AUSTRALIAN MEAT PROCESSOR CORPORATION

A Feasibility Study and provisional Business Case to assess the scope and potential for establishing and operating a world class Red Meat Processing Innovation Centre of Excellence in Australia

Project code:	2014/1031
Prepared by:	Edwina Toohey, Dr Derek Baker, Dr John Rice and Dr David Hopkins
Date Submitted:	26th August 2015
Date Published:	June 2016

Executive Summary

A major challenge in any industry is to facilitate the innovation process or translation of research into commercial outcomes. The goal of this project was to determine the feasibility of establishing a Red Meat Processing Innovation Centre of Excellence within Australia and identify what form and function it might take.

To address the goal a comprehensive understanding of processing companies' perceptions of risk and uncertainty around implementation of new technology and drivers that influence adoption and implementation of new technology was assembled. Also it was established what the role of a Red Meat Processing Innovation Centre of Excellence in Australia might be and what is needed to gain support for the establishment of any such centre. This was achieved through the analysis of an extensive national industry consultation process. Secondly a review of national and international processing technology and development companies was undertaken which included the uptake of technology. Thirdly a thorough understanding of previous and current research Centre's to fully understand what has driven successful innovation and what hasn't was established. To achieve this, a review of relevant Centre's was carried out. Fourthly, based on the outcomes from the national industry consultation and the literature a value chain analysis of issues around the viability of a potential Centre of Excellence was undertaken. This report discusses the viability of different potential models for a Red Meat Processing Innovation Centre of Excellence and provides recommendations around the feasibility of a potential Red Meat Processing Innovation Centre of Excellence within Australia.

Outcomes from the national industry processor consultation showed that **the key perceptions of risk and uncertainty (barriers)** around the implementation of new technology were identified as; reliability of technology, access to support, loss of production during installation, cost, retention of skilled staff and finance (which was dependent of innovation been funded predominately by profits or industry funds).

The **key drivers** to innovation were identified as; labour costs, energy costs, consumable costs, upper level management, slaughter chain and boning productivity, increased processing efficiency by minimising overall labour costs, contamination on chain, product loss on chain/boning/chilling), maximising product quality, productivity per worker, optimising whole carcase, increasing potential number of markets, product quality (food safety, shelf life, visual quality, eating quality), regulation (WH&S, animal welfare, food safety, environmental sustainability, HR). These results are not surprising and are supportive of other recent work.

One of the most important outcomes from this study is the understanding of what industry believes the **key roles** of a potential Red Meat Processing Innovation Centre of Excellence should be, which included; technology development, technology evaluation, industry demonstration, meat processing and meat science research, library database, education and training (industry/students). Other key considerations included; information sharing, extension, accessibility to all (location suitability) and collaborative rather than duplication.

There was significant **support** for the concept of a Centre. It appeared that there was less support for a physical structure (due to the legacy of Fututech). The majority of companies would prefer to mitigate risk of new technology through demonstration of technologies within a commercial

plant compared to within a Centre (this largely reflects a strong desire to see technologies under commercial conditions). The Centre would need to foster the development of new technologies (engineering, evaluation, pilot testing and concept evaluation) and would need to be both visionary and applied. Industry is also highly supportive of a collaborative approach.

The review of national and international processing technology development companies, new product development and the introduction of technology to industry showed that the market within Australia is relatively small scale. There is consolidation of Australian companies working in this space and there are a range of companies that develop technology, from slaughter line and boning robotics to water and waste management. A major challenge in working with companies is apportioning IP. Despite this a number of companies indicated interest in discussing how they could work with a "Centre of Excellence". It was also highlighted that the Australian industry needs to keep up with overseas developments in meat processing, adapting technology where applicable and that the industry often operates on a low profit margin which limits reinvestment in abattoirs and thus technology.

Models for the adoption of technology by the international processing industry were scant other than the concept of "integrators" (a concept used in the US). In this model the "integrator" works with a range of companies to identity technologies that could meet industry needs. In a limited way the company Robotic Technologies Australia Pty Ltd operates as an "integrator" linking manufacturing companies to suppliers of robotic solutions, with the provision of technical advice as part of the model. A "Centre of Excellence" could provide this service to industry.

