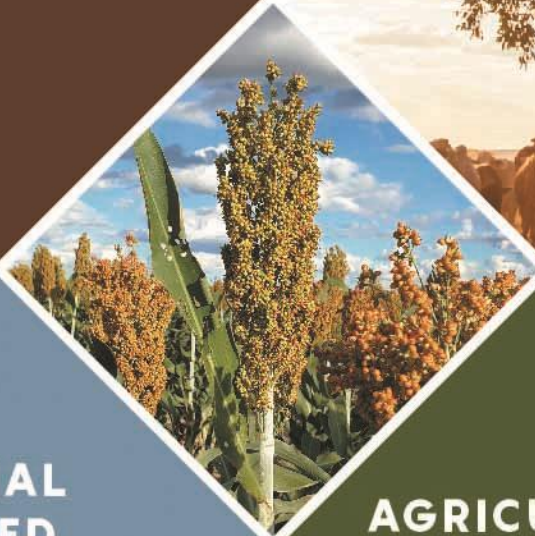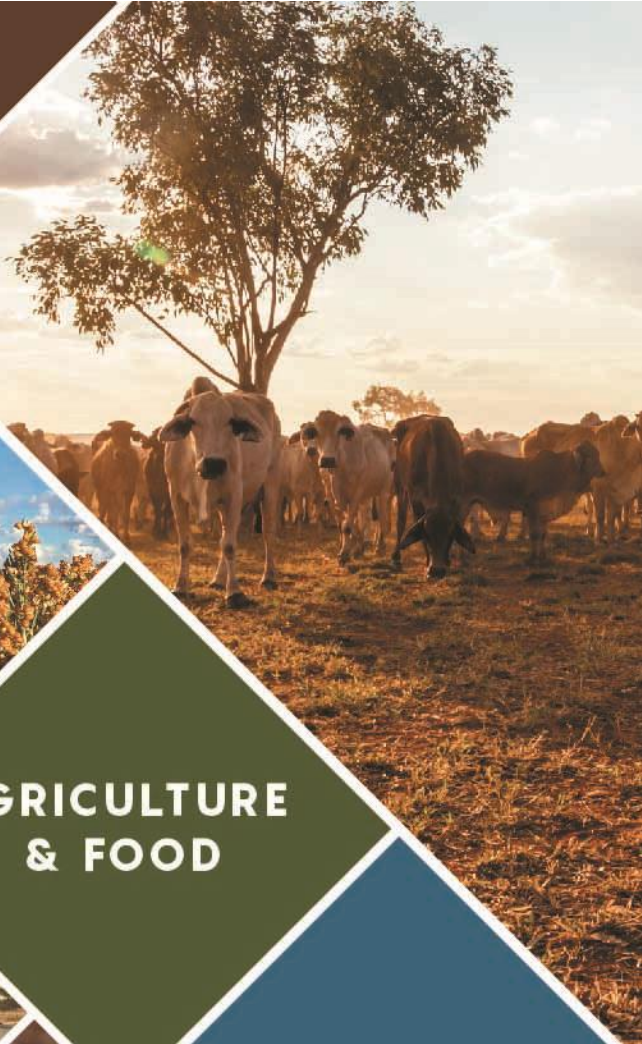NORTHERN HEALTH
SERVICE DELIVERY

TRADITIONAL
OWNER–LED
DEVELOPMENT

AGRICULTURE
& FOOD

Re-thinking supply chain performance

for Northern Australia development

The case for integrated data and supply/value
chain modelling

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CRCNA
DEVELOPING NORTHERN AUSTRALIA

Acknowledgements

Disclaimer

Peer Review Statement

The CRCNA recognises the value of knowledge exchange and the importance of objective peer review. It is committed to encouraging and supporting its research teams in this regard. The reviewer provided constructive feedback which was considered and addressed by the author(s).

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Summary

- With a strong resources economy, significant agricultural potential and opportunities for urban and tourism growth, Northern Australia is well poised to rethink its fragmented and predominantly southern-focused supply chains. Many sub-regional supply chains and opportunities for east-west connectivity, however, are poorly developed, and there is very limited vision about the potential expansion of supply chains into the wider Asia-Pacific region, but more specifically into Indonesia, Timor-Leste, Papua New Guinea and the Pacific.

