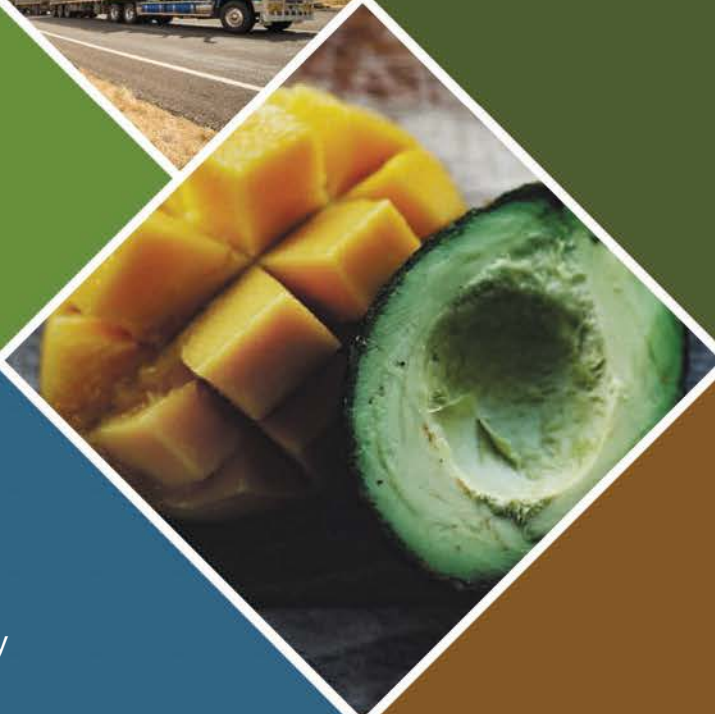


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Reframing Smart Supply Chains in Northern Australia

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2020

CRCNA
DEVELOPING NORTHERN AUSTRALIA





Published 2020

ISBN: [978-1-922437-01-3](#)

Acknowledgments

This research is funded by the CRC for the Cooperative Research Centres Program, an Australian Government initiative, supports Developing Northern Australia (CRCNA). The CRCNA also acknowledges the support of its investment partners The Western Australian, Northern Territory and Queensland Governments.

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Project Participants

This project was conducted by James Cook University and Charles Darwin University.



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Acronyms

SHORT FORM	FULL FORM
ABS	Australian Bureau of Statistics
ACC	Australian Competition and Consumer Commission
ADII	Australian Digital Inclusion Index
AIS	Australian Industry Standards
ALC	Australian Logistics Council
ASEAN	Association of Southeast Asian Nations
CDU	Charles Darwin University
CRCNA	Cooperative Research Centre for Northern Australia
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DPC	Department of Prime Minister and Cabinet
FNQROC	Far North QLD Regional Organisation of Councils
GDP	Gross Domestic Product
GVAP	Gross Value of Agricultural Production
IRC	Industry Reference Committee
JCU	James Cook University
NA	Northern Australia
NT	Northern Territory
NCVER	National Centre for Vocational Education Research
NRDAA	Northern Regional Development Australia Alliance
PWC	Price Waterhouse Coopers
QLD	Queensland
R&D	Research and Development
ROSI	Roads of Strategic Importance
TFES	Tasmanian Freight Equalisation Scheme
VET	Vocational Education and Training
WA	Western Australia

Introduction

The Australian Government is committed to the development of Northern Australia. *Our North, Our Future: White Paper on Developing Northern Australia* (2015) identified the potential for diversifying the economy for a more prosperous Northern Australia.

Given the current rapid changes in trading, technological, consumer and natural resource environments, and particularly in the post COVID environment, supply chains are critical in maintaining the overall competitiveness of Northern Australian industries. In the context of agricultural development in Northern Australia Ash and Watson (2018:302) argue that although there are climatic and environmental constraints, “it is mainly factors associated with finances and investment planning, land tenure and property rights, management, skills, and supply chains which provide the critical challenges”.

The Cooperative Research Centre for Developing Northern Australia (CRCNA) has funded James Cook University (JCU) and Charles Darwin University (CDU) to undertake the project “Re-Framing Smart Supply Chains in Northern Australia”. The project involves the development of a discussion paper and roundtables with key stakeholders to explore new and innovative thinking about the potential for agricultural supply chain redesign in Northern Australia. The purpose of the discussion paper is to explore key questions in reframing smart supply chains for Northern Australia. The discussion paper will serve as a base document for a series of electronic roundtables of key stakeholders focusing on renewed examination and reframing of supply chains. The project aims to open up thinking about possible new policy, budgetary and regulatory measures to support the development of alternative models of supply chain for Northern Australia that are more efficient, more effective, smart and agile. This work will identify potential partnerships for collaborative planning and implementation of supply chain initiatives across the North.

The Northern Australian context

Northern Australia constitutes 53% of Australia’s land mass, 1.3 million (5.2%) of the total population and almost 30 % of Australia’s Indigenous population live in Northern Australia (Dale et al 2020, Australian Government 2015). Northern Australia’s economy is growing, making up approximately 12% of Australia’s Gross Domestic Product (GDP) in 2015 (Infrastructure Australia, 2015:6). The potential for growth has been identified by a range of recent studies (PWC, 2019; Deloitte Access Economics, 2019; KPMG, 2020).

Among the well-accepted challenges facing Northern Australia’s economic growth, supply chain shortcomings play a prevalent role. This can be attributed to the infrastructure development lag that the Northern region has accrued as a result of Australia’s economic history. Northern Australia’s supply chains deficits constitute one of the key comparative disadvantages that the region faces, despite its outstanding resources, people and locational advantages. Northern Australia faces excessive freight costs (particularly for low volume agricultural products) and

supply chains are served by networks where limited options exist. This results in inadequate access to markets due to capacity constraints, high costs, low volumes and, more generally, network unreliability. Considering these challenges, Northern Australia struggles to attract capital investments and skills (except during mining booms) and endures stickiness issues (i.e. inability for economic adjustment) typical of peripheral regions around the world. The long-term impacts include a constant loss of key human capabilities and of the constant boom and bust approaches to efforts to build a sustainable economic base.

Supply chain characteristics for selected commodities in Northern Australia

Supply chains in Northern Australia are complex and involve a dynamic and interconnected network of organisations. They face significant challenges. Higgins et al (2018:341) provide an apt summary: “despite the longevity, scale and importance of agricultural industries in Australia, supply chains are usually characterised by high transport costs along rural roads, seasonal constraints on usability, infrastructure distant from areas of production, and significant vulnerability to market- and weather-related shocks”. A number of studies have been funded by the CRCNA (2018-2020), examining supply chains in selected regions including Far North Queensland, Northern Queensland and Mackay, Whitsundays and Isaac region. Additionally, a recent study was also undertaken to examine the key opportunities for Northern Australia exports to the ASEAN region. Moreover, there has been industry specific situational studies in forestry, rice, aquaculture, broadacre crops and beef. A summary of the key findings from these studies for some of the key commodities are:

Industry	Strengths	Challenges
Beef	Strong global demand Low input, low cost production Provenance, certification and traceability Low production input Strong supply	Key issues outlined included vast geographic footprint for supply chains, cost of freight, access to port and airport, feed and cold storage facilities, location of abattoirs, conditions of roads, seasonal variations, biosecurity risks, and workforce and skills gaps and shortages. Other important issues were feedlot allocation, access to water, regulatory processes, seasonal and climatic conditions, bio security risks, non-tariff barriers.
Aquaculture	Strong global demand Provenance, certification and traceability Quality supply of seafood R & D support in the North for the sector	Key issues outlined included location of processing, packaging and storage facilities, cost of freight, dependence on refrigerated container freight access, particularly reliant on air services due to lack of infrastructure at ports, access to market, infrastructure needs (e.g. water pumps, power), workforce and skills gaps and shortages, and digital connectivity problems. Other important issues were high-energy costs, regulatory constraints and biosecurity considerations.

Horticultural Products (Mangoes, Avocadoes, Lychees)	Strong consumer demand Quality of produce Domestic and global market demand	Key issues outlined included freight costs to access markets in southern States, cold storage facilities, processing plants and infrastructure, lack of processing, de-husking, and processing facilities, workforce and skills gaps/shortages, and digital connectivity. Other important issues identified were non-tariff barriers, biosecurity risks, water security and costs, climatic challenges, regulatory barriers and cost of power.
Sugar Cane	Established industry Export focused	Ageing infrastructure, an ageing workforce, high freight costs to mill or market, lack of scale of by-products, globally volatile markets,
Broadacre crops	Potential for export expansion Compatibility with other cropping systems	Food grade transport containers for shipping, supply limited, access to rail, port and airport, market access, fragmented jurisdictional agricultural policies, lack of processing and storage facilities (e.g. cotton gins, silos, mills), cost of freight, biosecurity challenges, small scale of industry sector in NA, regulatory barriers (e.g. vegetation legislation)

Source: ACIL Allen, 2020; KPMG, 2019, 2020; Dale et al, 2020

These studies outline the identification of strengths of each region as well as challenges faced in supply chains. Cumulatively, the studies enable an overall picture to be established for Northern Australia. The overall findings from the studies indicate that:

- There is potential for economic growth in Northern Australia across different industries if supply chains can be strengthened, trade volumes intensified, digitally smart technologies adopted and a more targeted market approach taken, particularly exports to ASEAN countries;
- Cooperation is needed along supply chains and the development of multi-purpose/multi-sector supply chains
- Freight networks and logistical connectivity between production stages needs to be more efficient;
- The need for multi-purpose/multi-sector enabling infrastructure
- Infrastructure gaps exist in areas such as transport, storage, biosecurity and export facilities and digital connectivity;
- The cost of doing business is higher in Northern Australia, particularly for freight;
- There is a need to ‘value-add’ via appropriate processing, storage, packing and handling facilities; and
- Requisite investment in infrastructure, research and human capital is needed.

