Remote Operations (Gamification)

Final Report

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1.0 Executive Summary

The primary objective is to produce a successful training method to enable operational staff to be more effective when operating a beef scribing saw.

There are two high level goals to be addressed:

1. Short term - Improving output quality from staff through training resulting in greater yields.
2. Long term - Improving safety through increased staff competence and process automation.

The short-term goal can be achieved through creating a learning and engagement tool that addresses current staff competency levels by delivering an engaging game style that is compelling for users and teaches them to scribe accurately at production level throughput.

Using the learning-based approach as a natural pathway to automation we can achieve the long-term goal of automation by taking advantage of the learnings and development that the application provides.

The following points were considered for the project approach and methodology.

- ◆ Learning outcomes
- ◆ Workplace health and safety
- ◆ User experience
- ◆ Gamification

The methodology chosen was in 3 parts with the later addition of the game. The first 3 parts are:

1. Show
2. Practice
3. Try

1. **Show**

    Have a video as part of the learning environment that allows the user to:
    - ▪ View the whole process from start to finish.
    - ▪ Scrub the timeline to watch/re-watch different parts of the video.

2. **Practice**
    - ▪ Allow the user to practice in a free environment that allows them to learn each step at their own pace.
    - ▪ Have the video available to aid their learning.

3. **Try**

    Once the user feels confident to attempt the process in full, they can do so with minimal (by displaying the steps) help. They must complete the exercise in the correct order then receive visual feedback on their performance.

Gamification

This is taking what they have learnt in the previous stages i.e., how and where to scribe correctly, then increase participation by making the learning experience fun and engaging with an element of competition.

As the project progressed the Try stage was superseded by the implementation of the game.

2.0 Introduction

The Australian Meat Processor Corporation's (**AMPC**) strategic plan has Advanced Manufacturing as one of the Core investment themes. A consistent theme through this component of the strategy is making operations more efficient whilst also improving WHS for operational staff.

One way to address both is through relocating operational staff from hands-on operations on the 'shop floor' to console operators, either on the floor or in control rooms. One day this may even extend to operational staff operating remote from a processor's site.

Gamification, and the enablers behind gamification are just one of the paths AMPC is pursuing to realise this aspirational vision for the future of meat processing within Australia.

3.0 Project Objectives

The primary goal for the innovation theme is a successful development(s) to enable operational staff to undertake beef scribing without having to hold onto the beef scribing saw, it is expected that all stages keep in mind both the primary and secondary goals in the context of the seven (7) strategic plan touch points, which are:

1. Removing staff from dangerous operations, via Hands-Off processing (Adv. Mft.),
2. Carcase Primal Profitability Optimisation, via accurate processing (Adv. Mft.)
3. Digitisation, via acquiring product information and leveraging data insights (Adv. Mft.),
4. Attraction, via demonstration and developing a wide range of operations (People & Culture),
5. Retention, via improving working conditions and making tasks exciting (People & Culture),
6. Development, via developing tasks that require higher skills and intellect – operational & technical
7. (People & Culture).
8. Safety and Wellbeing, via reducing the high-risk nature of processing operations (People &
9. Culture), are all foci of AMPC, and that this one innovation theme will aim to make a significant
10. impact upon all seven.

For the primary goal to be realised, timely and accurate cut locations need to be established for remote operations to be realised.

An ideal outcome is that the offering morphs into an engaging game that is compelling for industry and non-industry 'gamers' alike to immerse themselves in and almost forget that they are undertaking a beef scribing activity and focus on beating both their own accuracy/time scores and that of others.

4.0 Methodology

Our approach is to develop a windows-based proof of concept using the Unity3D platform. This extends the solution into web based or VR based experiences by using the same code base.

The following points were considered for the project approach and methodology.

◆ Learning outcomes - Accuracy and productivity are key measures that Company-X considered for proposed applications and these KPIs can be used to measure the success of the solution.

◆ Workplace health and safety - WHS is also considered to reduce health and safety incidents and make a safe environment to learn. In the long term, these applications will be supported to enable remote operations as well.

◆ User experience - UX is one of the key elements that Company-X has considered to enhance the usability of proposed application.

◆ Gamification - Number of gamification techniques will be used to enhance the user engagement.

◆ As well as the opportunity to evaluate possible training/production techniques there is also the opportunity to assess which platform(s) are best to deliver the app.

