.00	Considerable impact	1.82	Moderately likely	91%	Huge uncertainty
DF19	Urban Congestion	2.31	Great impact	2.50	Very likely	68%	Little uncertainty
<b>Political</b>							
DF20	Geopolitical Fragmentation	2.17	Considerable impact	1.54	Somewhat likely	83%	Significant uncertainty
DF21	Intentional Disruptions	1.94	Considerable impact	1.87	Moderately likely	88%	Great uncertainty
DF22	Short Political Cycle	2.01	Considerable impact	2.36	Very likely	78%	Significant uncertainty
DF23	Federal vs State	2.15	Considerable impact	2.31	Very likely	83%	Significant uncertainty
DF24	Exports as Strategic	2.25	Great impact	1.36	Somewhat likely	74%	Some uncertainty
<b>Social</b>							
DF25	Great Expectations	1.71	Some impact	1.99	Moderately likely	90%	Huge uncertainty
DF26	Workforce Issues	1.78	Considerable impact	2.17	Moderately likely	90%	Huge uncertainty
DF27	Growing Inequality	1.96	Considerable impact	1.54	Somewhat likely	85%	Significant uncertainty
DF28	Population Growth	1.74	Some impact	2.20	Moderately likely	80%	Significant uncertainty
<b>Local Factors</b>							
Local Factors		Impact		Likelihood		Uncertainty	
		Avg	Interpretation	Avg	Interpretation	Ind.	Interpretation
<b>Industry-Specific</b>							
LF29	End-to-end Freight	2.23	Considerable impact	1.97	Moderately likely	96%	Huge uncertainty
LF30	Consolidation	2.03	Considerable impact	2.28	Very likely	77%	Significant uncertainty
LF31	Complexity & Collaboration	2.14	Considerable impact	2.24	Moderately likely	78%	Significant uncertainty
<b>Infrastructure</b>							
LF32	Congestion and Bottlenecks	2.60	Great impact	2.30	Very likely	83%	Significant uncertainty
LF33	Intermodal Hubs and Interfaces	2.29	Great impact	1.96	Moderately likely	91%	Huge uncertainty
LF34	Improved Ports	2.25	Considerable impact	1.93	Moderately likely	89%	Great uncertainty
LF35	Improved Rail	2.26	Great impact	1.41	Somewhat likely	84%	Significant uncertainty
LF36	Road Pricing	2.21	Considerable impact	1.72	Somewhat likely	93%	Huge uncertainty
<b>Planning</b>							
LF37	Freight in Urban Planning	2.14	Considerable impact	1.36	Somewhat likely	83%	Significant uncertainty
LF38	Encroachment	2.53	Great impact	2.15	Moderately likely	90%	Huge uncertainty
LF39	Masterplan	2.54	Great impact	0.69	Not likely	60%	Very little uncertainty
<b>Regulations</b>							
LF40	Regulatory Burden	2.36	Great impact	1.84	Moderately likely	94%	Huge uncertainty
LF41	Driver Skills	1.51	Some impact	1.49	Somewhat likely	81%	Significant uncertainty
LF42	Truck Regulation	1.85	Considerable impact	1.61	Somewhat likely	82%	Significant uncertainty
LF43	Coastal Shipping	2.01	Considerable impact	1.16	Slightly likely	72%	Some uncertainty

## 3.3 Selecting the Axes

Following the methodology developed at MIT for the Future Freight Flows project, in this project we built our scenarios based on a 2-by-2 logical grid (Figure 3.3). This grid is created by selecting two driving forces (or groups of driving forces) to serve as its axes. These axes should represent the driving forces (or groups of driving forces) with the highest combined level of uncertainty and impact. That is to say, the potential events that are less certain and most impactful.

Figure 3.2, which plots the different driving forces for our project in terms of their uncertainty and impact scores, shows clearly that driving forces 3, 4 and 17 (found on the top right corner of the graph, within the red box) have - by far - the greatest combination of impact and uncertainty. In a close second come the driving forces 7, 5, 16 and 18 (inside the yellow box).

Two clear themes can be identified in these driving forces: automation technology and environmental pressures. Because of this, for our project, we determined the two axes as the basis for our 2-by-2 logical grid, as follows (notice that each axis is composed of several driving forces.)

### Axis 1: Automation Technology

- DF3 Autonomous vehicles
- DF4 Automated facilities
- DF5 Advanced manufacturing
- DF7 Autonomous delivery

### Axis 2: Environmental Pressures

- DF17 Energy and carbon footprint
- DF16 Climate change
- DF18 Green as a requirement

## 3.4 Defining the Full Scenario Logic

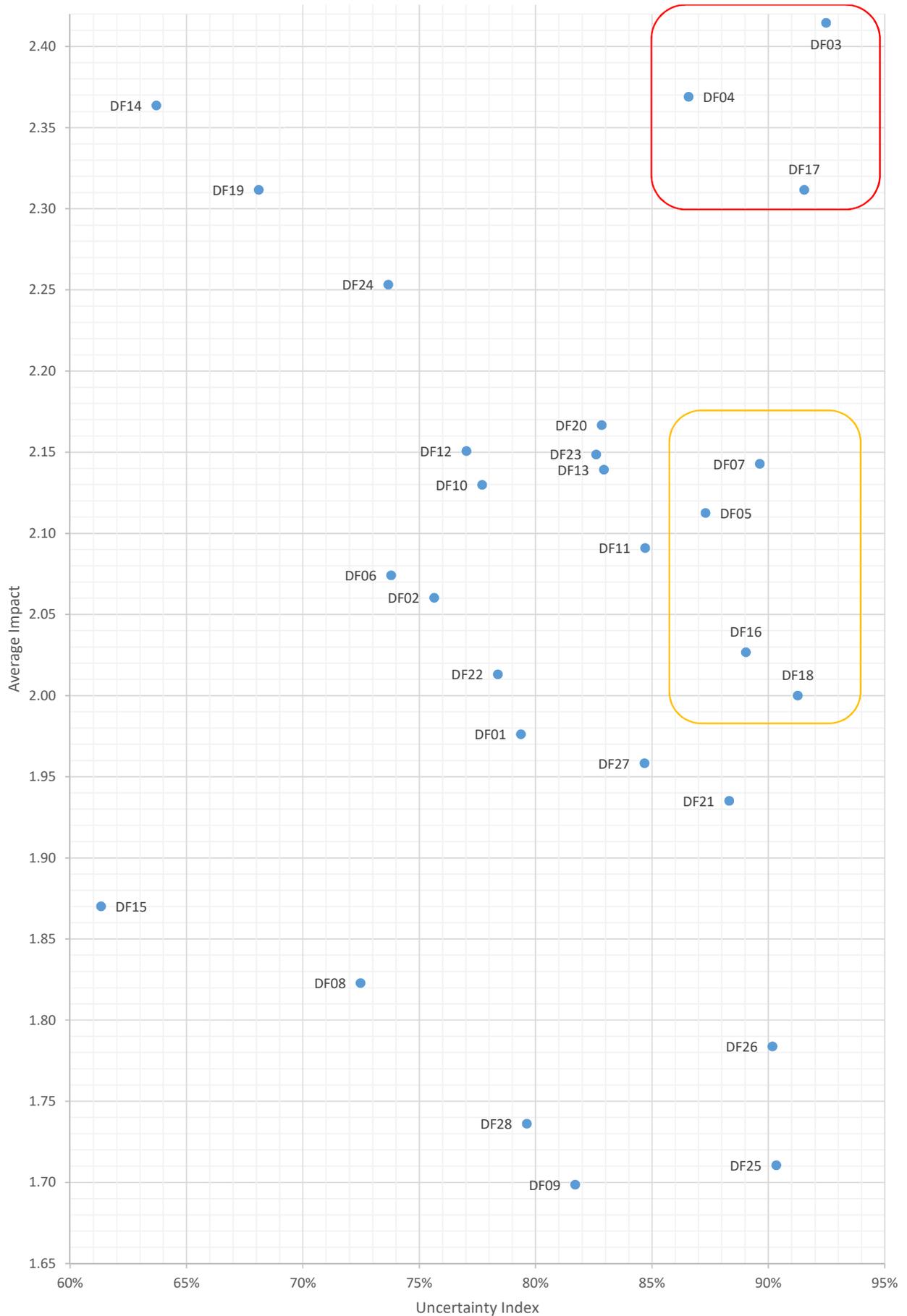
Upon the basis of this 2-by-2 grid, a full scenario logic is defined, with one scenario in each quadrant of the grid, numbered 1 through 4. This full logic is achieved by assigning different values of the driving forces to the four quadrants of the grid, with a frequency that matches their perceived likelihood and in a way that displays an internal coherence with the world being depicted in each quadrant.

Figure 3.3 shows the allocation of the different driving forces in the four scenarios. The presence of a driving force represents a scenario where that driving force is present in a strong or high form; an absence represents a scenario where that driving force is manifest in a weak or low form; and a "tempered" impact represents a scenario where that form takes some intermediate value between the strong and weak forms.

Notice that driving forces that were deemed by respondents as very likely (such DF14 'Online Retail, Direct Delivery' and DF15 'Visibility and Traceability') are present in all four scenarios in their strong or high form. All other driving forces have a weak or low value in one or two scenarios, depending on how likely they were deemed by the respondents.

Only driving forces are included in the scenario logic. Local factors, on the other hand, are not included in the scenario logic, because doing so would presuppose an outcome regarding something that falls within the scope of the question being explored by the scenario exercise. Please notice that categories 29, 30 and 31 are, nevertheless, included in the scenario logic after they were reclassified as driving forces instead of local factors. This reclassification resulted from a reassessment concerning whether they fell within the scope of influence of the stakeholders, based on feedback from the Inquiry's Expert Panel during a September progress report.

Figure 3.2: Driving Forces: Uncertainty v Impact



# Figure 3.3: Allocation of Driving Forces to Scenarios



# 4. SCENARIO NARRATIVES

**The next step was to create the narratives and vignettes that together constitute the four scenarios. The narratives serve as the central piece for each one of the four scenarios, and the companion vignettes serve to facilitate the assimilation of their main points of each scenario.**

It is important to notice that the four scenarios describe some out of many potential versions of the future. They were designed as aids to facilitate strategic discussion on Australia's freight and supply chain priorities. They are neither forecasts nor predictions, and should not be interpreted as preferred or official versions of the future.

The first step in developing the narratives was a rigorous, logical testing of their composing driving forces and their values. This aimed to ensure internal coherence and to provide nuance to the different values of the driving forces, in order to reduce or clarify seemingly contradicting situations.

