



Civic Ledger uses emerging technologies, including blockchain and smart contracts, to build open government platforms for innovation, simplifying its engagement with citizens and industry.

Introduction

The pace of innovation is increasing rapidly, and emerging and deep technologies like new treatment processes, artificial intelligence, remote sensing, Internet of Things (IoT) and blockchain technologies combined with ethical autonomous decision making are transforming entire industries. These new technologies are driving a “fourth industrial revolution.” Despite seeing pockets of innovation underway globally, the Australian agriculture water sector has been slower to adapt to this new paradigm.

The fourth industrial revolution holds both promise and peril for the Australian agriculture water sector – on the upside, innovation in water supply and water resource management could vastly improve the efficiency of the Australian agriculture water sector and democratise access for all irrigators. However, with any swift rate of change there also brings a range of unforeseeable risks. Balancing innovation with risks will require new partnerships between governments, institutions, and innovators, as well as new business models, policy frameworks and, importantly, new regulatory frameworks which focus on transparent governance and data interoperability – “compliance by design”.

Australian Water Markets and Trading

Water trading is conceptually simple, no different to buying and selling shares on the stock market. However, the significant difference between the two trading regimes is the complicated business rules that govern individual water entitlements and their transfer. This complicatedness has created an environment where market intermediaries thrive, and in their own way protect their business information by not encouraging transparency, as their business success may depend upon proprietary information generated through water trading – which we call this protection “information asymmetry”.

Improving the water market, whether through increased transparency or interoperable registers, has been a long-held goal embedded into the National Water Initiative (NWI), and even the Water Act. However, ambition has been frustrated by an inability to reach agreement at either a political, technical or operational level what transparency or interoperability looks like. As we have seen, progress has therefore been incremental, which has in turn reinforced frustration for market participants.

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Business Research and Innovation Initiative (BRII)

In September 2016, the Department of Industry managed the Business Research and Innovation Initiative (BRII) funding program where five (5) challenges were published encouraging eligible applicants to submit possible solutions to these challenges. One of these challenges was how to improve transparency and reliability of water market information within the Australian water markets.

The Department of Industry in collaboration with the Problem Owner would select four (4) applicants and provide funding up to \$100,000 to develop and deliver a Feasibility Study over twelve (12) weeks. Successful applicants were announced in late January 2017 with Feasibility Studies to commence in March 2017 and to be completed by end of June 2017. The four successful applicants were then eligible to apply for funding up to \$1M to develop and deliver a Proof of Concept (PoC) based on the Feasibility Study. The funding decisions were undertaken by the Australian Government's Entrepreneur Committee.

Civic Ledger was one of four companies selected to undertake a Feasibility Study into improving transparency and confidence in the Australian water markets however was not selected by the Entrepreneur Committee to deliver a PoC.

Who is Civic Ledger?

Founded in late September 2016, a multi-award-winning global company that provides strategic advice and technical delivery of blockchain-complete and surrounding technology solutions for government ecosystems. We specialise in data-driven platform solutions with a public sector perspective – within the civic service itself or where the civic service is a major stakeholder - to deliver fair access to shared public resources and entitlements.

What was the underlying challenge the Feasibility Study was tackling?

For the Australian Government's Department of Agriculture and Water, characteristics of Australia's water markets make the task of transparency and reliability of water market information challenging because:

- There are many different markets which can either be interconnected or not connected at all.
- Information ranges from readily available and requiring interpretation to not available.
- Limitations of rural telecommunications can make providing information to rural water users difficult.
- The market has few or no tools to interpret information and understand market drivers and trends.

What were the goals of the Feasibility Study?

The BRII challenge was seeking a solution that:

- Provided all the information a water user requires in order to trade.
- Enabled users to gain awareness of the market and market products.
- Enabled a user to gain an understanding of multiple markets.
- Improved transparency of the market so that users are more likely to participate and rapidly.
- Could be accessed by rural water users despite limited telecommunications.

