Final Report

AMPC
AUSTRALIAN MEAT PROCESSOR CORPORATION

Murray Bridge Digital Twin

Murray Bridge 2.0: 3D Rendered Visualisation Industry 4.0 Digital Twin

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1.0 Executive Summary

The Digital Twin of the Thomas Foods International (TFI) new Murray Bridge processing facility aimed to provide the delivery of a real-life 3D rendered visualisation that showcased the operating environment and produced a series of visualisations that support key communications and stakeholder engagement tools to support the pre-flight and ongoing operation of the facility.

In partnership with a 3rd party technology firm, animated and highly detailed recreations of the entire processing facility and operating equipment were generated enabling TFI and construction partners to interrogate the design and layout of the facility, and make informed amendments (improvements) to the design.

The digital twin has provided an excellent model of the facility that has and will continue to serve the following high value purposes to TFI and the broader industry:

- Identification of design flaws and inefficiencies
- Worker recruitment and retention tool to showcase the safe, high technology and industry leading work environment
- Environmental impact minimisation strategies employed by TFI

The complex nature of the Digital Twin production (principally made up of the challenges associated with obtaining such large number of design files and reference shots from the vast number of 3rd party vendors and design team) was the largest hurdle the project overcame. Industry participants would be well advised to ensure clear and concise communication with their project partners and vendors prior to the commissioning of a similar project with respect to the detail required to produce a high quality Digital Twin of a complex facility like a meat processing facility.

The Digital Twin is a valuable stakeholder engagement and training tool that allows TFI and its partners to easily showcase particular areas of the plant to key audiences including local community, regulatory authorities, and current and future employees.

2.0 Introduction

In 2018 Thomas Foods International (TFI) lost its Murray Bridge processing facility to fire, immediately rendering the site unusable for the purposes of meat processing and leaving more than 1,000 people unable to rely upon the site as their place of employment. TFI vowed to rebuild the site and in 2020 ‘broke ground’ for a new greenfield facility.

The purpose of this project is to develop a Digital Twin of the new build in order to assist in guiding key decisions related to the internal architecture, engineering, and implementation of new machinery and technologies, to demonstrate insights and outcomes to workflows throughout the complete production process. The Digital Twin also aims to facilitate the planning and design processes to clearly demonstrate the impacts and advantages of changes and alterations, without enduring the set-backs and delays, in a real world scenario. The Murray Bridge plant model will deliver immediate benefits in the recruitment and training of new employees, to sustain the facility in both traditional labour roles, and new highly skilled roles to operate the advanced equipment and technology through demonstrations of design directions and real-life processes.

The construction of a new meat processing plant also comes with particular challenges around stakeholder engagement, particularly with those not familiar with modern design initiatives and current technologies available to the meat processing industry. The Digital Twin will provide clear visualisations and the opportunity to demonstrate new capabilities to key stakeholder audiences through rich walkthrough experiences, fixed renders for use in printed and digital communication materials, and animated flythroughs.

The Digital Twin will be produced through the integration of CAD data, 2D and 3D design files and existing models of vendor equipment and infrastructure. High-end, feature film VFX 3D software such as 3D Studio Max, Substance and Unreal Engine will be heavily utilized by the developers to create a “millimetre perfect” and operational representation of the finished facility.

3.0 Project Objectives

The project objectives are:

- The delivery of a 3D Rendered Visualisation Digital Twin demonstrating real-life accuracy and replication of the Murray Bridge facility when completed and operating.

- Demonstrations and recreations of actual operations and technologies within the plant being applied, and capable of various interrogations via digital demonstrations, covering from lairage through to final load-out and dispatch of a variety of TFI products.

- Production of a series of digital photorealistic visuals of the Thomas Foods International (TFI) Murray Bridge development, well before completion, with key deliverables including web-based guided tours, fixed renders for use in 3D fly-throughs, VR environments, augmented reality demonstrations and opportunity for provider remote operation, servicing and fault finding.