Once logical coherence was established, the four detailed scenario narratives were carefully crafted. From the starting point of four lists of driving forces, stories were spun in order to provide context, texture and realism to each one of the scenarios, as rich, plausible, relevant, challenging and divergent visions of the future. The objectives the authors had in mind when creating the scenarios included the following:

- Each scenario should be *challenging*, pushing decision-makers outside of their comfort zone. Presenting a version of the future that is substantially similar to the present would defeat the purpose of the scenario planning exercise.
- The scenarios, as a set, should be *divergent*, different from each other. Presenting too similar scenarios only leads to too similar outcomes. Similarly, the scenarios should be *complementary*, in that, if a scenario pushes participants in a given direction for an uncertain force, then another scenario should push them in the opposite direction of that uncertain force.
- The scenarios should be *tempered* and *balanced*, shying away from purely optimistic or pessimistic visions. Far from utopias or dystopias, they should present the world as a place of dynamic, changing forces that include both challenges and opportunities. A world with too much happening can present too many issues for participants to consider; but worlds where nothing is happening prove to not be challenging enough.
- The scenarios should be *plausible* and *realistic*. This means the scenarios need to be *internally consistent*. It also means they must be based on informed observation of what is actually happening today and what is possible in the timeframe chosen for the scenarios, in this case 20 years.
- The scenarios should be *neutral*, in that they should not answer any of the questions that are on the table for decision-makers to consider. Scenarios are a tool to prompt strategic discussions amongst the expert participants. As such, they should not presume the failure or success of things within the control of decision-makers, so that they are allowed to draw their own conclusions about how to deal with the future.

For the present project, the four narratives prepared were:

1. *The Rise of the Machines*: A world of high technological advancement, and of high concern for the climate;
2. *Enter the Dragon*: A world of advancing technology, but one with little concern for the climate;
3. *Flat, Crowded and Divided*: A world where there is neither climate concern nor rampant automation, but instead the influence of increased population and inequality;
4. *Big Brother Goes Green*: A world of high climate concern, but where the promise of automation development has failed to come to fruition.

To further aid in the assimilation of the key points of the different scenarios, a suite of vignettes – in the form of newspaper articles – was prepared, giving the participants an insight into snippets of the future. We deliberately presented a mixture of “positive” and “negative” news stories within each scenario, reflecting the mix of challenges and opportunities described above, and the reality of life. The full suite of narratives and vignettes is available for download here:

<http://cscl.space/scenarios>

## 4.1 Scenario 1: The Rise of the Machines

In 2037 the evidence that man-made climate change is worse than previously anticipated, in both its impact and speed, is overwhelming. There is immense public pressure to take decisive action to counter its progression and effects. A series of international initiatives – involving governments, industries and communities – seeks to curb the negative effects of human activities on the environment. Moving energy production to renewables, minimising the use of fossil fuels, curbing greenhouse gas emissions, and reducing soil and water pollution now rank among the most pressing issues facing mankind, beyond partisan politics, and are widely seen as moral imperatives.

Fully supporting these environmental initiatives is necessary to stay in business. Gone are the days of short-lived and disposable products: goods are now expected to last a long time, and to be fully repairable, reusable, and recyclable. Sustainability criteria are given strategic weight in the design and operation of supply chains and freight networks. Packaging is also expected to be reusable and recyclable. Water and waste footprints of manufacturing and other industrial operations are expected to be minimal.

The price of fossil fuels has increased enormously. Carbon and other greenhouse gas emissions are taxed, capped and traded in global and local markets. Most supply chains and freight lanes are expected to achieve a carbon footprint of zero, by either reducing or offsetting their emissions. Hybrid, electric, fuel-cell and other alternative fuel engines are widely adopted in cars, trucks, trains, ships and even some planes. Their utilisation is maximised: futile, empty and half-empty trips are reduced or eliminated.

Driven by the twin engines of big data and automation, a veritable technological revolution has taken place over the past two decades, sending shockwaves through the manufacturing and supply chain landscapes.

Automation was developed and adopted much faster and more widely than anybody expected. In manufacturing, the most visible sign of the automation revolution is robotics: a wide range of cost-effective and reliable industrial robots, owned or rented on an hourly basis, are used extensively in factories. Advanced manufacturing technologies – including additive manufacturing (3D printing), nanotechnology, and advanced materials – are now common.

The effects of automation have also been felt in freight and supply chains. Autonomous and semi-autonomous transportation is widely used. Unattended children are driven around suburbs in autonomous cars. Driverless trucks – often traveling in platoons – carry freight along highways, and freight trains operate without drivers. Even container ships sail without crews and cargo jets fly without pilots. Autonomous fleets are remotely coordinated and supervised. Freight terminals, including intermodal and container terminals, are automated: a container can go from the deck of a ship to the floor of a warehouse without human handling.

Logistics facilities, such as loading docks and warehouses, are also automated. Orders are picked, packed and shipped at unmanned distribution centres. Many supply chain and business processes are also automated. Several autonomous systems have been developed for last-mile

delivery of goods, especially in urban and congested areas. Lightweight, high-value parcels are delivered using autonomous aerial vehicles ('drones'). Parcels that are heavier or less valuable are delivered using autonomous 'hubs on wheels', that is, unmanned vehicles that drive around urban areas delivering packages to customers.

Data generation, sharing and utilisation has exploded. Global data standards for industry, including for freight and supply chains, have been widely adopted, and huge amounts of high-quality data – about all aspects of business, freight and supply chains – are now routinely generated and collected by companies and governments. These data – about goods, vehicles, people, transactions – are then shared extensively and safely, and used productively, in ways that protect consumer privacy and commercial confidentiality.

Since visibility and traceability are now paramount in many supply chains, distributed ledger technologies – such as blockchain – are widely used in freight, supply chains and daily business operations, to track many physical and financial transactions. Due to security concerns, countries and some institutions demand complete visibility within certain supply chains, and require answers on chain of custody and ownership. Customers, concerned with fraud, substitution or adulteration demand a guarantee of provenance, and end-to-end traceability of their products. Blockchain and similar technologies have replaced paper-based documents and regular databases, providing a permanent and immutable record that allows end-to-end visibility to interested and authorised parties.

The combination of automation and data has fuelled the 'Uberisation' of the economy (i.e. the shift from full ownership of assets to the renting or leasing of assets), which has continued unabated and expanded to areas other than cars and houses. The sharing economy has become the norm: the Uber model is now commonly applied to trucks, freight and distribution systems, while the Airbnb model is applied to warehouses and other facilities.

One significant upside of automation is that Australian manufacturing has made a comeback. Automated production facilities are not set back by high labour costs. It started with Australian-made batteries, manufactured in giga-factories for export. Australia's exports are now experiencing a golden age. A whole portfolio of high-value, innovative goods manufactured in Australia is routinely exported to markets in Asia, Europe and North America, where they command premium prices thanks to Australia's brand as an environmentally and socially responsible producer.

There are also significant exports of Australian minerals and agricultural products. Rare elements and metals, mined with high social and environmental standards, as well as grains, dairy, fruits, vegetables and seafood – all of them sold under Australia's brand as 'clean and green' products – are sold at premium prices in niche markets, particularly in Asia. On the low-value end of the spectrum, however, local manufacturing has continued to decline. For simple and cheap consumer products, Australia relies more than ever on imported goods.

The major downside of automation is unemployment: low-skilled jobs, both manual and intellectual, have been automated. While tens of thousands of specialist jobs have been created to install the robots and supervise production in these automated factories, tens of millions of menial and repetitive manufacturing jobs around the world have been lost to the machines. The same goes for desk jobs: low-skill business tasks, previously conducted by junior workers, are now done through automation, software and artificial intelligence. There are fewer jobs, and these go to people with higher skill-sets, capable of conducting more complex tasks.

Partly because of the reduced employment opportunities, and partly because of the negative effects of conflicts and global warming, there is increasing economic disparity globally. The percentage of the world's population that falls into what could be called the 'middle class' is

greatly reduced. Poverty levels – including extreme poverty – have increased dramatically. Within Australia, several millions now face the challenge of satisfying their basic needs without full employment. This creates political instability and social tensions, which are often expressed as intentional disruptions: sabotage activities, such as deliberate disinformation campaigns against brands or companies that are seen as putting people out of work, are not uncommon. These include cyber-attacks on their networks, and sabotage on products, vehicles and facilities.

The population of Australia has grown faster than expected. Most Australians reside in urban areas, particularly in capital cities, which are now densely populated. As life expectancy improves, Australia has experienced a significant ageing of its population and workforce. Internationally, the populations of South-East Asia, India, Latin America and Africa have grown at even higher rates. Australia remains an attractive destination for skilled migrants seeking residency. Population growth is happening in both major cities and rural areas. Within cities, additional housing is being built in already settled areas: new houses on the fringes, and large apartment blocks in the centres. As more people live in them than ever before, city centres are denser and more congested. Movement of people and goods into and around these urban centres is now more challenging. Ensuring that consumers have access to the products and services they require is not a trivial issue.

Although brick-and-mortar stores remain, most consumer demand now goes through online retail channels. For most goods – including groceries, and heavy or bulky items – consumers in urban areas have come to expect 24/7, same-day delivery of their orders, directly to their homes or to nearby pick-up sites. Hybrid click-and-mortar models are used, along with multichannel and omnichannel.

In part due to the high unemployment, the Australian population is increasingly apathetic towards government and distrusting of politicians, whose decisions are often perceived as made predominantly for political gain. Reaching bipartisan agreement for important decisions proves difficult. The short-term political cycle results in an equally short-term outlook and mindset, with little stability or ongoing ownership of the issues. There is uncertainty around long-term planning, because it seems that “every four years there is a flip-flop”. Besides this, a fundamental problem concerning the distribution of power between the federal and state governments has become clear: both levels of government determine policy, yet have political goals and objectives that are often conflicting or in competition with each other. Balancing these competing federal and state interests has proven a roadblock for long-term planning. Moreover, a lack of coordination between federal, state and local governments has worked against long-term planning.

The consolidation of the shipping industry continues. Container ships and other vessels are larger than ever before. Significant consolidation has also taken place in the logistics industry. The remaining logistics players are on average larger and more powerful. They are willing to take on more roles within supply chains, and to invest more in facilities, technology and personnel. End-to-end supply chains have become much more complex.

As their complexity increases, managing these supply chains requires a different employee skill set, including soft skills (e.g. strategic thinking) and hard skills (e.g. optimisation). Algorithms are used extensively for optimisation. On the up side, many opportunities for improved productivity are possible with industry leadership and genuine collaboration across the supply chain.

## 4.2 Scenario 2: Enter the Dragon

Sit back and have a drink: the machines are in charge now. (Not quite! But everywhere you look in 2037, the promise of automation has been fully realised.)

The robots do most of the manufacturing and are ubiquitous in factories. They are surprisingly cost-effective, and can be either owned or rented on an hourly basis. Of course, humans do the installation, and some supervisors keep an eye on things as they run; but otherwise, robots rule the workplace. Advanced manufacturing, including additive manufacturing (3D printing), nanotechnology and the use of advanced materials, is the new game in town. And it is huge.

Freight terminals, including intermodal and container terminals, are automated: you can get a container from the deck of a ship to the floor of a warehouse without human intervention. It's the same situation in logistics facilities, where the only humans hanging around loading docks are hiding from the boss. Orders are picked, packed and shipped at unmanned distribution centres, while many supply-chain processes are also automated.