Other challenges included:

- Activity varied substantially across markets with 90% of activity in the southern Murray-Darling Basin.
- Quality of information across markets varied similarly.
- Timeliness and accuracy of information was an issue.
- The ability to see information in “real-time” was a problem.
- Trading, like most markets, could occur across some external platforms, between agents or between neighbours – however, transparency, understanding and confidence in water markets could be significantly better.
- Trades can be conducted by a range of means; the final arbiters are the state registries which confirm the trade is valid.
- Availability of market information in state registries (such as Victoria) could provide insight on current and possible future registry arrangements.
- For a water user, it is a time-consuming challenge to become aware of all the opportunities and products that may exist in the market.
- It is even more challenging to find information and insight on the drivers of prices, as well as finding timely and accurate information about the market for that day or week.

Why did we consider using blockchain to achieve these goals?

When Civic Ledger began the Feasibility Study, the hypothesis that the BRIL challenge asked us to test was the reason that some irrigators chose not to trade water in the Australian water markets was due to lack of transparency and reliability of water market information. However, the more we tested this hypothesis we found that it evolved from focusing on water information to the actual water trade itself as the challenge.

Civic Ledger’s research highlighted several critical barriers to water market participation including; complexity of the trading process, lack of price and volume transparency in some —closed water systems (e.g. Murrumbidgee system) and some irrigators having no clear understanding of how additional water can increase farm output. Further, intermediaries appeared to hold privileged, valuable contextual information that might impede some irrigators from trading.

We found that transparency and reliability of water market information was a key impediment to confidence in, and participation by, irrigators in the water market. While the transparency and reliability of information was an impediment to market participation by irrigators, we argued that it is not the most influential impediment in so far that water information was available, albeit clunky and found through multiple sources.

Why so was the problem centred around the ability to trade water?

In the Australian agriculture water market, there is 350 water products with 15,000 business rules traded across 5 state government jurisdictions (all with their own Registry) with the Australian Government as the overall regulator. To trade water effectively and efficiently with so many rules, restrictions and regulations is too difficult for many irrigators, so they opt out of trading and forgo potential economic benefit.

Once we redefined the hypothesis and focused on the water trades (with endorsement from the Department of Agriculture and Water after a workshop presenting our hypothesis) we were able to design a solution using blockchain technologies including smart contracts and token management services. It is important to note that our approach was not from the perspective of “blockchain looking for a solution”. Rather our approach was to correlate what was causing water trading to be complicated with the benefits associated with blockchain technology that current proprietary software solutions were unable to solve.

What are the greatest advantages of blockchain?

Blockchain technology is an emerging way for businesses, industries, and governments to almost instantaneously make and verify transactions—streamlining business processes, saving money, and reducing the potential for fraud. At its core, a blockchain is a data structure that is used to create a digital transaction ledger that, instead of resting with a single provider, is shared among a distributed network of computers.

The result is a more open, transparent, and publicly verifiable system that will fundamentally change the way governments can think about exchanging value and assets, enforcing contracts, and sharing data across industries. The applications using blockchain are almost limitless, ranging from loans, bonds, and payments to more efficient supply chains to even identity management and verification.

The benefits to the Australian water markets

Blockchain technology offers immense possibilities for the wider water sector ecosystem and its connecting industries and consumers. These possibilities include the opportunity for extraordinary economic growth and a safer and more secure Internet. Its ability to improve processes, increase cost-efficiency, and promote transparency across the water sector value chain leading to transforming ways in which the water sector ecosystem conducts business including:

- Instantaneous compliance, auditing and reporting of core activities to regulators and key stakeholders removing data silos, paper-based transactions and errors – “compliance by design”.
- Securing of registries holding sensitive data of entitlements, licenses and permits associated with water sector activities e.g. environmental permits, industry waste, historical laboratory testing and so on; and
- Establishment of peer-to-peer markets for water quality assets for claiming and trading of offsets and / or trading of agriculture or environmental water for example.

