Industry 4.0 - Evaluation of Digital Twins – Stage 1

Digital Twins – Remote Collaboration - Virtual Reality – Worker Validation and Training – Multi-User Virtual Worlds

Project Code	Prepared by	Date Submitted
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Project Description

The objective of this research was: 'to ascertain the benefits (or not) of the application of a Digital Twin to red meat processing facilities'. There were several wish-list items that were raised by project stakeholders, across three areas: Operations, Planning and Training. Those specifically being:

1) That the Digital Twin could better allow maintenance engineers to isolate and address acute and longer-term issues across the production equipment.
2) The possibility of having an animated twin that is running at the speed of production.
3) That it would allow executive decision-makers to visit the production-floor very quickly and easily (virtually) and be able to have constructive, collaborative conversations about optimisation.
4) That it might be foundational for creating the scenarios and simulations that trainees, and those being re-trained or upskilled, could have a sense of reality-within – while not needing to be in that real-world place.

This would be executed by several trips to project-partner, JBS Brooklyn, where scanning of 3 rooms would be conducted, along with 3D photogrammetry, and these scans would form the basis of the 'Digital Twin'

Project Content

We travelled to Melbourne, to JBS Brooklyn, with a Leica BLK360 - which is a LIDAR scanner which is designed for smaller spaces. The first space we worked on was Boning Room 3. We very quickly learned it would be a very big scanning task to ensure we got into every nook and cranny of the room. All-up, the scan took almost 11 hours, to gather spatial data from almost 80 locations. When processed the data through Leica's Cyclone Register Software, we were (at first) disappointed with the results. As suspected, the reflective metal surfaces in the Boning Room 3 and the Offal room made the laser data quite scattered and this caused the model to be of a poorer quality than we hoped.

That said, when we viewed the room in panorama mode, we could still do things like make highly accurate measurements point-to-point – but the visual quality was very high. Even in full 3D mode however, and despite the imperfections, the model was very useful for measuring and annotating with notes (which we could allocate to someone as a task). We subsequently suggested to the AMPC and JBS that we omit the scanning of Boning Room 1 and instead, go back to JBS Brooklyn during full production, and use our very hi-fidelity Insta 360 Pro One-Inch camera to 360 video-capture a number of locations across Boning Room 3 and the Offal Room so that we could connect it to the Virtual Reality static environment. The shoot was a success. \

We uploaded this all to our secure virtual cloud where it combined with our interaction and avatar systems so that anyone, anywhere can join the scene and interact + talk with anyone else who is there, wherever in the world they are located. The beauty of the system is that this can be done in:

1) a browser on a PC, or
2) in a tethered headset like VIVE Pro or Varjo, or
3) in an untethered headset like Meta Quest Pro, VIVE Focus 3 or Lenovo Thinkreality VRX.

The outputs were, therefore:

- An online Digital Twin viewing-tool of Boning Room 3 and the Offal Room that anyone (permissioned) can access to visualise, annotate and spatially task-allocate, measure, 3D clip, replace and export to any game engine or other 3D platform.

- A secure, immersive, 3D modelled real-time VR experience that up to 12 people can visit together (wherever they are in the world) and can click-through to hi-fidelity 360 videos, within which they can collaborate while they are closer to the 'production-action' than anyone could physically, practically get-to in the real-world.

- What is effectively a near-commercially-deployable role-qualifier for potential industry-hires, to ascertain whether they wish to proceed and be trained for weeks, knowing (now) exactly what their role will involve once they are put to work, which reduces the attrition rate and consequently, wasted training time + cost.

Project Outcome

The Digital Twin that we were able to produce has a number very powerful, immediate benefits and utilities otherwise, including:

1) The ability to navigate through the space in photo-real panorama-mode, while collaborating with remote viewers. This is an ideal way to showcase partners the facility, but also 3rd party consultants and vendors who might want to view and advise on new equipment, better processes etc – without getting in the way of production.

2) The ability to accurately measure-up anything within the twin, precise point to point, without having to get on the production-floor with a tape measure. The measurements can be very advanced and 3D volumetric, even.

3) Despite the meshed 3D spatial twin being quite rough due to the reflectivity, equipment and infrastructure can be clip-boxed and 'removed' from the plant floor, and a 3D model of a new piece of equipment (from a 3rd party vendor for example) can be uploaded and placed in-situ, whereby it's suitability and logistical compatibility can be visually and spatially checked.

4) Any item within the twin can be annotated as a task or point of follow-up and allocated to a particular worker. That worker can then access the twin, via the browser, on a ruggedised tablet in the plant and, by clicking on the task, will be visually and spatially 'zoomed-to' so the worker or his/her supervisor can understand exactly where to go, and can complete the work quickly and efficiently. The completion of tasks can then be marked-off and viewed by other stakeholders. This is an extraordinarily powerful tool, which spatially anchors and records current + historical asset data which very quickly visualises what is required to be done physically, in that space.

5) The 3D model can be downloaded across a wide range of file formats, and then used by 3D modellers, such as those on the Virtual Method team, to create well-surfaced models and animations of any part of the facility, as we did with the trimming station in Boning Room 3. And *that* model can form the spatially accurate 3D basis of any VR training, learning and development requirement so that the simulation of performing tasks is done in the true-to-life facility.

In addition, the Multi-User VR environment with 360 videos worked very well and all project stakeholders were given access to collaborate virtually in this room at any time through PC or VR.

Benefit for Industry

For the Australian Meat Processing industry, the outcomes of this project represent an affordable and powerful way for any facility to establish all the infrastructure that is needed to create immediate value and ROI through:

1) **Scalability + Affordability** - through empowered DIY Digital Twin creation.
2) **Multiple Utilities** – the raw point-cloud can be used across many other utilities into the future – including Microsoft Mesh and Azure Spatial anchors which will allow wayfinding and AR-anchored content in the next generation of AR glasses.
3) **Future-proofing** – as the Twin can be hosted both in the Prevu3D cloud (NVIDIA Omniverse-powered) – but also in UNITY3D (or you could export and download a 3D format and store in your own, secure cloud)
4) **Accessibility** – our virtual environment works across a very wide range of devices and interfaces, from PC screens to tablets/phones and a broad selection of tethered and untethered VR head-mounted-displays, giving industry stakeholders a wide range of choice.
5) **Inclusion** – our multi-user VR environment allows stakeholders from every aspect of meat process value-creation to join-together and collaborate in highly contextual virtual worlds, from wherever they are geolocated on the planet, and have round about 5MB/s (up/down) of connectivity or more.
6) **Cybersecurity** – our system is globally certified and used by organisations involved in operations-critical 'sovereign security' around the world, and has all the time, diligence and certifications invested in it to ensure this is the case.
7) **Training** – the Digital Twin creation, multi-user collaboration enablement and turnkey deep LMS integration represents and exceeds the minimum requirement for a truly scalable world-class VR onboarding and Training program.

Useful resources

- https://www.digitaltwinconsortium.org/
- https://aerometrex.com.au/resources/projects/pau/
- https://youtu.be/qVdylBoQTaI
- https://youtu.be/CvYEhSOm4sk