Out in the real world, many truckies and posties are out of a job. Autonomous and semi-autonomous transportation is widely used; people and packages are driven around in autonomous cars. Freight is often carried in driverless trucks up and down the highways, in trains without drivers, container ships without crews, and cargo jets without pilots. These fleets are remotely co-ordinated and supervised. Meanwhile, several autonomous delivery systems have taken responsibility for the last-mile delivery of goods, particularly in the big smoke. Lightweight, high-value packages zip overhead, attached to drones. Bulkier or less time-dependent parcels are delivered using autonomous 'hubs on wheels', unmanned vehicles that roam around the streets in much the same way a postie used to (but without complaining about sore feet.)

All this means that low-skilled jobs are a thing of the past. Be they manual or intellectual, low-skill and repetitive tasks are either automated or sent offshore. The jobs that are left go to people with higher skill sets, capable of conducting more complex tasks.

Shoppers are doing most of their buying online, but might occasionally pop into a bricks and mortar store. Buyers have come to expect 24/7, same-day delivery on pretty much everything, from groceries to furniture. And they want them delivered to their home, or work, or any place that's convenient to them. Hybrid click-and-mortar models are used extensively, along with multichannel and omnichannel.

In 2037, shoppers have very high standards. They want full visibility and traceability of the goods they are buying; concerned with fraud, substitution or adulteration, they demand answers on chain of custody and ownership, want a guarantee of provenance, and require end-to-end traceability of their goods.

To thrive in this complex environment, supply-chain operators have had to embrace the digital revolution. Global data standards for freight and supply chains have been widely adopted, and huge amounts of high-quality data are collected by companies and governments. These data – about goods, vehicles, people and transactions – are shared extensively and used productively, while still respecting consumer privacy and commercial confidentiality.

Underpinning these transactions are distributed ledger technologies, such as blockchain, which are widely used to track freight movements and financial transactions. These technologies have replaced paper-based documentation and regular databases, providing a permanent record that enhances end-to-end visibility.

End-to-end tracking has also been made easier in the shipping industry as consolidation continues. Container ships and other vessels are larger than ever before. Significant consolidation has taken

place in the logistics industry, too, and the players that remain are bigger and more powerful than ever. They are willing to take on more roles within supply chains, and to invest more in technology, facilities and people. Supply chains have fewer disconnects, and use a co-ordinated approach that includes sea, rail, road and air. For customers, it's now all one seamless, easy-to-use system with a single point of contact.

Australia, at the level of both government and citizens, increasingly sees exports as a matter of national importance and crucial to the nation's GDP. Governments (at all levels) have made it a strategic imperative to facilitate the timely and cost-effective movement of exports – mostly agricultural, but also some manufactured goods and minerals – by sea and air.

Chief among those export priorities is food and agricultural exports, particularly to Asia. And it's not just the basics such as wheat, wool and meat, but fruit, vegetables and a range of high-end products such as fish, lobsters and other crustaceans. Our reputation as a 'clean and green' producer allows high-quality products to be sold at a premium price in niche markets. The Asian middle class has grown significantly on the back of Chinese power. Most other countries have experienced a similar trend, to different degrees. Population growth worldwide has plateaued, and inequality isn't considered the problem it once was. As a result, terrorism is less of a threat than it has been for a long time. Migration levels are very manageable.

China is now a major economic and political power on the world stage, a very close second to the United States, and is expected to become the dominant political and economic force within a few decades. It projects its geopolitical influence boldly across the Eastern hemisphere. China has strong land and maritime connections throughout South-East Asia, the Middle East, Africa and Europe, and total authority over the South China Sea, now the world's most important waterway. China's domestic passenger and freight infrastructure also boosts its ability to get the job done.

As the global marketplace becomes even more competitive, Australia is manufacturing less at home and importing a lot more. Supply chains that were previously domestic now originate offshore, delivering directly to Australian ports. Products then travel less than 100km to the point of consumption. Domestic and international freight flows mix routinely.

Australia's population has concentrated in the major cities, with plenty of apartment development in inner areas, and new houses on the fringes. This can pose challenges for the movement of goods around these urban centres.

Our short political cycle continues to frustrate. Voters are increasingly apathetic towards government, and distrusting of politicians. Short-term political gain seems to trump long-term planning, and there is little stability or ongoing ownership of issues. It is the general perception that there is an about-face every four years.

Globally, nationalism and populism remain very much in the picture. Protectionism and stronger borders follow widespread scepticism about the benefits of globalisation and international collaboration. Many governments have turned to tariffs and duties to keep the voters happy, but these self-serving policies adversely affect other nations.

This nationalistic approach has also led to many of the world's leading nations largely turning a blind eye to the threat of climate change. Consumer expectations regarding environmental sustainability are in general not very high; most consumers are happy to buy reasonably sustainable products, as long as prices are affordable. Reflecting this public attitude, mandates from government and standards in industry in developing countries with respect to sustainability are equally tempered. Rules are designed to be pragmatic, and not slow down the progress of industry, while maintaining a reasonably low impact on the environment.

## 4.3 Scenario 3: Flat, Crowded and Divided

In 2037, the revolutionary promise of automation technologies (robotics, artificial intelligence, autonomous vehicles and automated facilities) has mostly dissipated. Australia's rapid population growth, in part fuelled by migration, has led to an unwillingness in the private sector to invest in technology; labour is accessible, relatively cheap, and – as opposed to automation – it doesn't require years of research and development funding.

Most Australians reside in urban areas, particularly in capital cities, which are now densely populated. Additional housing is built in already settled areas: new houses on the fringes, and large apartment blocks in the city centres. As more people live in them than ever before, city centres become denser. Ensuring that these new consumers have access to the products and services they require becomes something of a challenge.

Faster-than-expected population growth has also been a feature in Africa, South-East Asia, India and Latin America. Unfortunately, this has also resulted in more economic disparity; around the world there are now more people living in poverty and extreme poverty, both as a percentage and in number, than ever before in human history. Growing poverty and inequality have led to a rise in unrest around the world.

The inability of hundreds of millions of people to satisfy their basic needs creates increased political instability and social tensions, and triggers mass migrations. Radical movements have found fertile ground: terrorist attacks and other intentional disruptions, often affecting freight and supply chains, are relatively common. Maintaining safe freight lanes and supply chains through these regions requires intense and close collaboration across governmental jurisdictions and with multiple organisations.

In developing nations, the threat of climate change – although very serious – has been overshadowed by more immediate problems like poverty, conflicts and terrorism, and the struggle for equitable access to the necessary means for survival. In these nations, consumer expectations regarding environmental sustainability are in general not very high; most consumers are happy to buy reasonably sustainable products, as long as prices are affordable.

Reflecting this public attitude, mandates from government and standards in industry in developing countries with respect to sustainability are equally tempered. Rules are designed to be pragmatic, and not slow down the progress of industry, while maintaining a reasonably low impact on the environment.

China – now a global superpower and the dominant player in Asia Pacific – has asserted its authority over the South China Sea, now the world's most important waterway. Through its Belt and Road Plan, and other initiatives, China has developed strong land and maritime routes with South-East Asia, the Middle East, Africa and Europe, improving passenger and freight infrastructure and boosting trade. Economic prosperity has allowed China's middle-class population to quadruple over two decades. In a massive and unprecedented expansion in purchasing power, hundreds of millions of Chinese citizens can now afford more, and expect to consume better products and live better lives.

In Australia and other developed nations around the world, as well as in major Chinese cities, there is a whole generation of consumers (born in the first two decades of the new millennium) that has different values, lifestyles and priorities, which are reflected in the type of products and services they consume. These new consumers have more power as they are better informed and have more choice. Most of their consumer demand now goes through online retail channels.

For most goods – including groceries, and heavy or bulky items – consumers in urban areas have

come to expect 24/7, same-day delivery of their orders, directly to their homes or to nearby pick-up sites. Hybrid click-and-mortar models are used, along with multichannel and omnichannel.

The expectations of this new generation of middle-class consumers are also higher, in terms of service, quality, social responsibility and environmental sustainability. Consumers will bring their business only to those who meet their expectations. Regulations and standards regarding product quality, environmental impact and work conditions for goods made or sold in developed nations are tougher than ever before. As standards rise, so do the cost of goods, and their value density.

Due to security and environmental sustainability issues, there is an expectation of complete visibility and traceability within certain supply chains, including chain of custody, guarantee of provenance, and end-to-end traceability of many products. End-to-end supply chains have become much more complex, and managing them requires a different employee skill set, including soft skills (e.g. strategic thinking) and hard skills (e.g. optimisation). Algorithms are used extensively for optimising efficiency.

Many opportunities for improved productivity are possible with industry leadership and genuine collaboration across the supply chain. However, collaboration comes with challenges. The spread of big-data collection and sharing has cooled down after a series of very public and financially painful large-scale cyber-attacks, in which sensitive data was stolen and misused.

Australian firms face more competition than ever in a worldwide market. As local manufacturing continues to decline, Australia relies more than ever on imported goods. Supply chains that were previously domestic now originate offshore, delivering directly to Australian ports

Domestic and international freight flows mix routinely. At the same time, demand for Australian goods increases from both domestic consumers and international trading partners. Exports of Australia's food and agricultural products, particularly to China, continue to grow: not only staples (wheat, wool, meat), but also fruits and vegetables and more boutique products, like fish, high-priced lobsters and other crustaceans, among others. Australia's reputation as a 'clean and green' producer allows high-quality products to be sold at a premium price in niche markets in China and some capital cities across South-East Asia.

Australia remains an attractive destination for skilled migrants seeking residency. In the new workplace, diversity and inclusion are fundamental values: the new workforce is more diverse in terms of ethnicity and gender. Labour costs continue to increase, as does the rate of casual employment. Driver work hours are now logged automatically by electronic means. The sharing economy (i.e. the shift from full ownership of assets to the renting or leasing of assets) has expanded to areas other than cars and houses. The Uber-style model is now commonly applied to trucks, freight and distribution systems, while the AirBnB model is now applied to warehouses and other facilities.

## 4.4 Scenario 4: Big Brother Goes Green

In 2037, climate change dominates global discourse: its effects are being felt vividly and globally. Scientific evidence is now unequivocal – things are getting very bad, in a hurry, and humans are to blame. This awareness has led to a world where the public is putting increasing pressure on governments and companies to take decisive action towards minimising the environmental impact of industrial and commercial activities.

The price of fossil fuels is very high as carbon and other greenhouse gas emissions are taxed, capped and traded in global and local markets. Most supply chains and freight lanes are expected to achieve a carbon footprint of zero, by either reducing or offsetting their emissions. Hybrid, electric, fuel-cell and other alternative fuel engines are widely adopted in cars, trucks, trains, ships

and even planes. Their utilisation is maximised: futile, empty and half-empty trips are reduced or eliminated. Being green is a requirement to stay in business, and those organisations that don't meet the expected sustainability criteria are almost guaranteed to fail. Products are expected to be long-lasting, repairable, reusable and recyclable. Packaging is also expected to be reusable and recyclable. Manufacturers are expected to minimise their water and waste footprints.