As a result of the Feasibility Study, Civic Ledger designed a blockchain enabled peer to peer trading platform – Water Ledger – that allows for the secure and transparent trading of water entitlements and allocations within water markets, increase participation by irrigators and increase the overall allocative efficiency of the water resource. Water Ledger would provide substantial value for money for governments, contribute to increased revenue for irrigators, and keep farming communities strong and providing additional water for the environment.

The technology solution Water Ledger

Water Ledger addresses these challenges using several innovations to design an end-to-end registration and trading system built around blockchain technology taking advantage of its five features: decentralisation, cryptography, distributed network, tokenisation and encryption.

Water Ledger is a digital peer-to-peer water entitlement registry and trading platform. It aims to support improved river system management and optimise the economic output of irrigation systems by dramatically increasing the efficiency of water trading. Water Ledger simplifies and automates trades, increases price and volume transparency and makes it easier for non-traders to offer unused allocations therefore creating liquid markets. Benefits to regulators in that by its very nature, blockchain technology is “compliant by design”.

How far along is Water Ledger now?

Civic Ledger has built a blockchain based proof of concept (PoC) “Water Ledger” for the secure trade and settlement of water entitlements and allocations. Water Ledger uses a digital token (i.e. a digital “coin”) to represent the physical water asset (ML).

In May 2019, Civic Ledger submitted an Expression of Interest (EOI) to the Cooperative Research Centre for Northern Australia (CRCNA) to undertake a trial pilot project ***Improving Water Markets and Trading through New Digital Technologies*** in the Mareeba-Dimbulah Water Supply Scheme (MDWSS) in Queensland. The scope of the trial pilot project is to replicate the buying and selling of water allocations in compliance and as authorised in accordance with all applicable business and operating rules for the MDWSS.

The trial pilot project will also provide essential data for further research to be executed to inform trading market optimisation with relevance to the growing northern Australia agriculture industry and will provide valuable feedback for further development of the Water Ledger platform.

In early October 2019, the CRCNA advised Civic Ledger that it had been successful in its EOI and the pilot trial project will run from 28 January 2020 to 28 July 2020.

Trial Pilot Project: Improving Water Markets and Trading through New Digital Technologies

A key challenge to securing the ASEAN agriculture opportunity, in addition to infrastructure and non-tariff barriers, is providing assurance to potential investors of access to water markets and governance instruments to facilitate transparent water trading.

The objective to piloting Water Ledger in MDWSS is to research and evaluate blockchain’s potential to support and enhance the design and development of innovative new water markets in northern Australia. This objective includes evaluation of opportunities to enhance real time price discoverability, reduce trading costs, and improve liquidity of transfers to ensure water availability through the removal of information asymmetry by creating perfect water trading and market conditions.

The pilot project’s trading platform will conduct trades in parallel with the Queensland Government’s Department of Natural Resources, Mines and Energy’s (DNRME) existing Water Information Systems (WIS) used by the irrigators at MDWSS to collect data for analysis and to determine whether a smart market based on blockchain technology:

- Incentivises optimisation of water allocations.
- Increases market confidence.
- Decreases transaction costs.
- Improves data integrity.

The benefits and outcomes include providing key stakeholders an understanding of the governance and market mechanisms in the application of a blockchain enabled water trading platform and to help extend the project outputs to other parts of Australia with the view to exporting the solution to overseas markets. The outputs of the pilot project will complement several key projects already underway with the CRCNA which are evaluating agricultural opportunities as well as directing major investments.

Running the pilot project will provide valuable feedback to enable advancement and refinement of the Water Ledger platform under development. The inputs from and contributions by the operating system users enables platform development to further converge with the usability of the platform. Further, the pilot project records will provide essential trading and market data for further research to be executed to better

inform trading market optimisation considerations, with relevance to the growing northern Australia agriculture industry.

This pilot project directly impacts on the CRCNA objectives to deliver research which develops new technologies, efficiencies and approaches which are game changers for northern Australia, and which improves specific industry production chains. Providing ready access to water market trading information, and enabling cost effective, efficient and near to real time water trading transaction will provide substantial opportunity for these key CRCNA objectives.

What are the trial pilot project's research objectives?

