

Barrel Management System

World-first digitalisation and end-to-end automation project delivered for global wine company



2024

Elevator Pitch

Nukon, part of the SAGE Group, partnered with Treasury Wine Estates (TWE) and its automation suppliers to deliver a digitalisation and end-to-end automated Barrel Management System (BMS), transforming some of the traditional winemaking processes at TWE's Barossa Valley facility into a highly efficient, sustainable, and data-driven operation. Nukon are submitting the BMS to the Wine Industry Impact Awards in the category of 'Agtech and Digital'.

This end-to-end automation is a first in the global wine industry, replacing manual barrel management methods—such as chalk marks and paper cards—with a completely digital Barrel Management System (BMS). Leveraging QR codes, RFID tags, and mobile devices the BMS integrates with TWE's Automatic Guided Vehicles (AGVs), and robotic systems to, for the first time, bring together people, processes, and data to streamline operations across a facility with the capacity to store up to 125,000 barrels. The BMS ensures complete traceability, digitalising barrel operations from inventory management to emptying, washing, filling, and storage.

This initiative is expected to increase storage capacity by up to 60%, reduce manual handling risks, and lower energy consumption. It aligns with TWE's sustainability targets, including net zero emissions by 2030, as AGVs are powered by renewable energy. The project also set new standards for operational efficiency, with barrel operations now driven by data insights that inform winemaking decisions.

By integrating robotics and digital workflows into a traditionally manual industry, this project has created significant impact, demonstrating the potential of digitalisation in winemaking and setting a new benchmark for innovation, safety, sustainability, and operational excellence.

The broader industry can look to this project as a prime example of how digital transformation can revolutionise not only efficiency and productivity but also environmental sustainability and data-driven decision-making. The BMS digitalisation project introduces automation and smart processes that will influence the future direction of the industry.

Supporting Documentation

Overview and Background

Treasury Wine Estates (TWE) is one of the world's largest wine companies, with brands including Penfolds, Pepperjack, Wynns, and 19 Crimes available in over 70 countries. At its Barossa Valley, South Australia site the company embarked on a digitalisation and automation project aimed at transforming traditional winemaking processes.

Nukon was tasked with delivering an innovative Barrel Management System (BMS) and an automated solution to streamline and modernise TWE's operations at the Barossa Valley site's barrel hall, improving operational efficiency and safety.

The Problem

Historically, TWE's barrel management included some manual processes. With a growth in demand, manual chalk marks, paper cards, and physical labour to manage the barrel hall was no longer sustainable and TWE sought to improve throughput, reduce operational risks, enhance traceability, and meet its sustainability goals.

TWE aimed to develop an automated warehouse, to digitalise and automate processes, to gather more data from their barrels, to increase throughput, and improve safety in the facility.