Indeed, the young consumers of today – born in the new millennium – resent the environmental abuses of the previous generation and pride themselves on having a different set of values. They are extremely well informed, have more choice than ever, and are determined to wield their power over companies by voting with their wallets. They expect the highest standards in quality, service and corporate responsibility, and will be loyal to organisations that deliver on these, while shunning and shaming those that do not.

To make sure they meet these expectations in a transparent way, to earn them the goodwill of young consumers, the leading supply chain operators have embarked on a concerted program of visibility and traceability. Governments and customers both demand a visible chain of custody to ensure there is no fraud, substitution or adulteration – complete end-to-end traceability of products. The technology powering this transparency is that of distributed ledgers, including blockchain, which is widely used to track freight movements and financial transactions. Distributed ledgers have replaced paper-based documentation and regular databases, providing a permanent record that enhances end-to-end visibility.

One thing that both new and old consumers have in common is their love for online shopping. Most shopping nowadays is done online. Brick-and-mortar stores haven't disappeared completely: many of them serve to showcase physical goods that are then bought online. This type of click-and-mortar hybrid store is very popular, along with multichannel and omnichannel approaches for delivery. Urban consumers expect 24/7, short-turnaround delivery for just about everything, from groceries, to technology, to furniture. No matter the size, weight or value of the goods, the consumers expect these products delivered to their homes, office, or any place they choose.

In this complex environment, the most successful supply chain operators are those that have embraced the digital revolution. Global data standards for freight and supply chains have been widely adopted, allowing huge amounts of high-quality data to be routinely collected by companies and governments. These data – about goods, vehicles, people and transactions – are shared extensively and used productively, while still respecting privacy and commercial confidentiality.

In stark contrast to the success story of big data adoption, the revolutionary promise of automation technologies has failed miserably in being the game-changer that many people had predicted. Fear has dominated government policy-making, be it a fear of autonomous vehicles causing road chaos, or a fear of robots forcing humans out of the workforce. This fear has created a regulatory environment that is hostile to automation. Businesses are extremely cautious of investing in areas such as robotics, artificial intelligence, autonomous vehicles or automated facilities. Heavy regulation has also stymied any widespread use of an "Uber model" (namely the shift from full ownership of assets to the renting or leasing of assets) for labour or facilities, due to concerns for the long-term wellbeing of the people providing the services.

Worldwide, the middle-class population has increased quickly. Hundreds of millions of people can now afford more. Most of this growth has occurred in Asia, but there are positive signs on the horizon for South America and Africa as well.

Against this backdrop, China has emerged as a superpower in an increasingly fragmented world. The politics of nationalism and populism have made a comeback in many countries, riding a wave of scepticism about the benefits of globalisation and international collaboration. Protectionism

rises and stronger borders follow. Many governments are implementing tougher tariff regimes and higher duties. Several nations have implemented self-serving policies. Trade increasingly occurs within trusted blocs formed on the basis of either common geography or common history. While some see this fragmentation as a step backwards, it has led – paradoxically – to a relative calmness around the globe; the risk of terrorism or war is as low as it has been for a generation.

China enjoys unparalleled global influence. Through its Belt and Road plan, and other initiatives, China has strong land and maritime connections with South-East Asia, the Middle East and Europe, improving passenger and freight infrastructure and boosting its importance in trade. Unchallenged in the Eastern hemisphere, China has asserted its authority over the South China Sea, now the world's most important waterway.

To survive in this environment, the Australian Government increasingly sees exports as a matter of national importance and crucial to the nation's GDP. It is now a strategic imperative to facilitate the timely and cost-effective movement of exports – be they agricultural, manufactured goods or minerals – by sea and air. However, despite having a long-term approach to exports, long-term planning in general is not as healthy. The short political cycle has made Australians apathetic towards politicians, who are perceived as only interested in short-term political gain. Bipartisan agreement is almost unheard of, and the divide between federal, state and local governments is as disruptive as ever. All tiers want to influence policy, but often have goals that conflict with each other. The struggle to balance these competing aims is often to the detriment of long-term problem-solving.

Australia's population is centred firmly in the big cities; new houses on the fringes and increased apartment development in inner areas make for larger and denser cities, which makes the movement of people and goods more challenging. Densely populated urban areas, the high demands of millennial consumers, and the fragmented geopolitical landscape, translate into end-to-end supply chains that are more complex than ever. With this increased complexity, managing supply chains requires a different employee skill set, including soft skills (such as strategic thinking) and hard skills (such as optimisation). Algorithms are used extensively for optimisation, as businesses look to exploit opportunities for improved productivity.

There is now a strong push into a more coordinated freight supply chain that includes road, rail, sea and air. From the point of view of users, freight is becoming an integrated end-to-end service, one that is simple to use, with a single point of contact and improved traceability and reliability. The consolidation of the shipping industry worldwide has continued apace, as container ships and other vessels are larger than ever before. The logistics industry has also consolidated: the remaining logistics players are larger and more powerful, willing to take on more roles within supply chains, and ready to invest in facilities, technology and personnel.

In Australia, that investment in personnel is critical. The workforce is more diverse than ever in terms of gender and ethnicity, but too few young people come into freight and supply chains to replace existing workers. Australia's population growth has tapered, meaning low-skilled jobs, both manual and intellectual, are moving offshore; however, companies face shortages in highly skilled roles, leading to rising labour costs and greater casual employment. Desk workers do their work from home and might never be seen in the office. Drivers' work hours are logged automatically.

The brightest light on the horizon for Australian manufacturing in 2037 is a renewed interest in producing high-end equipment and devices related to sustainability and renewable energy. One example is advanced batteries, and Australia – seen as environmentally and socially responsible – has made moves to take advantage of this growing market.

# 5. SCENARIO WORKSHOPS

## 5.1 Outline of Workshops

Once the four scenario brochures (including narratives and vignettes) were completed, they were circulated within CSCL, DIRD's Inquiry team and the Inquiry's Expert Panel, requesting feedback. Based on the feedback, a few minor modifications were made to the scenarios.

These finalised scenarios were then used in a series of four workshops, as described below.

### Validation Workshop

A first workshop was conducted in Sydney on October 17. It was designed to last 90 minutes, and was attended exclusively by members of the Expert Panel, DIRD and Infrastructure Australia.

Before the workshop, each participant was asked to study a specific scenario and to prepare answers to the following question: "To succeed in a future like the one described in this scenario, what should Australia's top priorities be in terms of freight and supply chains?"

The workshop consisted of a review of the logic of the four scenarios, and a group discussion of the following question: "Which priorities work well across all four scenarios? And which work well in some scenarios, but not all?" Each participant was provided an anonymous answer form to write their individual answers to this question, so as to allow individual views and reduce group-think.

This first workshop was the first time these four scenarios were used in an applied setting, and as such served as the validation workshop for the project. The priorities collected from the answer forms from this workshop are considered equally as inputs along those from the other workshops.

### Implication Workshops

The remaining three workshops took place in Perth (October 18), Melbourne (October 27) and Sydney (November 1). These three workshops followed a design different to that of the first workshop, requiring a whole morning (approximately 4½ hours). Participants came mostly from industry, but also included several representatives of federal and state government entities.

Based on confirmed participation at the end of the business day before each workshop, there were 22 confirmed participants in the Perth workshop, 35 in the Melbourne workshop, and 28 in the Sydney workshop, for a total of 85 participants confirmed for these three workshops (and a total of 95 in all four scenario planning workshops). Actual numbers may have varied slightly due to no-shows.

All three implication workshops followed a similar mechanics. Before the workshop, each participant was assigned a scenario and asked to study it before the workshop day. On the morning of the workshop, the stage was set by explaining to participants the rationale for the exercise, the nature of scenario planning and the expectations for the day. After that came two breakout sessions.

For the first breakout session, participants were divided into four groups, one for each scenario. Each group was asked to consider, with the help of a facilitator, the following question: "To succeed in a future like the one described in this scenario, what should Australia's top priorities be in terms of freight and supply chains?" Because the four groups are working against the background of divergent scenarios, this breakout session is also called divergent thinking. Each participant was provided by the facilitator with an individual answer form, and asked to write in it their own individual thoughts on two areas: freight priorities and supply chain priorities.

After a short break, a second breakout session took place, where participants were divided into two (in Perth) or three (in Melbourne and Sydney) groups, different to those of the first session. To the extent possible, each one of the new groups combined participants from the four scenarios. After a brief overview of the four scenarios, the participants were asked to consider the following question: "Which priorities work well across all four scenarios?" Participants from each scenario were asked to volunteer priorities that they considered promising, for discussion by the group

at large. Participants were asked to write down their individual answers in a second part of the individual answer form.

A sample answer form and the facilitator's guide for the implication workshops are provided in Appendices 2 and 3.

## 5.2 Analysis of Workshop Data

### Transcription

The answers from the individual forms were carefully transcribed, to facilitate their analysis. The total text of the combined answers from all four workshops reached a total of 15,500 words, including 1057 entries. An entry is defined as a string of text provided as an answer by a participant in one of the workshops. In terms of content, approximately 60% of the words came from Breakout Sessions 1, and the remaining 40% came from Breakout Sessions 2.

### Open Coding

Data analysis started with 'open coding' of the raw data collected from the four Breakout Sessions 1. The term 'coding' refers to the process of assigning to a text a short label that describes its essence or main idea. When this labelling process is done without a reference, it is called 'open coding', because the researcher remains open to new directions and ideas with every line. So, the qualitative analysis of these data was a painstaking, line-by-line interpretation and summarisation of each entry from the Breakout Sessions 1. Out of the 634 entries analysed here, 32 were deemed unintelligible. The remaining 602 entries were retained for further analysis.

### Categorical Coding

The next step in the analysis was the 'categorical coding' of these 602 entries. The process of categorical coding is about finding recurring themes, families or categories for these labels. It is a highly iterative process, where the open codes are rearranged into categories and sub-categories, which are given tentative names and descriptions during the process. As it strives to make sense of the whole, not only the parts, the process of categorical coding is even more time consuming than that of open coding. Two researchers worked in parallel in the categorical coding, comparing thoughts about points that required clarity.

### Preparing the Summaries

After all the entries were categorised, the next step was to work on preparing a summary for each one of the resulting sub-categories or categories. This is not a linear process: as the summarisation effort is conducted, the meaning of the entries may be reassessed and their open codes may be revised. Their categorical codes (e.g. their place in the large scheme of categories) may also be revised. So, in a way, the process of summarising takes place at the same time as the final touches are being given to the open and categorical codes.

### Final Touches

After these summaries were prepared, the 443 entries from the Breakout Sessions 2 were examined to identify new ideas that may not have been present in the data from Breakout Session 1. In this step, approximately 10 modifications were made to the summaries, most of them for emphasis and clarity. The final result from this process is a hierarchical summary of the proposals made by the participants of the workshops, thoroughly grounded in the data, but restructured and reworded for clarity. These findings are presented in section 6.2 of the report.

# 6. FINDINGS

## 6.1 Insights Derived From the Interviews

During the interview process, participants raised several recurring themes that – although not included in the final scenarios – may be worth mentioning in this report<sup>1</sup>. They should be understood as opportunities and challenges that were mentioned by some participants during the interview stage, captured for future reference, not as an output of the scenario planning workshops.

