Final report

Data integration and connectivity of extensive pastoral businesses for sustainable business resilience

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Abstract

Operational and strategic decisions, livestock inventory, business projections, monitoring performance indicators and risk management responses require accurate and up-to-date live animal and property data. Consolidated Pastoral Company (CPC) own and operate properties across Northern Australia with data collected at an aggregated mob and individual animal level. This project expanded and centralised CPC's individual animal dataset across their stations.

A crush-side, animal management system at Newcastle Waters was piloted and integrated with lifetime animal data. The pilot trial reviewed the practical implications of implementing this system with 4-8 data points per animal.

Success can be partly attributed to the change management process and dedicated project management team who provided training, information technology support, one-on-one guidance, mentoring and oversight. Technology and animal management system providers were able to refine and develop robust systems that reliably function when operated in Northern Australian field conditions.

This project has proven it is possible to collect individual animal data without internet connectivity and access to mains power, enabling improved operational and strategic decision making for pastoral businesses.

Executive summary

Background

Extensive Northern Australian pastoral operations struggle with internet connectivity, and the creation and capture of accurate and reliable data. The lack of data and data integration limits operational decisions and impacts financial and strategic decision-making.

Objectives

The objectives of the project were:

(1) enable data connection across the CPC supply chain to provide unrealised insights by connecting key financial and operational data.
(2) identify data capture gaps which were constraining tactical and strategic decision-making to enable prioritisation of future projects and business planning.
(3) build staff capacity to support their understanding of the importance of complete, accurate data collection and how it impacts, supports, and plans for on-property decisions and the wider CPC business and supply chain.

The objectives of the project were achieved with data sources and business decisioning processes mapped to identify required data points for key business decisions per property, for finance and whole-of-business strategy. The data captured and stored on property was identified, replicated in a central location, and analysed to identify data collection gaps and idiosyncrasies per property. The existing animal management system didn't provide real-time, offline, crush-side decision-making capabilities. The existing system was not easily locked into standardised templates, which was required to ensure data can be compared and collated across properties. An animal management system working to solve issues typically experienced in Northern Australia was trialled on one station.

Methodology

Existing data, data processes and business processes were reviewed. The review identified:

- Data governance improvements

- Current data governance, and connectivity between databases and the existing NLIS RFID scan system do not support animal management.

- Crush-side information and reporting analysis is required.

An animal management system developed in Australia with a focus on working with and developing solutions for northern business enterprises was involved in conducting a pilot study at Newcastle Waters to test the ability of their system to meet field operational conditions and required business decision-making and reporting processes. A technical analyst located at Newcastle Waters provided training and developed documentation and systems to support practise change. Based on the findings from the pilot study, a data strategy was developed.

Results/key findings

Prior to data collection, a framework needed to be established to outline information flows for operational, strategic and financial decisions per property and business level. The decision processes

and data required per decision, report and analysis needed to be mapped together with appropriate data granularity (individual animal or mob-based), accuracy, timeliness and feedback loops.

Data is often collected in a range of formats; paper, electronic, automated, third-party applications. A key challenge involves bringing the disparate data sources together in a central location in an appropriate form as a single source of trust to support decision making.

Software challenges are being solved to work in Northern Australian field conditions. Hardware, including electronic identification (EID) readers and weigh scale challenges, still exist with difficulty connecting and collecting data. Changing data collection and integration across the business from operations to finance requires a change manager who can work on the ground at station and communicate with head office.

Cibo-Labs requires intensive on-the-ground activities to measure food-on-offer, pasture type, tree versus woody weed coverage and scrubs versus edible pastures. CPC have a rangeland pasture specialist which provided training, support and set-up for part of one station. The question is how to replicate this knowledge and build skills in pasture management and measurement as well as weed and pasture identification to facilitate industry wide skill building in a transient work force.

Benefits to industry

The early stages of this project helped provide feedback to Cibo-Labs on connectivity, data presentation and data cleansing which they built upon as part of the industry rollout of data per property. This project has provided feedback to the development of an Australia-based individual animal management program, to be used for multi-property businesses with hundreds of thousands of animals. CPC is participating in the NB2 program and sharing lessons learnt with fellow program participants. Improved data accuracy to support decisions will improve profitability through proactive culling, selling and herd management.

Future research and recommendations

To weigh animals which don't stand still in the crush, at yard speed, weigh scales need to be refined with operating system support. Improved device connectivity is required over current Bluetooth system which can be problematic crush-side and in steel yards. An 'over the gate' EID reader to provide accurate data of animals transferred between paddocks would be beneficial as individual animal data is connected to paddock and pasture management.