Studies indicate the challenges of scaling in Northern Australia. Transport is particularly challenging and can significantly impact on gross margins. In the context of agriculture, Ash and Watson (2018:302) state that “supply chains and associated transport logistics and infrastructure such as roads and ports, processing facilities and power are all significant challenges for establishing a larger-scale agricultural sector in northern Australia”. It is argued that there are opportunities for growth in Northern Australia, particularly in niche targeted agricultural products (Ash et al, 2017). The impediment of the high cost of transport to the overall cost of production is a key challenge that needs to be addressed.

Focus areas for reframing Northern Australia supply chains

From the consultations, the literature review and the CRCNA funded studies, a number of key and consistent issues are now emerging to stimulate a re-think of supply chains in Northern Australia.

Business as usual: Established supply chain patterns in Northern Australia

Current supply chain patterns and linkages are well established across Northern Australia. Individual producers have developed bespoke, 'fit for purpose' supply chains driven by managing risk/uncertainty, production cycles and weather conditions. Individual and small groups of producers, for example, arrange the transportation of their produce to meet their independent needs. Hall and Frew (2017:4) suggest that, in the context of Queensland, "these specific conditions make arranging efficient largescale transportation difficult... and this creates gaps in knowledge of what is moving where and when hence the issues with the transfer of information. In turn, this leads to less efficient supply chains and constrains the ability of the sector to move its produce at the lowest possible cost". Consultations identified that stakeholders believe 'business as usual' is not sustainable in the long term (Babacan & Tremblay, 2020). Supply chains specific to commodity or industry work with different degrees of effectiveness, depending on the commodity and target market (e.g. domestic, or export). Northern Australia's deficient supply chains constitute the key source of comparative disadvantage the region faces, despite its significant resources, people and locational advantages. High freight costs, low commodity volumes, network unreliability, boom and bust economic cycles of certain industries, human capital constraints impede development and reduce capital investment attractiveness.

The literature identifies that there is very little connectivity across sub-regions and commodities and that there may be efficiencies to be gained by capitalising on synergies (Hall & Frew, 2017). Consultations conducted across Northern Australia identified that

- Supply chains were seen as fragile;
- We need to revisit the way 'we do business'; and
- There are potential synergies across different commodity and industry groups for supply chain efficiencies (Babacan & Tremblay, 2020).

Some examples of synergies across commodities, identified in consultations, include sugar cane and other crops, aquaculture and horticulture, and timber and beef. Supply chain synergies were seen as a potential in cross industry producer-customer relationships in export markets. By altering supply chain linkages and networks it may be possible to gain benefits, reduce costs and develop agile systems, particularly where inefficiencies exist. It may also be possible to enable a multi-user investment strategy rather than enterprise or industry specific investment. The most significant challenge for development in Northern Australia remains the under-development of higher value and more efficient, low impact supply chains (Dale et al 2020). A multi-component supply chain development fund is suggested by CRCNA to enable research, partnership building

and feasibility assessment of new initiatives (Dale et al, 2020). The development of such a fund has the potential to be a game changer for Northern Australia and enable reframing of smart supply chains.

Questions for Discussion

- Are there supply chain synergies across different sub-regions and industries/commodities in Northern Australia?
- Can intermodal logistics hubs bring about supply chain efficiencies in Northern Australia?
- Should a supply chain fund be established for Northern Australia and what should it look like?

Cost of freight

Rural industries in Northern Australia are characterised by long supply chains between production, processing and markets. Climatic conditions, sparse and limited road networks challenge industries in accessing inputs and supplying products. The viability and profitability of North Australian industries are affected by many factors such as cost of productions, access to finance and farm debt, productivity, domestic and global prices and markets. Direct costs, such as freight, are a major contributor to enterprise profitability. Freight costs can constitute up to 35% (Higgins et al, 2015:32) and up to 48.5% of farm gate prices (PWC, 2019:37).

Current freight patterns are entrenched with routes and cost structures. Freight costs across Australia also show variability across different commodities as is demonstrated in Table 1:

Commodity	% Freight Cost as a share of Gross Value of Agricultural Production (GVAP)
Beef	6.4%
Grains	27.5%
Cotton	2.4%
Dairy	4.3%
Sugar	2.1%
Fruits and vegetables	21%

Table 1: Freight Costs as % of GVAP

Source: Deloitte Access Economics, 2019: 11

The transport options for Northern Australia span across all major modes of transport including sea, air, road and rail. Higgins et al (2015:32) note that the agriculture and horticulture in Northern Australia is characterised by long supply chains between production, processing and markets in Australia, with transport distances often upwards of 2,500 – 4,000km. The Northern Australia Infrastructure Audit identifies that there are 80 *airports* that provide regular public transport services (Infrastructure Australia 2015:68). Special charter services, privately owned airfield and smaller aerodromes also provide connectivity major centres such as Darwin, Townsville and Cairns. In terms of freight, the Northern Australian airports have limited and/or no refrigerated container capability which limits the export of high-quality agricultural products from the region. Infrastructure Australia notes (2015: 74) that substantial volumes of fruit and vegetables are trucked to Brisbane, Adelaide and Melbourne with subsequent air freighting to Southeast Asia and domestic use. They identify a combination of factors that lead to this including a substantial domestic market in the southern capitals, a road freight sector with refrigerated capability, low

international air freight rates from airports in southern capitals and availability of wide-body passenger aircraft (not available in Northern Australia).

The map below illustrates the major aviation, sea and road transport routes for Northern Australia.

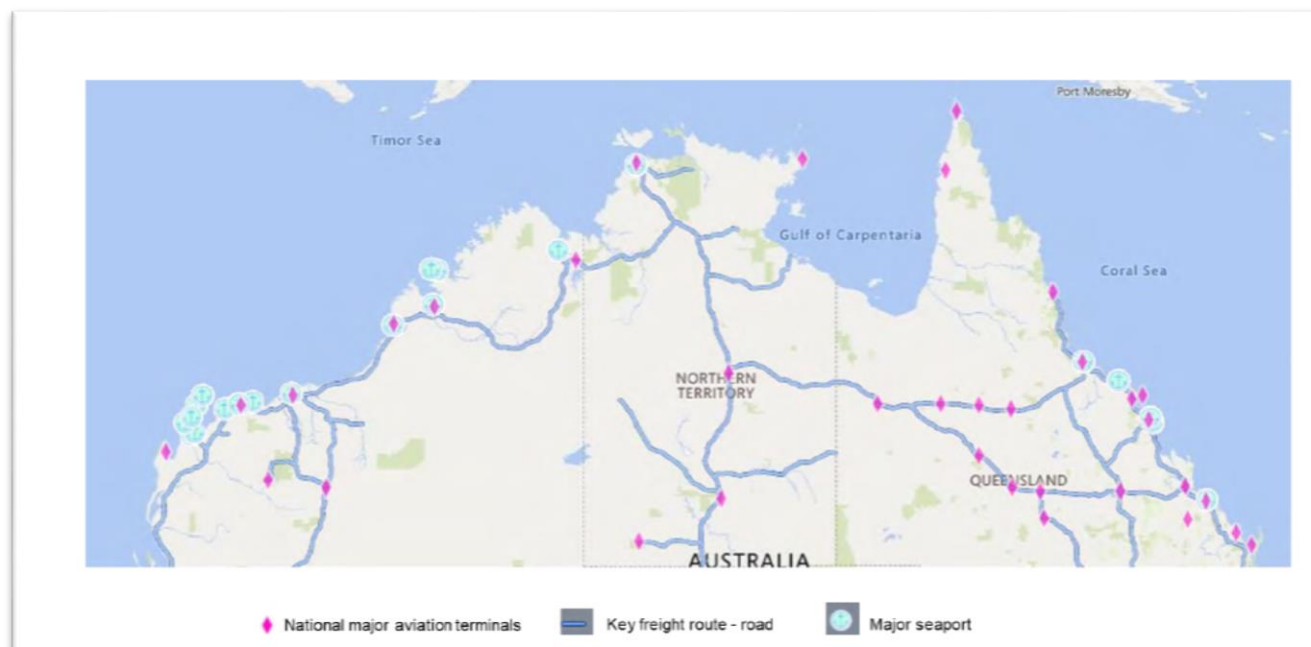


Diagram 1: Major sea, road and air routes in Northern Australia
Source: PWC, 2019:38

There are 25 ports in Northern Australia that are serviced by commercial vessel including containerised shipping line services for bulk goods for export/import, chartered vessels for mining and agricultural products as well as use for military and tourism (cruise ships) purposes (Infrastructure Australia 2015:76). Each port has their unique challenges depending on the natural characteristics of the port, the nature of commodities traded, channel depth for vessel entry, capability of vessels and terminal area and specialised port infrastructure (for storage, handling, stockpiling). Increase in port capacity is linked to changes in activity at the port driven by market demand such as the expansion of the nature of commodities or a change in the volume of commodities going through the port. Infrastructure Australia notes the variable growth the freight task in the different North Australia ports and identifies that there are key growth regions with specialised port infrastructure, mostly driven by minerals, while other areas are at a further distance from ports or the ports do not have adequate infrastructure.