Based on the reviewed previous research initiatives it can be concluded that investment in bricks and mortar can be high risk and there is considerable challenge to maintain currency and sustainability. In terms of funding, the common outcome is that a continued source of funding is required to keep facilities functioning. In terms of innovation transfer it was shown that for this to be successful research needs to be industry led which is facilitated through strong relationships between research and industry.

When the type of facilities of the current international research Centres were evaluated it was determined that the usage and hence feasibility of a **pilot plant** was low with the exception of Texas A&M and CSU where there was a greater focus on teaching of students. **Wet Areas** were well used by IRTA, Teagasc, DMRI, Georgia Tech, Texas A&M, CSU and AgResearch. These facilities tended to be more fully utilised as they are more versatile and are excellent facilities to test a variety of technologies. In most cases this is where Centre's were able to generate small incomes by hiring out wet rooms to private companies to evaluate and test equipment. Centres which had **Meat laboratories, food safety, engineering** and **education and training** facilities were all very well utilised as they are core to their operations and were also able to offset the risk of these facilities across a range of industries. There were other novel concepts such as the Teagasc mobile trailer and DMRI mobile truck that can transport equipment/technologies from plant to plant. All Centres' **funding** structures were slightly different. However, all were reliant on funding to be viable, meaning that not one facility was self-sufficient to remain cost neutral.

Common **innovation transfer strategies** that appeared across multiple Centres included; industry engagement (networks, training, workshops, demonstrations, partnerships), collaboration (industry/other R&D organisations) and extension. These concepts are not new and are often in

place, however, the degree of success of these strategies can be largely dependent on who might do these things.

Six current initiatives for collaboration were evaluated. Industry Growth Centre's (Australia), Catapult UK and Fraunhofer Institutes (Germany) are all Government initiatives with significant financial backing which has resulted in physical structures. All these Centres have a broad focus and hence spread the risk around these by diverse use from multiple sectors whilst increasing critical mass (infrastructure and people). The Cost-FAIM and AMSA are both networks and hence are 100% virtual. These networks don't actually fund any research, but fund the gathering of industry, technology providers, engineers and academia. CRC's are virtual in a sense that they don't really invest in capital, but essentially they do strategically partner with industry and research providers which can be seen as hubs as they provide physical infrastructure essential for CRC's to function. The CRC's have been shown to be a successful mechanism for innovation with minimal capital expenditure. Additionally they have been shown to be successful in building skills and capability within different sectors including the red meat industry. Common strategies which all of these initiatives rely on are; industry led research, long term strategic priorities, bridging the gap between research and industry, increasing knowledge transfer between research and industry, increasing capability and critical mass and collaboration. The ultimate goal amongst these Centres is to translate research into commercial outcomes thus increasing the rate of innovation. This goal seems agreeable with the ultimate goal of a potential Red Meat Processing Innovation Centre of Excellence (CoE). Hence, the above strategies should be applied to a potential CoE and it is demonstrated that these strategies can be applied with various levels of investment.

The value chain analysis which addressed issues surrounding viability of a proposed Red Meat Processing Innovation Centre of Excellence, with particular reference to costs and benefits accruing to participants in the red meat value chain showed that research into red meat processing generates substantial benefits, which are spread throughout the red meat value chain and onwards into public good. It was identified that gaps exist between research, and uptake of the knowledge produced by research as innovation. A number of explanations have been offered, including a reluctance to engage with other value chain participants in co-innovation along the value chain. Companies' wait-and-see attitude to innovation, and preference for cost-reducing over value adding innovation, was identified in the results from the national industry consultation. Five thematic areas were identified: new technology development; new technology evaluation and demonstration; meat science; education and training; and value chain research. Subdivisions of companies used featured orientation toward the consumer, the value chain and innovation overall, based on response to selected questions in the survey.

Throughout the feasibility study there were three models which have been identified including; bricks and mortar, virtual and hubs. The outcomes from the industry consultation indicate that there is significant support for a potential Red Meat Processing Innovation Centre of Excellence within Australia. It can also be determined that from all aspects of this report that a "bricks and mortar" type model would appear to be the least viable option (with particular reference to pilot plant) and least supported by industry. Based on current initiatives and influencing factors a "Hub" or "virtual" type model is suggested to be an effective and efficient way to increase

innovation and mitigate risk while maximising capability (infrastructure and personal).