4.0 Methodology

The methodology of this project will follow best practice of constructing a digital twin based on “Three steps to creating a digital twin” from open text:

- Design
- Operation
- Augmentation

Design

The first step in the design phase of the digital twin was to determine the enabling technology that would deliver a true representation of the operating environment and animation of moving parts both inside and outside of the plant. The project partner that was identified ag the best credentials and technology to deliver the Digital Twin was Model Farm. Model Farm have established a solid production process to allow CAD data to be ingested into their workflow. Whilst high-end, feature film VFX 3D software such as 3D Studio Max, Substance and Unreal Engine are all heavily utilized by the artists and developers. Model Farm’s state of the art, real time rendering technology, creates the opportunity to freely navigate and immerse yourself within the key areas of all modelled areas of the processing facility in order to gain a greater understanding of the innovative and class leading technology and ensure maximum benefits to the Australian beef and lamb industry in the short and long run.

Once the project partner was identified, significant meetings and discussions were undertaken to better understand the capabilities of the modelling process and to consequently identify the key outcomes that the model would deliver, and the inputs required to get to the targeted end point in the Digital Twin development. Key deliverables in the design of the Digital Twin were:

- Opportunity to critique and further improve the design and layout of the facility to maximise efficiencies and to support clash detection
- Deliver a real-life representation of the plant in an operating state in order to showcase and demonstrate industry-leading technologies to key stakeholder groups (i.e. people and food safety, animal welfare, efficiency, technology, environmental impact minimisation etc)

- Clearly communicate and demonstrate how the new facility would seamlessly integrate into the natural environment and existing surrounds
- Showcase the first class employee amenities to support the long term recruitment and retention of employees within the red meat industry

In order to deliver a Digital Twin that would support these outcomes, the initial information that was required by Model Farm included:

- CAD files for all spaces within the plant and the surrounding areas
- Revit/Sketchup files
- Material schedules (for interior and exterior)
- Landscape plans – CAD and PDF files as well as plant and material selections to deliver an accurate representation
- Interior elevations
- Specifications, Fixtures and Fittings for all parts throughout the facility (from light fixtures and flooring, to colour palate etc)
- References (video, photos, manuals etc.) for machinery, robotics etc.
- Animated reference for machinery motion

Operation

The purpose of the Digital Twin was to provide accurate and real-life simulations of the operational environment to support the design and construction, as well and deliver a key stakeholder engagement and training tool for TFI. The Digital Twin would enable TFI and our design partners to exploit analytics to improve operational performance and aid in the decision making process. Model Farm were able to confirm the creation of the Digital Twin would enable this interrogation through virtual walkthroughs and the ability to game-out the impacts of re-designing specific areas of the facility both internally and externally.

It was determined that the creation of stage one of the Digital Twin (i.e. pre-commissioning) of the model would not require the capture of specific data (such as product flows, effects of speeding up or slowing down machinery, or amending the manning of certain areas of the facility and understanding the consequential impacts of such changes, although it was well acknowledged that the Digital Twin could be utilised in such a way to maximise the operational efficiencies of the plant post-commissioning with a small amount of further development.

Augmentation

The initial development of the Digital Twin involved breaking the facility up into smaller, more management pieces to ‘size up’ and scale in order to deliver a white card version of all spaces. The identified spaces were:

- Exterior and surrounds including waste water treatment ponds
- Staff amenities, entry corridors and clerical office areas
- Kill floor
- Boning room area 1: slicing tables through to trim sortation and packaging
- Boning room area 2: primary boning and carcase disassembly area
- Cold store
- Palletising and load out areas