Roads form a major consideration in the freight task for Northern Australia and for connecting industries with economic activity. The Northern Australia road network is identified as extensive and characterised by long isolated roads and low daily traffic volumes, as well as major national highways. In some industries, there is significant over-reliance on road networks. For example, in the beef industry 5.3 million cattle movements occur per year, with most movements (2.4 million) between properties and over 1 million to export depots (Chilcott et al, 2019:3). Two thirds of Northern Territory's interstate land freight is moved on the road network (NT Government,

2018:5). The audit of infrastructure in Northern Australia revealed 72 roads in scope as a major connector to economic activity: 32 in Queensland, 17 in Northern Territory and 23 in Western Australia (Infrastructure Australia, 2015). The key north-south freight transport routes include the Bruce Highway and Gregory Highway in Queensland, the Stuart Highway in the Northern Territory and the North West Coastal Highway in Western Australia. Urban roads within Northern Australia account for a much smaller proportion of total network traffic than non-urban roads but provide vital links between economic activities.

An often-observed challenge associated with agricultural supply chains using road transportation is the *first and last mile* dilemma that occurs when linking and accessing key freight and processing facilities (Reed 2017). Significant proportions of Northern Australia's agricultural market are not serviced by any other freight options other than roads (Reed, 2017; Tremblay & Babacan, 2020). The quality of road links across Northern Australia is varied with large portions of the road in WA, NT and inland Queensland being unsealed. Climate conditions challenge road reliability, especially during floods. Limited road options are most often manifested in inadequate quality and reliability and are a main source of uncertainty for the delivery of many key commodities commonly resulting in excessive freight costs, as well as related impacts in the form of road deterioration, and time delays getting products to market. The level of service the road network is able to provide is impacted by a number of factors including the climate (wet and dry seasons), levels of economic activity and the configuration of the road e.g. sealed, unsealed, weight restrictions (Infrastructure Australia, 2015). The Northern Australian Roads Programme is an investment the Australian Government include upgrades, safety and productivity improvements, such as road widening, overtaking lane construction and pavement renewal. Similarly, the Australia Beef Roads Programme was a targeted investment for key roads necessary for transporting cattle. In the 2019-2020 Budget, \$4.5 billion funding was committed to the Roads of Strategic Importance (ROSI) with a view to improving freight connectivity for agricultural and mining regions. CSIRO was funded to develop a transport network strategic investment logistics tool (TRANSIT) to map routes and costings across Australia agricultural supply chain.

Rail in Northern Australia is the main transport mode for moving bulk minerals and supports road transport in moving grains, livestock and other agricultural products. There are major north south rail routes such as The North-South transcontinental railway from Darwin to Adelaide and North Coast Line system in Queensland. There are numerous commodity specific rail routes that support the mining industry across Northern Australia. The Northern Regional Development Australia Alliance argues that “a number of key challenges exist in our rail freight system with no consistency around rail gauges or axle load limits. This has a significant impact on the efficiency of general freight and bulk commodity movements” (Reed, 2017:5). Studies have shown that increased efficiencies can be achieved via improvements to the railways e.g. narrow gauge in Central Queensland (Acil Allen, 2020). The *National Rail Vision and Work program*, endorsed by the Transport and Infrastructure Council in November 2016, provides the key reform areas including access, pricing and interoperability, safety and incident regulation, environmental regulation and corridor protection along with funding and investment and performance measurement and management, much of which is applicable to Northern Australia.

Given the high contribution of the transport to the overall costs of production, freight considerations in Northern Australia require further attention in relation to efficiencies and improving net returns.

The Potential for a freight subsidy

Consultations have, anecdotally, raised the value of consideration of a freight subsidy for Northern Australia. A subsidy is defined as any form of government support provided to producers or consumers (Riley, 2020). It is an economic benefit that is granted directly or indirectly. There a range of subsidies such as guaranteed payment on the factor cost of a product (e.g. minimum price on a commodity); an input subsidy which subsidises the costs of inputs in production; grants to cover losses; industry bailout; and financial assistance (loans and grants) (Riley, 2020).

There are mixed views among economists and policymakers about the effects and impacts of subsidies applied to support specific industries or sectors. The key benefits and disadvantages are outlined below.

The *benefits* of a subsidy are identified as:

- Enables industry/enterprises to respond to problematic situations;
- Reduces production and input cost for suppliers;
- Assist disadvantaged industry or regions to be competitive, level out the playing field by assisting in gaining a comparative advantage;
- Provide encouragement and incentive to develop more efficient and innovative production and distribution processes;
- Provides economic stability or stimulate economic development in particular regions or industries, including support to indirect beneficiaries;
- Can correct imperfections in the market and enable market adjustments; and
- Government subsidies may be used to leverage and attract private sector investment.

The *disadvantages* of a subsidy may include:

- Market distortion effects (e.g. competition, price, demand and supply levels) and weakens profit-loss signals in the economy and reduces entrepreneurship;
- Create reliance on subsidy by industry/enterprise and continue inefficient production processes;
- The impact of the subsidy can consolidate particular types of enterprises and exclude others, with unseen losses of un-subsidised competitors;
- Subsidies have been shown to benefit the wealthy first and have not gone to the enterprises that need it;
- May contradict some international agreements;
- Can increase transaction and administrative costs;
- Public expenditure supports private gains that raise social distribution and equity considerations, and the opportunity cost of public investment in other areas may result in net welfare loss; and
- Government subsidies may create favouritism of specialist groups or have other corrupting influences (Li et al, 2018; Simpson & Clifton, 2016; Mitra & Webster, 2008; Bartik, 2005; Baum, 1987).

Simpson and Clifton (2016) identify that there are major distributional, procedural and outcome issues in relation to subsidies. In the decision to provide subsidies, it is important for policymakers to ensure that comprehensive data and market analytics is available, a vision for market/industry direction is articulated, modelling is undertaken to understand the impact of the intervention against economic and regional development objectives and a realistic assessment of direct and indirect costs and benefits across beneficiaries. The policy interventions that are discretionary

and adhoc have been shown to result in distortions, unpredictability, leading to unintended consequences (Pernechele et al, 2018). Economists have long debated the merit of subsidies as a policy mechanism. The importance of keeping a long-perspective on the costs and benefits derived from subsidy interventions is critical in policy deliberations (Baum, 1987).

Freight policies and subsidies, however, do exist in Australia. The liner cargo shipping services to and from Australia have access to a wide suite of exemptions from Australia's competition law which are set out in the *Australian Government Competition and Consumer Act 2010*. These exemptions lower the operating and capital costs to provide reliable cargo services to Australia. In 2015, *Australia's Competition Policy* was reviewed (the Harper Review) which called for a repeal of the cargo shipping services exemptions arguing that no other industry with similar characteristics is provided with these exemptions (ACCC, 2019). The implications of such a change, if adopted, for supply chains in Northern Australia is likely to be significant. Arguments in relation to competition, nature of intervention and equality between industries often neglect considerations of equity of regions and the capacity of regions to compete (Babacan & Dale, 2019).

In other policy initiatives of relevance to the North, *the Tasmanian Wheat Freight Subsidy Scheme* was established to subsidise the cost of bulk shipments of wheat from the mainland to Tasmania by sea. *The Tasmanian Freight Equalisation Scheme* (TFES) was introduced in 1976. The Government's objective was to establish a cost equalisation scheme to alleviate the freight cost disadvantage incurred by shippers of eligible non-bulk goods moved between the mainland and Tasmania by sea (Productivity Commission, 2006). The key motivations for establishing the scheme were:

- Addressing disadvantage for producers who rely on shipping across the Bass Strait. Using shipping can more than double the cost of road transport for a similar distance to the mainland;
- Addressing geographical disadvantage; and
- Achieving overall regional economic development objectives.

A review of TFES by the Productivity Commission (2006) raised a range of key issues. These included how to assess the disadvantage faced by producers, how to set parameters for the subsidy reimbursements, changing costs to shipping over time, and manipulation of the scheme by operators. Modelling by the Tasmanian government identified benefits to firms at the enterprise level (depending on the shipping freight task). The TFES industry groups estimated to have expanded, due to the support of the subsidy, were wood and paper (\$21.7 million); food (\$15.6 million); and agriculture (\$9.2 million). The modelling also identified that the introduction of the TFES increased overall Tasmanian output and employment by about 2 %. Beyond the direct recipients, the TFES is estimated to have indirectly advantaged other Tasmanian industries, including related service industries. The multiplier impacts were estimated to result in a gain to Tasmania from an expansion and creation of employment to 4,300 people (Productivity Commission, 2006:52). Submissions to the Productivity Commission Inquiry (2006) indicated that TFES enabled enterprises to make market adjustments to competitive pressures. However, the Commission identified that TFES payments are equivalent to about 0.9 % of total costs and about 2.3 % of the value-added for the agriculture, mining and manufacturing sectors of the Tasmanian economy (2006:47). The benefits to different industries varied, e.g. benefits of TFES payments to paper *and paper products* represented about 4.3 % of industry costs, and *food*, TFES payments constitute about 2.1 % of industry costs (Productivity Commission, 2006:50). The Victorian

Government, in its submission to the Productivity Commission Inquiry into TFES, supported the continuation of the Scheme, most importantly pointing to the flow-on, positive economic impacts of TFES directly into the Victorian economy and also indirectly to other states (via freight forwarding to other states) (Victorian Government, 2006). The Productivity Commission raised an important question about whether different regional economic development stimulations may achieve economic development outcomes rather than a subsidy.

Relevant parallels can be drawn between Northern Australia and the Tasmanian experience in relation to the need for freight subsidy. Northern Australia, as with Tasmania, experiences significant disadvantage due to transport costs for industry based on geography. There is significant potential for enterprises and industry to attract necessary investment due to the challenges of distance. The Australian Government has made a commitment to the economic development in Northern Australia and a proposed freight subsidy may be viewed as one key measure to be adopted. Elements of the Tasmanian scheme can be emulated for Northern Australia and applied conditionally across defined sectors, markets and commodities. The possibility of a subsidy may provide stimulus to re-frame supply chains in Northern Australia towards northbound exports rather than reinforcing the traditional routes and southbound trade.