Based on information provided in this report it is recommended that any potential Centre of Excellence would need to be industry led with a combination of blue sky and applied research and long term strategic priorities. The potential Centre should not duplicate but facilitate (use existing facilities, infrastructure, people and initiatives) and overall increase capability and critical mass within the sector. It would need to be accessible and use various strategies for disseminate information including extension type service. Based on the value chain analysis the potential centre would need to facilitate the collective action on fixed costs, enhance public relations by identifying and emphasising public benefits. The potential Centre has the opportunity to bridge the gap between industry and research and increase the knowledge transfer between research and industry through brokerage of identifying supply of and demand for innovation, identifying co-innovation and alternative funding sources. The potential Centre would act as an agent of "culture change" for factors such as co-innovation, customer focus. Above all the potential Centre would need strong governance that has a combination of both sound industry and academic knowledge to be successful.

Table of Contents

1. Introduction 10
2. Project Objectives 12
3. Processor reference panel 13
   3.1. Industry reference panel composition 13
   3.2. Industry reference panel report 13
4. National processor consultation 13
   4.1. Methodology 14
      4.1.1.Target Population 14
      4.1.2.Data Collection 14
      4.1.3.Statistical analysis 14
   4.2. Results - National Industry Processor Consultation 14
      4.2.1.Descriptive overview of surveyed abattoirs 15
      4.2.2.Perception of risk and uncertainty around implementation of new technology 16
      4.2.3.Drivers that influence the adoption and implementation of new technology 22
      4.2.4.Role of a Red Meat Processing Innovation Centre of Excellence in Australia 27
      4.2.5.What is needed to gain support for a Red Meat Processing Centre of Excellence 29
   4.3. Discussion 33
      4.3.1.Perception of risk and uncertainty around implementation of new technology 33
      4.3.2.Drivers that influence the adoption and implementation of new technology 36
      4.3.3.Role of a Red Meat Processing Innovation Centre of Excellence in Australia 38
      4.3.4.What is needed to gain support for a Red Meat Processing Centre of Excellence 38
   4.4. Summary – National industry processor consultation 41
5. National and International processing technology development 43

6. Review of previous and current National and International Research Centre's 44
   6.1. Previous Research Centre's 44
      6.1.1.Fututech 44
      6.1.2. CSIRO Cannon Hill 45
      6.1.3. Meat Training Research Centre Victorian DPI 46
      6.1.4. MIRINZ 48

6.1.5.Summary of Previous Research Centre's 49
6.2. Examples of existing Research Centre's 50
6.2.1. Institute of Agrifood Research and Technology (IRTA) -Spain 50
6.2.2. Teagasc – Ireland 54
6.2.3. SRUC -Scotland's Rural College 56
6.2.4. DMRI – Danish Meat Research Institute 58
6.2.5. Georgia Tech 61
6.2.6. Texas A & M 64
6.2.7. Colorado State University 67
6.2.8. Grimsby Institute 69
6.2.9. AgResearch 72
6.2.10. Summary of existing Research Centre's 73
6.3. Current initiatives and influencing factors 77
6.3.1. Australian Innovation System Report, Department of Industry 77
6.3.2. Industry Growth Centre's (Australia) 79
6.3.3. Cooperative Research Centre's (CRC) 80
6.3.4. Catapult 81
6.3.5. Fraunhofer 83
6.3.6. COST – European Cooperation in Science & Technology / FAIM 84
6.3.7. American Meat Science Association (AMSA) 85
6.3.8. Summary current initiatives and influencing factors 85
7. Value chain analysis of issues around the viability of a CoE 86
7.1. Introduction 86
7.2. Costs and benefits of adoption of new technology 87
7.2.1. Allocation of costs and benefits in the primary industry value chain 87
7.2.2. Gaps between research and innovation 89
7.2.2.1. Definitional items 89
7.2.2.2. Empirical evidence for red meat industry 89
7.2.2.3. Analysis of survey results with regard to thematic areas for Centre action 91
7.2.3. Entry points for enhancing technology uptake 93
7.2.3.1. A model of adoption identifying intervention points 93
7.2.3.2. The nature of costs and benefits of innovation 94