Figure 1 Initial white card production of exterior

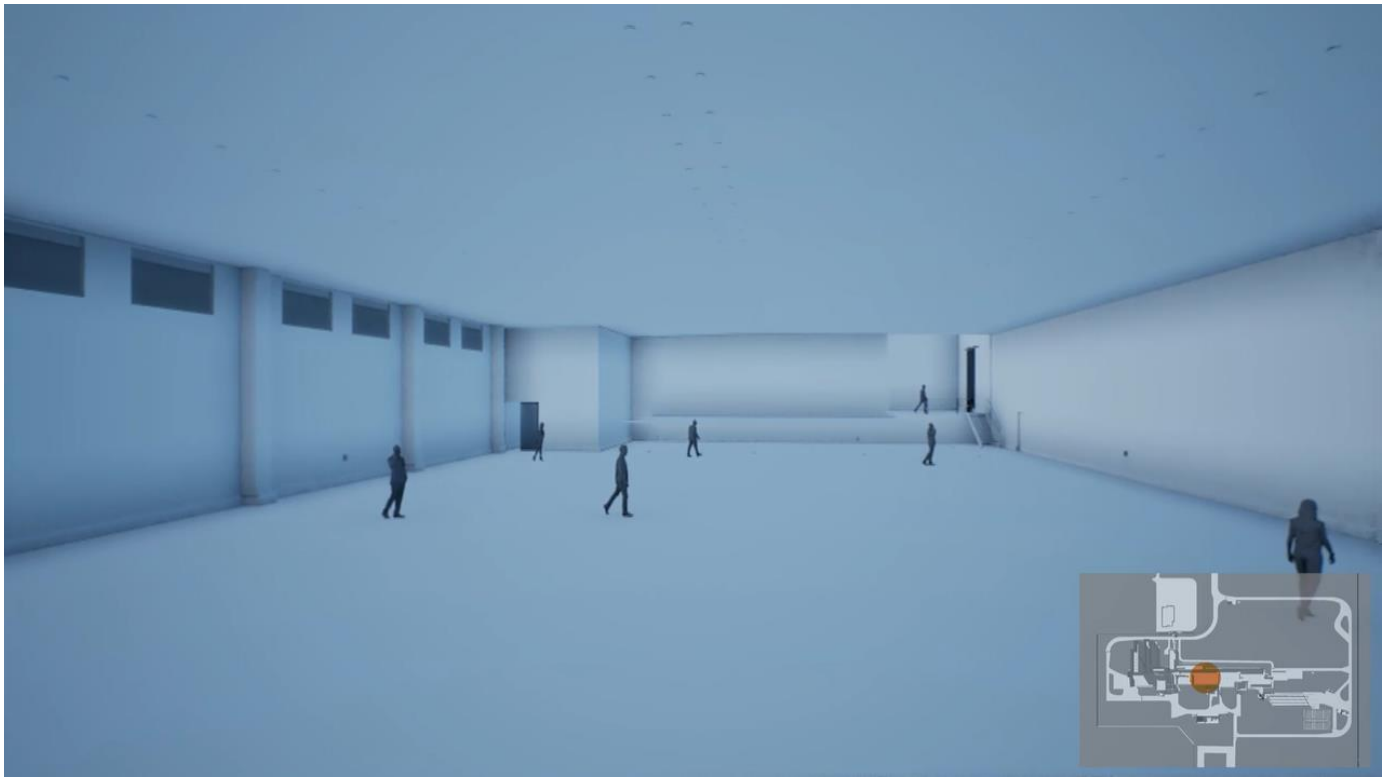


Figure 2 Initial white card production of boning room showing elevations and including people as a reference for size

As the Digital Twin evolved and progressed, each space was built out to include scale representations of machinery and equipment, detailed geometry creation for all equipment leading to the insertion of high fidelity models of equipment, and finally the animation to represent the facility ‘in operation’.

4. 1 Appointment of 3rd party supplier

Model Farm were identified as the technical partner for the creation of the Digital Twin. ModelFarm is a 3D visualisation studio that builds worlds for Film, TV, Virtual Production and Immersive Experience with extensive experience in the creation of digital models involving large scale building projects not dissimilar to the Murray Bridge facility.

4. 2 Initial file supply

Upon appointment Model Farm were granted wide-ranging access to Revit and CAD files and a comprehensive suite of reference images and videos in order to grasp the enormity of the project and undertake a thorough assessment to the requirements of the project. Additionally multiple stakeholder meetings were conducted between Thomas Foods International and Model Farm to ensure all parties were of a shared understanding as to the requirements and scope of the project.

4.3 Initial White Card Render and Implementation plan

Following the appointment of Model Farm as the external service provider for the creation of the digital twin, Thomas Foods International conducted a series of virtual and in-person meetings to further scope the reach and key deliverables as part of the project. Model Farm conducted extensive file interrogation to determine the sufficiency of the data that had been shared from physical project partners in order to deliver the project.

Thomas Foods International and Model Farm jointly identified gaps in missing data and communicated with external service providers to source missing Navisworks files and to improve Model Farm's understanding of the operating environment of the facility.