The extensive pastoral industry needs to support employee upskilling on pasture and pasture management for example through training programs, intensive sessions, workshops and downloadable applications. For sustainable operations in Northern Australia, woody and invasive weeds need to be identified and managed to maintain biodiverse ecosystems, and stock rates adjusted based on available feed reserves to ensure palatable species aren't overgrazed. The ability to calculate feed on offer for paddocks for a period for example between first and second muster, provides an opportunity to align stocking rate to actual carrying capacity. Research is required to understand the influence of dry season supplementation and relationship with feed on offer calculations.

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1. Background

Consolidated Pastoral Company (CPC) operate nine properties in Queensland, Northern Territory and Western Australia covering more than 3.2 million hectares. CPC services the live export industry, owning and operating two feedlots in Indonesia, sells feeder and slaughter cattle domestically, and have previously run branded beef programs. CPC is committed to further understanding their customer and tailoring the livestock product to their customers having made significant investment in their northern herds through the introduction of new genetics for fertility and animal performance.

CPC was acquired by the Hands Family Office (HFO) which has interests in a range of global food and red-meat protein companies. The HFO is open to new and innovative ways to increase productivity and value along with complementary income sources to pastoral investments. CPC seeks to further understand how to diversify business operations to increase business resilience and harness emerging consumer trends. To achieve these objectives, improved access to accurate and reliable data connected across the CPC portfolio is required to support the business units to adapt to emerging market trends.

This project sought to develop a base level of operational and financial data integration that increased the responsiveness of extensive livestock production systems, allowing them to manage and analyse best management practices whilst leveraging emerging consumer trends. The project involved enhanced data capture and data connectivity to create insights and data-based decisions.

Learnings around the process of data integration for various systems and the value propositions realised through this effort, provided the foundation of insights that could be gained from end-to-end data integration in future. This allows for strategic business analysis, operational change and, ultimately, business growth. The systems developed in this project (technology, people capability and supply chain connectivity) supplied enabling capabilities required to scope gaps in future strategy options and new business models.

Project learnings may assist other extensive pastoral businesses to understand value propositions for data integration across the supply chain. Each value proposition involves business productivity and profitability, and how data enables business process improvement, monitoring and reporting.

This project originated from challenges associated with linkage of operational and financial data to reflect the impact of inputs on improving performance of existing operations. Furthermore, this lack of granular data has created flow-on challenges, limiting ability to explore, test and validate new business models for pastoral operations to underpin innovative supply chain strategy.

This project specifically addressed:

- Operational systems – a lack of connection between operational inputs and their outputs. This inability to connect operational and financial data in near real-time:
    - Limits best practice management insights required for continuous improvement.
    - Limits detail required to manage supply chain market risks.

2. Objectives

The objectives of the project were:

1. Data integration,
2. Enabling the use of data for decision support,
3. Identification of data gaps, and
4. Build staff capability.

Data integration was achieved, connecting previously unconnected data across parts of the CPC supply chain. New data connection practices were established with connecting key financial and operational data providing previously unrealised insights into primary business drivers.

The project enabled the use of data for operational and strategic decisions, on-station and at head office. The pilot project successfully established enhanced crush-side data collection for improved decision-making. Gaps in data capture were identified and prioritised for business enhancement in future projects.

Staff capacity building included the provision of training in best management practices on property and the provision of data and decision frameworks to equip them with tools to view their actions as part of a wider supply chain with a sharp focus on key metrics.

3. Methodology

3.1 Data integration and improved decision processes

3.1.1 Baseline data mapping

To undertake the baseline data mapping, meetings were held with project staff and connections made with software service providers to the different back-end and front-end data connection options for each program. Greenleaf Enterprises utilised the Data Maturity Assessment Tool and reviewed the business, how data informs strategy, culture around data, mapping of the architecture, data governance, and data storage and procurement. This review was repeated upon project completion to identify progress made through business transformational processes during the project.

The architecture roadmap describing the strategic blueprint for aligning business processes with future Information Technology (IT) and information development was developed and refined to identify and prioritise data integration areas.

The draft IT architecture design was developed by data integration specialists to support integration of operational and financial data as the first step to develop an architecture roadmap. The draft was further developed as additional policies, procedures and business processes were identified.

Three CPC personnel based at Head Office and one Greenleaf representative travelled to Newcastle Waters station, departing on Tuesday 9th Nov 2021 and returning on Saturday 13th Nov 2021. During their visit the project team talked with station staff, observed program activities, observed data downloads, analysis and discussed operational challenges with CPC record keeping requirements and collection, download and analysis of data on three animal management programs in use. Processes and information flows were documented. Interviews were conducted with managers and key staff of Newcastle Waters Station.

