final report

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Beef Heavy Bone Saw – Ex-works

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Executive Summary

Many portioning tasks, such as portioning beef hindquarter shanks into Osso Bucco, require bandsaw operators to conduct rapid cuts with the their hands in close proximity to the bandsaw blade. The Beef Heavy Bone Saw (BHBS) has been designed to semi-automate the Osso Bucco portioning process, with the aim of reducing the hazards associated with the task, improving product dimensional consistency and maintaining a consistent throughput.

The BHBS has built on learnings from an earlier Osso Bucco machine developed by NS Innovations. This earlier Osso Bucco machine never progressed beyond the testing and development phase. The design and build of the BHBS was completed successfully and factory acceptance trials, including limited in-factory product testing, have been concluded. The testing indicated that there remain some opportunities to fine tune the operation of the BHBS and some of these have already been implemented. The BHBS can be tested more rigorously (volume and variability of product) during full scale production tests at a processing site.

The Beef Heavy Bone Saw is able to eliminate many of the risks associated with manual bandsaw portioning of Osso Bucco. With further development the unit will continue to improve in product presentation, dimensional consistency and throughput. Additionally, given the flexibility designed into the machine, there are opportunities for the technology to be adapted to conduct other portioning processes in the future.

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1 Background

This project took learnings from previous Osso Bucco processing projects (P.PIP.0273 and P.PSH.0522) to develop a multipurpose semi-automated Beef Heavy Bone Saw.

From 2010-2013 NS Innovations (NCMC and Scott Technology) commenced the development of an Osso Bucco saw for use at NCMC and ultimately global commercialisation. At the conclusion of that development work, all agreed that although a commercial solution was not developed (due to technical constraints of the hardware available at the time), the concept still had merit for the following reasons:

- the concept could be extended to other heavy beef bone processing tasks
- reduced the number of labour units required for the task, and moved remaining labour units away from the saw blade
- increased yield
- improved product presentation.

Northern Cooperative Meat Company (NCMC) [and others] currently engage dedicated trained operators to cut the hind shanks of a beef carcase into a product known as "Osso Bucco", consisting of circular sections measuring between 25 mm and 30 mm. This is a manually performed, arduous task, requiring high levels of accuracy to maximise yield. This process is labour intensive, process flow inhibiting and is an area of extreme OH&S risk.

The production of Osso Bucco currently utilises a standard bandsaw which has inherent OH&S risks. There are additional challenges with this process such as the dimensional variability and slipperiness of the beef shank, coupled with the need for intricate manipulation of the product resulting in the operator’s hands regularly coming very close to the bandsaw blade.

Every known commercial cutting equipment supplier (AEW Deltord. Triet, Jarvis, FSA, MLA, Scanvaegt, CBS, FPS, Freund) was approached to determine whether any suitable or easily adaptable equipment currently exists that could perform this task. In parallel to this research of existing equipment, consultations with mechatronics/electrical service providers have also been undertaken with no commercially available solution identified.

Semi-automating this process would preserve product value through consistency in product dimensions and presentation, eliminate an extreme OH&S risk bandsaw task and stabilize product throughput.

2 Project Objectives

The following objectives were set out for this project.

- Develop a “refined” working production prototype that is production stable and ready for site trialling and further evaluation.
- Identify and explore potential applications of the resulting technology to products other than Osso Bucco.
- Develop concepts for automated loading of shank and removal of Osso Bucco Parts as a subsequent future development stage opportunity.
- At the conclusion of this project it is expected that NCMC will be the host site for the installation of the above unit.

3 Methodology

3.1 Design and Build

The design of the BHBS was based off of knowledge gained through earlier Osso Bucco saw projects. Servo driven part motion technology was incorporated into this latest system that will allow for more precise customisation of the processing cycle. This should allow the machine cycle to be fine-tuned and even adapted to other portioning tasks in the future.