Following the collation of all files, Model Farm, in conjunction with key project members from TFI developed an initial white card render of the facility, thereby creating the foundations of the digital twin that would be built upon to create the future working model. Model Farm developers and design engineers began to scale external finishes and further develop 3D white card renders of the external finishes of the processing plant.

Thomas Foods International partnered with external project partners to determine a flight path for the initial 'fly throughs' to follow in order to best identify the areas of focus for the model and to identify which third party experts might need to be interviewed by Model Farm in order to further deliver the project during later milestones.

HR representatives began drafting plans for utilising the finished product for the purposes of attracting and training future employees to the business.

4.4 3D rendering of operating environment and production of initial fixed renders.

Model Farm, Thomas Foods International and Badge (TFI's construction partners) maintained open and extensive communication channels throughout the milestone in order to progress the rendering of a 3D design of the operating environment and accurately replicating the future landscaping surrounding the facility.

At this stage a full day workshop held between Model Farm and TFI managers assisted the model architects understanding of the physical operating environment.

File exchange continued through this stage of the development in order to re-create the geometry of all the equipment inside the physical plant. At this stage, the first fixed renders for use in communication materials were generated.

4.5 Operating Model Completed and working environment replicated

Model Farm successfully completed the creation of the Digital Twin by animating a number of working parts within the facility including, but not limited to:

- Livestock in lairage
- Staff in clerical spaces
- Splitting saw
- Boning room conveyors
- Carton storage retrieval
- Robotic palletising

A virtual replica of such object (digital twin) is based in the cloud computing platform and hosts the real-time physical object data, 2D and 3D models, historical data, and bill of materials (BOM) for further processing, analytics, and visualization.

4.6 Design and construction critique

Throughout the model construction, Model Farm supplied regular flythroughs showcasing the areas delivered. As the detail of the Digital Twin progressed, the utility of the model became increasingly evident as the project team were able to identify clashes in design and also make informed decisions with respect to the design of the facility.

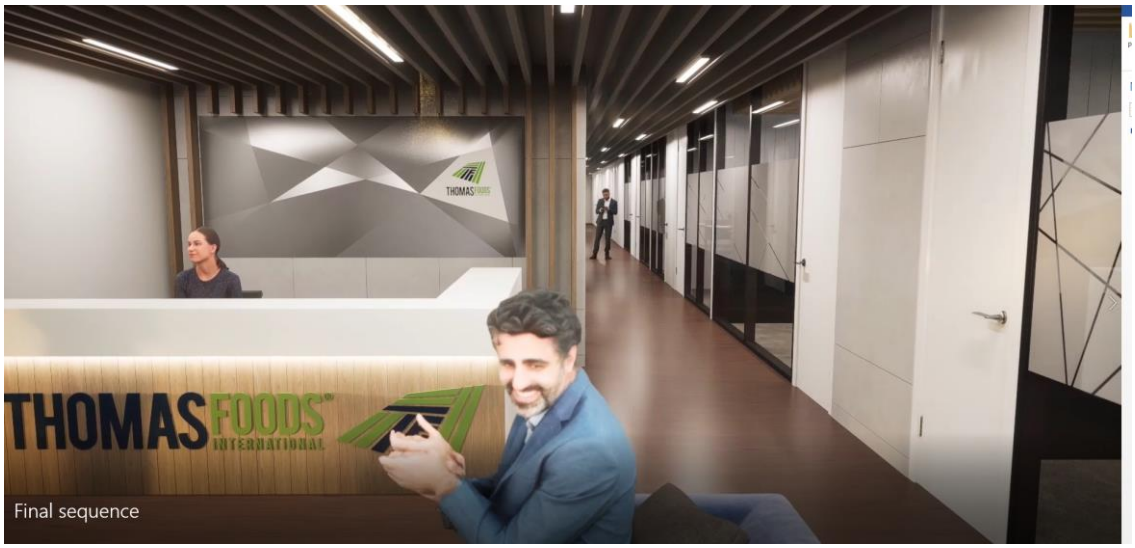
5.0 Project Outcomes

The Digital Twin has been successfully delivered, showcasing the entire facility to a very high standard both internally and externally and has delivered upon the project objectives, even prior to its completion.