7.3. Technology adoption and the Australian red meat industry 94
7.3.1.Factors affecting adoption within innovation systems 94
7.3.1.1. Facilitation of adoption 94
7.3.1.2. Changing sources of new technology as an innovation system driver 95
7.3.1.3. Systems as recipients of facilitative assistance 95
7.3.2.Within-firm mechanisms of innovation 96
7.3.3.Within-value chain mechanisms of innovation 97
7.3.4. Institutional aspects of accelerating adoption 99
7.3.4.1. Response to “system failure” 99
7.3.4.2. Response to “demand and supply gaps” 99
7.4. Insight from survey results, for design of proposed Centre 100
7.4.1. Decomposition of survey material into thematic areas 100
7.4.2. Firms’ expectations of benefits across thematic areas of Centre operation 101
7.4.2.1. Customer focus 101
7.4.2.2. Innovation focus 102
7.4.2.3. Value chain focus 103
7.5. Conclusions 104
7.5.1.Benefits and costs of innovation in red meat processing 104
7.5.1.1. Form and configuration of costs and benefits 104
7.5.1.2. Co-innovation 105
7.5.2.Functions of a Red Meat Processing Innovation Centre of Excellence 105
7.5.2.1. Recognition of diverse innovation focus 105
7.5.2.2. Recognition of diverse firms’ innovation motivation 106
7.5.2.3. Key design features 107
8. Discussion 108
9. Potential models for a Red Meat Processing Innovation Centre of Excellence 112
9.1. Bricks and mortar 112
9.2. Virtual 112
9.3. Hubs 113
9.4. SWOT analysis of the different models 113
10. Conclusions 115

11. Recommendations 115

12. Acknowledgements 116

13. Bibliography 116

14. Appendixes 119

14.1. Appendix 1 – Reference panel Agenda and meeting notes 119

14.2. Appendix 2 – Survey 123

14.3. Appendix 3 – Survey letter 135

14.4. Appendix 4 – Survey results (raw data) 136

14.5. Appendix 5 - Survey results (raw data) 137

14.6. Appendix 6 – Survey results (raw data) 139

14.7. Appendix 7 – AgInfo Report 141

1. Introduction

Innovation is defined by the Oxford Dictionary (2015) as the "introduction of new things, ideas or ways of doing something" and broadly it has been identified there are four types of innovation which are: product innovations, process innovations, marketing innovations and organisational innovations (Anon, 2014). In order to fully understand the process of innovation, an understanding of research is needed. Research is defined by the Oxford Dictionary (2015) as the "systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions". Broadly research can be divided into "applied research" where research is aimed to solve practical problems and find solutions to everyday problems or "blue-sky" where research is not limited by conventional notions of what is practical or feasible; imaginative or visionary.

For industry to be successful it is critical to understand the interaction between innovation and research. This relationship is illustrated in Fig 1 where; research is a lever that provided with money will generate knowledge whilst innovation is a lever that provided with knowledge will generate money (Saracco, 2014).

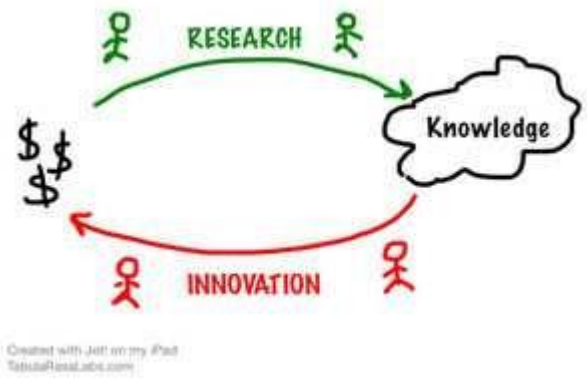


Fig 1. Relationship between research and innovation source; Saracco (2014).

New products and markets offer changed revenue and cost streams to the meat industry and has been shown to be the area where the biggest financial gains can be generated (Anon, 2014). Innovations in processing pave the way for improved throughput and utilisation. New organisational and marketing procedures can improve product flows and access to quality products and markets. The rate of adoption of processing innovations that may improve productivity, processing efficiency and value of the red meat processing industry is thought to be low. This notion is supported for example by the findings in a recent report which investigated Australian processor views on the value of online measurement technology (Toohey & Hopkins, 2015), which concurred with the outcomes by Coleman, (2014) which investigated barriers to adoption. The outcomes presented by Toohey & Hopkins (2015) showed that despite research demonstrating successful technologies the adoption has been low. This would indicate enhanced strategies are needed for innovations to make the transition into industry application.