Figure 1: Beef Heavy Bone Saw control station and product loading port

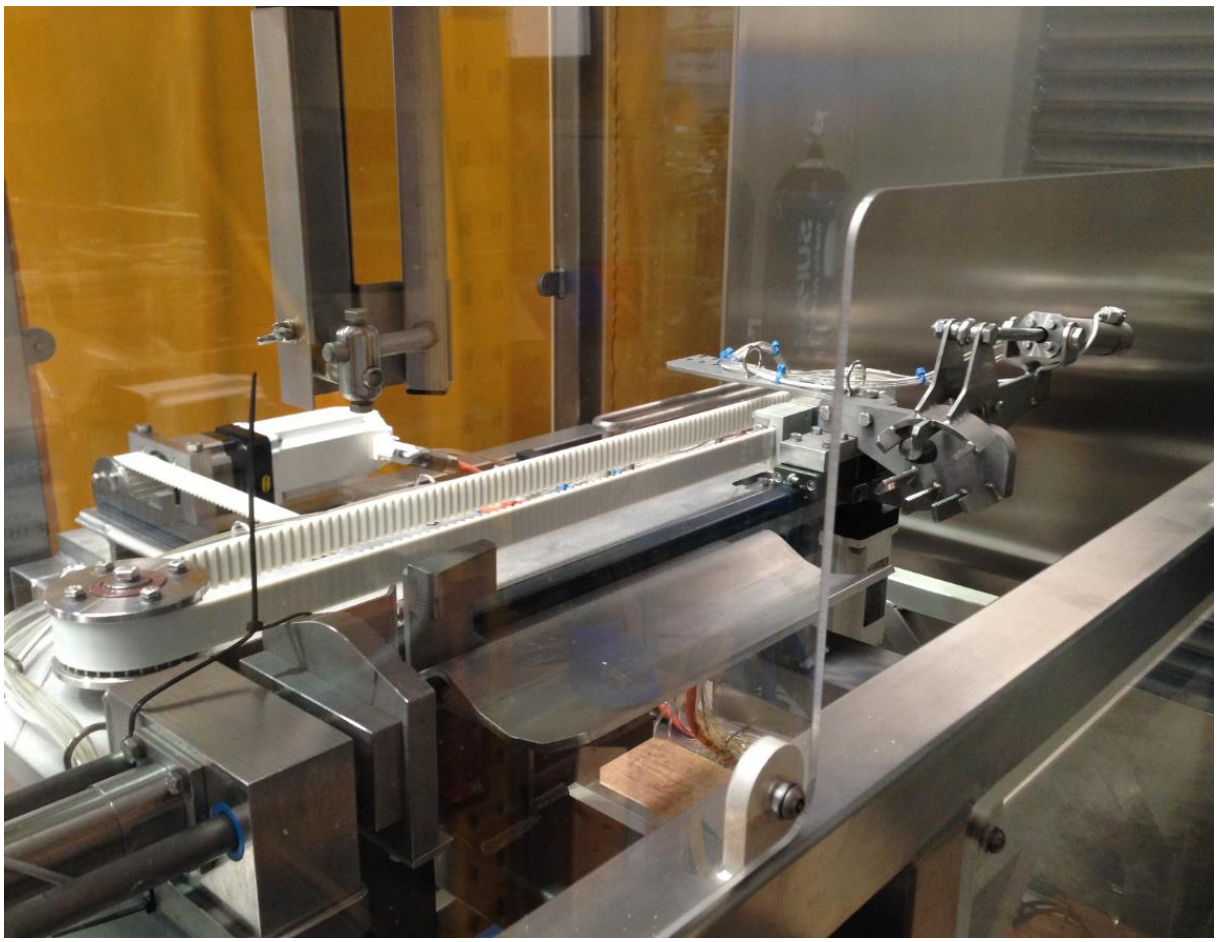

Figure 2: Beef Heavy Bone Saw product cradle, clamp, stabilisation, ejection and cycle mechanisms.

3.2 Factory Acceptance Trials

3.2.1 Testing New Zealand Product

The BHBS was subjected to a series of processing tests using New Zealand product. The unit was successfully able to portion beef hindquarter shanks into Osso Bucco, as can be seen in the “Beef Heavy Bone Saw FAT in NZ” video. Following these successful tests the unit was shipped to Australia for demonstration to MLA and NCMC.