Questions for Discussion

- What are the key issues in freight and logistical connections between production stages in Northern Australia?
- What are the benefits and disadvantages of freight subsidies for Northern Australia?
- If a freight subsidy scheme was proposed, what model would work best for Northern Australia? (e.g. guaranteed payment on the factor cost of production, input subsidy grants to cover losses, industry bailout, financial loans or grants).
- If a freight subsidy was to be introduced which modes of freight would yield the most productive outcomes?
- How do you measure the success of such a scheme? What may be the end goal (e.g. reduced cost, creation of scale)?

Supply chain infrastructure

The vast majority of policy statements around Northern Australian economic development place Northern freight performance as the key source of comparative disadvantage and identify under-performance in that domain relative to the rest of the country (Tremblay & Babacan, 2020). The Australian Logistics Council estimates that for every 1% increase in efficiency gained in the supply chain sector, GDP will be boosted by \$2 million (ALC, 2016:3). With Northern Australia constituting approximately 12% of Australia's GDP, equivalent to \$187 billion in 2016-17 (Dale et al, 2020:8), there is significant gains to be made from infrastructure that provides supply chain efficiencies.

The *Industry Innovation and Competitiveness Agenda, 2014*, identified that Australia's size and geographic location placed a critical requirement for transport networks to be as efficient as possible and infrastructure was fundamental to Australia's competitiveness. The main recommendations were to increase public investment in infrastructure; improve infrastructure project selection, funding, finance and delivery processes; and encourage private sector investment in infrastructure (DPC, 2014). The Harper Competition Review (2015) identified that the roads are the least reformed of the infrastructure sectors with little change to funding, and

institutional arrangements in the past 20 years. The Review argued that “more effective institutional arrangements are needed to promote efficient investment in and usage of roads and to put road transport on a similar footing with other infrastructure sectors” and that appropriate pricing policy options needed to be identified (Harper et al, 2015:38).

The Productivity Commission inquiry into public infrastructure argued that the drivers behind the focus on public infrastructure are:

- Widely held views that deficiencies in certain aspects of Australia’s infrastructure — such as in roads, rail, and ports — are holding back productivity growth and affecting the amenity of our cities and regional areas. This gives rise to concerns about an overall infrastructure deficit;
- Apprehension about the costs of delivering new public infrastructure and the potential for efficiency gains in the delivery and use of infrastructure;
- Concerns about debt and long-term budgetary pressures being faced by governments at all levels and how these might affect the provision of public infrastructure; and
- Macroeconomic objectives of offsetting decreasing investment and employment in other sectors and promoting economic growth more generally (Productivity Commission, 2014:3).

The Australian Transport and Infrastructure Council has released Australia’s first *National Freight and Supply Chain Strategy* in 2019, with goals and targets out to 2024. The four priority areas are:

- Smarter and targeted infrastructure investment;
- Enable improved supply chain efficiency;
- Better planning, coordination and regulation; and
- Better freight location and performance data.

In these priority areas, infrastructure features centrally for action:

- Ensure that domestic and international supply chains are serviced by resilient and efficient key freight corridors, precincts and assets. This will require the development of a comprehensive ‘infrastructure investment framework’;
- Provide regional and remote Australia with the infrastructure capability to connect regions and communities to major gateways, through land links, regional airports or coastal shipping;
- Identify and support digital infrastructure and communication services necessary for improved and innovative supply chains: recognising the need to future-proof new infrastructure, improve mobile coverage along major freight lines, plus digital infrastructure deployed to support innovative operations and technology improvements and
- Advance heavy vehicle road reform to facilitate efficient investment in infrastructure (Australian Transport and Infrastructure Council, 2019).

Northern Australia’s critical infrastructure challenges have been identified to fall within four characteristics:

- *Demand gaps* for infrastructure where demand exceeds capacity, or approaches capacity such that the service becomes congested, unreliable, unsafe, or where capacity is inadequate for larger, more efficient services;
- *Opportunity gaps*, where the provision of improved or lower cost infrastructure could generate demand that is not currently present, stimulating economic development or population growth;
- *Cost gaps*, where the cost of providing infrastructure is higher than in other locations or facilities, due to scale differences or other factors, limiting or deterring economic development activity; and
- *Service standard gaps*, where the level of infrastructure service falls short of community, policy-based or legislated standards for attributes such as safety, availability and quality (Infrastructure Australia, 2015:15).

Much of Northern Australia can be classified as rural, regional and remote. Infrastructure Australia (2019:187) notes that developments in the economy, regulation, technology and service delivery mean our infrastructure needs are changing, leaving some regional centres at risk of being left behind. Lags in infrastructure quality and access to services in smaller cities and regional centres could lead to a growing gap in productivity and liveability, relative to larger cities. These lags have direct impacts on supply chains. The recently completed regional studies, as noted above, identified significant supply chain infrastructure needs and concluded that infrastructure for priority products was inefficient or underdeveloped. These studies illustrated numerous critical supply chain infrastructure issues for Northern Australia, including:

- Roads: access, condition upgrades, bridges and networks;
- Aviation: routes, hubs, storage and refrigeration;
- Ports: access to infrastructure that can enable multi-modal use, cold chains;
- Rail: interoperability, rail gauges or axle load limits, routes;
- Digital connectivity, communications, internet, and including black spots;
- Power: cost of energy, access to power;
- Water: water access for irrigation, water supply; and
- Distribution, storage, processing hubs (Acil Allen, 2020; KPMG, 2020; KPMG, 2019)

The use of infrastructure across Northern Australia can be seasonal with high demand at particular points of the year such as harvesting time. Boom and bust cycles, cyclical nature of demand and seasonal variations in Northern Australia call for much more adaptive infrastructure (Infrastructure Australia, 2020). It is argued that infrastructure bottlenecks have the potential to increase the cost of freight across the supply chain (Deloitte Access Economics, 2019). However, infrastructure is aging and there is also competition within commodities for freight capacity (Hall & Frew, 2016). Northern Australia's infrastructure needs fit into many categories of the Australian Government's 'Infrastructure Priority List', namely, asset renewal, corridor preservation, efficient markets, the opportunity for growth, remote infrastructure, resilience, road safety and social infrastructure (Infrastructure Australia, 2020). It is concluded that there is a lack of adequate

infrastructure to support supply chains and upgrading the logistics network must be a priority for investment for Northern Australia to reduce the cost incurred by domestic and foreign investors (PWC, 2019). The catalytic role of enabling supply chain infrastructure for economic prosperity and development is strongly identified in the Northern Australian context.

The problematic nature of infrastructure development in Northern Australia has been noted and that “some of the region’s supply chain infrastructure for priority products is underdeveloped or inefficient” (Dale et al, 2020:31). Infrastructure Australia argues that there are ‘sources of market failure’ which in infrastructure delivery which requires a government response. The sources of market failure include limited economic scale in many infrastructure settings, resulting in a high cost and/or poor quality of service, or an absence of competition in service provision; ‘first mover disadvantage’; coordination externalities that preclude more extensive networks, which would provide more reliable and lower cost service; and low socio-economic circumstances, with resulting weak capacity to pay for infrastructure services. (Infrastructure Australia, 2015:5). For remote and rural towns and cities, infrastructure challenges include high cost of construction, lack of compelling economic justification for investment, exposure to climate and weather events and reliance on single asset and networks with an increased likelihood of asset failure (Infrastructure Australia, 2020).

Modern infrastructure planning requires a collaborative effort (Kosansky & Schaefer, 2011). There is a need for connectivity between different aspects of supply chain operations. Better communication, appropriate data, decision-making processes and synergies across industries is fundamental. Finding consensus on where to invest is a critical issue in a period of unprecedented infrastructure demand and investment (Infrastructure Australia, 2020). A new wave of infrastructure demands for investment is emerging in the wake of the national bushfire crisis, the floods in early 2019 in Victoria, New South Wales, Queensland and the ongoing drought across different parts of Australia (Infrastructure Australia, 2020). The *Infrastructure Priority List* identifies 37 new high priority initiatives, some of which are in Northern Australia including roads, water and electricity (Infrastructure Australia, 2020).

There is evidence that fragmentation occurs across jurisdictions in relation to infrastructure planning across Northern Australia. Areas of fragmentation include lack of prioritisation of existing infrastructure, project feasibility, development and evaluation processes, duplication and lack of coordination (Productivity Commission, 2016; Infrastructure Australia, 2015; Australian Logistics Council, 2016). The Productivity Commission (2014) argued that there is a need to overhaul the processes for assessing and developing public infrastructure in Australia, much of it relevant to Northern Australia. Infrastructure Australia (2019:193) concludes that lack of coordination and planning and investment across jurisdictions in Northern Australia has resulted in disconnected transport and energy networks and inefficient supply chains. The Commission (2014:2) called for a reform in governance and institutional arrangements for public infrastructure for better decision making in project selection, transparent cost-benefit analysis, risk analysis, financing and delivery of services from new and existing infrastructure. Infrastructure Australia (2015:26) posits that strengthened infrastructure network planning and coordination merits consideration as a means to help lower the costs of infrastructure service and improve the reliability of supply. The Productivity Commission (2014:37) argues that there are significant differences between jurisdictions in their level of privatisation, preparedness to embark on large new infrastructure programs and funding flexibility. The ALC has called for the development of national governance principles in partnership with governments and the private sector to support the development of long-term integrated infrastructure supply chain plans (ALC, 2016). The need for strategic planning and regulatory framework to ensure infrastructure can be efficiently utilised by industry has also been articulated. (Deloitte Access Economics, 2019:1). Studies indicate that there is

no consolidated understanding of investment requirements in Northern Australia that in turn hinders potential foreign investments in the area, leading to investor uncertainty and increasing level of risk (PWC, 2019:12, Dale et al. 2020).