Reluctance to innovate or for technology transfer to occur within the processing sector will have a negative influence on productivity improvements and operating costs that will influence the future competiveness of the Australian red meat industry. Some of the barriers to adoption of new technologies may include, variability in processor business size, structure and business models, high capital cost of technology and time to cost recovery, training needs, capability and skills available, equipment support costs, reliability and maintenance requirements, available space, retrofitting opportunity and additional engineering costs, conflicting business priorities, awareness and management requirements, coordination and information flows along the value chain (Coleman, 2014). Innovation is a resource-consuming activity which shares with research an uncertainty as to outcomes that restricts innovation by risk-averse companies. Innovation's outcomes may also be difficult to exclude from commercial rivals, which creates a wait-and-see incentive.

Improving the rate of innovation and technology transfer uptake within red meat processing industries requires strategies to enhance adoption and must address industry challenges and needs. Some of the drivers for adoption include; decreased operating costs though reduction in staff numbers, enhanced response to customer demand, improved consistency of product, processing efficiency and production, increased flexibility in operation, specification and management, reduction in waste from processing and improved work health and safety and food safety.

The red meat processing industry in Australia is both large and diverse. Many of the barriers to and drivers of adoption within individual business will differ due to the variable nature of processing across the country and the differing needs and aspirations of individual companies. However, the major barriers to adoption and drivers of uptake are related and can be grouped under the following overarching issues:

A perception of high risk and uncertainly around implementation of new processing technologies that are disruptive or lack impact at the whole business level,

A lack of understanding as to the most appropriate location in the value chain for innovation and/or adoption to occur, based on the sharing of profitability and risk, and

The commonality of new meat industry and market knowledge resulting in lack of clarity in ownership and coordination of delivery.

We consider that to gain industry support, any study wishing to investigate the feasibility of a Red Meat Processing Innovation Centre of Excellence in Australia needs to:

1) Consider the benefit of mitigating, pooling or sharing risk in testing and implementing new technologies between processors and the subsequent models for adoption by industry,

2) Include development of an economic understanding of the relative benefits of developing, implementing and managing new technologies across the whole value chain,

3) Identify the shared, as opposed to individual, interests and incentives which would identify the nature of the Centre's range and work, and

4) Reconcile points 1) to 3) above with an appropriate Centre ownership model. This approach requires separation of the interests of companies, the processing industry, producers and other supply chain participants, and society at large. Such separation enables

consideration of both costs and benefits of participation in such a Centre of Excellence.

In order to achieve the above goals this feasibility will first show a comprehensive understanding of processing companies' perceptions of risk and uncertainty around implementation of new technology, drivers that influence adoption and implementation of new technology, what the role of a Red Meat Processing Innovation Centre of Excellence in Australia might be and what is needed to gain support. This will be achieved through the analysis of an extensive national industry consultation process. Secondly this report will review national and international processing technology and development companies and their uptake. Thirdly this report aims to provide a thorough understanding of previous and current research Centre's to fully understand what has driven successful innovation and what hasn't. To achieve this, a review of relevant Centre's will be presented. Fourthly, based on the outcomes from the national industry consultation and the literature a value chain analysis of issues around the viability of a potential Centre of Excellence will be presented. Lastly this report will evaluate the viability of different potential models for a Red Meat Processing Innovation Centre of Excellence.

2. Project objectives

1. A review of the background, past and current industry issues related to technology transfer and adoption, current trends and recommendations made for future needs and opportunities for improving technology transfer to the red meat processing sector.
2. Guidelines and recommendations regarding the issues, linkage and benefits to industry, research development and education/training from analysis of National and International red meat research and development centres.
3. A review of the issues around development of processing technologies and uptake by industry nationally and internationally.
4. Guidelines and recommendations for a centre that address issues around the uptake of technology within the processing sector nationally and internationally will be completed including a preliminary analysis of the state and form of Meat Industry Innovation.
5. A Value Chain economic analysis of models of technology development, implementation and management for business, industry and public cost/benefit and risk response.
6. An overview workshop of preliminary findings for evaluation by a processor reference panel and AMPC to allow discussion and oversight of the direction of the findings and implications for a future Red Meat Processing Innovation Centre of Excellence.
7. A Final report which will include:

   A compilation of all project data and final analysis for the purposes of interpretation and making final directions regarding future needs, opportunities, models and structures.