• *The delivery of a 3D Rendered Visualisation Digital Twin demonstrating real-life accuracy and replication of the Murray Bridge facility when completed and operating.*

• *Demonstrations and recreations of actual operations and technologies within the plant being applied, and capable of various interrogations via digital demonstrations, covering from lairage through to final load-out and dispatch of a variety of TFI products.*

• *Production of a series of digital photorealistic visuals of the Thomas Foods International (TFI) Murray Bridge development, well before completion, with key deliverables including web-based guided tours, fixed renders for use in 3D fly-throughs, VR environments, augmented reality demonstrations and opportunity for provider remote operation, servicing and fault finding.*



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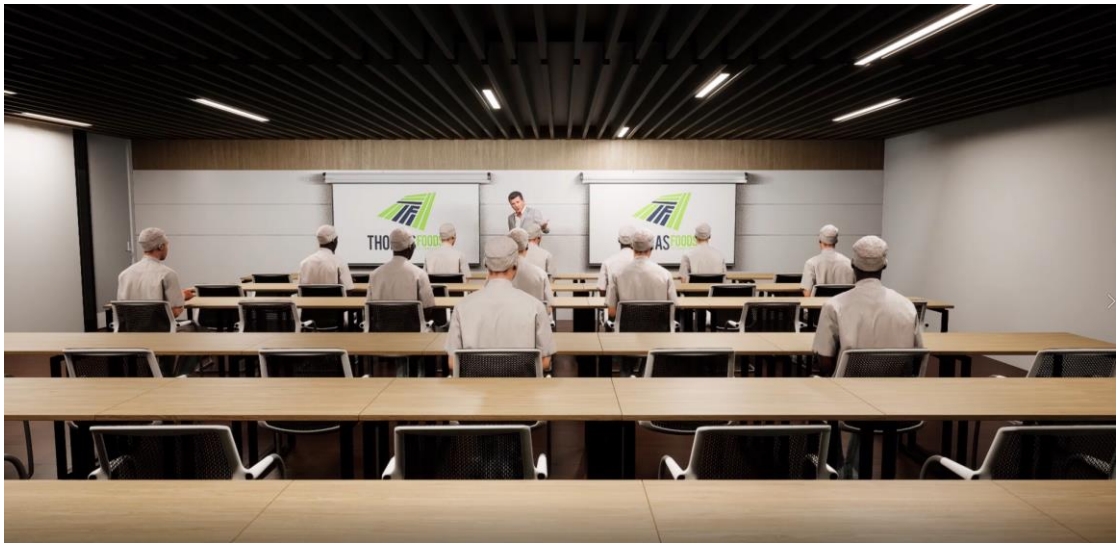


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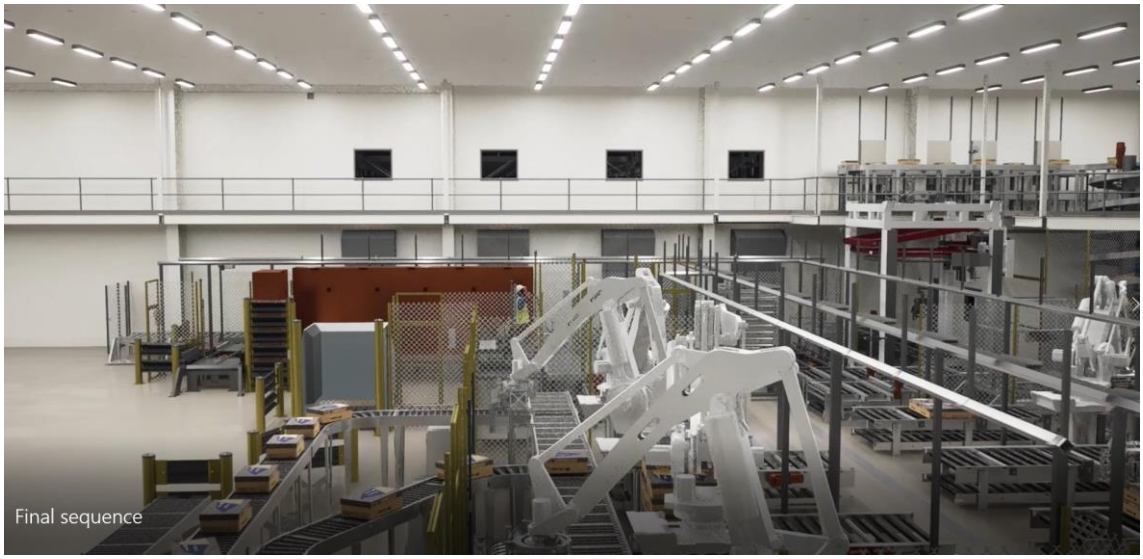
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• *Cost benefit analysis of the application of the 3D Rendered Visualisation Digital Twin and associated technologies, to the planning and construction phases i.e. time and cost savings, risk mitigations, other associated benefits.*