The data integration priority was identified in a site visit; focusing on livestock, integrating pregnancy testing information across the station and herd to predict numbers of calves to be born and their ages to assist in planning for mustering, trucks, feed purchase and sale of animals.

Key users and IT staff were consulted to understand the ongoing requirements to support connected pastoral and company decisions and the value propositions from collecting individual animal data were identified. Data was collected and stored in different locations including in the cloud, on property and at head office. Each data source was mapped and identified with a data governance program. Activities were undertaken as part of the data governance program to improve accessibility for example access to Cibo-labs reports and usability on limited internet bandwidth.

Meetings were held within CPC between representatives of Greenleaf Enterprises and CPC to identify current operational decision points at a property, finance, and reporting level. Existing reporting undertaken by CPC were reviewed by Greenleaf Enterprises to extract operational decision points. Industry experts from Greenleaf Enterprises recommended future operational decision points based on best management practices, referring to industry Key Performance Indicators (KPI's) and benchmarks including the CashCow and Northern Breeding Business (NB2) programs.

3.1.2 Pilot project at Newcastle Waters

The methodology applied to the Newcastle Waters pilot project is described in this section including implementation activities which included:

1. Identify business units involved and source data from existing systems,
2. Identify relevant existing data,
3. Migrate existing data to new Animal Management system,
4. Agree approach for capturing different business unit data in the new application,
5. Acquire and set up relevant technology,
6. Identify repeatable processes to manage as part of pilot,
7. Determine training required,
8. Document repeatable processes, training procedures and cheat sheets,
9. Identify who will be trained and when,
10. Undertake training on-station and head office,
11. On-farm visit for training with trainers,
12. Gather data using the animal management system,
13. Record risks and issues,
14. Work with software developer to resolve issues where appropriate,
15. Reporting from front end and back end of application,
16. Assess suitability of application and integrated data gathering platform for operational, tactical and strategic decisions and
17. Document suitability and lessons learnt from pilot including:
    a. Ease of staff being trained in use of the application to collect, load and download crush-side data,
    b. The ability of the application to upload and download data over the available internet bandwidth,
    c. The ability of the data to be transferred, retrieved and analysed on property and by financial and operational management staff as required,
    d. Reliability to collect and retrieve data and generate required reports crush-side in field conditions (no internet connectivity with large numbers of head processed per day over multiple days in the same “mob”).

The pilot project charter was developed, and a technical analyst employed to oversee Newcastle Waters implementation. The technical analyst visited Head Office and took training on the animal management system. They were deployed with Head Office staff. 2 trainers from the Animal Management system travelled to site and conducted onsite training. 6 people with management and supervisory roles on site were trained, along with 5 system administrators (4 from Head Office + technical analyst based at Newcastle Waters station).

The technical analyst provided onsite training to each mustering crew and oversight when the crew were initially learning the software. The technical analyst provided training and support to managerial staff for upload, download and sync requirements. The technical analyst’s observations were fed back to refine training materials, system functionality and standard operating procedure (SOP) documentation.

A list of medical and non-medical treatments were created and input with dosage rates, withholding periods and export slaughter intervals where applicable into the animal management system. These

input animal husbandry procedures and treatments provided template drop-down options for operators to choose from.

Once the classification attributes, paddocks and treatments were input, session templates were developed to streamline data collection. The templates were a collaborative effort between station staff and communicated back to the project team for consideration. The templates were developed to streamline data collection by semi-automating data input based on on-site operations and attributes. Data was collected crush-side with three crews collecting and processing stock at one time. Data was synced each night where possible through a crew member who drove to a location on the property with mobile phone reception. If too far away from mobile phone reception, the data was synced when back at the homestead.

3.1.3 Modelling value propositions

To understand the value in collecting data including individual animal movement between paddocks and feed regimes, weight and pregnancy data modelling was undertaken on existing data. The information from the NLIS database was downloaded and the cattle movements between properties mapped.

Using the existing animal records, transfer and handling records and financial records, different scenarios were modelled using @Risk modelling program. The modelling included animal valuation, branding % and death rates.

4. Results

4.1 Data integration and improved decision processes

4.1.1 Data points and KPI reporting

Prior to the data integration undertaken in the project, individual property managers maintained their own herd inventory and animal health records. Through the data integration process, the data collected on property was copied into a central location with analysts and senior management having access to raw individual animal data and paddock data. The data received at head office was predominately mob based, aggregated, paper-based data with extensive delays between transactions occurring and receiving the scanned paper records.

Bringing together the data has identified the need for standardised data collection and naming conventions. Mapping decisions and KPIs has refined what data needs to be collected, ensuring the reporting data is collected. Beef industry KPIs and data points corresponding to these KPIs were identified and shown in Table 1.