3.2.2 Testing Australian Product

The BHBS has been tested at the Scott Sydney workshop, producing Osso Bucco from beef hindquarter shanks. Early results were mixed with product rigidity and stability impacting on the quality of the cuts being produced. Critically, blade speed reduction during the cut (of up to 50%) was identified as a contributor to poor cut quality. The original bandsaw motor was upsized, this also required the upsizing of the VSD, dynamic breaking resistor, bandsaw pulleys and bandsaw motor enclosure. Subsequent FATs confirmed that the blade speed reduction issue had been corrected. Additional testing should be conducted at a processing site where access to large quantities of properly chilled product will allow for many more parts and variations of product to be tested. Only then will the true performance of the machine be assessable and opportunities for further improvements identified.

Figure 3: Beef Heavy Bone Saw with product loaded ready for processing during factory acceptance trials

Figure 4: Osso Bucco medallions produced by the Beef Heavy Bone Saw

4 Results

Factory acceptance testing conducted at the Scott Sydney workshop revealed that the cutting cycle would sometimes have to be halted in order to clear a poorly ejected Osso Bucco portions/medallions. Additionally, further testing is required to correct blade deflection which in some cases can result in a failed cut. With further product testing, mechanical modifications and cycle optimisation the BHBS will be able to conduct its process more reliably, produce portions with higher dimensional consistency and visual quality and will also improve in overall processing speed/throughput. The BHBS can be see processing Osso Bucco in the “Beef Heavy Bone Saw FAT in AU” video. Currently the BHBS can process approximately 120 parts per hour, assuming 10 cuts per part.

5 Discussion

5.1 Limitations of factory testing

The variation in performance between the machine during FATs at NZ and then in Australia could be the result of product variation. These variations include:

- overall product length, shape and rigidity,
- bone density, thickness and shape,
- protein rigidity and distribution,
- sinew (including silver skin) location, texture and behaviour during cutting.

The project may have been streamlined if the BHBS was tested on a wider range of beef hindquarter product before it left the factory. However, it is somewhat impractical to supply large samples of product (numbering in the hundreds) to a machine/workshop. Therefore, the current method of in production testing at a processor site, followed by evaluation and if necessary modification, seems to be the most viable.

5.2 Automated loading and unloading of product

Attempts have been made to develop a mechanical product loading system for Osso Bucco machines. However, the end result has always been that an operator still has to load the loading machine and give instructions on where to start and end the cuts along the length of the shank. Given the rapidly improving capabilities (and falling prices) of robotic handling technologies coupled with Scott's ever increasing expertise in this field, it would seem inevitable that the first practical and cost effective solution in this space would be a fully robotic system that picks the shank from the belt, determines the ideal cutting locations (most likely by comparing the overall shape of the part against thousands of previous attempts), then loads the part into a purpose built BHBS in the ideal orientation. An example of a comparable process (but different product) already taking advantage of this type of technology would be the "LEAP 5 Automated Lamb Forequarter Boning System".

Figure 5: LEAP 5 system utilizing laser topography to determine product shape and the ideal cutting locations

5.3 Processing product other than Osso Bucco

The BHBS has the potential to be re-tasked for other portioning tasks. The complexity of the modifications required to perform other portioning tasks depends on the portioning tasks being considered. For example, modifications to process venison shanks would presumably be relatively simple, whereas portioning lamb shoulder steaks would require significant modifications to the cradle and clamp. Conceivably and perhaps ideally, future versions of the machine would have modular components that would allow a single system to be adaptable to a number of portioning tasks. This would afford processors additional flexibility and ensure the machine is never underutilised. The product handling mechanisms of the BHBS are based on servo driven part motion technology which affords the adaptability required to accommodate for other portioning tasks.

6 Conclusions/Recommendations

The semi-automated Beef Heavy Bone Saw (BHBS) has been designed to replace the task of manual portioning of Osso Bucco on a bandsaw, a task with unacceptably high risk of injury.

The BHBS does require some fine tuning to improve its cycle reliability, product presentation and increase its throughput rate. As with other development projects, the best environment to isolate opportunities for improvement will be while processing hundreds of product on a processing site.

It is therefore recommended that the Beef Heavy Bone Saw be permitted to be sent to a processor site so that full production tests can be conducted.

7 Appendix

7.1 Appendix 1

Video – “Beef Heavy Bone Saw FAT in NZ”

7.2 Appendix 2

Video – “Beef Heavy Bone Saw FAT in AU 01”

7.3 Appendix 3

Video – “Beef Heavy Bone Saw FAT in AU 02”

7.4 Appendix 4

Video – “Beef Heavy Bone Saw FAT in AU 03”