In going forward, it will be critical to have

- An integrated infrastructure plan for Northern Australia;
- Appropriate cross jurisdictional governance and coordination;
- Investment in infrastructure that can benefit many enterprises and industries;
- Investment in infrastructure that can cut across one State/Territory;
- Generate multi-user investment to secure greater benefits from infrastructure; and
- Stop leakages from the local economies of the North.

Questions for Discussion

- What significant supply chain infrastructure gaps need to be addressed to unlock the growth potential for Northern Australia?

- How can multi-user infrastructure be achieved to realise net positive benefits from infrastructure?

- What planning, budgeting and investment attraction approaches are best suited to the Northern Australian infrastructure development context?

Infrastructure needs vary across sectors in Northern Australia. The common outcomes sought from infrastructure is resilience, adaptability, reliability and efficiency (Infrastructure Australia, 2020). Given the unique challenges of vast distances, climatic variability, small and dispersed populations, remoteness, investment in connectivity (transport and telecommunications), key elements of supply chains, such as storage, refrigeration, value-adding facilities, are fundamentally important to enable enterprises to expand markets and have a competitive advantage.

Supply chain workforce and skills needs

The economies of Northern Australia have undergone structural change and adjustment due to increasing and rapid exposure to global markets, deregulation, withdrawal of industry protection measures, fluctuating terms of trade, impacts of technological change, environmental concerns and changing consumer demand. The regions, industries, and enterprises are all being affected by industry transition with varying “speed, magnitude and severity” across different industries (Jobs Queensland, 2018: 7). The resultant change has been variable in terms of impacts on communities; the nature of labour markets and workforce needs in different locations. These transitions, likewise, impact on the workforce – skills, gaps and shortages (Productivity Commission, 2017; Wibrow & Circelli, 2016; Beer, 2015). The *2016 Australian Industry Report* outlined that the workforce in industries facing structural change, need transitional adjustments to develop skills that allow them to adapt to improvements in technology, knowledge and innovation needed for the restructured industry (Department of Industry, Innovation and Science, 2016).

A survey of employers in Northern Australia demonstrated difficulties in recruitment across different sub-regions, as seen below in Diagram 2.

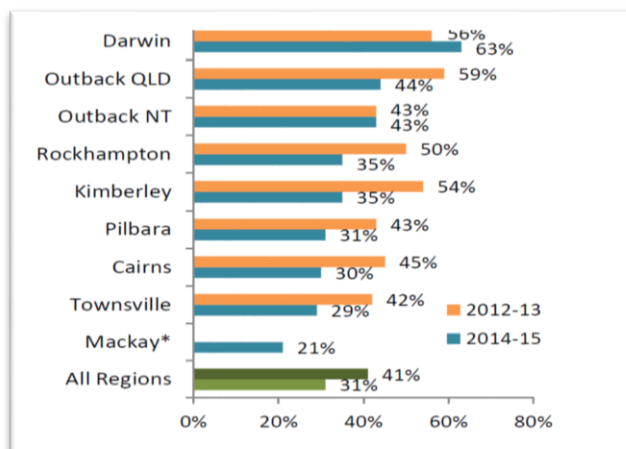


Diagram 2: Recruitment difficulties in Northern Australia
Source: Department of Employment, 2016:6

As can be seen from Diagram 2, 20-70% of employers identified difficulties in recruitment. This trend is reflected in the transport and supply chain industries. The transport and logistics industries are an important part of supply chains in Australia. The Transport and Infrastructure Council (2019:17) noted that “the Australian freight sector is having difficulties in attracting skilled workers across its various functions - including logistics, quality control, warehousing and trade negotiations”. The transport, postal and warehousing industry employed 667,000 people (full and part-time) in February 2020 across Australia (ABS 2020) and is projected to grow to by 6.5% by 2024. The Northern Australian States and Territory made up 41% of the industry workforce (NT 10%; WE 11% and Qld 20%) (ABS, 2020). The characteristics of the workforce in 2019 were:

- The average age is 44.8 years (4 years older than the national average) and bus and coach driver average is 57 years;
- Majority working in small business (98%), medium business (1.1%) and large business (0.9%)
- 81% male and only 19% female; and
- Growth in employment to 2024 is largest in freight transport (6.5%) then followed by passenger transport, storage and delivery by 3% (AIS, 2019).

The Australian Industry Council surveyed the transport and logistics industry workforce needs in 2018-2019. Over 80% of employers in the industry reported experiencing skills shortages in the last 12 months. The occupations reported as being in shortage were:

- Heavy vehicle drivers;
- Drivers (general);
- Educators, trainers and assessors;

- Warehousing; and
- Supervisors/managers (AIS, 2019:27).

The reason for the shortages was identified as ageing population and retirement of current staff; unattractive job prospects; poor industry image; cost and time to achieve the required qualification; competition from other organisations (within and outside the industry) and wages considered too low (AIS, 2019:28). Consultations conducted across Northern Australia identified a number of other workforce shortages including:

- Mismatches in the labour market between what industry needs and education/training provided;
- A negative perception of the industry and difficulty to recruit local staff;
- Lack of employer skills (e.g. recruitment);
- Problems with attracting and retention of workers in rural areas (including work satisfaction, wages and conditions and liveability factors);
- An ageing workforce, limited options (for education, training); and
- Boom and bust cycles in rural economies causing insecurity of jobs.

The fly-in-fly-out workforce (FIFO) was seen as problematic for a range of reasons including major impacts on the employee and their families, lack of integration with the local community, lack of sustainability for the industry (due to worker burnout) and leakage from the local economy of wages. Informants pointed to the increasing need for advisors or consultants, particularly where new technology and innovation was implemented.

Of the 4.9 million persons in the labour force aged 45 years and over, 3.9 million (79%) indicated that they intended to retire from the labour force in the future (ABS, 2015). Given the higher average age of workers in the industry, the Transport and Logistics industry Reference Council (IRC) laments the on-going recruitment challenge. Planning and appropriate recruitment strategies for workforce succession is critical to ensure the industry can continue to operate. The Transport and Logistics IRC identify that “attracting, training and retaining young workers to undertake a career in the transport and logistics industry is proving to be a challenge” (AIS, 2018:9). Compounding the recruitment challenges are factors such as perceptions of the industry by the community as non-professional, limited career pathways and subcontracting.

The TLI *Transport and Logistics Training Package* provides nationally recognised Vocational Education and Training (VET) qualifications (from Certificate level 1 to Advanced Diploma levels) for occupations involved in warehousing and logistics operations, driving operations, stevedoring, yard operations freight handler, furniture removals, international freight forwarding, mobile crane operations, waste driving operations, driving instruction for car, heavy vehicle and motorcycles, materiel and deployment logistics, traffic operations, bus and coach operations and customs broking. Enrolments in the TLI Training Packages have decreased by 51% over the last four years (AIS, 2019:15).

The skills identified as most needed in the next 3-5 years were health and safety, driving, operational compliance and digital (AIS, 2018). Significant workforce disruptions and change to

industries are also anticipated in the near future due to new technologies, (automation and artificial intelligence), global competition for workers, ageing population, shift towards service industries and improved productivity gains. Advancements in technology in the industry will be posing challenges to existing business models and practices, including workforce practices. Change is expected in the work tasks and locations to being undertaken, redefining the concept of work. New growth industries will require a higher level of qualifications and skills (Babacan et al, 2019). The changing nature of the workforce is accompanied by shifts in skills set required. The Transport and Logistics IRC identify that 'soft skill', digital literacy, cybersecurity, and data analytics are integral for the future (AIS 2019, 2018). AIS (2019) has identified the major changes to the industry which will require new workforce skills:

- New technological innovations including robotisation and artificial intelligence, Internet of Things, cloud technology;
- Disruptive technologies including the potential gig economy labour market characteristics of work using digital platforms;
- Big data used in increasing volumes to inform decision making; vehicles equipped with sensors collecting data in real time which can be used for improved delivery, route optimisation, remote diagnostics to monitor the condition of equipment and transport;
- Deployment of telematics which transmits computerised information over long distances;
- Industry-specific cybersecurity due to increased risks of technological innovation;
- Digital supply chains and omnichannel logistics with personalised supply chain demands e.g. customer service is online, 24 per day, multiple methods of delivery and convenience to the customer;
- An increasing need for traceability and visibility of products through technologies such as blockchain; and
- Environmental pressures to reduce greenhouse gas emissions and environmental compliance and safety and regulation.

These technological innovations are reshaping the Transport and Logistics industry at a rapid pace and provide opportunities and challenges. The new industrial revolution, incorporating complex computerised systems, data and software to create 'smart' processes and products are significantly altering the skills needs of the Transport and Logistics workforce. Remotely piloted aircraft (drones) are delivering parcels; manual tasks are being automated; a large volume of real-time data is being produced daily and electric vehicles are being trialled for the rollout are some examples (AIS 2019:16). Employers see workforce skills in digital literacy, cybersecurity, and data analytics as critical. Non-technical skills such as leadership, management, teamwork, problem solving and creativity have been identified as being integral to the successful adoption and implementation of disruptive technologies (AIS, 2019). The Industry survey ranked the skills needed in the workforce as

1. Managerial / Leadership
2. Language, Literacy and Numeracy
3. Learning agility / Information literacy /Intellectual autonomy and self-management
4. Technology
5. Design mindset / Thinking critically / System thinking / Solving problems
6. Customer service / Marketing
7. Communication / Virtual collaboration / Social intelligence
8. Data analysis
9. Science, Technology, Engineering, Mathematics
10. Environmental and Sustainability
11. Financial
12. Entrepreneurial (AIS, 2019:11)

Questions for Discussion

- How can employment, education and skilling providers be better equipped to support the needs of supply chain and logistics industry in Northern Australia?
- What strategies are needed to develop a multi-skilled and adaptive supply chain workforce in Northern Australia?