Table 1: Strategic Decisions

What	Key Performance Indicator (KPI)	Elements which impact the KPI
Genetics	↑ kg beef/ha produced ↑ Kg beef/AE	↑ weaning % → ↑ cows PTIC, ↑ hybrid vigour (↑ turnoff weight), ↓ age puberty, ↓ age turned off
Watering points - Infrastructure	↑ kg beef/ha produced ↑ Kg beef/AE	↓ distance to water, ↑ pasture utilisation, ↓ grazing pressure in certain areas
Marketing strategy	↓ risk, ↑ $/kg beef profit	↓ animals which outside target specs
Business strategy	↓ risk, ↑ $/ha profit	↑ diversification, ↑ water infiltration & usage
Improved animal welfare	↑ kg beef/ha produced	Breeding for polled animals Improved temperament ↑ BCS (↑ cows PTIC) ↓ distance to water
Improve climate risk management	↑ land in A&B condition Improve climate risk management	↓ unpalatable species, ↑ ground cover & palatable species, ↓ woody weeds, ↑ cool burns, ↑ monitoring pastures, ↑ paddock rotations, Stocking Rate (SR) based on pasture mapping ↓ erosion, ↑ water infiltration
Supplements Protein, Energy, Phosphorus	↑ kg beef/ha produced ↑ Kg beef/AE	↑ reproductive rate (BCS ↑), ↓ Mortality rate ↑ Turnoff weight
Decisions using data	↑ forward planning	↑ links to decision support systems, ↑ Internet connectivity
Staff retention	↓ staff turnover	Easy to use system, clear standard operating procedures, ↑ staff training ↑ feedback loops
Pasture	↑ kg beef/ha produced	↑ reproductive rate (BCS ↑),

digestibility	↑ Kg beef/AE	↓ Mortality rate ↑ Turnoff weight → Planting new species; legumes, forage crops (dryland/irrigated), ↑ grazing management
Land use	Profit/ha/year/100mm rainfall	

Based on policies, procedures and KPIs, CPC has mapped data points per animal, per handling session to collect in the animal livestock management system. These include:

Commercial herd individual animal records:

a. Originating station location (PIC)
b. Originating paddock location
c. RFiD tag
d. Breed
e. Sex (M/F)
f. Neutered
g. Year of Brand
h. Estimated month and year of birth (or dentition if an older animal)

Session Data (name and date + changing attributes):

i. Status when last seen (previous session)
iii. Weight
iv. Wet / dry
v. PTE / PTIC
vi. PTIC Months
vii. Body Condition Score
viii. Cull/keep
ix. Current PIC
x. Business Unit
xi. Paddock
xii. Animal Health Treatments
xii. Retag RFiD
xiii. Paddock animals transferred into
xiv. Transfer in or off property

Farm management records include:

- Lick quantity and type distributed to what paddock and when,
- Number of animals and which animals to what paddocks,
- Pasture quality and quantity available to be grazed per paddock translated into estimated Adult Equivalent.

4.1.2 Data Maturity

At the start of the project the review of baseline mapping identified each business unit and station was at a different data maturity level, depending on access to hardware, software, training, data connectivity and cultural focus on data. Several managers were interested in improving access to data, however the existing animal management system's lack of functional access to reports and animal history offline while crush-side influenced their willingness to invest time and effort into data entry and management.

Staff who needed individual animal data (e.g. weight) rather than mob based data had developed work arounds in excel spreadsheets to divide the truck weight by the number of animals and code this as a mob to then estimate when they would be at saleable weight. These data insights were used to inform business decisions and planning. Under the Data Maturity Assessment Tool in Table 2, the business operated between a 1 and 2 level pre-project, depending on department and area.

Table 2: Summary of Data Maturity Assessment Tool

LEVEL	1	2	3	4
Business Strategy	Data is used solely for reporting purposes	Data insights are used to inform business decisions	Competitive business strategy is built from data	Data informs a continuous evolution of business strategy
Data	The firm uses solely uses its own internal data	External data sets used to enrich and supplement own data	Third party data used as a differentiator	Firm looking to leverage new data sets from non-obvious sources.
Culture	The use of data and analysis is left up to the individual	Data used to measure results. No used in planning or vice versa.	Decision makers are enabled with the results of data analysis to optimize business outcomes.	Firm using algorithms to adapt and improve.
Architecture	No cohesive data architecture	Basic architecture of data flows	Architecture is mapped and enables all staff to be data driven.	Architecture is built for large volumes of data.
Data Governance	Governance is largely manual and lacks consistency	Some processes in place to ensure data quality	Confidence in data and resulting insights	Data governance is integrated into all business processes.
Procurement	Ad-hoc basis	Individual departments are responsible for procuring own data.	Streamlined process for data procurement	Data procurement team sources new data.
	No clear understanding of where data is stored and who has access	Some policies and procedures in place which are reasonably well defined and adhered to.	Adopted and enforced data management policies and processes.	All staff are responsible for data management and data is managed as an asset.

