

KIT 4.4

Improve automation of transport and handling activities and/or alternative logistics and distribution models to realise greater value capture by growers.



Impact Grower profitability is improved through more efficient transport and handling operations, achieving greater value capture from new distribution models and the optimisation of grain quality.

Summary

- Operational costs are optimised through more efficient movement and handling of grain.
- New technologies optimise grain quality and reduce costs and losses associated with downgrading and rejection.
- Value capture is improved through understanding and leveraging alternate distribution models.

OVERVIEW

Historically, the total Australian grains industry supply chain costs have been around 30 per cent of the total cost of grain production, substantially more than several of our major competitors (see Table 1). In addition, many of our bulk commodity competitors are improving their bulk handling infrastructure, further reducing their costs. Reducing Australian supply chain costs generally, but especially relative to those of international competitors, could be an opportunity for enhancing the profitability of Australian grain production businesses.

Key definitions

Transport – the movement of grain from one place to another by means of a vehicle.

Handling – the receiving, conveying, processing and storing of harvested grain.

Logistics – the activity of organising and implementing a complex operation.

Distribution – the process of selling grain to customers.

Table 1: Grain supply chain costs in Australia and major export competitors¹.

	2013	2014		2015/16	2016		2017	
Country	Australia	Canada	Australia	Ukraine	Russia	Australia	Argentina	Australia
Total supply chain cost (\$/t)	\$73.30	\$107.30	\$83.80	\$56.90	\$55.80	\$84.60	\$62.50	\$71.30

Key Investment Target (KIT) 4.4 considers opportunities to reduce supply chain costs and help growers capture greater value through the development or adaptation of grain handling and logistics systems and technologies including the potential for automation. KIT 4.4 will focus on three key areas: transport and logistics; grain handling technologies; and understanding new or novel distribution models. In these areas there is important strategic cross-over within KITS 4.1, 2.2, 3.7 and 4.3.

Transport and logistics

Opportunities exist to optimise on-farm and off-farm grain transport logistics, and to enable grain growers to capture additional value from provenance and/or paddock-to-plate traceability value differentiation systems or models.

Growers have considerable capital and labour deployed in the harvesting, handling, storing and arranging for transportation of grain. Poor planning or scheduling of these activities can waste considerable time (labour units) and resources. Optimising these processes is challenging, especially given that growers can often do very little to limit delays occurring during delivery into external commercial bulk handling facilities.

¹ White, P., Carter, C. and Kingwell, R. (2018) Australia's grain supply chains - costs, risks and opportunities. AEGIC Industry Report, October 2018. https://www.aegic.org.au/wp-content/uploads/2019/01/FULL-REPORT-Australias-grain-supply-chains-DIGITAL___.pdf

Grain transport and commercial bulk handling receival site capacity are regularly a limiting factor during harvest season. Congestion at the receival site can be highly variable and largely depends on the quality of infrastructure and the efficiency of processes and procedures at that site. Spikes in traffic can create long waiting times that are not only expensive in terms of labour costs but can also cause delayed harvest operations which increases the risk of lost value due to weather damaged grain. On-farm storage, segregation of grain based on harvester quality monitoring and the use of contractors could assist with improving harvest time logistics and ultimately business profitability, but this adds another layer of complexity. It is in this complexity that opportunities to optimise transport logistics present themselves.

More than ever, consumers are demanding to know where their food comes from as food safety is becoming paramount in the minds of consumers. Currently shipping documentation is paper-based, time consuming and not able to track the level of detail required in a timely manner to ensure or prove safe food practices. Improving grain grower's ability to trace grain from paddock-to-plate is becoming increasingly important. Growers need to be able to prove authenticity and a food safe delivery pathway. This will become increasingly important for retaining market access in the face of increasingly stringent standards and to access new and emerging higher-value markets based on safe food traceability and/or provenance. Access to existing markets also depends on being able to identify and manage any potential source of contamination, such as chemical residues, insects or weed seeds.

There is considerable scope to optimise the systems and processes involved in the delivery of grain into commercial bulk handling facilities through increased automation. The introduction of new systems and processes for coordinating logistics will also enable improved traceability and support increased value capture through exploiting crop provenance advantages.