The innovations in supply chains offer new opportunities, as well as disruptions to organisations and communities. Given the challenges of attracting and retaining workers in rural/regional areas and the lower levels of qualifications and barriers to access to education, upskilling and retraining the current and future workforce a priority for Northern Australia in order to keep pace with future changes.

Technologies and digital connectivity

Internet, telecommunications and digital connectivity are essential for prosperity and development in all societies in the knowledge economy.

The *Australian Digital Inclusion Index* (ADII) measures the extent to and effectiveness with which people can *access, afford, and use (ability)* digital media and communication technologies (Thomas et al, 2019). The Index has identified significant differences across rural/regional and capital city digital inclusion:

Digital Inclusion Index	Differences in inclusion points between rural/regional and capital city
Overall digital inclusion score	8.1 points less in rural areas (overall Australia is 61.9 points in 2019)
Access	5.6 points less for rural areas
Affordability	11.7 points less for rural areas
Ability	10.2 points less for rural areas

Source: Thomas et al, 2019:14

The Index demonstrates that rural areas of Australia lag behind in all measures of digital connectivity (access, affordability and ability), scoring much lower points than the capital city counterparts. Other studies confirm the findings of ADII. For example, the ABS' *Household Use of Information Technology Survey* (2014-15) found that households located in major cities were more likely to have internet access at home (88%) than those in remote or very remote parts of Australia (77%) (ABS, 2018). The ABS *Business Use of Information Technology* statistics highlighted many businesses, particularly in agriculture, forestry and fishing had insufficient knowledge of computing services such as cloud (30%) and had the highest proportion of use of

mobile wireless, fixed wireless and satellite as their main internet connection (ABS, 2017). The audit of infrastructure in Northern Australia identified critical issues of access and quality. For example, 21 % of premises in Northern Australia were rated as having 'good availability' of access to these mobile broadband services. By contrast, in southern Australia, 91% of premises have either 'good availability' or 'very good availability' access to mobile broadband (Infrastructure Australia, 2015:168); only 5% of premises in North Queensland, 9% of Northern Territory premises and 7% of those in North Western Australia had access to 'quality A' level of fixed broadband service.

The Better Internet for Rural, Regional & Remote Australia (2018), in their submission to *Regional Telecommunications Independent Review Committee*, identified digital connectivity barriers relevant to Northern Australia and pointed out that despite the rollout of the NBN and Mobile Blackspot Program there remains a major digital divide. The key issues raised include the reliability of regional connections, no backup or alternative options, delayed service, power outages, digital literacy, consumer lack of knowledge on digital knowledge and independent advice. Lack of awareness about the Universal Service Obligation, lack of technical information such as antennas, boosters, lack of options for small business, affordability, lack of competition for technology choices, data limits, latency issues of satellite connection, poor speeds, mobile network coverage (no coverage in some areas, only 3G towers) and poor planning between infrastructure services. As all of Northern Australia falls within the definition of rural, regional and remote, digital inclusion is a major issue that impacts on communities and businesses.

More localised studies also reinforce the digital connectivity challenges. Marshall et al. (2019) in a study of the pastoral industry in Far North Queensland, found a range of issues of relevance to the wider Northern Australian context, including barriers to connection, lack of continuity in the telecommunications network, social factors impacting digital resource allocation and consumption (such as intergenerational and gender-related circumstances); threats to agricultural industry (such as the need to preserve product integrity and to attract or train workers); and consumer-level insights (such as population heterogeneity and expectations of fairness). These comprehensive findings gave rise to several recommendations that include improving basic infrastructure, diversifying service plans, embracing alternative connectivity infrastructure, need to define true costs, delivery of digital capability programs and upskilling remote workers with digital skills. Far North QLD Regional Organisation of Councils (FNQROC) commissioned the Digital Economy Group to undertake mobile coverage testing. The Digital Economy Group (2019) conducted 316 tests across Far North Queensland, covering 5,100 kms. The findings identify that across 3550km (i.e. 70%) there was no signal strength in any of the carriers. In capital cities, this would be less than 1% (Digital Economy Group, 2019:1)

The previous section of this report identified the disruptions to the transport and supply chains through new technologies and digital connectivity. 'Smart' supply chains are increasingly reliant on digital connectivity. The newly adopted *National Freight Strategy 2019* has a priority action (action 1.3) in relation to the need identify and support digital infrastructure and communication services necessary for improved and innovative supply chains (Transport and Infrastructure Council, 2019). The *National Action Plan* (Transport and Infrastructure Council 2019a: 9) sets out actions to 2024:

By 2024 – strategy actions	Examples of actions
Investigate digital infrastructure needs to support the deployment of innovative freight technologies	<ul style="list-style-type: none"> • Upgrade navigation and positioning infrastructure, including the Satellite-Based Augmentation System (Cth) • Identify barriers to the Internet of Things and 5G uptake (Cth) • Explore opportunities to apply new technology to manage transport networks (all state and territory governments)
Improve telecommunications access to support freight operations	<ul style="list-style-type: none"> • Continue Mobile Black Spot Program (Cth) • Complete NBN rollout (Cth) • Access to spectrum (Cth) • Remote Telecommunications Co-investment Program (NT)c)
Ensure digital security in the freight system, including in the collection of data from innovative freight technologies	<ul style="list-style-type: none"> • Telecommunications Security Sector Reform (Cth) • Reforms to enable data collection from Cooperative Intelligent Transport Systems (Cth - NTC)

Source: *Transport and Infrastructure Council 2019a: 9*

Infrastructure Australia (2015:178) identifies major infrastructure gaps in digital connectivity including broadband service, mobile services, transmission infrastructure and international connections. Infrastructure Australia states that the “shortcomings in communications services in Northern Australia will not be solved by expecting market forces alone to establish the necessary infrastructure” (2015:178). The difficulties of providing digital connectivity infrastructure in thin markets is acknowledged in the literature (Productivity Commission, 2017a; Bandais & Siva, 2005). Digital infrastructure is perceived as the lynchpin for achieving sustainable economic and social development (Bandais & Siva, 2005). Without appropriate digital connectivity access, affordability, infrastructure and ability, the disparities already experienced Northern Australia will be further exacerbated.

Fragmentation and coordination

The supply chain network across Northern Australia is a complex network of organisations. At the *government level*, Northern Australia comprises of 74 local government, 3 State/Territory government and the Australian Government. Each level of government is undertaking initiatives to develop their region, State/Territory or Northern Australia. Some of the strategies across jurisdictions include:

Questions for Discussion

-What are innovative ways to address digital connectivity challenges for Northern Australian supply chains?

- How can digital abilities be improved in the supply chain workforce in Northern Australia?

- *Our North, Our Future: White Paper on Developing Northern Australia* (Commonwealth Government);
- *Northern Australia Infrastructure Facility*;
- *Cooperative Research Centre for Developing Northern Australia*;
- *Advancing North Queensland* (Qld Government);

- *Developing the North and Economic Development Framework* (Northern Territory Government);
- *State Planning Strategy 2050* (Western Australia Government); and
- Local Government and regional economic agency initiatives.

Accompanying these initiatives is an attempt to integrate Commonwealth, State and Territory Government efforts through Northern Australian Strategic Partnership, the Northern Australian Ministerial Forum and the Northern Australian Advisory Group. These initiatives aim to drive integrated approaches to the development of Northern Australia. The CRCNA argues that “the identification and resolution of higher-level policy- thinking and the development of coordinated cross-jurisdictional responses will be important for the future of Northern Australia” (Dale et al, 2020:32).

While these initiatives aim to develop all or parts of Northern Australia and aim for integration at a higher level, the literature and our consultations identified significant fragmentation. There is a lack of a common vision overall for Northern Australia supply chains and collaboration efforts are fragmented. Key issues emerging include:

- Contradictory interventions at place-level across three tiers of government;
- Inconsistent decision making;
- Non-harmonised policy frameworks e.g. road safety, heavy vehicle regulation, biosecurity, load limits, land use, waste management;
- Excessive red tape, regulation and protocols;
- Duplication or major gaps;
- Lack of engagement and partial engagement of stakeholders; and
- Lack of long-term strategic land use and infrastructure planning.

In the context of freight, the fragmentation is recognised by the Transport and Infrastructure Council (2019:16). The Council acknowledges that the freight sector has suffered from inconsistent decision-making, lack of certainty and inconsistent rules (e.g. managing fatigue, drug and alcohol use, speed zoning), causing confusion, duplication and increased costs for operators. Stakeholders have identified the need to develop, a robust and transparent end-to-end supply chain governance framework for Northern Australia. Such a process would also support the de-risking investment in infrastructure and supply chains as a lack of certainty inhibits making investment decisions.