   A compendium of Meat Industry views and aspirations for joint action in research, and associated experience from Australia and abroad.

   A framework for decision-making about form, funding, ownership and activities for a Centre.

3. Processor Reference panel

As part of the feasibility study an industry reference panel of up to 8 processors was developed as preliminary activities prior to National Industry processing consultation, test, oversee, and approve the project consultation methodology.

3.1. Industry reference panel composition

The invited reference panel was made up of the following industry representatives

Company	Participant
NH Foods Australia	Stephen Kelly
Gundagai Meat Processors	Will Barton
AL Colac	Mick Bird, Dale Smith
Wodonga Rendering	John Hayes
Nolan's Meat	Terry Nolan
Thomas Foods International	Murray Miller
Fletcher International	Farron Fletcher
GA Gathercoles	Justin Gathercole
Australian Country Choice	David Foote

3.2. Industry reference panel meeting report

Reference Panel representatives (Mick Bird, Dale Smith and Will Barton) along with representatives from the project team Matt McDonagh and Edwina Toohey (NSW DPI), Derek Baker (UNE) and David Lind and Justin Roach (AMPC) met on Wednesday the 1st of October to discuss the project background, scope and methodology. Please see attached Appendix 1 for meeting agenda and notes.

4. National industry processor consultation

This section relates to Activity 1 of the project methodology. The objective of the national industry processor consultation was to identify industry issues with technology transfer, opportunities to improve this and ultimately determine the merit or otherwise of establishing a Red Meat Processing Innovation Centre of Excellence in Australia. To achieve this, the survey was broken up into four sections, firstly, to identify the perception of risk and uncertainly around implementing new processing technologies. Secondly, the focus was on what are the drivers that influence the adoption and implementation of new technologies. This information was collected in association with commentary on the innovation processes and structures that exist within companies. Thirdly, it was deemed important to understand what potential role processors saw

in the establishment of a Red Meat Processing Innovation Centre of Excellence in Australia and lastly what would be needed to gain support for a Red Meat Processing Innovation Centre of Excellence in Australia. The processor consultation also generated information about the innovation process within companies, and the priorities and role attached to innovation by companies.

4.1. Methodology

4.1.1. Target population

The target population of the survey was selected to cover a significant cross section of industry including small, medium and large processors across multispecies with a focus on cattle, sheep and goats; and all localities. However it needs to be noted that during the consultation phase NSW DPI was advised by AMPC not to engage with JBS Australia for various reasons. Given the size and diversity of this company it is disappointing not to have had early engagement with JBS to understand their views on the feasibility of a Red Meat Processing Innovation Centre of Excellence.

4.1.2. Data collection

The surveys were conducted over a six month period. The survey was developed using an online method called google forms, however, all surveys have been conducted in person with follow up calls if necessary. The survey is attached see Appendix 2.

Initial contact with individual processors was through an introductory letter sent by AMPC. This was followed by telephone contact NSW DPI followed by immediate email. The introductory letter was developed to provide processors with further information regarding the project. This letter was aimed to aid the processor to determine the most suitable contacts within the company. Please see Appendix 3 attached.

4.1.3. Statistical analysis

All Data was analysed using general summary of statistics of tally and frequency. Most traits were analysed using a REML procedure in Genstat (Genstat 2014), which contained fixed effects for company size to examine whether it had an effect over level of importance for companies. Where, company size was determined by number of employees (small, <100 staff, medium, 100<500 staff, large, 500+staff).

4.2. Results - National Industry processor consultation

In total, data was collected in face to face interviews with personnel from 39 companies representing 50 abattoirs across Australia. Abattoirs were strategically engaged to ensure a good cross section of the industry was represented on factors such as;

Plant size (Small =<100 staff, Medium = 100<500 staff, Large =500+staff)
Species (cattle, sheep and goat),
Production type hot bone/cold bone
State.