The project mapped the architecture, and staff became data driven from crush-side to senior management. Policies and procedures were clearly defined for data collection processes, data security, and permissions to alter and cleanse data. The focus on data integration across the business lifted the data maturity. Data collection, analysis and source of truth were refined across departments. The timeliness and accuracy of data improved and people collecting the data understood the implications for the entire business on accurate data entry with understanding where data is used across the business for decision-making and planning.

4.2 Pilot project at Newcastle Waters

An Animal Management system was utilised on the commercial herd at Newcastle Waters as a trial to understand the implications of a companywide rollout. Standard Operating Procedures (SOPs) were developed. It was identified crush-side operators needed more concise quick reference guide instructions to connect the hardware, for the crush-side activity and to sync the animal management system. Detailed SOP's were needed for office activities to check, reconcile and bulk edit data for example paddock movement post-processing.

4.2.1 Process standardisation

The pilot project brought together finance and operations teams to standardise process flows, data collection points and nomenclature. Process flows data were identified for weaner, branding, trade steers, bulls and cows, and information generation was automated through the animal management system with reporting metrics, documented in Figure 1 for cows.

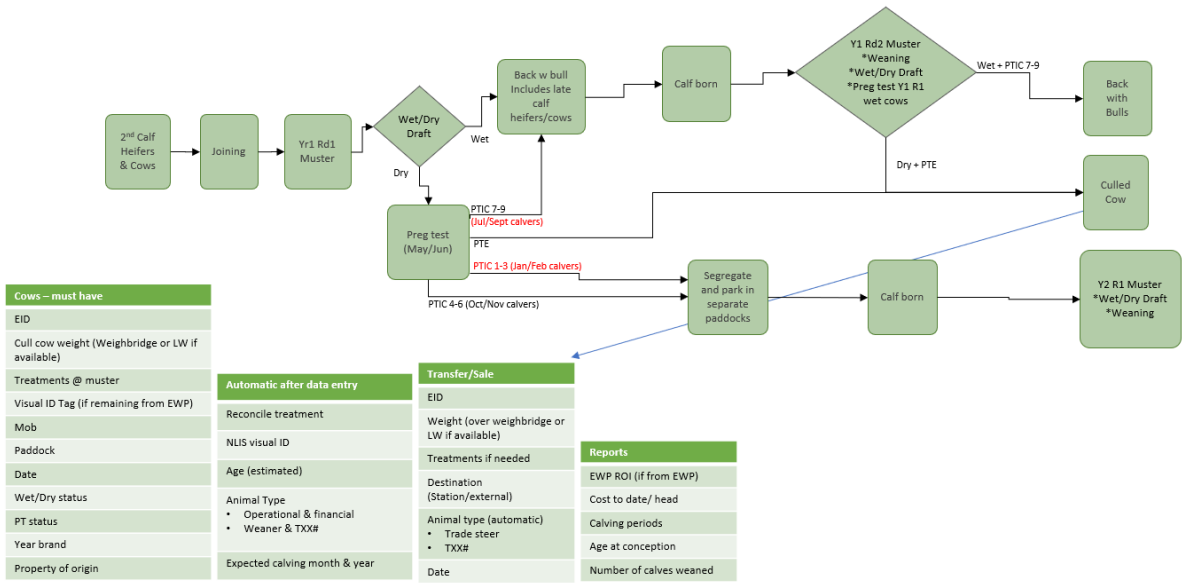

Figure 1: Cow process flow, data and reporting metrics

4.2.2 Application of animal management system in extensive pastoral businesses

The animal management system provided individual animal traceability and data collection. The pilot has provided learnings for industry, service providers and CPC. Increased data accuracy and granularity provides opportunity for new business processes to be developed, with paper-based systems like Cattle Movement Reports being generated from the input data, cross-checked with the counts in the yards.

Changes in business processes include updating and cross-checking the NLIS database using the software rather than manual processes which currently take days to process. Other changes in business processes include moving from a mob-based weights system to an individual animal.

The ability to see an animal's history crush-side makes opportunity for real-time decision-making. For example, animals which were pregnancy tested empty and dry for 2 years can immediately be

marked as a cull. Animals which have been pregnancy tested in calf and wet for 2 years can be marked as a super cow and separated as per CPC policies.