At the *industry level*, the industry generally operates along single sector lines, regardless of the clear common interests across sectors (Acil Allen, 2020). Examples of possible cross-sectoral

Questions for Discussion

- What should governments do to support a more collaborative governance across and within Northern Australian jurisdictions?
- Is there a need for an improved supply chain coordination and governance for Northern Australia?
- Is there a need to establish a supply chain co-ordinator role for Northern Australia to facilitate coordination efforts?

collaboration in the context of Whitsundays region include: Cane growers could benefit from discussions with croppers beyond the Eton Ranges to coordinate the production of a single crop such as soy or other legumes, to get production to scale across the region; horticulture and aquaculture could work together on the potential for cold-chain logistics and storage and freight and cane, cropping and horticulture could collaborate around green waste opportunities for the region (Acil Allen, 2020:13). There are numerous examples identified in consultations from potential collaborations and benefits for Northern Australia.

Identifying the fragmentation in the supply chains in Queensland's agriculture sector, Hall and Frew (2017) note that stakeholders would need to collaborate with an objective to achieve cross coordination, collective action, information sharing, and long-term planning. The benefits of coordination in supply chains may include:

- more efficient allocation of freight network capacity;
- reduced uncertainties in the supply chain;
- coordinated long-term planning;
- improved flexibility of the supply chain;
- better positioning the sector for handling greater volumes of outputs; and
- allow for centralised governance of the supply chain, improving advocacy and regulation (Hall & Frew 2017:7).

Key areas of strengthened cross-sectoral and cross-jurisdictional planning and coordination across the different parts of the supply chain has the potential to reduce fragmentation, gain efficiencies and improve reliability.

Conclusion: Considerations in the of reframing supply chains for Northern Australia

As the White Paper (2015:65) noted that “in the north, small and medium businesses face unique challenges that are not prevalent in the south, such as a lack of information and uncertainty around basic economic infrastructure. Such constraints leave these businesses at a disadvantage to pursue growth and new market opportunities, and to risk-averse to access, or develop, supply chains.” Supply chains are fundamental to the improvement of competitiveness, productivity and sustainability of Northern Australia.

Supply chains are changing with increased emphasis on customer relationships, transparency of supply chains, adaptive capability, information sharing and utilisation, the integrated whole of systems approach, skills and knowledge of employees, and measurement of overall value management rather than specific metrics of performance (Stank et al, 2015). A recent World Economic Forum survey (2012) identified that more than 90% of respondents indicated that supply chain and transport risk management has become a greater priority in their organisations over the five years. Adaptive, resilient and smart supply chains will be a catalyst for greenfield and ongoing development in Northern Australia and support businesses sustainability in the long run. Improved value creation across the supply chain cycle, agility, smart and integrated supply chains are going to be critical to Northern Australia. Out of the box thinking is needed to disrupt

the way business is done if Northern Australia is not be left behind in an increasingly globally integrated and competitive market. Reframing supply chains in Northern Australia will require consideration of:

- *Breaking the North-South reliance:* much of the produce goes through supply chain networks into southern Australia, even when ultimately the products are northbound (Acil Allen, 2020; KPMG, 2020, 2019). While domestic population densities are in the south, there are potential to benefit from export-focused supply chains, especially in high-value products. This requires a rethink of what investments needs to be made in infrastructure, new supply chain business model incentives, place-based intermodal hubs and building workforce capability. This might entail deliberately attempting to disrupt some of the north-south road-based freight flows and using different policy principles to guide investments. It may also require new economic modelling to see how Brisbane and Perth may benefit from different freight flows.
- *Doing things ‘Smarter’:* It is clear that the impact of new technologies and innovations on supply chain design will play a critical role in shaping future of Northern Australia to bring about opportunities and increase the productivity gap. In a futuristic outlook on what transport will look like in 2050, Azurium (2015) predicts major changes. They argue that the future will see talk of digital, hub, cloud, network, replication (e.g. 3D printing) and drone added to the transport lexicon. Disruptions to industry will mean that traditional systems e.g. modes of transport – road, rail, air and sea – will not offer the solutions required (Azurium, 2015:14). Technological change is predicted to establish multimodal hubs that provide diverse ways of distribution of goods, including final mile delivery using a variety of modes, environmentally clean options and convenience to meet customer expectations. There is a need for an integrated plan for supply chain technological innovation and investment for Northern Australia.
- *Bluesky Options:* As 2050 approaches, there will be a need to think outside the box and look at multiple channels for sourcing supply chain requirements (Azurium, 2015). In a world of globalisation and increased speed of interaction, Northern Australia needs to look to Asia. While there is much discussion about the opportunities in Asia, with 60% of global population growth in Asia by 2030, there is not adequate momentum to change business practice in Northern Australia to capitalise on the impending gains. There is a need to leverage the proximity factor more effectively to provide an advantage to the North. North Australia’s ports and airports have the ability to gain significant access to Asia. There are opportunities to value-add to Australian products (packaging, processing, new niche products) which can be based and developed in Asia, through purpose-built logistics hubs, with lower input and production costs. Many Asian countries in proximity to Northern Australia have economic development plans. Indonesia, Malaysia and Thailand have major technological and agribusiness hubs. Neighbouring developing countries such as East Timor and Papua New Guinea have economic development plans and want to attract investment. These countries can offer sites for production and labour. Supply chain feasibility studies and trials need to be incentivised to think and act outside the box.
- *Hybrid Solutions:* Supply chains are often industry-specific. Aggregated examination or specific industry practices conceal opportunities (Kosansky & Schaefer, 2011). Hybrid supply chain considerations are needed in Northern Australia for integrated multi-modal

supply chains that are flexible, adaptive and resilient. It is time to consider what strategic investments need to be made in Northern Australia that can enable:

i) multi-industry/product supply chains such as how can refrigerated product chains be expanded to create scope economies by servicing a range of industries such as beef, horticulture and aquaculture.

ii) what strategies are needed to scale up supply chains including containerisation, vessel access, storage. While it is not clear who needs to take the lead in developing such approaches, it will require strong industry and government collaboration.

- *Incentives and Subsidies for Supply Chains in Northern Australia:* The cost of doing business in Northern Australia is a key consideration in reframing supply chains. Distance and geography render Northern Australia in a disadvantageous position. Freight subsidies and other incentives will play a critical role in equitable development outcomes for Northern Australia.
- *Human Capability and Workforce Considerations:* As noted above, Northern Australia faces workforce shortages, management capabilities, skills and training deficits. Adaptive and resilient supply chains cannot occur unless human capability and workforce barriers are addressed. Addressing training and skilling option, using alternative modes of training via digital disruptive technologies is critical, given the barriers to accessing education and training and population distribution in Northern Australia.
- *Circular Economy:* Globally there is an increasing concern with environmentally sound production and waste management processes and more effectively managing earth's finite resources to limit environmental pressures. Circular supply chains are concerned with cleaner production, re-using waste and by-products, effective waste management, packaging, biosecurity risks and sustainable practices. Consumers are increasingly demanding visibility and traceability linked with environmental concerns and this can provide an opportunity to brand and market products as 'clean' or 'green'. There is emerging cross-sectoral work across Australia in relation to transitioning circular economies. Northern Australia supply chains can potentially have sustainability and marketing benefits from engaging with circular supply chains.
- *Policy Coordination and Collaboration:* As noted in the above section, there is a need to take a harmonised approach across Northern Australia. This involves policy development and implementation coordination, cross-industry collaboration across the supply chain process; cross-jurisdictional planning process, improved data and research; and the development of a Northern Australia supply chain vision. A supply chain coordination role needs to be considered to provide a mandate for action and forging partnerships.

Supply chains play a prevalent role in Northern Australia's development. Addressing their challenges and barriers is critical to the future economic growth, prosperity and wellbeing. Addressing North Australia's supply chain deficiencies is a key requirement to improve competitive advantage and address the disadvantages. This discussion paper identified key issues in relation to supply chains including freight and transport, subsidies and incentives, infrastructure, digital connectivity, workforce and skills, fragmentation and coordination. Timing is right to re-examine the supply chains and develop innovative strategies to re-frame supply chains so that Northern Australia is able to overcome impediments of geography and other historical and

institutional disadvantages. Aspirational, out of the box and innovative thinking and action are needed. All relevant stakeholders need to be engaged in a coordinated and collaborative effort to develop adaptive, smart and resilient supply chains in Northern Australia.