◆ As the app will be developed in Unity3D the core functionality will be the same for every platform, so in relation to interface design this can be adjusted without major impact if it is decided to use a different delivery method thus ensuring greater flexibility to change and faster iteration times.

For early-stage development we prioritised a windows desktop app for the following reasons:

◆ Benefits of the UI designs can be assessed using a functional Proof of Concept.

◆ Familiarity of users with desktop applications meaning less user resistance to a new application.

◆ No cross-browser compatibility related or performance issues.

◆ Can run offline without internet.

◆ No technology constraints such as hardware (e.g. VR headsets) therefore increasing portability to other users/testers in the early stages.

It was decided to leave VR as a future solution at this point for the following reasons:

◆ There is a certain level of friction when it comes to using a new technology such as VR. Our experience has been that it takes time for new users to acclimatise, and this can hinder the early-stage solution assessment process.

◆ We would intend to bring VR in a little later in the learning process after the user has been through the windows/web app. So, in effect it can be seen as the "practical" part of the learning.

The methodology chosen was in 3 parts with the later addition of the game. The first 3 parts are:

1. Show
2. Practice
3. Try

1. Show

Have a video as part of the learning environment that allows the user to:

- View the whole process from start to finish.
- Scrub the timeline to watch/re-watch different parts of the video.

2. Practice

- Allow the user to practice in a free environment that allows them to learn each step at their own pace.
- Have the video available to aid their learning.

3. Try

- Once the user feels confident to attempt the process in full, they can do so with minimal (by displaying the steps) help. They must complete the exercise in the correct order then receive visual feedback on their performance.

The user is in control of their learning process so they can move between the different tools i.e., video and practice area, at their discretion but structure is provided (in the Try option) by enforcing the correct steps, that will enable them to learn best practice.

Gamification

This is taking what they have learnt in the previous stages i.e., how, and where to scribe correctly, then increase participation by making the learning experience fun and engaging with an element of competition. The thinking here is that if it is fun, engaging then that will increase participation thereby achieving the goal of increasing accuracy but in a time constrained environment as found on the shop floor.

The main features are:

- Time constraints

    - Difficulty levels
        - Novice = 30 seconds per carcass
        - Intermediate = 20 seconds per carcass
        - Expert = 6 seconds per carcass
    - Game time default = 90 seconds
    - User determined – the faster they are the more images they get

- Performance and Accuracy

	Assessment	Points
Accuracy	Start Point of cut 1	10
	Cutline <= 5mm	10
	>5mm - <= 10mm	5

- Interface content

  - Countdown timer
    - This is the game duration counting down to zero
  - Carcasses processed
  - Bonuses achieved (maximum of 3 per game)
  - Average time spent on each carcass.

- Bonus

  - Every time 3 carcasses are correctly processed in a row an extra 10 bonus seconds are added to the game duration.
  - Maximum of 3 bonuses per game.

- Scorecard and Leaderboard

  - Average accuracy
  - Points
  - Ranking – Novice, Experienced, Expert
  - Achieved at predetermined points levels

- Scoring system

  - Based on accuracy and performance
  - Each cutline is assessed and scored

5.0 Project Outcomes

◆ Show, Practice and Try functionality was achieved that met the requirements detailed in the methodology. While still at a proof-of-concept stage there was enough positive response from internal users to suggest that value was being realised.

◆ While the structure of the learning proved successful there were certain usability issues when it came to the carcass images that were problematic.

◆ From limited user testing the game itself was very popular and even at this early stage engaged the testers and met anticipated outcomes.

◆ Some testers used a pen and tablet, which was not anticipated but did enhance the usability and the effectiveness of the application.

◆ The game was developed last in the cycle due to the practicalities of ensuring basic form and function of the app before gamifying the learning and as the project progressed it became an intrinsic part of the learning process that increased engagement and thereby increasing the user's knowledge and skill regarding the process.

◆ The addition of the gaming function supplanted the need for the 'Try' part so this was removed from the app.

6.0 Conclusions / Recommendations

Conclusions

◆ It is felt that the methodology did meet expectations as an effective learning experience.

◆ There were several areas with regards to the user interface and subsequently the user experience that went through several iterations. The need for a better way to make the carcass bigger so it is easier to recognise ribs and place cutlines is needed.