The ease of data collection crush-side enabled additional information to be collected including body condition score, live weight, breed, to previously collected data. The data collection points continue to evolve as decisions are made into the future based on previously collected data. Consideration of implications in the future are required when collecting data as collecting estimated birth date when branding enables cull-for-age decisions, average daily gains and age to turnoff weight.

The hardware issues which were encountered included unreliable Bluetooth connectivity between the weighing scales and the tablets which operated the animal management software with time to connect ranging from immediate connection to 90 minutes. The weighing scales require stabilisation before they will record a weight which takes time and holds up the flow of the animals. Dust was entering the tablet cases, impacting visibility and use of the touch functionality. When the tablet was held by the operator the sun made the screen hard to read, a longer cord was needed from the tablet to the powerpack to enable the powerpack to sit in the operator's pocket.

Overall improved efficiencies were noticed with improved animal health records, offline availability of history while at the yards and unattended sessions scanning animals' movement between paddocks or onto trucks. The animal management software enabled the movement from a mob weight-based system to an individual animal. The un-attended scan sessions in the animal management system allowed for simple updates on the NLIS database.

Lifetime animal health data collected at an individual animal level at a business unit and property level wasn't transferred between properties. By shifting to one animal management system which allows cloud-based interconnectivity and offline backups, animal lifetime health records and management information is tracked across an animal's lifetime.

4.3 Modelling value propositions

Benchmarking was undertaken to identify the % of females contributing a weaner. During benchmarking the process used by CashCow was identified as different to the method used by the NB2 Program, provided by a firm consulting to Northern Producers, which was different again to CPC's method.

Increasing the number of weaners born provided the largest impact to the P&L Statement relative to price received, cost of inputs and other income streams. Increasing branding rate to the 75th percentile (78%) as identified by the CashCow project will increase revenue by 11% (McGowan et al. 2014).

Cattle movements between properties were mapped by Greenleaf Enterprises using NLIS database records. A potential $ 65 per head saving was identified in average transport cost per animal by reducing average animal movements per head. Reducing animal movements between properties across their life requires feed reserves to support that length of animal grazing, achieved through improved pasture monitoring and appropriate energy and protein supplements.

5. Conclusion

5.1 Key findings

Improving data integration and connectivity for extensive pastoral businesses is possible. A change manager will be key to facilitating practise changes and reinforcing change at each data collection point. Feedback loops further reinforce the importance of accurate data collection to people on the ground, in the form of reports and insights to staff and management who handle data.

Limited internet connectivity, and hot, dusty environments are challenges, but rugged hardware and software is available, and can operate satisfactorily. This requires power packs, spare tablets for when they overheat and methods to cool and protect the tablets from dust are needed.

Key findings for data integration and connectivity in extensive pastoral businesses include:

- One trusted point of truth is required to drive business wide data-based decisions.
- Business processes often drive data collection, however changed data collection processes can mean a change in business processes.
- The value in having accurate, reliable data is multi-dimensional.
- Business decisions at an operational, tactical and strategic level, legal requirements and financial reporting requirements should drive data which is collected.
- Calculations for KPI's vary depending on which methodology is applied.
- Business, business unit and manager KPIs align with seniority and business strategy.
- Infrastructure, training and learning resource investment supports digital strategy.

5.1.1 One point of truth is required to facilitate data driven decisions.

When there are multiple data sets, which often don't align, decision makers are unsure where to focus their energy to drive improvements due to difficulty in seeing the complete picture. Data gaps and/or data which is only recorded at a mob-based level reduces analytic accuracy. Tracing an individual animal through its entire life using a single stock management system provides tremendous value and insight into operational and strategic decisions.

Moving to one centralised system where internal records of movements are a system output, not an input, increases data granularity and reduces labour and effort to maintain multiple systems.

Using stock inventory as an example, within pastoral businesses there will be:

(1) NLIS database with information on the number of animals within the business and the number transferred in and out,
(2) Company records – internal documentation sent to head office for example cattle movement records, branding, and pregnancy testing records,
(3) Paddock books – manual counts out of the yards or into the paddock with records held by station managers and
(4) Animal management programs such as Elynx StockMate, KoolCollect and Agriwebb.

When these systems are separated, double ups occur compared to a centralised digitalised system.

5.1.2 While business processes often drive data collection, changed data collection processes can mean a change in business processes.

Successfully facilitating change is difficult and requires a change management plan. Technology adoption and implementation needs to be accompanied by a plan to train, mentor and support people through the change.

Cattle movement reports and paddock books have been generated and shared to management manually. Automated data collection provides a significant benefit to the business, and between business units. Automated data uploads and sharing also benefit the business through reduced downtime between data collection and analysis and report.