Grain handling

Australia's high grain quality standards are fundamental to maintaining our market advantage, however assessing grain quality remains a challenge. Grain growers having the capacity to accurately assess quality in real time at several points in the grain logistics pathway would provide them with the ability to actively stack manage and optimise grain quality to meet the customers specifications. This could include limiting the potential for grain to be downgraded or rejected at the delivery point. Many of the quality assessments undertaken at grain receival sites are subjective, time consuming and often undertaken largely by casual employees working long hours. There is also considerable pressure to achieve both a fast turnaround and a result that matches grower expectations. More rigorous consumer demands and stricter import standards will require more rapid, objective, and accurate assessment across areas including functionality and contamination by foreign material. Left undetected, any rejection at the export destination could inflict further substantial costs onto the supply chain and ultimately the grower.

The limited size of the Australian market often makes it financially unviable for existing automated quality testing technology to be specifically adapted to meet Australia's stringent standards and operating conditions. For instance, the CBH evaluation of the EyeFoss™ digital grain analyser² found that it would need to be adapted to Australian conditions, but our market was too small to justify this expense (pers comm). With the high cost of having loads of grain rejected at receival point more and more grain growers are undertaking their own grain quality analysis, cleaning and blending to meet customer expectations and in turn maximise returns. This creates additional challenges in the accuracy of quality assessment on-farm, the efficiency of blending and the on-farm work health and safety of staff involved in these operations.

Australian grain growers are storing more grain on-farm than ever before. On-farm storage is used to assist with harvest logistics and enable increased flexibility in grain marketing options. Growers are also blending large quantities of grain to help optimise quality. The operations involved in achieving this can include grain transport, on-farm storage, grading, drying and blending. However, grain handling by growers on-farm is the one of the most labour intensive and dangerous parts of the grain distribution system. These activities can pose serious safety risks to farm workers.

The reliance on augers and power take off (PTO) drives for on-farm grain handling is a significant contributor to work health and safety risk. Grain auger related incidents account for around 60 serious injuries each year in Australia³. Unless workplace systems and processes are improved, it is likely that increased on-farm storage and handling will lead to an even more dangerous workplace for grain growers.

² EyeFOSS image analysis system (Retrieved 24 June 2020) <https://www.fossanalytics.com/en/products/eyefoss>

³ Farmsafe Australia Inc. (Retrieved 24 June 2020) Tractor and machinery safety. Farmsafe Australia Inc. <https://www.farmsafe.org.au/Tractor-and-Machinery-Safety>

Opportunities exist to provide growers with access to better tools for assessing quality and better systems to improve the efficiency and safety of grain handling for harvest, delivery, cleaning and blending.

Distribution models

Distribution models are the pathways for transacting the grain produced to customers. In the last 20 years, and particularly since de-regulation of wheat marketing in Australia, the number of post-harvest options for managing the pathway to market for grain have increased considerably providing both opportunities and challenges for growers. Post-harvest grain management may include short or long-term on-farm storage, delivery to local commercial bulk handling receivals sites or delivering direct to port, containerisation and shipping options such as trans-shipping, direct marketing to end users or through other value-added channels.

Growers on the East coast of Australia generally have a wide range of post-farm gate grain management options available to them presenting additional profit opportunities, but this means that marketing and handling the crop can now be almost as challenging as growing a crop. As well, many of the grain management decisions need to be made during or directly after harvest when time, labour and transport and storage infrastructure is in high demand. However, in some areas such as Western Australia, a reduction in upcountry receival sites has reduced the number of options leading to limited segregation opportunities. Containerisation of grain for export increases marketing options and is increasing at a rate like that seen for on-farm storage. Containerisation provide access to differentiated small batch size and high-value markets including those that exploit advantages in crop provenance. However, challenges associated with the availability of food-grade containers and ready access to container packing are significant limitations.

Post-harvest grain transport, as part of post-harvest grain management, is a major cost for grain growers which includes labour for operating machinery. While automation is almost certain to play a significant role in the future of grain harvest and distribution, existing supply-chain partners may not have enough incentive to invest in innovation and technologies to reduce post-harvest transport costs⁴. Australia is a small market for farm machinery and technology and there is limited interest from international players to invest in tools specific to Australian needs.

Opportunities exist to help growers identify the most profitable distribution methods for their harvested grain and to understand the benefits and risks of new models as they become available. New technology may also assist in automating some parts of the distribution model saving time or labour and improving user safety.

FUTURE RD&E FOCUS

SCOPE – Improved transport and logistics

Logistical tools and knowledge are developed to improve the efficiency of transport and support greater value capture through traceability.

Investment Outcome 4.4.1 – Growers and their contractors have access to logistical planning tools that optimise the use of harvest and/or transport assets, improve scheduling and reduce queuing and operational downtime.