References

- ABS (2020) 6291.0.55.003 - *Labour Force, Australia, Detailed*, Quarterly, Feb 2020, Australian Bureau of Statistics, Australian Government, Canberra.
- ABS (2018) 8164.0 – *Household Use of Information Technology*, Australia, 2016-17, Australian Bureau of Statistics, Australian Government, Canberra.
- ABS (2017) *Business Use of Information Technology, 2015-16*, Australian Bureau of Statistics, Australian Government, Canberra.
- ABS (2015) *Retirement and Retirement Intentions*. Australian Bureau of Statistics, Australian Government, Canberra.
- ACCC (2019) *Proposed Class Exemption for Ocean Liner Shipping*, Australian Competition and Consumer Commission, Canberra, available at <https://www.accc.gov.au/public-registers/class-exemptions-register/ocean-liner-shipping-class-exemption>
- ACIL Allen Consulting (2020) *Regional Agribusiness Supply Chains*, Greater Whitsunday Alliance and CRCNA, Brisbane.
- AIS (2019) *Transport and Logistics Skills Forecast*, Australian Industry Standards and Transport and Logistics Industry Reference Committee, South Melbourne.
- AIS (2018) *Transport and Logistics Industry 2018 Key Findings Discussion Paper*, Australian Industry Standards and Transport and Logistics Industry Reference Committee, South Melbourne.
- ALC (2016) *Getting the Supply Chain Right: Building the Economy Through Efficient and Safe Supply Chains*, Australian Logistics Council, Deakin West.
- Ash A. & Watson I. (2018) Developing the North: Learning From the Past to Guide Future Plans and Policies, *The Rangeland Journal*, Vol. 40: 301–314.
- Ash A., Gleeson T., Hall M., Higgins A., Hopwood G., MacLeod N., Paini D., Poulton P., Prestwidge D., Webster T. & Wilson P. (2017) Irrigated Agricultural Development in Northern Australia: Value-Chain Challenges and Opportunities. *Agricultural Systems*, Vol. 155: 116–125.
- Azurium (2015) *Look Out! Here Comes the Future: Transport 2050*, Azurium and Ferrier Hodgson, Melbourne.
- Babacan H. & Tremblay P. (2020) *Report of Supply Chain Consultations in Northern Australia*, James Cook University, Charles Darwin University and CRCNA, Unpublished Paper, Townsville.
- Babacan H. & Dale A. (2019) *Emerging Rural and Regional Policy Considerations for Queensland: An Overview Paper*, Rural Economies Centre of Excellence and James Cook University, Cairns.
- Babacan H., Dale A., & McHugh J. (2019) *Queensland Rural/Regional Workforce Policy Analysis*, Rural Economies Centre of Excellence & James Cook University, Cairns.
- Bandias S., & Siva R. V. (2005) Telecommunications Infrastructure Facilitating Sustainable Development of Rural and Remote Communities in Northern Australia, *Telecommunications Policy*, Vol.29(2): 237-249.
- Bartik T.J. (2005) Solving the Problems of Economic Development Incentives, *Growth and Change*, Vol. 36(2): 139-166.
- Baum D.N. (1987) The Economic Effects of State and local Business Incentives, *Land Economics*, Vol. 63(4): 348-360.
- Beer A. (2015) Structural Adjustment Programmes and Regional Development in Australia, *Local Economy*, Vol.30 (1), pp.21–40.
- Better Internet for Rural, Regional and Remote Australia (BIRRR) (2018) RTIRC Submission. 5 August 2018, available at <https://birrraus.files.wordpress.com/2018/08/rtirc-submission-birrr.pdf>.
- Chilcott C., Ash A., Lehnert S., Stokes C., Charmley E., Collins K., Pavey C., Macintosh A., Simpson A., Berglas R., White E., & Amity A. (2020, Forthcoming) *Northern Australia Beef Situation Analysis*, CRCNA and CSIRO, Townsville.
- Dale A., Keith C., Matz J., & MacLean B. (2020) *Securing Outcomes and Measuring Progress: A Preliminary Report Into Agricultural Development and Tropical Health Servicing in Northern Australia*, Cooperative Research Centre for Northern Australia (CRCNA), Townsville.
- Deloitte Access Economics (2019) *The Impact of Freight Costs on Australian Farms*, AgriFutures Australia, Wagga Wagga.
- Department of Employment (2016) *Demand for Labour in Northern Australia: Survey of Employers' Recruitment Experiences- July 2014- April 2015*, Australian Government, Canberra.

Department of Industry, Innovation and Science (2016) *Australian Industry Report 2016*, Australian Government, Canberra, available at <https://www.industry.gov.au/australian-industry-report—2016>

Digital Economy Group (2019) *Mobile Coverage Report*, Far North Queensland Regional Organisation of Councils, Cairns.

DPC (2014) *Industry Innovation and Competitiveness Agenda Report: An Action Plan for a Stronger Australia*, Department of Prime Minister and Cabinet, Australian Government, Canberra.

Hall M. & Frew J. (2017) *Supply Chain Coordination in Queensland: How Queensland Could Meet a Boom in Agriculture*, KPMG and Australasian Transport Research Forum, Melbourne.

Harper I., Anderson P., McCluskey S. & O'Bryan M. (2015) *Competition Policy Review*, Final Report, the Australian government, Canberra, available at https://treasury.gov.au/sites/default/files/2019-03/Competition-policy-review-report_online.pdf

Higgins A., McFallan S., McKeown A., Bruce C., & Chilcott C. (2018) Informing Major Government Programs for Rural Transport Infrastructure in Northern Australia, *The Rangeland Journal*, Vol. 40: 341-351.

Higgins A., McFallan S., Laredo L., Prestwide D., & Stone P. (2015) TRANSIT- A Model for Simulating Infrastructure and Policy Interventions in Agriculture Logistics: Application to the Northern Australian Beef Industry, *Computers and Electronics in Agriculture*, Vol. 114: 32–42

Infrastructure Australia (2020) *An Assessment of Australia's Future Infrastructure Needs: The Australian Infrastructure Audit 2019*, Australian Government, Canberra.

Infrastructure Australia (2019) *Northern Australia Audit, Infrastructure for a Developing North*, Australian Government, Canberra.

Infrastructure Australia (2015) *Northern Australia Audit, Infrastructure for a Developing North*, Australian Government, Canberra.

Jobs Queensland (2018) *Anticipating Future Skills: Jobs Growth and Alternative Futures for Queensland to 2022*, Queensland Government, available at <https://jobsqueensland.qld.gov.au/wp-content/.../anticipating-future-skills-report.pdf>

KPMG (2020, forthcoming) *Far North Queensland Supply Chain Study*, Advance Cairns and CRCNA, Cairns.

KPMG (2019) *North Queensland Agricultural Supply Chain Study*, Townsville Enterprises, and CRCNA, Townsville.

Kosansky A., & Schaefer T. (2011) 10 Guidelines for Supply Chain Network Infrastructure Planning, *Industry Weekly*, July 14, 2011, available at <https://www.industryweek.com/talent/article/21933281/10-guidelines-for-supply-chain-network-infrastructure-planning>

Li Z., Zheng W., Meng Q., & Jin S. (2018) The Impact of Government Subsidy and Tax Policy on the Competitive Decision Making of Remanufacturing Supply Chains, *International Journal of Sustainable Engineering*, Vol. 12(1): 18-29.

Marshall A., Dale A.P., Babacan H. & Dezuanni M. (2019) *Connectivity and Digital Inclusion in Far North Queensland's Agricultural Communities*, The Cairns Institute, James Cook University, Cairns, Australia.

Mitra S. & Webster S. (2008) Competition in Remanufacturing and the Effects of Government Subsidies." *International Journal of Production Economics*, Vol. 111 (2): 287–298.

NT Government (2018) *Territory-Wide Logistics Master Plan: Discussion Paper*, Department of Infrastructure, Planning and Logistics, Darwin.

Pernechele V., Bailie J., Ghins L. (2018) *Agricultural Policy Incentives in Sub-Saharan Africa in the Last Decade (2015-2016)*, Food and Agriculture Organization of the United Nations, Rome.

Productivity Commission (2017) *Transitioning Regional Economies*, Productivity Commission Study Report, Productivity Commission, Commonwealth of Australia, East Melbourne.

Productivity Commission (2017a) *Telecommunications Universal Service Obligation Inquiry Report*, Productivity Commission, Commonwealth of Australia, East Melbourne.

Productivity Commission (2014) *Public Infrastructure*, Productivity Commission Inquiry Report No 71, Productivity Commission, Commonwealth of Australia, East Melbourne.

Productivity Commission (2006) *Tasmanian Freight Subsidy Arrangements*, Productivity Commission Inquiry Report No 39, Productivity Commission, Commonwealth of Australia, East Melbourne.

PWC (2019) *Northern Australia Agriculture Investor Identification*, Price Waterhouse Coopers and CRCNA, Townsville.

Reed M. (2017) *Submission to the Inquiry into National Freight and Supply Chain Priorities*, Northern Regional Development Australia Alliance (NRDAA), Rockhampton.

Riley G. (2020) *Producer Subsidies: Government Intervention*, Tutor2U, West Yorkshire, UK.

Simpson G. & Clifton J. (2016) Subsidies for Residential Solar Photovoltaic Energy Systems in Western Australia: Distributional, Procedural and Outcome Justice, *Renewable and Sustainable Energy Reviews*, Vol. 65: 262–273.

Stank T., Autry C., Daugherty P. & Closs D. (2015) Reimagining the 10 Megatrends That Will Revolutionize Supply Chain Logistics, *Transportation Journal*, Vol. 54(1), pp. 7-33.

Thomas J., Barraket J., Wilson C.K., Rennie E., Ewing S. & MacDonald, T. (2019) *Measuring Australia's Digital Divide: The Australian Digital Inclusion Index 2019*, RMIT University and Swinburne University of Technology.

Transport and Infrastructure Council (2019) *National Freight and Supply Chain Strategy*, Commonwealth of Australia, Canberra, available at <https://www.freightaustralia.gov.au/sites/default/files/documents/national-action-plan-august-2019.pdf>

Transport and Infrastructure Council (2019a) *National Freight and Supply Chain Strategy, National Action Plan*, Commonwealth of Australia, Canberra, available at <https://www.freightaustralia.gov.au/sites/default/files/documents/national-action-plan-august-2019.pdf>

Tremblay P. & Babacan H. (2020, Forthcoming) *Northern Australia Supply Chains: Review of Literature*, Charles Darwin University, James Cook University & CRCNA, Darwin.

Victorian Government (2006) *Response to Productivity Commission's Issues Paper on Tasmanian Freight Subsidy Arrangements*, Victorian Government, Melbourne.

Wibrow B. & Circelli M. (2016) *When One Door Closes: VET's Role in Helping Displaced Workers Find Jobs*, National Centre for Vocational Education Research (NCVER), Adelaide.

World Economic Forum (2012) *New Models for Addressing Supply Chain and Transport Risk*, Geneva, available at <https://www.weforum.org/.../new-models-addressing-supply-chain-and-transport-risk>