Business processes need to change to run unaccompanied scan sessions. Wand readers need to be available and functional. Animals need to walk single file through the race or crush to have their EID scanned. All animals need to have an EID in the correct ear (or two readers running to read the tags). The software and hardware systems must also be robust and reliable with easy troubleshooting if things go wrong.

5.1.3 The value in having accurate, reliable data is multi-dimensional.

Starting from a low data maturity base, collecting data on individual animals is often seen as an impost in Northern Australia, with questions raised on the value in collecting individual animal data. Access to accurate and reliable data, as outlined in Table 1, allows return-on-investment analysis including supplementary feeding, early weaning programs, pasture improvement and property improvement assessments.

For a firm to establish data driven decisions, it is important to raise data maturity across all areas. Data maturity is the extent to which a firm utilises their data.

A mature, data driven organisation has clear policies and procedures for data:

- Management
- Governance
- Analytic capabilities
- Quality
- Literacy
- Usage
- Architecture
- Tools – hardware and software

People elements associated with these activities include:

- Tools used - applications and infrastructure,
- Skills and capabilities,
- Organisational data culture, and
- Organisational data leadership, ownership and management.

5.1.4 Business decisions at operational and strategic levels, and legal and financial reporting requirements drive data collection.

Communicating what data is to be collected and why often helps people understand the importance and companywide ramifications for what they are doing crush-side when they collect data. Insights to where data is used across the business and feedback loops support individual operators to realise and recognise they are an important cog in the wheel of business decisions and activities. They can realise the legal and financial implications.

Unless data is mapped before collection, businesses will collect some data which is superfluous or unable to be used in analysis and will not collect or provide other data they do need in a timely and accurate manner. Mistakes have been made in many businesses where data has been collected without a clear purpose in how it will be utilised, analysed and what feedback loops will exist at different levels of responsibility within the business.

5.1.5 KPI calculations vary depending on which methodology is applied.

Through the process of defining the KPI's, it has been identified that there are different formulae being utilised to calculate branding and weaning percentage in industry.

> Method 1: Calves branded/weaned in the year / Closing breeders for the previous year x 100
> Method 2: Calves branded/weaned in the year/ Closing breeders from previous year + half of females joined in the current year x 100
> Method 3: Calves branded/weaned in the year / Breeding females joined from the previous year x 100

Each method provides a different branding /weaning value. When benchmarking and comparing branding (weaning) rates it is important to understand which method is being applied to compare like with like. Northern Australian beef fertility project: CashCow utilises Method 3 (McGowan et al. 2014).

5.1.6 KPIs for businesses, business units and managers need to be aligned with level of influence and strategy of the business.

People work to KPIs. Setting KPIs for businesses, business units and managers must be carefully considered. KPIs underpin business culture, what is important and what people work to. If the KPI is the number of animals processed per day with certain targets, there will be more focus on quantity of animals being processed rather than quality of data collected. When business culture becomes data driven, KPIs need to shift to 'data accuracy, timeliness and reliability'.

The recommendation is for reporting per business unit, with KPIs known at a senior management level, but not implications or judgement at a junior or middle management level to avoid the risk of skewing results. Where junior or middle managers have control over outcomes, KPIs are only effective after they have the necessary skills, experience and knowledge to meet KPIs. Baselines and expectations can be set for activities – with reporting undertaken if they were met and reasons for under/overachievement for example short staffed/great staff, drought/excellent season, bulls not performing as expected and low body condition score.

5.1.7 Investment in infrastructure and training and learning resources is required to support a digital strategy.

When developing a digital strategy, it is important that operational, functional, and suitable infrastructure is available. Areas identified for further industry attention to develop fit-for-purpose products for Northern Australia:

(1) Weigh scales for branding cradle – if this is a KPI which is going to be measured.
(2) Weigh scales at the crush which can quickly take an estimated weight, without requiring the animal to stand perfectly still.
(3) EID readers which can fit over a gate to record when moving animals from one paddock to another or from a yard into the paddock without the needs to file through a race.

Areas where additional training and upskilling is required is in recording body condition scores and in pasture and weed identification as a component of natural resource management. The software providers, training providers and industry need to continue to work to upskill station staff in training and learning resources which support and enhance accurate data collection.

5.2 Benefits to industry

The extensive pastoral industry has been slow to adopt data driven systems due to the reliance on applications and systems needing cloud connectivity and or mobile phone reception to operate effectively. Software applications including animal management systems have recently been developed which can operate within the system constraints and requirements, however many pastoralists lack confidence to invest time and resources. Through the pilot undertaken in this project it has demonstrated digital integration and connectivity is possible. To achieve practice change, realise improved data-based decisions and gain a return on investment a digitalisation process involving the entire business from finance to administration and property management is required.