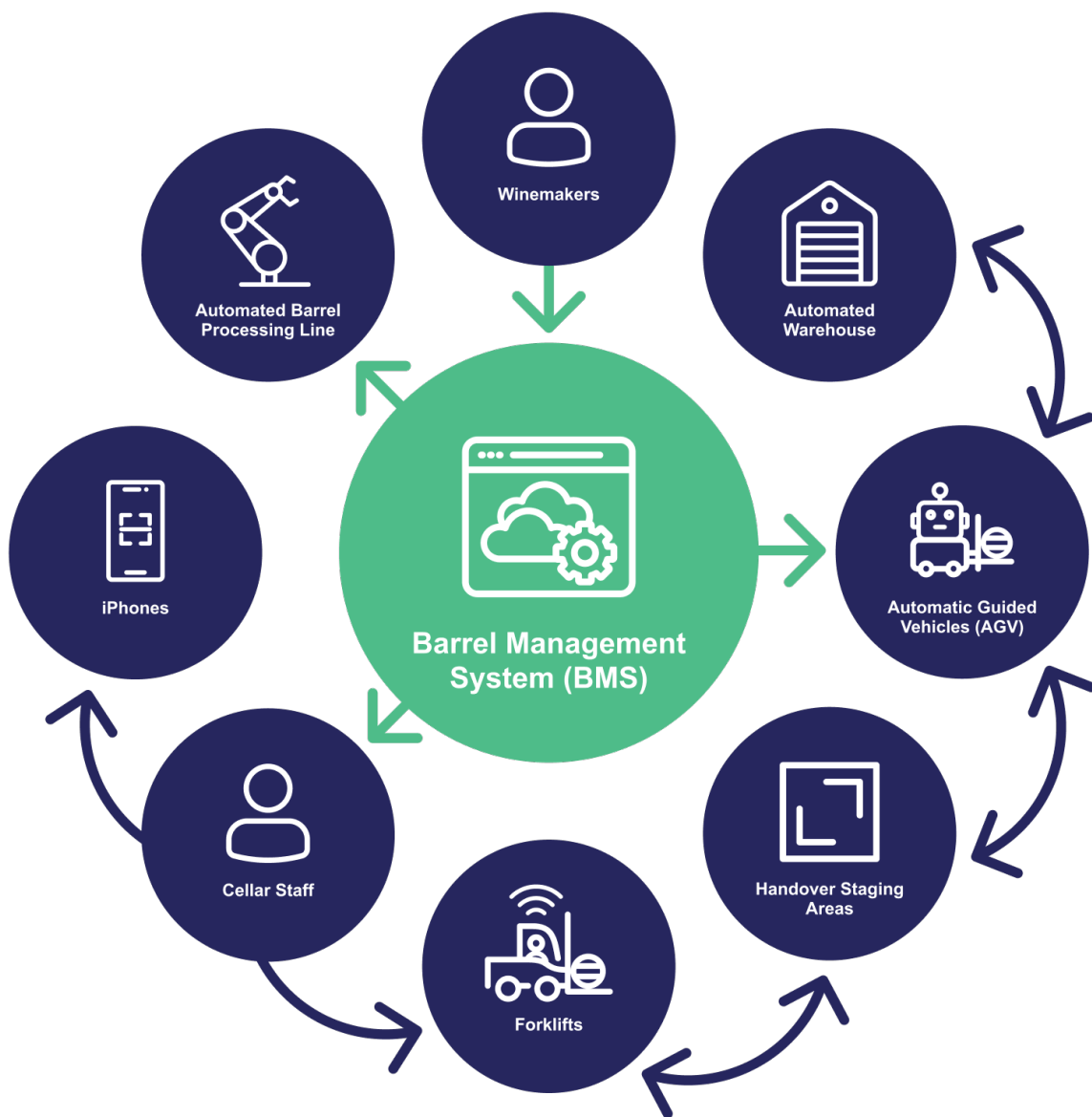
The Solution to the Problem – Proof and Results

Nukon developed a world-first Barrel Management System (BMS) that digitalised every aspect of barrel handling and management in the 35,000m² barrel hall, integrating digital workflows, AGVs, and robotic automation.

Using a business process modelling and notation engine (BPMN), digital workflows were developed and implemented, connecting and integrating people, systems, processes, data, and robotics. This is one of [Nukon's core offerings – Digital Workflow](#). Central to this approach is [the concept of a connected worker](#) where digital workflows push user tasks to an automated task list for users to action.

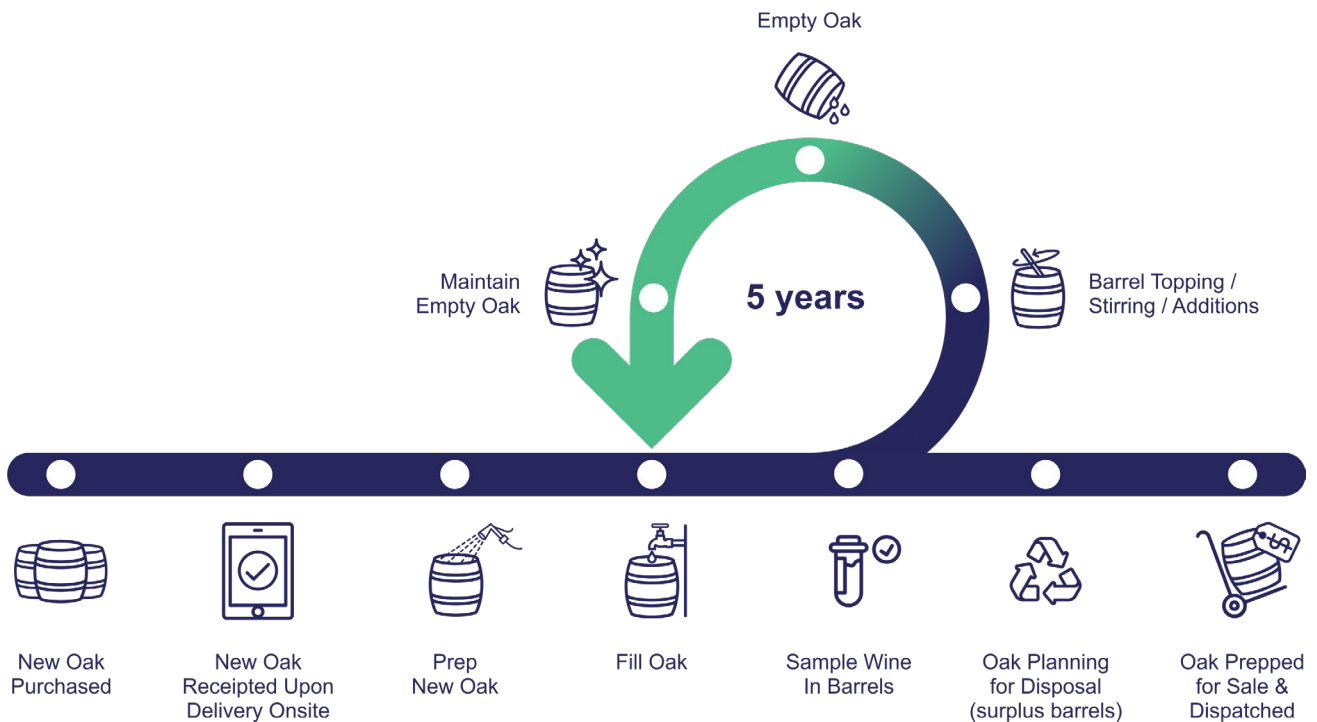
James Roberts, TWE Supply Technology Delivery Manager, said *“Our barrel management system or BMS is very much the brains of the operation. What the BMS does is essentially translates what our winemakers need to do to the barrels into instructions that the robots can then follow.”*