- The COVID pandemic has reinforced the need for a greater internal resilience of Australia's supply chains. COVID recovery, recent flooding in Central and South Eastern Australia, geo-politics and market opportunity also demand a greater focus on Northern Australia more closely integrating its supply chains across the northern landscape and towards its near northern neighbours.

- Several recent studies and Infrastructure Australia's leadership role in the audit of Northern Australian infrastructure all point to the need for a more visionary supply chain approach, but stress that this is limited by cross sectoral, evidence based supply chain modelling. Such modelling will need to inform a visionary approach and align consequent policy and investment.

- This paper is intended to inform the emergence of a wider stakeholder-based partnership for the development of long term supply chain modelling that can inform policy and investment directions and enable effective economic modelling of new approaches.

- This approach is intended to inform enhanced bilateral infrastructure discussions between the Commonwealth and the jurisdictions, with real world industry data and insight.

Introduction

The Australian Government, the Western Australian (WA), Northern Territory (NT) and Queensland governments are all committed to the development of Northern Australia. Our North, Our Future: White Paper on Developing Northern Australia (Australian Government, 2015) identified the potential for diversifying the economy for a more prosperous north. Indeed, the value proposition of developing Northern Australia for the economic growth, prosperity and security of the entire Australian nation was reinforced as themes across several annual Developing Northern Australia Conferences (DNAC, 2019). This extensive Northern Australian region, comprises approximately 53% of the landmass of Australia, but accounts for only 5.3% of Australia's population (ONA 2021:2). Covering 17 million hectares of arable soil and receiving 60% of the country's rainfall (PWC, 2020:11), it also contributes approximately 12% of the national Gross Domestic Product (GDP). Importantly, however, the region is extremely well positioned to significantly grow supply chains between Australia and South East Asia, Indonesia, Timor, Papua New Guinea and the wider Pacific region.

With these supply chains in mind, Northern Australia has significant minerals and resources economy and substantial agricultural potential. It currently produces more than 93% of Australia's mangoes, more than 94% of Australia's bananas, and more than 95% of Australia's sugar (ONA, 2021:2). It has 64% of Australia's national beef cattle herd and over 70% of Australia's known resources of iron ore, lead, and zinc. Pre COVID, the North's natural landscapes and seven World Heritage sites attracted more than a million international visitors each year (ONA, 2021: 2). Several studies have reiterated the general competitive advantage of Northern Australia for further development (KPMG, 2020; ACIL Allen, 2020; Babacan et al. 2020). The opportunity for enhanced export markets to Asia, particularly for selected commodities, was identified in a range of studies (Austcham, 2019; ACIL Allen, 2020, KPMG, 2020).

The Australian Government has renewed its commitment to the development of Northern Australia. The refresh of the whitepaper, Our North, Our Future: 2021-2026, Targeted Growth, identifies that "the focus now is to leverage the advantages and strengths of the north to overcome obstacles and create the right conditions for industry to thrive and achieve a sustainable northern economy" (ONA, 2021:8), with priority areas including supply chains, infrastructure and workforce development. As noted above, the potential for development across regions in Northern Australia is high due to a strong natural resource base, relatively good access to water, fertile soils and consistent agricultural supply which is a desirable attribute for domestic and international markets and investment attraction. There is an increasing willingness to uptake knowledge and innovation such as utilisation of new technologies, diversify economies and build human capacity.

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". As most supply chains tend to flow north-south before export the recent floods in central Australia have also reminded the nation of the need to improve overall resilience of the Northern Australian supply chain.

A number of deeply engaged studies outline the need for effective and smart supply chains to support economic and social development in Northern Australia. Babacan et al (2020) argued for re-thinking supply chains in Northern Australia. At the same time, these studies highlight the need for ongoing in-depth research, improved data gathering and accessibility, and new evidence-based insights and solutions (Babacan et al 2020, CRCNA 2020). A recommendation, in a major study examining rethinking supply chains in Northern Australia, was "commissioning of long-term research

on the development and continuous improvement of partnership-based and data-rich models of horizontal and vertical supply /value planning and collaboration within and across sectors in Northern Australia" (Babacan et al. 2020). This important discussion paper outlined the key issues and challenges of supply chain in Northern Australia. The paper argues the need for a more proactive, integrated intersectoral and multi-modal supply/value chain modelling capacity to guide decision making on development and investment. The development of supply modelling capacity will enable effective supply chain data framework; data collection, integration and sharing; and scenario-based planning and analysis. Improved modelling will inform options for multiple pathways for successful Northern Australian development and address key issues such as de-risking for agricultural development, identify scale and opportunity for investment, appropriate business models, support options for expansion of export markets, workforce and human capability and COVID-19 resilient supply chains. Multi-modal modelling framework can assist in cross jurisdictional and intersectoral coordination and fragmentation through quality data, improved knowledge and evidence base.