◆ Delivering as a windows app was not the best platform due to screen resolution issues experienced so we settled on a web application that is delivered via browser. This also simplified and sped up the release of updates.

◆ The images that were used created issues regarding the accuracy of the scribe due to not being able to define the exact size of each carcass. Without a way to calculate the actual size of each carcass it was problematic in calculating accuracy. This is solvable by having a ruler in the image with the carcass thus providing a scale to measure from.

◆ We would intend to bring VR in a little later in the learning process after the user has been through the web app. So, in effect it can be seen as the "practical" part of the learning.
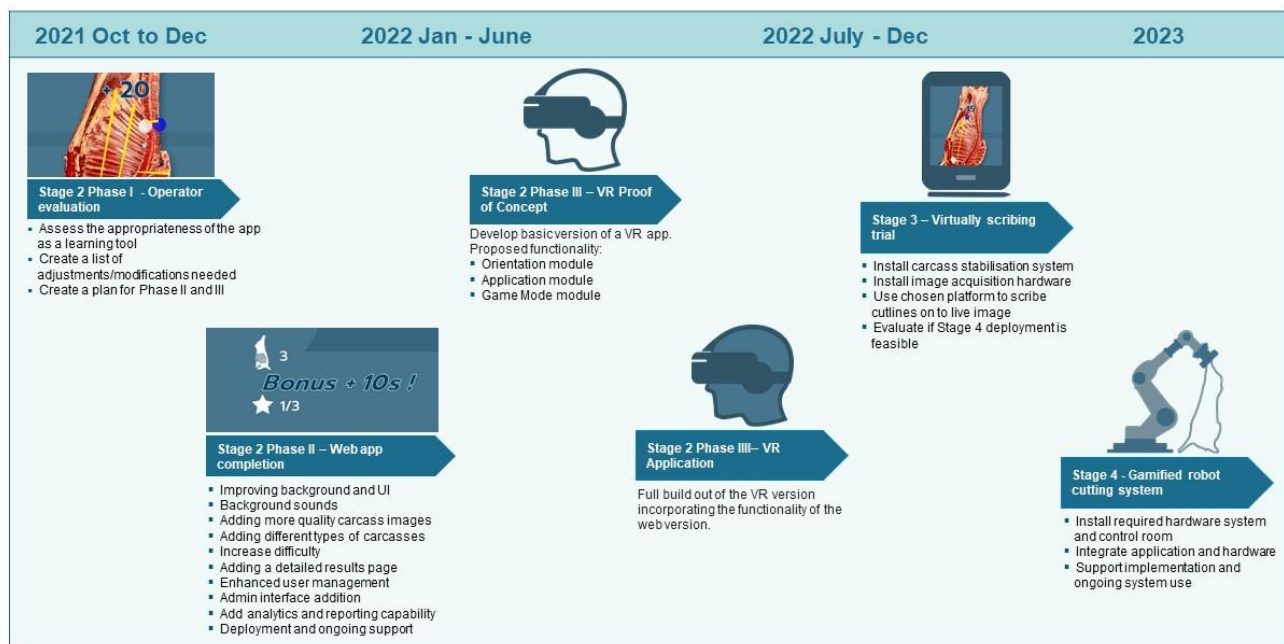
Recommendations

◆ Improving background and UI to provide more of a feel for the real world.
◆ Background sounds.
◆ Adding more quality carcass images.

- With properly scaled carcasses the target points can be accurately defined.
- Adding different types of Carcasses especially with a curved spine.
- Increase the difficulty by adding images with fat and blood.
- Adding a detailed results page.
- Enhanced user management to allow for storing of an individual's scribing performance to enable greater learning management.
- Introduce an admin interface to manage the configuration of the application. For example, adjust game time or bonus criteria.
- Add analytics and reporting capability.

7.0 Future roadmap

High-Level Roadmap

Stage 2 Phase I – Operator evaluation

Evaluate the app with a user group to obtain feedback on the user experience.

The objectives of this testing phase will be:

- Assess the appropriateness of the app as a learning tool.
- Create a list of adjustments/modifications needed.
- Create a plan for Phase II and III.