The BMS is at the heart of winemaking barrel operations connecting and integrating people, systems, processes, data, and robotics.



BMS functional map

The following diagram illustrates the functions digitalised by BMS across the entire barrel lifecycle.



BMS functions

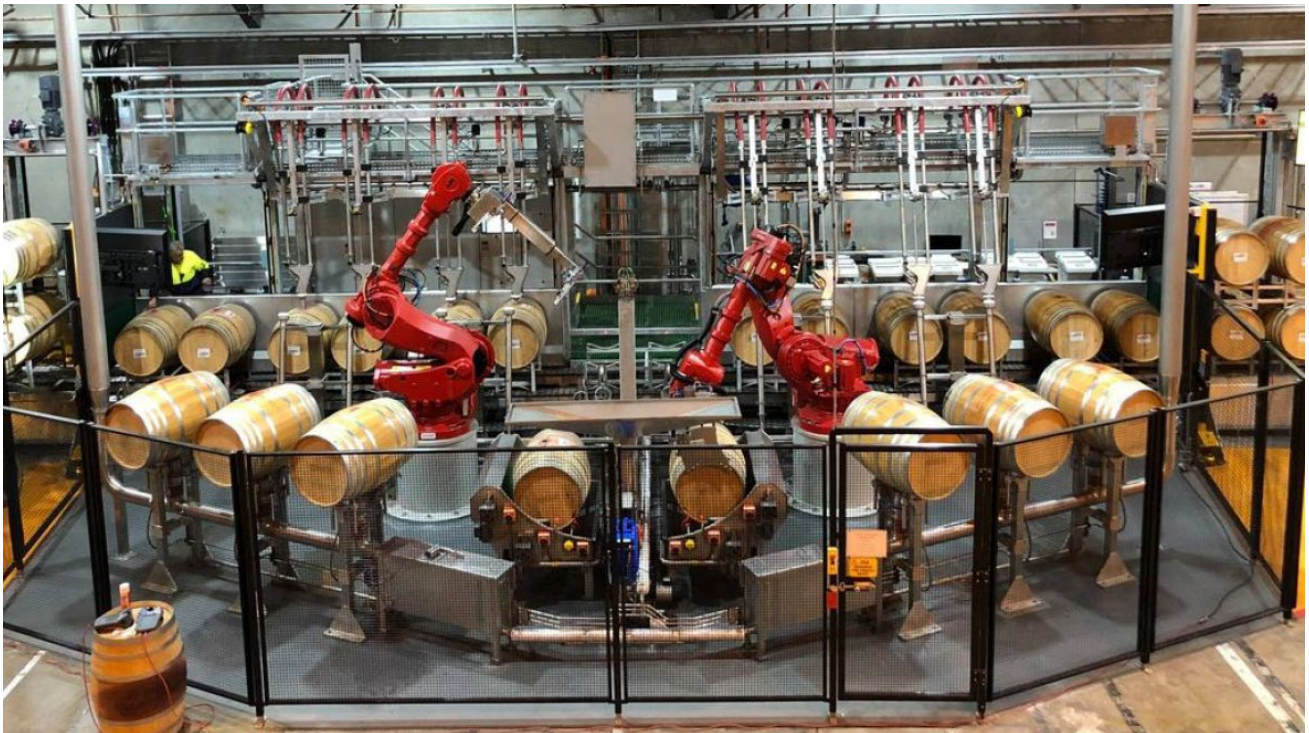
- Receipt of new barrels into inventory, application and scanning of unique identification QR codes and RFID tags, pairing with transport units, and data capture of detailed barrel attributes (country, cooper, forest, toast, etc.)
- Orchestration of automatic guided vehicles (AGVs) to move barrels into automated storage, and to processing areas and back, including the Robotic Automated Barrel Processing Line.
- Integration with winemaking ERP system to receive winemaker requests for barrel operations including filling, emptying, sampling, topping, wine additions, etc.
- Barrel inventory management for empty barrels and full barrels
- Empty barrel stock-on-hand selection, allowing winemaking teams to search and select barrels to fill based on barrel attributes, such as country, cooper, forest, toast, MPF allocation, barrel reservation, etc.
- Full barrel selection down to the individual barrel level to allow winemakers to sample, empty or add to individual barrels, a whole barrel group, or the most accessible nominated quantity for AGVs to retrieve from automated storage.
- End-to-end digital barrel operation request execution management including:
 - Integration with the Robotic Automated Barrel Processing Line (APL)
 - Integration with AGV to service the APL infeed and outfeed, and replenish and return from forklift handover staging areas
 - User task list management to push digital tasks to:
 - Forklift operators using in-vehicle tablets and RFID scanning equipment to pick up barrels from AGV handover staging areas and deliver to work areas