Supply Chains in Northern Australia

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 and settlement 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 (Babacan et al, 2020a). 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".

Opportunities and barriers for supply chains in Northern Australia display commodity, industry and region-specific characteristics. A number of studies have been undertaken, (PWC 2019; ACIL Allen 2020; KPMG, 2020; KPMG, 2019; Chilcott et al., 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 Australian exports to the ASEAN region. Moreover, there has been industry-specific situational studies in forestry, rice, aquaculture, broadacre crops and beef. For industry specific supply chain characteristics refer to Babacan and Tremblay (2020), ACIL Allen (2020), KPMG (2019, 2020) and Akbar et al. (2019).

The supply chain barriers in Northern Australia, across various commodities, can be summarised as:

Supply Chain Barriers in Northern Australia	
Summarised common challenges	**Considerations and risks**
Challenges of access to transport, air, sea, rail, road.	Provenance, certification, traceability.
Lack of interoperability.	Challenges of access to markets, particularly in Asia and non-tariff barriers.
Lack of adequate storage facilities, particularly cold storage.	Difficulty attracting supply chain investment.
Lack of refrigerated container freight access.	Challenging digital connectivity.
Infrastructure challenges.	Water allocation and access for production.
Regulatory fragmentation across jurisdictions and/or regulatory burden.	Lack of progressing facilities and limited value-adding.
Workforce skills gaps and shortages.	Challenges of production and scaling up.
High cost of energy and power.	Lack of coordination multi-purpose/multi-sector supply chains.
	Long established supply chain patterns, risk aversions by producers.

Source: Babacan et al. 2020a; Tremblay et al. 2020; ACIL Allen, 2020, KPMG,2019, 2020.

The overall findings from the various studies conclude that:

- While significant scope for export and domestic market growth exists in Northern Australia, particularly in high value crops, there is an entrenched primarily road-based supply chain to southern domestic markets and significant infrastructure gaps, making it difficult to disrupt and capitalise on opportunities;

- Multi-purpose/multi-sector enabling infrastructure is needed with major gaps in areas such as transport, storage, biosecurity, digital connectivity and export facilities;

- Cooperation is needed along supply chains across sectors and jurisdictions to develop multi-purpose/multi-sector supply chains. At the industry level, the industry generally operates along single sector lines, regardless of the clear common interests across sectors (Acil Allen, 2020). Key areas of strengthened cross-sectoral and multimodal planning and coordination across the different parts of the supply chains has the potential to reduce fragmentation, gain efficiencies and improve reliability;

- The cost of doing business is much higher in Northern Australia, particularly linked with freight costs;

- 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). There are major workforce challenges across the supply/value chains including skills gaps and shortages, ageing workforce, difficulties of attracting and retention, training and re-training challenges, impacts of digital technologies on the workforce and capacity for innovation adoption for smart supply chains (Babacan et al., 2020);

- The supply chain network across Northern Australia is a complex network of organisations. At the government level, Northern Australia comprises of 74 local government agencies, 3 State/Territory government and the Australian Government. 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 (Babacan 2020, 2020a). There is a need for more effective supply chain governance, particularly cross jurisdictional coordination in planning, policy and regulation;

- The digital connectivity challenges in Northern Australia were identified by Marshall et al (2020) and included access, affordability and ability. These challenges will need to be addressed as the impact of new technologies 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 to the supply chain operating and management processes. 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. This diverse delivery options are becoming even more critical in light of current fuel prices; and

- Requisite investment in building a strong research and data framework is needed (Dale 2019; Dale et al, 2020; Babacan et al 2020). Consultations with over 120 stakeholders across Northern Australia identified the need for disaggregated and granular data, integrated and shared data, data gaps and the need for greater supply chain modelling capacity (Babacan et al. 2020).