Time and materiel estimated cost: AUD $9,500.00

Stage 2 Phase II – Web app completion

- ◆ Improving background and UI to provide more of a feel for the real world.
- ◆ Background sounds.
- ◆ Adding more quality carcass images.
- ◆ With properly scaled carcasses the target points can be accurately defined.
- ◆ Adding different types of Carcasses especially with a curved spine.
- ◆ Increase the difficulty by adding images with fat and blood.
- ◆ Adding a detailed results page.
- ◆ Enhanced user management to allow for storing of an individual's scribing performance to enable greater learning management.
- ◆ Introduce an admin interface to manage the configuration of the application. For example, adjust game time or bonus criteria.
- ◆ Add analytics and reporting capability.
- ◆ Implement this version of the app into selected sites to gain operator feedback.

Time and materiel estimated cost: AUD $65,000.00

Stage 2 Phase III – VR Proof of Concept

We envisage that there is a solid case to have both VR and web-based applications which comprise of a 3-part learning process:

1. Theoretical - Web app.
2. Virtual – Virtual reality.
3. Practical – On the floor training.

Using the web app as a foundation, we will create a VR version of the app. Initially, this will be a basic implementation to assess user engagement for VR vs web app.

It will be made up of 3 parts:

- ◆ Orientation – This will be where a trainee will be come accustomed to the VR experience and learn how to operate in the environment.
- ◆ Application – Once acclimatised the trainee can then practice scribing a carcass at their own pace.
- ◆ Game Mode – This will be a simplified version of the game mode found in the web app.

After user feedback and testing an assessment will be made on whether to carry on to Phase IIII or move forward to Stage 3.

Time and materiel estimated cost: AUD $54,000.00

Stage 2 Phase IIII – VR Application

If the trial is successful, then we will build out the VR app to be a fully functional experience.

At the end of Stage 2 a decision can be made as to the preferred system to use for Stage 3. Keeping in mind our 3-part learning process, this can be either the web app, the VR app or even combining both platforms as a final solution.

Not possible to estimate costs at this stage.

Stage 3 – Virtual Scribing

1. Install carcass stabilisation system.
2. Install camera image acquisition hardware installed.
3. Using the chosen platform (web app or VR) as a foundation to facilitate scribing the cutlines on to a live image.
4. A trial will be implemented to evaluate the users as they virtually scribe the carcasses.
5. Evaluate if Stage 4 deployment is feasible.

Not possible to estimate costs at this stage.

Stage 4 – Implement gamification enabled robot cutting system

1. Install required cutting system and control room for operational staff.
2. Integrate the application with the hardware.
3. Support the implementation and ongoing use of the system.

Note: Separate programs may be developed once results from this trial are assessed.

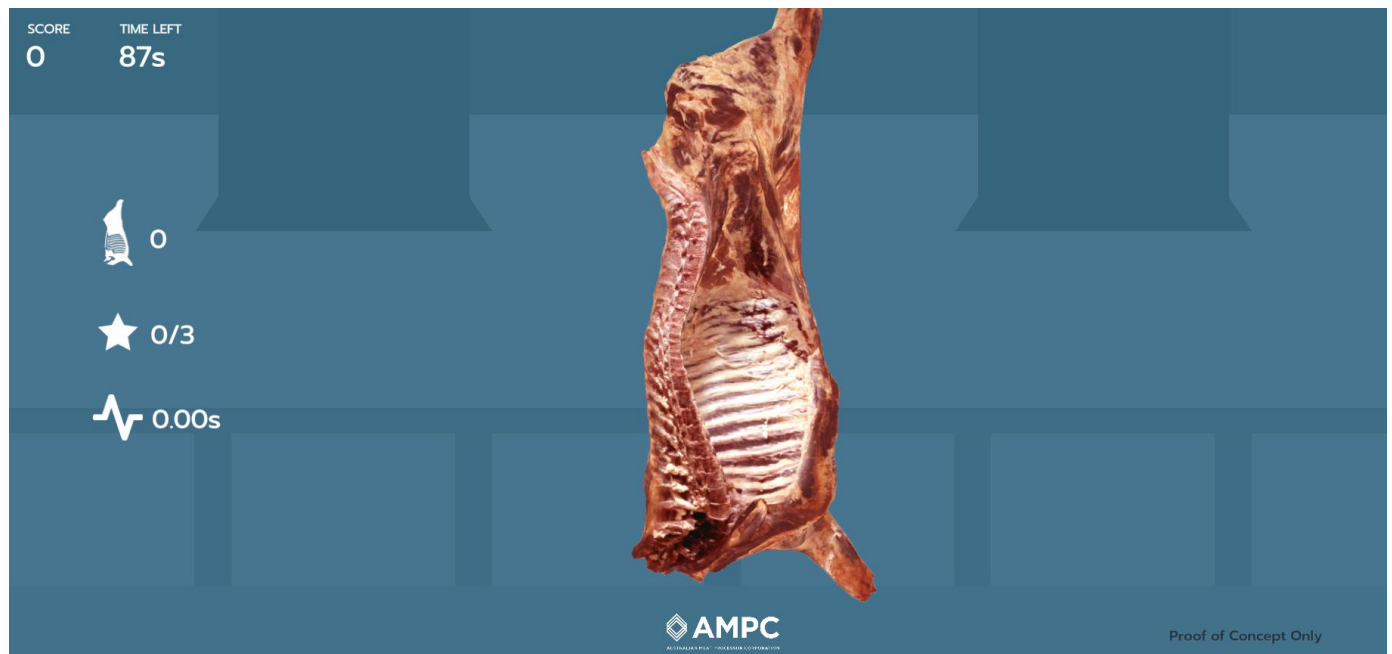Not possible to estimate costs at this stage.