- iPhone users to scan and validate barrels and transact barrel operations such as filling, emptying, sampling, etc.
- Barrel validation and error proofing via QR code and RFID scanning for every barrel operation transaction execution resulting in better adherence to process, better winemaking quality assurance and data quality assurance for higher quality decision making using that data.
- Digital tracking of the barrels, as well as the transport units they sit on, throughout the entire barrel lifecycle including data capture of every transaction recorded against each individual barrel for traceability and to unlock winemaking insights through data.
- Material movement handling of transport units containing barrels so that physical barrel locations are known at all times in data.
- Execution and timing optimisation of barrel maintenance activities including washing, sulphuring, and steaming.

Robotic Automated Barrel Processing Line (APL)

TWE also implemented a robotic processing line – a bespoke piece of mechanical engineering designed and developed in-house at TWE – which is a fully automated work cell capable of emptying, washing, and filling barrels. The electrical and controls engineering was implemented by Nukon’s sister company SAGE Automation.

The BMS integrates with the APL to download barrel operation requests and receive barrel transactions in real time as the APL processes each barrel. The BMS is responsible for orchestrating AGVs to replenish the right barrels to the APL infeed and then collect processed barrels from the APL outfeed and put them back away to automated storage.



Automatic Guided Vehicles (AGVs)

The AGVs, or driverless forklifts, transport barrels across the 35,000m² barrel hall, orchestrated by the customised BMS.

With sensors guiding the AGVs and RFID scanning equipment to identify barrels, they are highly efficient and precise in transporting barrels, lowering energy consumption, and creating a safer work environment. The AGVs are powered by renewable energy, helping TWE to further reduce their emissions.

Capable of stacking barrels to eight levels high, the introduction of AGVs has increased barrel storage capacity on the site to allow for further expansion in wine operations.



BMS Automatic Operations

Interfacing with the Robotic Automated Barrel Processing Line (APL) and AGVs the BMS orchestrates wine operations to a level close to the “lights-out manufacturing” pinnacle of digitalisation as illustrated below.



BMS Manual Operations

Manual barrel operations are also performed at the Barossa site for high value wines including the usage of AGV to manual forklift handover areas, manual forklifts with RFID scanning equipment and tablets running BMS, and iPhones in manual work areas scanning QR codes for barrel validation.



These innovations resulted in a 60% increase in storage capacity, while ensuring full traceability of barrel operations, from procurement to disposal. The solution also enabled TWE to make data-driven decisions, improving product quality and optimising operational efficiency. Additionally, the introduction of AGVs reduced workplace injuries and manual handling risks, creating a safer environment for employees.