The trial pilot project will help to understand the governance and market mechanisms for the efficient functioning of water trade and marketplace based on a mix of conventional and appropriate distributed ledger technologies including blockchain technology and smart contracts. By exploring the conditions required for the successful application of blockchain technology in water trading within the MDWSS, the pilot project intends to address the following questions:

- How can blockchain technology design incentives for irrigators to optimise water allocations usage leading to increased agri-economic outputs and improved environmental benefits?
- As an institutional utility, can blockchain technology help design new regulatory and governance frameworks for emerging water markets in Northern Australia to deliver truthful and symmetric revelation of information about water prices and market volume to capture the ASEAN agricultural opportunity?

The objective of the research is to understand:

- If there is price and market volume transparency in near real time offered by a blockchain enabled water trading platform does this lead to the optimisation of water allocations (liquidity)?
- If there is a simplified trading process and reduced trading cost does this lead to increased water market trading participation?
- How does this approach differ from current methods of water trading using intermediaries?

The research output includes a blockchain enabled trading platform (pilot) for the trading of temporary allocations using smart contracts to automate the conditions based on the MDWSS water trading rules.

What is the trial pilot project's research methodology?

The proposed research methodology is to follow the overall process as set out below.

Research Objective

The research objective is defined as seeking quantitative and qualitative answers to the following:

- How can blockchain technology design incentives for irrigators to optimise water allocations leading to increased agri-economic outputs and improved environmental benefits?
- As an institutional utility, can blockchain technology help design new regulatory and governance frameworks for emerging water markets in Northern Australia to deliver truthful and symmetric revelation of information about water prices and market volume to capture the ASEAN agricultural opportunity?
- If there is price and market volume transparency in near real time offered by a blockchain enabled water trading platform does this lead to the optimisation of water allocations (liquidity)?

- How does this approach differ from current methods of water trading using intermediaries?

Research Output

The research output includes a blockchain enabled trading platform (pilot) for the trading of temporary water allocations using smart contracts to automate the conditions based on the MDWSS water trading rules.

Historical Data Analysis

The research project will collate data for analysis from MDWSS government and other sources. Water trading data for MDWSS to be obtained from DNRME and SunWater (Brisbane and Mareeba) including from existing SunWater Orion system.

MDWSS high level system parameters will be identified including:

- Overall capacities
- Zones
- Water products

MDWSS operating rules will be closely collated including as may pertain to:

- Announced allocations
- Carryovers
- Seasonal assignment
- Range of water products

MDWSS water trading / business rules will be collated including, as applicable, re following:

- Licensing requirements
- Trading limits
- Trading restrictions
- Zone transfers
- Seasonal factors applied

Data relating to actual water trading activity will be compiled including the following:

- Trade activity over a selected period (perhaps one year)
- Trade sellers and buyers (who may be anonymised)
- Trading intermediary parties and roles
- Trade pricing information
- Transaction duration (time to settlement and register updating)

Water Ledger Trial

Historical trades will be replicated on the Water Ledger platform involving developing smart contracts and transactions which will replicate trading in accordance with MDWSS rules and restrictions. Water allocation trading on Water Ledger platform will be mapped and a data set of transaction activity compiled which, along with all other collated data, will be used for the subsequent further research and evaluation.

Post-trial pilot project research

RMIT's Blockchain Innovation Hub will undertake the research post-trial and will draw on trial findings and further extend research analysis into some theoretical, practical and policy questions. These research analyses question include:

Theoretical research

The theoretical research contributes to the potential of transforming the pilot from MVP to Beta, including questions such as:

- How can the market be **designed** to maximise incentives for irrigators to efficiently allocate water rights?
- How does a blockchain-based water rights infrastructure differ compared to existing centralised systems (e.g. organisational characteristics such as speed, potential for smart contracting)?
- What **benefits** does blockchain provide from the perspective of stakeholders within the water ecosystem (e.g. irrigators, operators, governments, traders).
- What are the **risks** of more decentralised blockchain water trading infrastructure, including integration with existing governance and market mechanisms?
- What are the **strategic considerations** in implementing blockchain infrastructure (e.g. choice of blockchain platform, overcoming potential market barriers)?