Stage 5 – Adoption

◆ Using the PIP model for early adopters, we would support the implementation and ongoing development of the system.
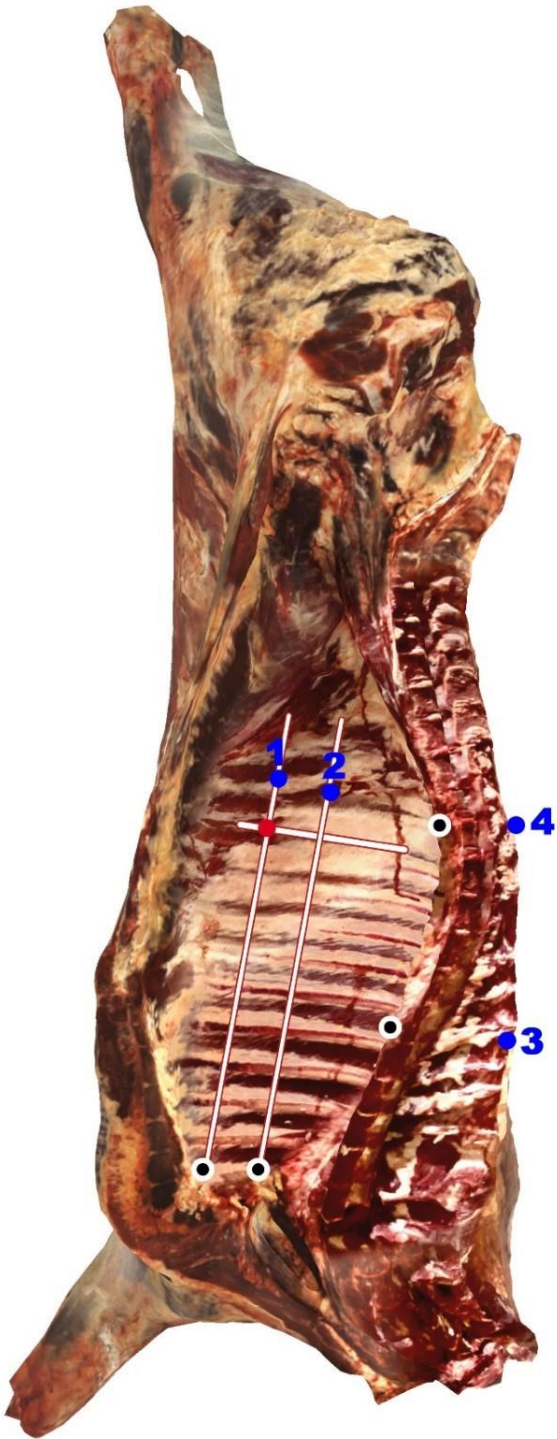◆ Support further development of previously identified end use cases.

Not possible to estimate costs at this stage.

8.0 Appendices

8.1 Current Game Interface

8.2 Start and End Target Points

Key

Blue = Start points
Black/White = Target points
Red = Rib 11/Diaphragm intersection