In terms of *infrastructure*, the following were mentioned:

- The challenge posed by *congestion and bottlenecks*. According to some participants, there is a risk that in the future Australia may face a catastrophic congestion problem, due to significant infrastructure bottlenecks that slow down the flow of freight and the movement of passengers. Without proper action, they say, an abundance of choke points may make supply chains slower and less productive. Traffic could get worse every year, especially in and around major cities, and roads could be full of passenger cars and heavy vehicles. As a result, when moving cargo, “there will always be always a bottleneck somewhere”.
- The opportunity to *improve ports*. Some participants mentioned the opportunity of improving rail access into ports, of building new port capacity to keep up with demand, and of establishing a Port Community System to handle electronic communication in ports between the private transport operators, the private hinterland, the importers and exporters, the port authorities, customs and other authorities.
- The opportunity to *improve rail*. Some participants mentioned, for example, the option that government may intervene to make rail more competitive and achieve critical mass, so as to move freight away from roads and into rails; or the need to make plans, allocate funds and secure land for new rail corridors – capable of higher speeds – and for intermodal facilities. Completing the inland rail project, a north-to-south corridor moving freight along the east coast, was also mentioned, as was the separation of passenger and freight rail lines in the city, to improve liveability.
- The opportunity to create *intermodal hubs and interfaces*. Some participants mentioned that there is an opportunity to achieve better coordination between transportation modes; that intermodal hubs could be created to take advantage of higher efficiency vehicles and rail interfaces; that rail networks, doing the bulk of long distance transport, could connect into intermodal hubs, where freight would be moved to road transport for the last kilometres to the customer, with these intermodal hubs being integrated into the strategies of ports.
- The option of using *road pricing*. Some participants mentioned that, as a response to road congestion, a policy of road pricing could be implemented, whereby road users would pay an amount calculated as a function of the distance travelled and the capacity of the vehicle. These funds would then be used directly to invest in new road capacity. Road pricing was seen by these participants as a way to create a more level and transparent playing field, where road and rail freight would compete more equitably.

In terms of *planning*, the following were mentioned:

- The challenge of *urban encroachment*. Several participants mentioned the risk that, faced with rising population growth, Australia may fail to protect enough land for freight corridors and logistics facilities from urban encroachment. The fear is that, in those places where infrastructure like roads, rail, ports, airports and intermodal hubs will be needed, nearby land may be encroached

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<sup>1</sup> We are referring to local factors in areas such as infrastructure, planning and regulation. As recommended by the MIT FFF methodology, local factors were not included in the scenario narratives, because they fall within the influence of stakeholders. Including them in the scenarios would have presupposed decisions that fall within the control of the stakeholders, therefore predetermining the output of the scenario exercise, which defeats the purpose of the scenario planning process.

upon by residential areas and other incompatible activities. This could result in even more curfews and bans of trucks, trains and airplanes. Industrial activities that generate smoke or similar hazards could constrain the use of airports. High-efficiency heavy vehicles may be unable to access the consumption centres where goods are needed.

- The flipside of that challenge is the opportunity of including *freight in urban planning*. Several participants mentioned that increased awareness of the importance of freight and supply chains for their communities could result in a more sympathetic attitude, and improved planning, from city councils. It was argued that municipalities should include freight and supply chain considerations in their plans for the design and management of cities and suburbs, to reduce congestion and cost, and to increase safety. It was also proposed that shared warehouse space could be made available closer to city centres, and intermodal sites could be built on the city edges to receive freight from trucks that would then be loaded into smaller vehicles better suited for the urban areas.
- The great opportunity of a *master plan*. Several participants argued that there is a golden opportunity for developing a holistic masterplan for freight and supply chains in Australia, in coordination with all branches of government – local, state and federal – and in close collaboration with industry. Guided by an apolitical vision, this masterplan would identify future freight and supply chain needs, and provide a blueprint for long term investment in major infrastructure, as well as laws and regulation. Funding would be put aside, unaffected by political changes, for a range of projects and programs around this masterplan.

Finally, in terms of *regulation*, the following were mentioned:

- The opportunity of increased *coastal shipping*. Some participants suggested that the Australian Government has an opportunity to amend coastal shipping laws, to remove barriers to accessing coastal shipping, allowing domestic shippers to integrate with international shippers, in using the “substantial spare capacity” travelling between Australia’s coastal ports for carrying domestic cargo.
- The opportunity of improved *driver skills*. Some participants suggested that more attention should be given to skill development of truck drivers. They argue that many people driving trucks below 12 tonnes today are not properly trained as truck drivers, and generally have a low level of driving skills. Skill development, licensing, and accreditation of all drivers, should receive more attention as an industry issue, they say, improving the minimum training required to get a truck licence, and tightening the regulatory requirements, with less paperwork and greater emphasis on safety.
- The challenge of *regulatory burden*. Some participants argued that the layers of regulation across levels of government must be reduced. Regulation keeps piling up, they say, regulation that is perceived by industry as rigid, excessive and outdated, neither sufficiently smart nor flexible to keep up with technological developments. There is a risk that the regulatory burden – and regulatory cost – in Australia may continue to be very heavy, in terms of both time and money. Businesses would struggle to keep up in the future with ever more complex regulation, while trying to remain competitive internationally.
- The opportunity for better *truck regulation*. Some participants mentioned that regulation of the trucking industry should be thoroughly rethought and revised. Outdated and duplicated rules should be eliminated. Smarter rules should be developed to address present and future issues, including safety concerns. These rules, they argue, could include mandatory minimum safety standards, including for trucks under 12 tonnes that carry local freight. Larger and heavier high-productivity freight vehicles, they say, could be mostly limited to specific routes that are identified and engineered to fit their weight and other requirements.

## 6.2 Priorities Proposed During the Workshops

The following is a hierarchical summary of the proposals made by participants of the scenario planning workshops. They are responses to the basic question: "To remain successful in the future, what should be Australia's freight and supply chain priorities?"

The responses are separated into categories for ease of understanding, but those categories are by no means mutually exclusive. Many of the concepts are closely related, and similar ideas will appear under different labels.

Alongside each category or sub-category is a count of the number of participant responses that referred to that concept, alongside a reference to the scenarios that prompted the ideas.

### Infrastructure

*(71 entries; scenarios 1, 2, 3 and 4)*

#### Air Hubs

A significant increase in exports of fresh produce or high value-density products will require looking at air freight in a new way. We may need to move away from just putting air cargo on a passenger plane under people's feet, towards dedicated freight-only flights, operating out of freight-only airports. Each state could have a freight airport approved for international flights to expedite the export of fresh produce. Ideally, these air hubs would be away from the capital cities, to avoid bringing produce into the urban environment only to send it out again on a plane. Air hubs outside the major cities could also have an import functionality and help meet customer expectations for quick delivery of goods. Existing airports should be redesigned to improve throughput, and to welcome aircraft fitted with new technologies. *(8 entries; scenario 3)*

#### Corridors

Protection of supply chain corridors is essential to ensure growing populations are fed, and supplied with imports. Our cities are increasingly urban and congested, so we must maximise freight's access to corridors. Corridors are also mentioned in the urban considerations section. *(5 entries; scenarios 2, 3 and 4)*

#### Ports

Planning ahead with ports is vital. We must plan and develop efficient, high-capacity ports that are fit for purpose, rather than just adapting the infrastructure we already have. We must be ready for the economies of sea freight to shift. Initially shipping lines will focus on larger ships to secure economies of scale and profit, but we should be alert to Australia's position in the global shipping market, and be prepared for a shift towards medium-sized vessels visiting more frequently. This could necessitate the need for more, smaller ports, which would in turn have the effect of providing multiple points of entry and serve to provide contingency and resilience. More, smaller ports could also help improve speed to market by reducing the distance between the port and the final delivery point. However, the ocean remains our only cost-effective way of moving heavy commodities, and we must ensure our channels and ports are deep enough and big enough to handle large vessels. Maximising port throughput will be important, and could involve automation, as well as rethinking the design of slips. Port operators need to tackle the imbalance of empty containers. *(9 entries; scenarios 1, 2, 3 and 4)*

#### Hubs and Decentralisation

Hubs should be decentralised into regional areas. They should cluster freight from value-adding firms and small producers, to streamline gateways to overseas markets. Decentralised distribution centres and manufacturing freight hubs will support quicker delivery. *(6 entries; scenarios 1 and 3)*

#### Regional and Metropolitan Connectors

Efficient connectors from the regions to the city are essential, particularly connecting the

hinterland to ports. We must ensure funding priority for the connectors, and – in the case of rail – the trains needed to transport the goods. Metropolitan connectors need to support the efficient import and distribution of goods in urban environments, while regional infrastructure needs investment oriented to agriculture. *(7 entries; scenarios 1, 2 and 3)*

## **Future-proofing**

Infrastructure and associated networks – such as roads, railways, ports and airports – need to be ready for autonomous vehicles and autonomous operation in the future. This infrastructure needs to be supported by an appropriate regulatory framework, and services such as charging stations for electric vehicles. Design should also take into account the size and volume of the loads any piece of infrastructure is likely to handle. Governments should be proactive in assessing infrastructure needs, and may consider repurposing some freight infrastructure – such as coal facilities – to act as conduits for future needs, such as manufacturing or food production. *(10 entries; scenarios 1, 3 and 4)*

## **Multimodal Hubs**

Industry participants need to work together in a strategic approach to multimodal transport. True streamlined, decentralised multimodal hubs are essential. They require infrastructure to support modal interoperability, and a focus on the security of interfaces between modes. *(6 entries; scenarios 2 and 3)*

## **Investment and Funding Models**

Infrastructure investment needs to be intelligently assessed. It should be assessed against potential capacity boosts from the advent of automation. It needs to ensure cost-efficient and fast movement of goods. Investment criteria ought to reflect the importance of the infrastructure, and exist within a framework that enables faster investment to ensure rapid development. Conditional funding of infrastructure, against specific KPIs, may be used to achieve higher service standards and supply chain efficiency. There should be incentives for investing in rural supply chains.

Investment in digital infrastructure, particularly in regional Australia, is vital; as is investment in infrastructure that facilitates freight flow between regional and urban areas. Different funding models – including a user-pays system or market-driven approaches – should be seriously considered, particularly for roads, to ensure they remain at an appropriate standard.