There is considerable scope to optimise supply chain costs associated with harvesting, handling, storing and transporting grain through increased automation and the introduction of new logistics planning tools (eg time and motion studies) and processes. New automation tools, for example, are likely to require the establishment of new types of value chains involving multiple and sometimes non-traditional stakeholders including growers, contractors, operational staff at local receival sites, machinery dealerships, software suppliers and farm business consultants. For example, R&D aimed at developing new techniques to optimise the sequence of harvest logistics on-farm to reduce input costs may benefit from integration of machine telemetry with new software tools, presumably sold to growers and supported by machinery supplier support networks.

⁴ White, P., Carter, C. and Kingwell, R. (2018) Australia's grain supply chains - costs, risks and opportunities. AEGIC Industry Report, October 2018. https://www.aegic.org.au/wp-content/uploads/2019/01/FULL-REPORT-Australias-grain-supply-chains-DIGITAL_.pdf

An application of similar operations-optimisation based technology could be applied to multiple farm businesses in collaboration with local receival sites to minimise downtime and deliver greater net benefits to the grower, contractor, grain handler and software supplier all involved in the exchange. An example of this is local and regional coordination of bulk handling site delivery traffic. For these reasons, thorough assessments of value-chain dependencies will be key to ensuring RD&E investments in this space have real and lasting impacts on grower profitability.

Investment Outcome 4.4.2 – Growers have tools and knowledge to reduce costs and improve the timeliness of transportation.

Online tools that can monitor vehicle locations and traffic at bulk handling grain receival sites to provide information on wait times have the potential to reduce queuing by allowing growers to divert to another receival site, delay sending trucks, or log a virtual place in the queue without needing to be physically present. There is also great potential in online tools for managing transport capacity. Apps such as Cargo42 and Indigo – Uber-style apps for grain trucks – could facilitate the use of excess transport capacity at peak times. Such services have the potential to disrupt the industry and lower business overhead costs by improving scheduling and reduced queuing and downtime⁴.

GRDC will look to work with industry partners to carry out forward looking analyses on what can be done to deliver tools to transform the grain transport system.

Investment Outcome 4.4.3 – Growers are aware of and have access to traceability technology to capture provenance, reduce paperwork and simplify shipping.

New technologies in traceability are needed to demonstrate and capture the value from the provenance of grain. This could include capture of data such as harvester quality analysis, GPS locations, farm inputs and so on. Technologies are now available to develop trusted traceability solutions that would not only assist in capturing value from provenance, but also greatly simplify shipping processes. Such technology would alleviate the need for paper records and as such greatly reduce the administrative burden involved in exporting grain. KIT 2.1 and 2.2 focus on developing new and improved differentiated grain-quality characteristics for different markets and end-uses that are likely to require the use of traceability technologies to assist in capturing price premiums for growers.

GRDC is unlikely to invest in the direct development of commercial software platforms, it will instead consider focusing on fundamental research that pursues opportunities and/or overcomes constraints for applying existing technology to Australian grains industry use-cases.

SCOPE – Grain handling technology and systems

Grain handling systems are automated and enhanced to speed up operations, reduce inefficiencies and capture greater value for growers.

Investment Outcome 4.4.4 – Growers and other industry participants are aware of and have access to new tools and procedures that improve the efficiency and/or robustness of grain quality assessments.

Access to new and existing markets is likely in the future to depend on the implementation of accurate and affordable quality assessment solutions. Technologies such as near-infrared (NIR) and hyperspectral imagery, and analysis methods such as machine learning are currently available for objective and accurate grain quality assessment for receival standards. Efforts are required to promote further adoption of existing technologies and there is increasing demand for rapid reliable on-farm grain quality assessment tools covering a wider range of measurement parameters. Growers with header-based grain protein and moisture monitoring are already using that data to inform the blending of harvested grain to optimise price, but a wider range of on-farm quality assessment tools are required to more rapidly and easily meet the demands of emerging high-value markets.

Linking robust certified grain-quality assessment methods along with trusted technology solutions (see Investment Outcome 4.4.3) could, in future, see growers assess their own grain for receival standards being accepted by the industry, particularly with increasing containerisation. This approach has already been successfully adopted by the Dutch flower industry where maintenance of grower reputation is paramount and traded upon.