Among the well-accepted challenges facing Northern Australia's economic growth and hindering the potential re-orientation of Northern Australia to its north, 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 and settlement 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. Addressing these challenges for the development of Northern Australia will require a strong evidence base, an integrated data framework and supply chain modelling to inform key planning and decision making.

> *Unreliable supply chains not only increase costs for businesses, households, and government agencies in Northern Australia, they compromise liveability, delivery of essential services and national security. Building more efficient and resilient supply chains to, from and within Northern Australia should be a government priority.*
>
> *~Infrastructure Australia, 2021a:188*

Towards a more integrated data framework and supply chain modelling capacity

Competitiveness in Northern Australia is going to be underpinned by effective and smart supply chains, efficient and reliable transport and logistics with highly skilled workforce. Inconsistencies in funding principles, priority settings, types of uses and users, and connectivity have resulted in barriers. These barriers have been debated at length in policy documents describing Northern transportation challenges and road infrastructure gaps (Tremblay et al. 2020). Data and knowledge gaps have been identified and there has been initial attempts made to fill some of those gaps, in ways more consistent with industry needs. For example, the Northern Australia Beef Roads Program backed by CSIRO modelling and scenarios using State, Territory and Local governments data combined with their Transport Network Strategic Investment Tool (TraNSIT) to assist in the prioritisation of projects (Higgins et al., 2015, 2017). However, there is still a major gap in evidence for supply chains in Northern Australia across commodity groups, industry sectors and different dimensions of the value chain. The Productivity 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, all requiring better analytical and data frameworks. A stronger modelling and data framework is required to address:

There needs to be better data to inform decision-making, including on population, the environment, natural resources and infrastructure requirements

~Infrastructure Australia, 2021a:181.

- Consistent supply chain vision, narrative and goals across Northern Australia;
- Scaling up challenges;
- Shift from inward transport and logistics effort towards a more outward focus;
- Move from a transactional freight (air, shipping in particular) effort to a more integrated transport infrastructure planning to support NA development;
- Intermodal and intersectoral integration;
- Transport and freight network planning and investment;
- Capitalising on export potential and improved international trade outcomes;
- Returns on strategic and catalytic infrastructure investment;
- Investment in workforce, education and training development and planning;
- Costs and benefits of governance integration and cross jurisdictional harmonization and integration;
- Land and natural use planning for effective supply chains;
- De-risking for investment in economic development, including supply chains; and
- Supply chain resilience in the face of disruption and shocks.

In a recent supply chain consultation and roundtables with over 120 stakeholders in Northern Australia, data gaps and fragmentation and modelling capability was identified as key issues. As one roundtable participant stated, "we do not have enough data, evidence and information to base our

decisions" (Babacan et al. 2020:31). The key issues in relation to an appropriate supply chain evidence base were:

- Lack of adequate data across the whole of the supply chains;

- Lack of granular data across different locations/regions;

- Existing data patchy and fragmented, data collection and sources are not consistent (e.g. definitions of regions, focus topic across different levels of government, industry data) and lack of integration of data and the need for a more integrated data collection and utilization framework;

- Lack of modelling capacity for forecasting, cost benefit and risk analysis and scenario based planning (particularly system wide modelling and scenario planning);

- Research/data gaps in key areas such as workforce, trade and governance;

- Lack of use of data in deliberative planning, decision making, investment attraction, infrastructure and workforce development;

- Lack of translation and/or uptake of existing data/research in practice; and

- Lack of resources for research (Babacan et al., 2020).

Some participants identified the confidential nature of research in some government agencies and transport companies and lack of public accessibility of data. Many participants identified that research/evidence was often seen as an 'optional' when budgets were pressured. Participants acknowledged that CRCNA had contributed to building a significant body of work in a relatively short period of time, particularly in relation to agricultural development and supply chains.

Addressing gaps in our knowledge base was identified as a key measure in re-framing supply chains. In an age of big data analytics, sharing data and information and joint interpretation across businesses and stakeholders improves competitiveness. The absence of quality supply chain data and evidence is a major drawback in more visionary planning and making strategic decisions and prioritisation of future directions. Supply chain modelling for Northern Australia is critical as it can support alternative supply chain decisions, evaluate performance and analyse weakness of the supply chains and can support efficiency and responsiveness in the context of global competition.