New sources of capital should be explored in order to reduce the reliance on the taxpayer. Government and financial regulatory structure should support infrastructure investment through means such as sovereign wealth funds and superannuation, through provision of tax benefits. To that end, there is a need to improve interaction between the private and public sectors when investing in infrastructure projects; particularly around the trend towards the sale or long-term lease of key infrastructure, where risk profiles can hamper private investment in some sectors (for example, grain, which is subject to the impact of weather). Privatisation of assets such as urban freeways, energy and water sources could also be considered. We should actively seek to extend Australia's own supply structure overseas. *(20 entries; scenarios 1, 2 and 4)*

## **Data and Information**

*(58 entries; scenarios 1, 2, 3 and 4)*

### **Sharing**

Data has to be shared to realise its full potential, and increase Australia's competitiveness. For example, sharing of supply chain data across operators creates a composite picture of the supply chain that allows for larger-scale optimisation, management and prediction; and in freight, the sharing of data can allow the consolidation of freight. To make this possible, data sharing needs to be encouraged, even between competitors. This may require: a) agreements or incentives to encourage the sharing of data across parties, and assuage the concerns they may have; b) investment in the creation of a framework or platform for the safe, transparent and equitable sharing of data across supply chains and freight networks; c) a government policy that regulates

and facilitates the sharing and use of data; and d) updates to data ownership and sharing protocols. (16 entries; scenarios 1, 2, 3 and 4)

## Standards

Adopting open, common, global data standards would facilitate the widespread use of data. Standards are needed for data collection, so that the resulting data is consistent and can be understood and used by other parties. Standards can also apply to product and freight labelling, which would enable their traceability. With standards in place, it is possible to generate data for the movement of goods and their attributes, recording as events their transit through different points in the supply chain. The same applies to freight: freight should be uniquely identified with a standards-based serialised identification code, to enable the widespread and accurate tracking of goods. This may require government intervention: left to its own devices, the industry is unlikely to adopt this in a timely manner. Standards also facilitate interoperability of data sets. A 'master data' policy can provide a standard for collecting data on different levels of aggregation of freight, such as TEU, pallet, tray and cage, that are logically linked to each other. (9 entries; scenarios 1, 2, 3 and 4)

## Quality, Integrity, Transparency

Quality, integrity and transparency are important when it comes to data. For data to be useful it must be of good quality, and this needs to be understood by all parties: poor-quality data will not deliver the expected benefits. Accuracy is part of this definition of quality: it is important that the data collected and shared be accurate. Another important aspect of data is its integrity, which should be protected. To be useful, data sources should be trustworthy. The use of blockchain, or a similar technology, may help in this regard. Finally, the transparency of data concerning the origin, destination and other attributes of goods or freight, are important. (7 entries; scenarios 1, 2, 3 and 4)

## Real-time Capture

The process of capturing, storing and using data requires thorough consideration. Data collection, for example, should occur in a stable manner, so that the data stream is not interrupted. Collection in real-time could allow for continuous improvement of infrastructure and removal of bottlenecks and inefficiencies. Freight events can be captured, logged and shared securely in real time, which allows for predictive modeling of volume flows, capacity requirements, etc. It is important, however, that this data is captured and shared in a de-identified way that protects privacy. (5 entries; scenarios 1, 2 and 3)

## Safekeeping

We must learn how to store, manage and share data well and securely. This includes the ability to verify the authenticity of data shared, and to protect the networks and systems used to store, manage and share it from threats such as fraud and hacking. Data about payments and other transactions can be made more secure using blockchain or related technologies. Concerning the storage of data, keeping valuable data in multiple repositories could provide some protection via redundancy. However, all these storage sites must be secure, especially for sensitive data. (7 entries; scenarios 1, 2 and 3)

## Access

Relevant, useful data should be accessible to all supply chain parties, including producers and consumers. Governments and companies need to have abundant information available and the ability to distribute it to citizens and customers. Since big business will look after its own investment, the government should provide data management capability to smaller businesses, to help them compete. The government should also create a high-speed data network that works for all, with access to all regions and reliability. An open and safe data management platform can be made available to companies and the public. (6 entries; scenarios 1, 2, 3 and 4)

## Regulations and Ownership

Data management may have to be legislated. Besides investing in data, government may also have to create new laws and regulations to protect data and promote its safe use. Developing a comprehensive regulatory framework around data collection, management and application would be ideal. (5 entries; scenarios 1, 2 and 3)

## Education and Skills

*(54 entries; scenarios 1, 2, 3 and 4)*

### Focus on the Future

Our education should be focused on the future. From the early years of education, we have to prepare our children for the future. Our education system has to adapt to the changing face of the world, focusing on skills required in the economy, including skills needed for freight and supply chains. It should be a future-focused education, with training in areas like robotics, automation, artificial intelligence, data and the management of autonomous vehicles, to produce the workers required for the future. It is necessary to reinvent supply chain education, to include subjects like urban planning and the networked economy. *(16 entries; scenarios 1, 2, 3 and 4)*

### Start STEM Early

To compete globally through technology and innovation, greater investment in education will be the key. We must ensure that an education pathway exists to meet future industry needs. We must invest in developing the knowledge and skills to support freight and supply chains. This means greater emphasis on particular subjects, such as data analytics, the digital economy, automation and robotics. But it also means an improved education in general, and a greater support for STEM subjects (science, technology, engineering and maths) in schools and universities. This must start early, from Year 1, with priority, and continue until graduation. *(15 entries; scenarios 1, 2, 3 and 4)*

### Reskilling

As automation spreads and low-skilled jobs disappear, government and industry must be diligent in facilitating the transition of members of the workforce that may be left behind. This includes developing a targeted and multi-disciplinary education and training agenda, to upskill and prepare these members of the workforce for value-adding jobs in the future. Among these are: dealing with complex logistics data, and managing and optimising automation, among others. Labor force planning may be necessary, ensuring the right skills are developed and retained, and that displaced employees can transition to new jobs or retire. *(13 entries; scenarios 1, 2, 3 and 4)*

### VET

Our education system should support the development of manual and trade skills, with VET courses and content appropriate for shipping, transportation, freight, logistics, automation, supply chain management, etc. Vocational careers could help workers reposition in supply chain related jobs in the digital economy. Trade skills development may help reduce unemployment and deliver skilled workers for manufacturing and supply chain jobs. We must make sure there are enough trained drivers to move goods from production to distribution sites. *(6 entries; scenarios 2, 3, 4)*

### Others in Education

**Other recommendations in the area of education and skills are as follows:**

- International engagement skills. The future will be more integrated, and Australia's workforce should have the language and cultural skills to engage with international markets, especially from Asia.
- A common body of knowledge could be developed, with a corresponding set of accreditations accepted by industry.
- Risk management should be part of the basic skill set of workers in our industry.
- Short educational programs, possibly offered by the government, may help companies address inefficiencies and overcome managerial barriers or skill shortcomings.

*(6 entries; scenarios 1, 2, and 3)*

## Regulation

*(54 entries; scenarios 1, 2, 3 and 4)*

### Regulatory Harmonisation

Simplify, standardise and harmonise regulations across levels of government, geographies and modes. Competing government interests create bottlenecks: a national economy requires a national approach. Government policy on freight and supply chains should be national, or at least display a national cohesiveness, without state and local imbalances. This requires a harmonisation of laws, regulations and standards across state borders, and across levels of government (federal, state and local). The legal framework should also be harmonised across different transportation modes (road/rail/sea), possibly via a shift to an integrated multimodal approach. Public policy and regulatory frameworks should be aligned. There should be a better coordination and harmonisation of the regulatory and investment frameworks that impact state-based and national-level freight and supply chains, such as grain supply chains and interstate containerised freight supply chain. Harmonised customs regulations, and a National Supply Chain Authority (focussed on the flow of goods, as opposed to just the infrastructure) could be part of this. *(17 entries; scenarios 1, 2, 3 and 4)*

### Innovation and Automation

The advancement of automation will require a significant regulatory framework. Essentially, the government needs to stay ahead of the game, with progressive, streamlined and flexible regulation that facilitates innovation while balancing development, safety and jobs. The regulatory responsibility needs to be clearly defined between the tiers of government. Regulation needs to recognise the likelihood of automation across all aspects of freight movement, including autonomous vehicles and drones (and related needs, such as flight corridors for drones). Labour laws need to reflect any push towards automation. Reasonable, adaptable and up-to-date regulation for autonomous vehicles and technology is needed. *(16 entries; scenarios 1, 2, 3 and 4)*

### Speed, Flexibility and Red Tape

An effective operating environment requires less regulation and red tape. We need to develop a better understanding of the cost of regulations. Laws need to be reviewed more frequently and quickly to ensure the progress and adoption of new technology is not unnecessarily hindered: this promotes a flexibility to react to changes in the market. The regulation of innovations needs to be consistent and timely, allowing for fast-paced technological development; it should avoid placing artificial constraints on development. *(12 entries; scenarios 1, 2, 3 and 4)*

### Access

Regulation must ensure freight operators have the required access to population centres. It should aim to facilitate the cohesion of communities and transport operators. Regulation around access should be reviewed with a view to enabling freight on roads at night to make the most of existing capacity. The impact of such access can be lessened by using quieter electric vehicles, for example, or other technologies. Likewise, policy signals and pricing regulation should be used to address congested urban networks. Meanwhile, legislation must ensure Australian exporters have equitable access to the global marketplace. *(5 entries; scenarios 1 and 2)*

### Competition Law

Anti-competitive behaviours need to be better regulated. Competition laws should be reviews to ensure larger or more powerful companies don't have undue control. *(2 entries; scenarios 1 and 3)*

### Food Production

Localised regulation should allow for the redistribution of traditional "centralised" functions such as food and power generation. This should include reconsideration of rules around urban farming, as well as decentralising manufacturing, with a view to achieving closer proximity to the end consumer. *(2 entries; scenarios 1 and 3)*

## Automation Technology

Automation technology was a recurrent theme in the recommendations from participants: even though half of the scenarios pushed them away from automation, recommendations for automation were advanced by participants in all scenarios. The many recommendations made with regards to automation technology are outlined below. *(33 entries; scenarios 1, 2, 3 and 4)*

### Innovation

Innovation and technology are essential for Australia to remain competitive globally. Government can lead this. Greater investment in education will be the key. Research and development investment into smart and technology-enabled supply chain theory could help make Australia a “world’s best” player. *(4 entries; scenarios 1 and 4)*

### Transition

The most recurrent recommendation regarding automation was the importance of managing the transition from today to a semi-automated and then a fully automated society and industry. It is important to prepare our workforce for the transition. Government leadership may be necessary in managing the transition, and in creating a greater sense of social inclusion in the benefits of highly automated industry. The goal is to ensure a smooth integration of the human capital in this new economy, and to ensure that automated environments for freight and supply chains that do not adversely affect impact humans. In the case of employees that are displaced by automation, support is needed for their retraining or career changes. Tax incentives and other policy levers may be needed to encourage these outcomes, and to ensure that people who have lost their jobs to automation are given a chance to contribute to society. In short, we must make sure the population is brought along, not left behind by automation. *(11 entries; scenarios 1 and 2)*

### Educate the Public

Equally important is to manage the expectations of the public. This may require: a) developing in the public the trust that the government will manage managing social implications of automation; b) addressing the anti-automation culture and mindset by clarifying negative conceptions about automation; c) articulating the value of new technologies for the communities and the individuals, in the form of lower costs and more safety through new technologies; among others. *(6 entries; scenarios 2 and 4)*

### Others in Automation

Other recommendations about automation technology include the following:

- To ensure a good interaction between human and machine, it is important to design good interfaces between the automated components and the human operators.
- It is important to retain always a human component for security, and to plan properly for emergencies and disruptions, such as major technology breakdowns or intentional disruptions (including hacking).
- Automation could be used extensively in security applications, such as freight scanning systems, risk detection and screening capabilities at the wharf, and automated inbound customs quarantine clearance.
- Insurance regimes may have to be adapted to automation, to include autonomous vehicles, and the insurance of autonomously delivered cargo.
- Government incentives may be needed to encourage industry to invest in technology and automation.
- Artificial intelligence could be applied to freight and supply chains, in areas such as congestion management and fuel efficiency.
- An interoperability of technology is required to deliver connectedness and transparency.
- The creators of technological disruption are in the industry. It is important to have early engagement with the large global technology players looking at new methods of SC management (e.g. Apple, Amazon, Uber, Tesla ). *(13 entries; scenarios 1, 2, 3 and 4)*

## Planning

*(30 entries; scenarios 1, 2, 3 and 4)*

### National Strategy

A national freight and supply chain strategy must take a long-term, bipartisan view to survive political cycles. Initiatives should be measurable, with published targets that allow industry certainty when investing. The strategy needs regular updating to ensure it remains contemporary, and should allow for contingencies. It should align across all tiers of government, as well as with key international trading partners. We should look to cities around the world that currently have populations in the vicinity of 10 million to help inform our thinking for the next 20 years. *(20 entries; scenarios 1, 2, 3 and 4)*

### Land use

Any long-term strategy should identify and reserve land for manufacturing, food production and distribution centres, and be subject to independent review. Australia needs to be clear on the priority of land use for agriculture, and the strategic prioritisation of exports. Land use should strengthen agricultural and horticultural industries, and the movement of these products to international markets. Supply chain corridors need to be reserved, with strategies developed for better urban distribution. *(10 entries; scenarios 1 and 3)*

## Government

*(28 entries; scenarios 1, 2, 3 and 4)*

### Government Structure

Australia's triple-layered approach to government is inefficient and needs reform. Ultimately, it would be most efficient to reduce the number of tiers of government bureaucracy in order to expedite decision-making. However, should that prove elusive, there are other steps towards overcoming some of the inefficiencies of the existing structure: Better co-ordination and alignment of policies across jurisdictions would allow more efficient movement of freight. Better definition of the roles of each tier of government – in questions of planning, policy and decision-making, among others – would also be beneficial, even for the bureaucracies themselves. Operationally, control of critical infrastructure should fall to a single consolidated entity or at least be harmonised across the three tiers of government. Australia's "short" political cycles are also a huge concern, as they come in the way of long-term planning and decisions. Reorganisation of terms should be pursued. *(14 entries; scenarios 1, 2, and 4)*

### Government Policy

Governments – at all levels – need to consult better with business, unions and other stakeholders. Governments need to more clearly determine what role they should play in freight and supply chain. They also need to catch up with the speed at which business moves; development of policies around open access, e-commerce, technology and freight priority are vital. Protectionism should be avoided lest it increases the cost of doing business. In some scenarios, governments also need to prepare for the management of social unrest. *(10 entries; scenarios 1, 2, 3 and 4)*

### Transport Policy

Introduce road pricing; possibly for all vehicles, possibly just for heavy vehicles, but with agricultural use subsidised. Reduce the regulatory impediments to coastal shipping. *(4 entries; scenarios 2, 3 and 4)*

## Exports / Imports

*(27 entries; scenarios 1, 2, 3 and 4)*

### Streamlining

Government red tape and paperwork needs to be reduced in order to guard against delays at the point of import/export, and to facilitate the global movement of goods. To this end, investment in systems to acquire data from goods in transit will enable their digital fingerprinting; regulatory bodies should not have to wait until goods are stationary to process information about them. Likewise, technology that enables consolidation of export tasks and the use of different transport modes will help drive costs down. Australia needs to be easy and cheap to work with; our competitive advantage depends on the efficient export of freight to take advantage of proximity and customer preference. We can't afford governmental inefficiencies. Infrastructure and import/export policies should align with the imperative of more efficient flow of goods. *(10 entries; scenarios 1, 2, 3 and 4)*

### Competitiveness and Resilience

Exports need to be given priority. Our relative competitive advantage needs to be understood to ensure that we can maintain it. We must build competencies to be internationally competitive. Developing a mix of export capabilities will make us more resilient in the future. Investment in the development of new sectors will help ensure the sustainability of our export offerings. We should strive to balance imports and exports. A suggestion was made by one participant proposing an increase in the import of manufactured goods. *(11 entries; scenarios 1, 2, 3 and 4)*

### Routes and networks

Key export routes must be protected, militarily if needed, on the high seas. Australia should control the supply chain all the way to end customers in Asia. We need to identify national monopoly assets and invest to support growth. Regional networks need to remain strong, with the potential to divert exports away from major cities where it is commercially viable. *(6 entries; scenarios 1, 3 and 4)*

## Urban Considerations

*(27 entries; scenarios 1, 2, 3 and 4)*

More efficient and thoughtful long-term urban planning is required to support and protect supply chains, and the land they require. Freight corridors should be reserved early in the planning process, and key parts of the supply chain should be protected from encroachment. Urban amenity needs to be taken into account when considering inner-city logistics and last-mile delivery. Nimbyism may be conquered through a mix of subsidies and levies. Urban planners need more emphasis on estimations of throughputs of freight at new developments.

We should rethink urban freight from the ground up and reimagine solutions to first- and last-mile issues. This should include consideration of 24/7 deliveries using low-emission electric vehicles, or other means that do not increase congestion or impact on urban amenity.

Cities require better, 24-hour, congestion management to succeed. Urban ports and airports need capability to directly supply urban areas, using electric vans. Current urban planning practices are too complex; business would benefit from decreased bureaucracy. Urban planning should strive to remove curfews, be they road, rail or air.

Ideally, we need to proactively design green cities that are connected to transport and have centralised food production. Urban planning should recognise consolidation of rural land into commercial packages.

## Security and Resilience

*(22 entries; scenarios 1, 2, 3 and 4)*

We must protect our freight and supply chains against disruptions (natural disasters, terrorism, civil unrest, sabotage, etc.). We should design with resilience in mind, so that recovery is easier when disruptions happen. This includes designing supply chains without critical nodes, networks with redundancies built in for the sake of robustness, and clear plans for quick recovery in the face of contingencies. Given the potential impacts of climate change, supply chain infrastructure should be designed so as to be responsive to natural disasters.

As data and technology become more pervasive, security considerations include also developing an understanding of cyber threats to critical networks and systems that support our freight and supply chains. The necessary cybersecurity measures should be deployed to protect these systems and networks, to ensure their uninterrupted service, and to facilitate their recovery in the face of a disruption.

Security considerations should also extend to facilities, means of production, goods, trade routes, and people. While our response to international security threats should not go overboard, we must find ways to navigate these risks. It is important to properly design and fund safety policies and to educate the parties involved. The ability to monitor supply chains from end to end, enabled by greater visibility as discussed elsewhere, will also aid towards this goal.

## Distribution and Deliveries

*(21 entries; scenarios 1, 2, 3 and 4)*

### Urban Distribution

Delivering closer to the consumer before distribution will aid efficiency and reduce congestion. This could be achieved through the repurposing of retail outlets to become click-and-collect centres, or through regional distribution/fulfillment centres that deliver straight to homes. These centres should not necessarily be in CBDs, but urban planning needs to allow the appropriate land for them. Explore the possibility to have these urban deliveries occur around the clock, or in dedicated off-peak freight delivery windows; either way, timeliness to the consumer is important. We need to support regulation and infrastructure for the growing number of smaller freight vehicles, be they something like a bicycle delivering takeaway food, or an autonomous vehicle (which may even deliver direct from port to home). Thorough co-ordination of these small deliveries is important from the standpoints of both congestion management and environmental impact. Governments and industry will need to balance the demands of just-in-time deliveries against the environmental and social impacts of an increase in freight movements. *(15 entries; scenarios 1, 2, 3 and 4)*

### Broad Distribution

To reduce our reliance on warehouse packaging, it is possible to have more containers packed overseas with the right mix of products inside, ready for 'clever' delivery once they arrive in Australia. Further down the chain, companies – even those in competition – need to consider consolidating parallel freight tasks. The industry needs to rebuild the capacity for inter/intra regional distribution of locally produced goods. Companies also need to more carefully consider reverse supply chains, or the logistics of returns. *(6 entries; scenarios 1, 2, 3 and 4)*

## Labour

*(17 entries; scenarios 1, 2, 3 and 4)*

### Talent

We need to attract young people into the industry to supplement an ageing workforce. We need smart people and innovating thinkers. Achieving these goals will require us to improve our talent pipeline by marketing the industry as vital for the country and as an attractive career path to young people. Part of that program involves the branding and marketing of freight, supply chain and logistics: it needs to appear sophisticated and fresh, and support job growth in in-demand areas. Australia requires a clear immigration policy on the skills required by the country. *(9 entries; scenarios 1, 2, 3 and 4)*

### Transformation

The freight and supply chain workforce faces huge disruptions in the future, such as the advent of automation. The private and public sectors need to develop plans for low-skilled workers that will be displaced by automation, and to understand the social and financial implications of these changes. (More on this subject is found in the Automation Technology section). It will be important to offer new opportunities for people out of work, and to develop programs to encourage the workforce participation of disadvantaged members of society. As an industry, we need to increase diversity. Industry needs to move away from “on-the-job” blue-collar training, and show more appreciation for training and education (such as VET). We also need to recognise that younger workers are keen to work from home, and explore those opportunities. Union involvement needs to be handled carefully, with a less adversarial approach taken. *(8 entries; scenarios 1, 2, 3 and 4)*

## Traceability and Visibility

*(15 entries; scenarios 3 and 4)*

We must develop greater visibility into supply chains and get better at end-to-end product traceability, from source to destination, so that the provenance of Australian products can be ascertained. Developing the ability to track products along the supply chain, identifying what is moving through each step, will require the use of geo-mapping and unique identifiers, where all freight is uniquely identified and its critical attributes are associated and shared in real time using common open data standards. Increased visibility and transparency can help prevent the substitution of Australian goods with counterfeits, increasing the consumer's confidence in Australia's exports. It can also improve supply chain security, reducing the need for intervention and delay by border agencies.

## Freight

*(15 entries; scenarios 1, 2 and 3)*

Freight consolidation may alleviate urban congestion problems. But to achieve it, we need to solve issues that stem from intense competition (such as distrust between parties), as well as commercial and regulatory barriers to freight consolidation. Urban demand management could be crucial in order to meet consumer demand. We must develop the capacity for more frequent movements of smaller quantities of goods. Modular freight, utilising import/export containers, could allow optimisation across modes, but we have to acknowledge that the inbound and outbound freight tasks are very different, and ensure our infrastructure can work both ways. Freight is ideally separated from non-freight functions: freight that doesn't have to go through cities should circumvent cities, and freight and passenger movements are best kept apart across all modes. Ultimately, freight networks should be adaptable, and protected no matter the mode, including road, rail and airspace. Multi-tier freight options could be used to cater to different service levels.