How It Created Industry IMPACT

This project is the first of its kind in the global wine industry, setting new standards in sustainability, efficiency, and innovation, and demonstrating how technology can solve complex operational challenges while driving a positive environmental impact.

- **Sustainability:** The AGVs used in the facility are powered by renewable energy, helping TWE achieve its goal of net zero emissions by 2030. The BMS optimised the use of resources, reducing energy consumption and minimising waste.
- **Efficiency:** Automating barrel operations reduced manual handling tasks, improved accuracy, and enabled TWE to increase storage capacity by 60% without expanding the workforce. The digital transformation also improved product consistency and operational reliability. TWE now has real-time data from its barrel operations – enabling faster and more effective decision making for example adjustments to the plan to ensure best utilisation of assets and overall equipment effectiveness.
- **Innovation:** This project pioneered the use of digital workflows and automation in winemaking, showcasing the possibilities of integrating robotics, data analytics, and process automation in an industry traditionally reliant on manual processes.
- **Collaboration and Partnership:** The success of the project relied on Nukon partnering with TWE and working closely with TWE’s winemaking team to develop a solution tailored to the specific needs of winemaking, ensuring that the digital transformation was both practical and effective.

Supplementary Material

Customer Testimonials

- Speaking at the launch event attended by government and industry representatives, TWE’s Chief Supply & Sustainability Officer Kerrin Petty said *“Our Barossa Valley site is fast becoming an international hub of innovation in winemaking, sustainability and resilience. Introducing full automation in our barrel hall increases our luxury and premium winemaking capacity, so we can craft more of our renowned wines for wine lovers around the world while creating a safer working environment for our people.”*
- James Roberts, Supply Technology Delivery Manager at TWE explains, *“Introducing automatic guided vehicles and a new digital barrel management system transforms our traditional paper-based processes into a highly automated and highly digitised operation and really sets the agenda for the rest of the winery and the rest of the industry. (This) represents something close to lights out manufacturing and fully automated wine manufacturing!”*
- Director of Supply Technology Jodie Rowlands added *“We’ve seen improvements in safety, efficiency, and traceability in our barrel hall, with the team on site embracing the new way of working. The efficiency and precision of automated, sensor-based forklifts to transport the barrels lowers energy consumption compared to manual handling processes.”*

Trial Results

- The implementation of the BMS as the key enabler of the integrated automated facility creates capacity for up to 60% more storage, while significantly reducing the number of manual handling incidents. The digitalisation of barrel operations provided complete traceability and delivered data insights that helped improve winemaking decisions.

Additional Explanation of Benefits

- The BMS allows the wine producer's international winemaking team to control and monitor barrel operations remotely to move barrels through the maturation process, providing unprecedented flexibility.
- Digital tracking of the barrels, as well as the transport units they sit on, throughout the entire barrel lifecycle including data capture of every transaction recorded against each individual barrel for traceability and to unlock winemaking insights through data, answering questions like:
 - "How much time did the wine spend in oak, which oak specifically, how closely does that align with the oak recipe and target flavour profile, and what can we learn from that to improve our winemaking craft?"
 - "How many barrels of a particular type are currently available to be filled, and how many barrels will become available by the time I'm ready to fill them?"
 - "How long have individual barrels had wine in them for and therefore how seasoned are they down to minutes, rather than how many years have they been on site, and how does that compare to the lease term of the barrels to drive decisions for when optimally to dispose of old barrels?"
 - "What are the statistics and trends for empty barrel stock utilisation each year that can inform new barrel purchasing behaviour to optimise new barrel costs?"
- TWE's forklift operators have either been re-skilled to operate the digital barrel management system and manage the new automated vehicles or have upskilled into other roles at the site.

Conclusion

The TWE project is a model for how innovation, sustainability, and Nukon partnering with its client can come together to solve industry challenges and create IMPACT for the wine industry. This digital transformation project not only improved TWE's operational efficiency and safety but also set a new benchmark for winemaking processes.

News Clippings & Videos

The Australian Business Review: <https://links.streem.com.au/the-australian-20240716-aNOYGeNsJyXTjUNh7h9hYLEyW3>

LinkedIn: https://www.linkedin.com/posts/treasury-wine-estates_twe-australianwine-innovation-activity-7219955740583608320-iw5I?utm_source=share&utm_medium=member_desktop

TWE: <https://www.tweglobal.com/media/news/barossa-valley-automation>