Developing modelling and data integration capacity in Northern Australia will require:

- The development of a cohesive alliance of key supply chain stakeholders to co-invest in and support the development of a long-term modelling approach and capacity;

- Focusing attention on the need for multi-modal and cross-sectoral freight data collection and integration data framework across targeted supply chains localities, regions and across Northern Australia and taking a holistic supply chain optimization approach;

- Modelling visionary and scenario-based supply chains that are integrated across the north, and focused attention on selected sites/Northern Australia, with multiple horizons, that is intersectoral and cross modal/industry based supply chain practices. This will establish the basis for modelling for enablers and flexibility of supply chains that deliver triple bottom line outcomes;

- Through the most desirable scenarios, exploring data-driven supply chain performance modelling in Northern Australia, including forecasting, understanding future freight demand and analysis of the effects of factors such as level of skills and workforce, infrastructure development, digital connectivity, consumer preferences, energy costs, industry capacity, geographical location, supplier and firm behaviour, use of materials, information flows, intermodal transport, and influence of governance and policy frameworks on the supply chains;

- Developing predictive risk analysis across the supply chains, particularly potential failure points and overall impact of these risks through a systems thinking approach, enabling the identification and prioritization of emerging supply chain policy and infrastructure priorities;

- The development of adaptive supply chain resilience and sustainability modelling;

- Development of cost benefit and return on investment analysis;

- The potential for modelling benefits. equity and distributional effects (i.e. including national, jurisdictional and local benefits emerging from key supply chain interventions);

- The potential development of comparative case studies and analysis to support the prioritization of emerging "regions of growth" and "regional planning" approaches to land use and resources development across Northern Australia; and

- Cohesive research work geared towards better understanding the potential opportunity for integrated Northern Australia supply chain modelling. This work would need to include identifying potential data sources, data uses, data gaps, data gathering and integration. As argued by Shapiro (2007), this requires elaborate collection, validation, and transformation of data from disparate sources; loading of these data into relevant supply chain decision databases; integration of these databases with decision support software; and development of efficient, effective, and interactive user-interfaces for the sustained usage of these modelling and information systems.

The following diagram presents a visual illustration of the proposed integrated data framework and supply chain modelling capacity development.
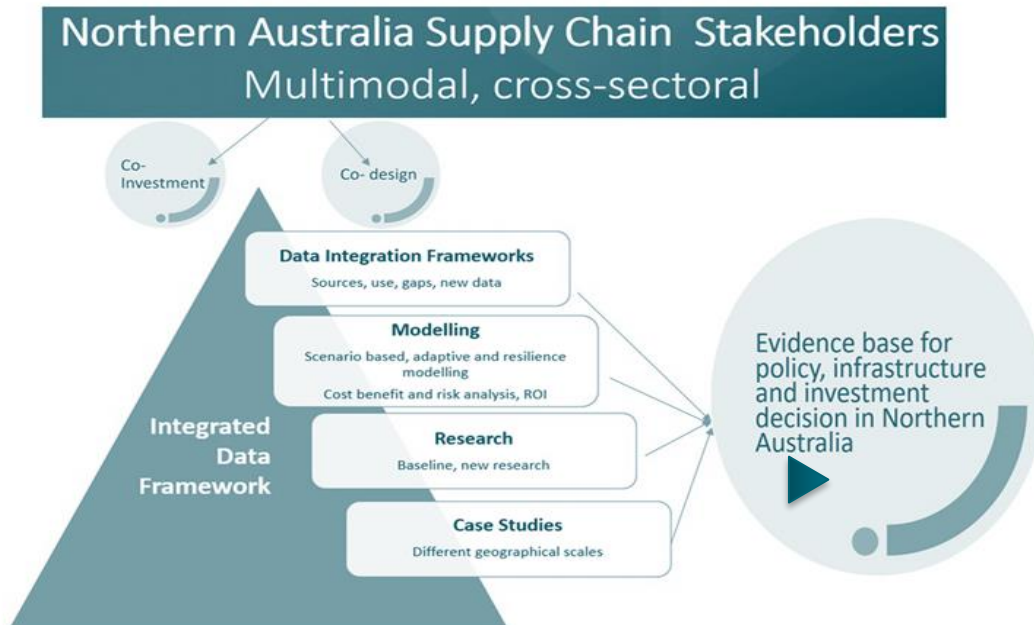

Undertaking baseline research work geared towards better understanding the potential opportunity for integrated Northern Australia supply chain modelling will require co-investment and co-design. The integrated approach will use multi-method approaches to provide an effective and rich evidence base for policy, infrastructure and investment decisions in Northern Australia.