## Environment

*(15 entries; scenarios 1, 2, 3 and 4)*

**Carbon neutral.** Acknowledge climate change, and the impacts it could have on supply chains. We must start on a pathway towards carbon-neutral supply chains that focuses on sustainable solutions. This pathway should involve investment in technology that helps reduce our carbon footprint. To this end, businesses in the supply chain need to take responsibility for environmental factors, such as reducing waste and handling animal effluent. Water management will be essential to ensuring our climate responsibilities are met.

**Climate shocks.** Disruptions caused by climate change will increase, and supply chains need to be adaptive to this increased vulnerability. But to achieve this, the private sector requires governmental support. Governments need to invest in climate research and development, and do as much as possible to measure and predict the impact of climate change. Specifically, more effort needs to be spent on planning the possible impact of climate change on infrastructure across the nation. Governments should incentivise investment in climate change mitigation, rather than increasing the regulatory burden.

**Long-term policy.** Overall, industry needs the government to have a clear, long-term and achievable environmental policy so that businesses can invest with certainty. That policy should aim to protect natural resources in order to reduce the risk to the country's economy.

## Supply Chains

*(15 entries; scenarios 2, 3 and 4)*

### Management

Supply chains should be seen as being in the national interest. They need to be resilient to serious disruptions of any type (including intentional disruptions), both at home and abroad. As more chains become closed networks – involving only trusted partners that provide end-to-end supply routes – it will become important to enable small business to become part of these trusted supply chains, so as to foster competition and innovation. Mature supply chains should be managed differently to emerging ones. Australia needs to move towards higher-valued goods on the supply chain. *(7 entries; scenarios 2, 3 and 4)*

### Efficiency

Australia needs shorter and more efficient supply chains, both to compete on cost in the global market, and to meet consumer demands domestically. Better management is vital. To that end, sellers need to use technology to advance “in-transit sale” – that is, they shouldn't wait for a sale before shipping goods. The government has a role to play in helping supply chain operators improve their efficiency, and in seeking a balance between supply chain efficiency and community amenity. *(5 entries; scenarios 3 and 4)*

### Consolidation

Participants provided mixed feedback on supply chain consolidation. Two advocated for greater consolidation (“legitimate sharing across the supply chain” and “supply chain consolidation and adoption of a sharing economy”); while one participant advocated for less consolidation (“address consolidation .. to avoid monopolistic behaviour and economic inefficiency”). There was a similar conflict in the inputs regarding small players: while one advocated for protecting small players against takeover from larger corporations, another participant recommended accepting their decline. *(5 entries; scenarios 2, 3 and 4)*

### Systems and Networks

We should facilitate end-to-end, borderless systems that are available around the clock and that are able to integrate with supply chain companies. *(3 entries; scenarios 2 and 3)*

## Collaboration

*(14 entries; scenarios 1, 2, 3 and 4)*

Greater collaboration is required among supply chain members, between government and industry, and even among competitors – locally and internationally – to find joint solutions, share data, develop common standards and infrastructure and achieve greater efficiency. Close interaction and partnerships between government, industry and education sectors could help foster innovation for improved freight and supply chain solutions. The move from a non-collaborative culture to one that balances competition and collaboration may require the development of a guiding framework from the top. Easing the tension between competitors and finding ways to collaborate while respecting privacy and confidentiality, could result in better outcomes for the country and consumers.

## Production

*(13 entries; scenarios 1, 2, 3 and 4)*

Australia should incentivise flexible, value-added production in both the food and manufacturing sectors, in order to achieve growth. We should explore opportunities to develop small, decentralised pockets of niche manufacturing, such as small-cell manufacturing for white goods or gadgets, leveraging the Industry 4.0 technologies (artificial intelligence, automation, robotics, big data, etc.) It will be important to secure the supply of strategically important ingredients that are no longer produced in Australia and have to be imported. Besides essentials like food and water, government policy should cover also the production of basic goods necessary to support our population. We should look to have fewer wasted resources and emissions in our manufacturing and sourcing processes. In a digital economy, the protection and commercialisation of intellectual property (IP) as a form of production could play a key role.

## Energy

*(13 entries; scenarios 1, 2 and 4)*

Ensure that abundant clean, reliable and cheap energy is available. Cheap energy is critical, but it must be environmentally sound. This may require a national clean energy plan. This may require a national clean energy plan. Give priority to investment in sustainable energy sources (as opposed to fossil fuels) while ensuring peak-demand periods and 24/7 operational requirements are met. Explore the use of nuclear energy and investigate more local energy production. Develop a plan for the widespread introduction of batteries and charging capabilities that may be required by electric vehicles in the future.

## Public Perception

*(12 entries; scenarios 2 and 4)*

Communities need a better understanding of what freight and supply chains are, and how they benefit everybody. The industry needs to be better at understanding, articulating and communicating to the public the purpose of freight and supply chains. More community engagement is necessary to generate public awareness and appreciation of the strategic importance of freight and supply chains, and of the benefits they provides to their communities and businesses, to lifestyles and jobs, and the material competitiveness of the country. This engagement includes addressing the concerns of communities, and applying new policies and technologies to reduce any negative impact on their amenity. When the public recognises, with their hearts and minds, that freight and supply chains are vital, they will provide more community and political support. Also, a perception of jobs in these areas as premier roles, not just blue collar or unskilled, would also get more people into the industry.

## Brand Australia

*(12 entries; scenarios 3 and 1)*

Protect the 'Australia' brand. Protect its reputation as 'clean and green', through regulation of, and support to, producers of Australian goods. Protect the integrity of Australian products, along their supply chains, against tampering, fraud and counterfeiting. A better understanding of the different supply chains, to identify areas of risk, could be helpful in this regard. A chain of responsibility could also help in this regard. Preserve and grow the clean, safe and green reputation of the 'Australia' brand. Towards this goal, ensure that Australian agriculture is sustainable, and that Australian products are produced ethically. Ensure also that the integrity of Australian products is preserved along the supply chain, without an exaggerated increase in regulations or costs. Greater visibility and traceability, discussed elsewhere, could help with this.

## Trade

*(12 entries; scenarios 1, 2, 3 and 4)*

Build and strengthen international trade relations. Negotiate trade access and establish international trade agreements to promote Australian goods in areas where we have a comparative advantage, and to retain and expand Australia's market share. Develop good bilateral relationships with partners in South-East Asia, and with China and India.

## Food and Agriculture

*(12 entries; scenarios 1, 2, 3 and 4)*

Protect and assist Australia's food and agricultural sector. Explore efficient and innovative supply chain solutions, including the use of air and sea for fresh produce into Asia. Seek food export options that are in the national interest. Introduce quality control and assurance systems for food exports. Ensure food production is clean and localised. Review water policy to aid agriculture growth. Support bespoke agriculture, such as custom-blend containerised grain.

## Other Recommendations

### Better Understanding

More social engagement of the industry was recommended, to develop a better understanding of new social and consumer trends, including the preferences and higher expectations of newer generations. This would allow us to predict, to a certain extent, future product consumption patterns. Trends like a decline in materialism and an increase in spending in experiences, not "things". There was a recommendation to address the consumerism culture in Australia, as a way to reduce our carbon footprint and make the world more sustainable. *(8 entries; scenarios 1, 2, 3 and 4)*

### Other Investments

We need to encourage capital investment to move forward in a range of areas, including – but not limited to – technology. We should attract capital investment in Australian transport technologies. We should also invest in a knowledge economy to avoid reliance on primary resources. We should review whether our investment policies will succeed in a global environment, and explore shared investment frameworks. Part of this will require attracting capital from a younger generation of investors. *(7 entries; scenarios 2 and 4)*

### Uberisation

Understand how the sharing economy will impact on freight volumes. Facilitate the sharing of warehouses. Support small businesses in the pursuit of uberisation. *(4 entries; scenarios 3 and 4)*

# 7. CONCLUSIONS

## 7. Conclusions

The present scenario planning project was commissioned four months ago by the Department of Infrastructure and Regional Development, to supplement consultation advice in the Inquiry into National Freight and Supply Chain Priorities. After 17 weeks of work by a team from Deakin University's Centre for Supply Chain and Logistics, the project's findings are made available in Section 6 of the present report.

The recommendations and views found therein are not those of CSCL. Following a rigorous research methodology, we have limited our role to eliciting, distilling and summarising these views, without including our opinions in them. They are based exclusively on what we learned from our scenario planning exercise with industry, through a literature review, more than 40 hours of interviews, 6479 data points from a survey, and the careful study of 1057 recommendations collected in four workshops across Australia.

Without attempting to summarise the 8000-plus words spread over 15 pages of findings from Section 6, we would like to present below a few final conclusions.

Although nothing is certain about the future, it is very likely that freight and supply chains in Australia – and around the world – will face important challenges and opportunities in the near future.

A technology-driven industrial revolution is at our doorstep, powered by the twin engines of automation and data. Large-scale collection, sharing, analysis and application of data will allow for greater understanding and system-wide improvements. The extensive use of automation in vehicles, facilities and production processes, along with artificial intelligence, will make possible higher levels of efficiency and speed.

Taking full advantage of this technological revolution will require rethinking our education and training approach, to include more numerical, technical and analytical subjects, as well as more future-focused courses on subjects such as robotics and optimisation. At the same time, the loss of low-skill jobs displaced by technology will bring a series of social and workforce challenges, forcing retraining and career changes for employees. Managing this transition is important.

To remain competitive internationally, Australia must embrace the new technological revolution. Australian regulations should stay ahead of the technological changes that automation and data will bring, enabling the implementation of the most promising advances for the sake of greater competitiveness. Likewise, Australian infrastructure should not lag in adapting to new developments in transportation, such as autonomous vehicles.

Social changes are also taking place. New generations of consumers embrace different values and have increased expectations. They expect direct delivery of their goods, with few delays, and aligned with their views of social and environmental sustainability. A minimal carbon footprint, and great respect for both people and the environment, may become non-negotiable attributes of supply chains and production methods in the future. Higher transparency, visibility and traceability may become requirements for success. Australia's reputation as a 'clean and green' brand could prove an invaluable asset in a future where exports are given the importance of a strategic imperative.

As Australia's population and economy grow over the next few decades, infrastructure and regulation can serve as enablers of progress or as bottlenecks. There is fear from industry that a lack of coordination across levels of governments and disparities across state jurisdictions, combined with the etch-a-sketch effect of Australia's short political cycles, may prevent the development of a harmonious regulatory framework and long-term plan for infrastructure development.

There is an enormous opportunity here for different levels of government to find a way out of their respective jurisdictional labyrinths, and to agree – along with industry and society – on a long-term master plan, separate from politics, for the planning, infrastructure and regulation of freight and supply chains in Australia. This master plan must protect the necessary corridors and land from encroachment, and factor supply chain and freight into municipal decisions. It must also strive to balance the amenity of communities with the reality of what it takes to satisfy their freight and supply chain needs.

While these are the major points, there are many other equally important – albeit more specific – recommendations in Section 6. The careful reader should not consider these final pages a substitute for reading that section in full.

It is our hope that the fruits of this effort prove useful to the Department of Infrastructure and Regional Development in its effort to better understand the national priorities in freight and supply chain that could help Australia remain successful in an uncertain and volatile future.





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