Empirical research

The empirical research draws directly on the outcomes and learnings of the pilot, placing this within the broader context of digitally transforming water markets. This includes:

- A detailed **case study analysis** of the pilot, including its successes and challenges, placing these within the context of the theoretical research.
- How does the **operation of the pilot** differ from the existing operation of water markets?
- What are some identified clear **quantifiable economic benefits** from the pilot?
- **Analysis and comparison of jurisdictions** who have undergone digital transformations of water markets, including the challenges they faced.

Policy research

The policy research places the pilot within the broader political economy regulatory context, revealing both solutions to existing policy problems, and potential policy barriers or tensions including:

- How are legacy water trading rules (e.g. limits) affected by new blockchain-based water trading infrastructure? Are these **regulations fit-for-purpose**?
- What other areas of regulation should be considered (e.g. privacy, data rights)?
- How might blockchain-based infrastructure solve existing political problems and challenges (e.g. Indigenous water access and rights)?
- What are some **export opportunities** for new digital infrastructure, particularly into the ASEAN region?

How do we plan to ensure that end users adopt the trial pilot project outputs?

End users for the Water Ledger trading platform initially include existing and emerging irrigators and water traders. These end users will utilise Water Ledger for water trading, both as licensees and as traders / investors in water markets. The end users will grow to include water scheme operators (entitlements monitoring, billings etc.), as well as government registries and other government departments. End Users and potential end users are emergent throughout Australia and internationally.

To ensure that the end users adopt the Water Ledger platform, multiple strategies will be implemented through the development of Water Ledger. Some plans that have relevance during the pilot project include the following:

- Close engagement with irrigators through the planning, trial and research phases.
- Engagement with and participation of scheme operator SunWater.
- Engagement with and participation of DNRME.
- Comprehensive communications planning prior to, throughout and post pilot project.
- Engagement with multiple stakeholders including Mareeba Shire Council and industry bodies including but not limited to Australia Water Partnership, CSIRO, Austrade and Trade Investment Queensland.
- Media releases including on regional media about Water Ledger trials, outcomes and benefits for end users.

The end user adoption of Water Ledger requires support from State Government (DNRME) and the water supply scheme operator, SunWater. These parties have been engaged with during planning prior to the pilot project and have acknowledged in writing their supports for the trial pilot project. Local government Mareeba Shire Council including Mayor Tom Gilmore have also been engaged with, and their support is confirmed. Engagement with industry groups including Queensland Farmers Federation and Queensland Canegrowers Association will continue through the pilot project.

Engagement with participants and stakeholders will continue through the pilot project. This engagement will include regular progress updates through all project phases, as well as a program of scheduled and other meetings at opportune times. Water Ledger development also includes partnering with ASX Ltd (who are currently replacing CHES with Distributed Ledger Technology).

Media releases and active social media participation is also current and will continue for Civic Ledger / Water Ledger. This will include news feed pertaining to the pilot project. The social media following for Civic ledger is very substantial both nationally and globally, and this will draw much international attention to this world first pilot in Queensland. In the course of the pilot project media engagement is planned to result in a further rural media article (e.g. <https://www.theland.com.au/story/6274260/blockchain-in-the-pipeline/>) e.g. Queensland Country Life. An article may also be included into a professional journal (e.g. Australian Water Association Journal or Engineers Australia Create Journal).

Conclusion

This submission to the ACCC's enquiry into the Murray Darling Basin Water Markets is to offer potential solutions to the complexity of water trading within Australia's water markets.

We are very aware of Blockchain technology's hype cycle of the past couple of years. It is our intent to provide rich insights to the ACCC of our work over the past 2 or so more years working with stakeholders on all levels to solve the challenges within Australia's water markets. We strongly believe that to solve this problem, cooperation is required to agree on the transparent governance and, ultimately, data interoperability.

We are grateful to the ACCC for this opportunity to submit our response.