5.2.1 Adaption of software applications to Northern Australian pastoral requirements

The project has worked with applications including the Animal Management system and Cibo Labs to help the software development teams build functionality and features. The project has helped support the refinement of Cibo Labs in the way data is available and accessed for personnel who have limited internet connection, allowing greater accessibility to satellite data on Food on Offer for management decisions.

The trial with an animal management system at Newcastle Waters Station supported the development and refinement of the system to include features and usability requirements for pastoral companies with multiple crews working offline in separate yards at the same time. Other features included the transfer of stock between business units while on the same property for example to export holding yards.

5.2.2 Digitisation process

Insights were generated into the digitalisation of a multi-site livestock business with steps and procedures defined. Through the research and development process undertaken in the project a framework template for digitalisation of data and business processes was developed and refined.

The steps include:

1. Identifying and mapping what data is being collected by whom and where it is being stored.
2. Map the current applications and IoT devices being used across the different business units and departments.
3. Identify the decisions both operational and strategic and what information is needed to make these decisions.
    a. Categorise the frequency of the decisions, importance of data accuracy (can it be estimated data or actual data, mob based or individual animal data)
4. Map the KPI's and reporting requirements including financial, administrative and legislative.
5. For the decisions, KPI's and reporting requirements identify the data required to generate the information and insights needed.
6. Map the process flows of information through the business considering the timeliness and accuracy requirements.
7. Develop a data glossary and dictionary creating standardised terminology and classifications for breed, age, sex (neutered terminology) and stock type. For example, definitions for age and stage: heifer, sale heifer, cull heifer, first calf heifer, second calf heifer, cow, super cow, spayed cow and cull cow.
8. Classify information and data by security and access rights and restrictions.
9. Review existing data collection processes and compare against data required. Identify data gaps.
10. Review existing and new systems and applications to improve and streamline business decisions and processes and improve availability and reliability of data and information.
11. Determine systems and applications, software and hardware required.
12. Review and update policies, procedures, SOPs and templates including:
    a. identifying what data is regarded as the 'source of truth' within the business,
    b. who has access and permission to change raw data,
    c. identifying which data is an input and which data is now a system output and which data provides checks and balances during the digitisation process.
13. Develop a change management plan which includes a dedicated person(s) to support and training for staff in data collection and change in processes which are required to implement the new systems and applications.
14. Review and refinement of systems and processes based on feedback through the chain management process.
15. Monitoring and review the digitalisation process has provided the required data and information for operational and strategic decisions as well as reporting metrics required by the different business sections.

A methodical mapping process as shown in Figure 1 and Table 1 provides industry with insights into the necessary business requirements to successfully move from a paper-based record system across the business to digitalised records. A critically important activity is the definition and standardisation of the data across the business between business units and between departments.

The activities of the project highlighted for all businesses adding an Internet of Things (IoT) device – the device is a measurement device for pasture growth, rainfall, temperature, in paddock weights, water consumption, soil moisture, etc. The measurement from the IoT device in the context of the business is that it provides an additional or more accurate, reliable and granular data point. Adding isolated data points to the business doesn't necessarily improve business decisions or streamline efficiencies and processes. The IoT device and data it generates needs to be reviewed in the context of the business decisioning processors, data storage, security and integration with existing data.

6. Future research and recommendations

The development of software applications and IoT devices which are suited to remote and northern Australian conditions has provided an opportunity for Northern pastoral businesses to collect and analyse data for improved decision making. To fully realise and capitalise on the opportunities a whole of business perspective is required. Examples of how businesses have incorporated IoT devices and software into their business and the associated change management processes (people, training, decision making, reporting) would support the adoption process for extensive pastoral companies.

The provision of additional data points from satellite imagery through Cibo Labs including Feed on Offer for paddocks and areas around watering points enables improved management of biodiverse ecosystems and to adjust stocking rates based on available feed reserves. The interpretation of the data and knowing the residual values required for different grasses and ecosystems requires knowledge and skills. Training and upskilling are required in pasture identification and pasture management to be able to identify woody and invasive weeds and ensure palatable species aren't overgrazed.

7. References

McGowan, M.R., Fordyce, G., O'Rourke, P.K., Barnes, T.S., Morton, J., Menzies, D., Jephcott, S., McCosker, K., Smith, D., Perkins, N.R. and Marquart, L., 2014. Northern Australia beef fertility project: Cash Cow, Meat & Livestock Australia, Sydney. Accessed online: https://www.mla.com.au/research-and-development/reports/2014/cash-cow---northern-australian-beef-fertility-project/