Investment opportunities to develop adaptations to existing grain quality testing systems and/or develop fundamentally new processes and systems to meet the needs of end users are firmly within the scope of KIT 4.4. GRDC does not seek to subsidise commercial endeavours but will consider direct co-investment with commercial companies and/or other entities in the pursuit of new grain quality testing solutions wherever there is a strong business case for growers and a clear path to market for outputs.

Investment Outcome 4.4.5 – Growers and other industry participants have access to automated grain handling technology and systems that help to optimise grain quality and reduce the risks of grain downgrades or rejections.

New systems that can assist growers in shifting and blending grain more easily, ideally incorporating automated processes, would save time and money, particularly when paired with on-farm quality assessment technology (see Investment Outcome 4.4.4). Methods that allow effective grain cleaning on-farm could greatly reduce the risk of downgrade or load rejection (see KIT 2.2, Investment Outcome 2.2.4). Contaminants such as snail shells are hard to segregate and new image-based technologies, combined with new analytical techniques, could be the basis of improved grain cleaning and drying methods. Increased containerisation of grain is opening access to new markets, but new handling technology to enable more widespread container loading on-farm is needed to further expand this industry and related marketing opportunities.

Investment Outcome 4.4.6 – Growers and other industry participants have access to technology and systems that reduce the costs and improve the safety of grain handling activities.

The development of new component technologies in the areas of sensing and perception, electric drives and control systems are supporting higher levels of automation and precision of agricultural machinery. Grain handling equipment is no exception and there is an opportunity for GRDC RD&E investment (through KIT 4.4. and 3.7) that investigates how advancements in component technologies can reduce the overall costs of handling processes.

New processes and technologies could be developed to continually improve the speed and efficiency of grain handling processes but reducing the safety risks of existing practices also needs to be a priority. Increasing the level of automation of handling processes is one way to avoid unnecessary exposure to safety risks and new grain-handling technologies also need to be engineered to directly address identified safety issues.

SCOPE – New and/or novel distribution models

New ways of distributing grain that increase the value captured by growers are investigated and understood.

Investment Outcome 4.4.7 – Growers have greater understanding of current grain marketing and/or distribution options and how these might impact on profitability.

Tools to help growers in their pre and post-harvest decision making could have a major impact on maximising profits. Planning for marketing the crop ideally starts before growers have planted with questions such as; *will chickpeas be worth enough this year or should those hectares be sown to wheat?* Growers might forward sell via a forward marketing contract or cash price or use other risk management mechanisms such as currency hedging, swaps or options. However, for growers to take advantage of different selling options they first need to be fully aware of them. Methodologies required to underpin tools and services to help growers optimise post-harvest distribution options already exist and have great potential to help growers maximise returns.

There is considerable scope for improving grower awareness of the benefits and risks of current grain marketing/distribution options, part of which may involve studies to better understand what tactics the most profitable growers are pursuing.

Investment Outcome 4.4.8 – Growers, other industry participants and government agencies are aware of ways in which new technological developments such as intelligent systems, IT platforms and autonomous vehicles can support new and/or novel distribution models.

Intelligent systems, such as autonomous vehicles, could have a major impact on farm profitability and labour management into the future. The new generation of farm workers have never known life without a smart phone, driverless

cars are on trial throughout the world and most of the current modern harvest and seeding machinery is capable of being operated autonomously. The technology is developing rapidly and is currently being implemented in other industries such as mining and freight logistics. As an example, for the grains industry, technology already exists to enable an autonomous harvester to be monitored and adjusted via a smartphone and be supported by autonomous chaser bins capable of delivering to on-farm storage or directly to receival sites. And as per Investment Outcome 4.4.3, traceability data could be automatically attached and carried through each stage of the harvest and distribution process.

While the use of autonomous vehicles is still restricted by the need to overcome legislative hurdles, it is vital that the grain growers and other industry participants understand how technology advancements in automation will change distribution landscapes and support new/novel distribution models.

Investment Outcome 4.4.9 – Growers, other industry participants and government agencies are aware of potential new and/or novel distribution models that support greater value capture at the farm gate.

To maintain and increase profitability, the grains industry needs a sustained and concerted effort in identifying investments opportunities that facilitate access to high-value markets or novel distribution models that reduce supply chain costs. While the market itself ought to guide RD&E investments, there are cases where stakeholders lack the incentive to invest; namely, where new distribution models disrupt or compete with existing ones. As such, GRDC will consider investing in the analysis of new and novel distribution models, particularly where they are related to:

- KIT 2.1 – Supporting the expansion of high-value crops
- KIT 2.2 – Maintain and/or improve the price of Australian grain through differentiation.