Next Steps

Achieving effective integrated data and supply/value chain modelling will require a Northern Australian wide alliance and structured partnerships with potential collaboration between:

- Infrastructure Australia;
- Australian Government, including Department of Industry, Science, Energy and Resources and Department of Infrastructure, Transport, Regional Development;
- State and Territory Governments including northern and economic development, agriculture and transport portfolios;
- Australian Logistics Council;
- Universities;
- Supply chain related research bodies (e.g. iMove);
- Supply Chain and Logistics Association of Australia;
- Queensland Transport and Logistics Council, Freight and Logistics Council of WA and NT Road Transport Authority;
- Selected industry bodies and key supply businesses;
- Relevant local government agencies or peak groups; and
- Other key stakeholders.
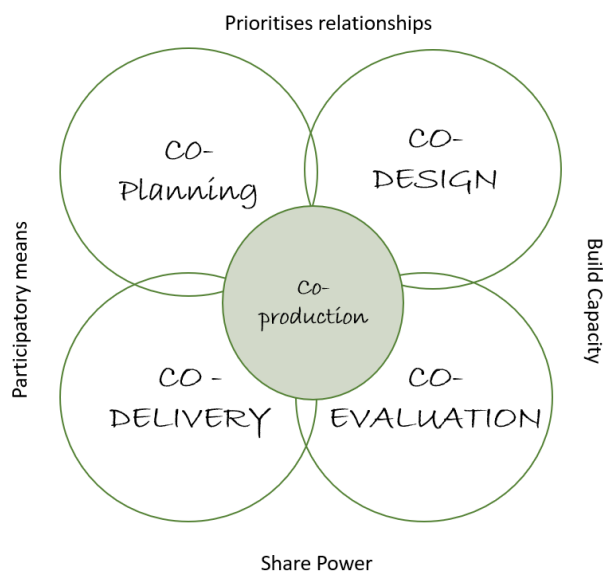
Principles for Co-Design (Source McKercher, 2020)

There are a number of networks, alliances and working groups and existing forums relating to supply and value chains, freight and logistics and Northern Australia development that are key stakeholders and important to connect with. The approach that is needed is co-design. Co-design is a participatory method that brings key stakeholders together, to plan, design, build the right conditions, immerse, align, implement, discover, test and refine and learn through a collaborative process (McKercher, 2020). The co-design will connect key stakeholders, to identify key issues and challenges in data and evidence, establish data and knowledge sharing arrangements and develop joint solutions to address the key issues. This process will support the process of adaptive and iterative management practices across supply chain strategic planning and decision making in Northern Australia.

The proposed work will need to align with policy and program initiatives of key agencies and government departments. An element of co-design is identified how this project, through integrated data and knowledge, aligns and value adds to initiatives of government and other stakeholders. The project can enhance implementation of strategies such as Our North, Our Future 2021-26, National Freight and Supply Chain Strategy, the Australian Infrastructure Plan and others through improving investor certainty by integrated data and knowledge on supply chains; supporting evidence based infrastructure investment decisions in Northern Australia; developing human capacity, skills and workforce; supporting Indigenous led development; improving liveability and wellbeing in Northern Australia. Bodies such as Infrastructure Australia (IA) have identified the market capacity challenges, both demand and supply side, of delivering infrastructure including plant/equipment, materials and workforce (labour and skills (IA, 2021). Infrastructure Australia (2021a:181) points to the challenges of investment in infrastructure in Northern Australia and has begun to address the critical issues of long and fragile supply chains, workforce skills and capacity, energy and transport costs, and inadequate telecommunications and digital connectivity. Infrastructure planning is being designed, delivered and scaled to meet unique needs of populations and industry in Northern Australia which will require better data and information.

The development of Northern Australia is an important step for local communities and is of national benefit. Ensuring the smart and efficient supply chains are critical to the success of the development of the North. Data driven, evidence-based approaches will result in strategic decision making, making accurate analysis and successful interventions for supply chain outcomes for long term prosperity and resilience.

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