The Digital Twin was built in parallel to the plant being constructed. Given the total budget of a build, investing in the creation of the Digital Twin was an obvious and relatively minor undertaking that assisted to the planning and construction phases in the following ways:

Misalignment in lairage identified

As the Digital Twin was created and multiple layers of the actual designs were paired together, it became apparent that there was a misalignment of the pens and support beams that hold up the roof over the lairage. It has been estimated that if this misalignment had not been identified prior to construction, the cost to remedy has been calculated to be a multi-million dollar repair made up of:

- structural steel requirements
- cladding
- belly wash
- drainage systems
- demolition
- site clearance
- redesign and documentation
- lost time

• *Analysis of the impact the developed communication resources had on attractiveness and draw of new TFI employees to the Murray Bridge project.*

Still renders of the Digital Twin have been used extensively on communication resources to assist in the recruitment of people. The use of these images has allowed TFI to accurately reflect the operational environment for future employees.

- *Analysis of the communication tools and the impact they had on the various Stakeholders they were targeted to.*

TFI has utilised the 3D renders and virtual tours of the finished processing facility on a number of occasions including:

- Community stakeholder events
- Hosting site visits of key stakeholders such as politicians, livestock suppliers and future senior managers during their recruitment

Throughout the development of the Digital Twin, challenges emerged that significantly slowed the development process. Given the unique nature of a meat processing facility, many of the vendors and design partners did not have immediate access to the file types, either at all or to the standard required to accurately deliver the Digital Twin. This complexity and additional requirement were certainly unknown prior to beginning the project and would be seen as a key learning for industry prior to building any additional Digital Twins in the future.

6.0 Discussion

The creation of the Digital Twin would be considered a successful project that has provided extensive value to support the design of the new facility and in TFI's stakeholder engagement process. Despite the resounding success of the project and the ongoing and considerable value the digital Twill will deliver for TFI and industry moving forward, there were a number of challenges that needed to be overcome throughout the development process including:

Developers understanding of the operating environment

Availability of sufficient file types for the developer to remodel

On-Going utility of the Digital Twin

The Digital Twin of the Murray Bridge processing plant will provide extensive value for TFI through to, and beyond completion, of the physical facility.

Stakeholder engagement

The utilisation of the Digital Twin has been highlighted as a key activity in the broader project Stakeholder Engagement plan. Our stakeholder audiences have been categorised as follows, with a brief description as to how the Digital Twin will support:

- Community:
- Government & Industry
- Enablers
- People

- Commercial

7.0 Conclusions / Recommendations

In conclusion, the project would be considered highly successful and TFI will actively consider creating similar virtual productions of future construction projects.

Key learnings of the project that would further improve the utility and efficiency of the project would include:

- The digital service provider having a greater understanding of the operating environment.
- Understanding the file types and detail required by the developer to effectively recreate the model

TFI will continue to rollout the use of high resolution images and various fly throughs to showcase specific areas of the plant in multiple ways throughout the pre and post-commissioning periods of the facility. Mass stakeholder and audience engagement spaces such as the project webpage within the TFI website (https://thomasfoods.com/bigger-better-stronger/) is a critical and high traffic location where these assets are widely utilised. Additionally, TFI has used the high resolution images in the regular stakeholder engagement eNewsletters and social media updates.

As the build of the Murray Bridge facility progresses and evolves over the coming years and decades, TFI will continue to augment the Digital Twin in order to ensure the most current ‘future’ version of the facility is represented by the model.

8.0 Bibliography

N/A

9.0 Appendices

N/a