4.2.1. Descriptive overview of surveyed abattoirs

In total, data were collected in face to face interviews with personnel from 39 companies across Australia, with 14 from NSW, 18 from QLD, 7 from VIC, 2 from SA, 4 from WA and 1 from TAS. These companies are representative of approximately 52 abattoirs. A basic summary of statistics of abattoirs surveyed is shown in Table 1.

Table 1. Summary statistics of companies surveyed.

	Max	Min
Number of cattle killed per day	6,678	9
Chain speed per hour (cattle)	198	4
Number of sheep killed per day	21,850	20
Chain speed per min (sheep)	13.2	0.25
Number of goats killed per day	3200	1
Chain speed per min (goat)	10	0.25

Of the abattoirs surveyed 57% processed sheep, 73% processed cattle, 34% processed goat and 14% processed other species (including; deer, pigs, water buffalo, and camels) as illustrated Fig 2.

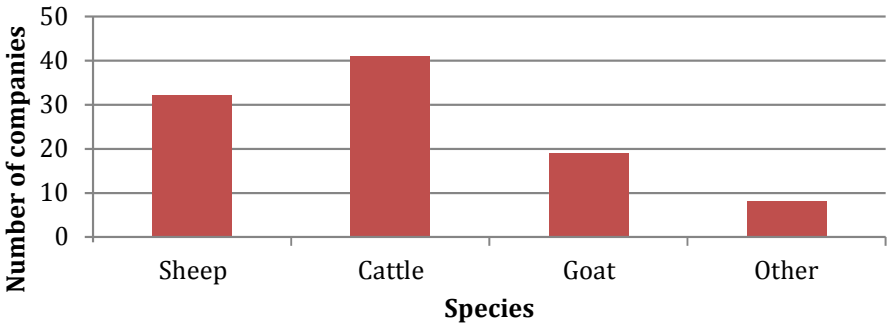


Fig 2. Number of companies that process each species

Of the companies surveyed 15% processed sheep only, 44% processed cattle only, 41% processed mixed species as illustrated in Fig 3.

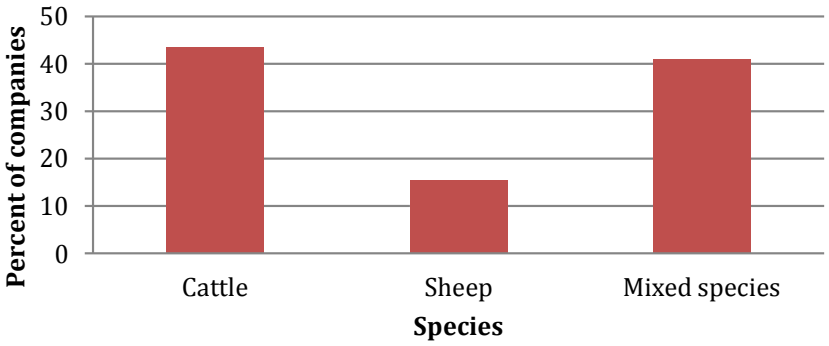


Fig 3. Percent of companies survey killing cattle only, sheep only and mixed species

4.2.2. Processor perception of high risk and uncertainty around implementing new processing technologies.

Processors were asked to rank how important various cost and constraint factors are when deciding to implement a new technology as shown in Table 2. All factors were seen as mostly either very important or important with only 2.6% and 7.7% listing space availability and loss of production during construction and installation as not important respectively.

Table 2. Level of importance that companies place on cost and constraint factors when deciding to implement a new technology.

Cost and constraint factors	Very Important	Important	Somewhat Important	Not Important
Reliability of the technology	87.2%	12.8%	-	-
Access to support	69.2%	25.6%	5.1%	-
Loss of production during construction/installation	66.7%	17.9%	7.7%	7.7%
Outlay cost to buy and install equipment	64.1%	28.2%	7.7%	-
Space availability	43.6%	30.8%	23.1%	2.6%
Maintenance costs	41.0%	51.3%	7.7%	-

When companies were asked which was the most important factor 39% responded with reliability of technology; 33% responding with outlay cost and 15% responding with loss of production during construction and installation. Despite 69.2% (Table 5) of processors indicating access to support was “very important” none deemed it as the most important (Fig 4).

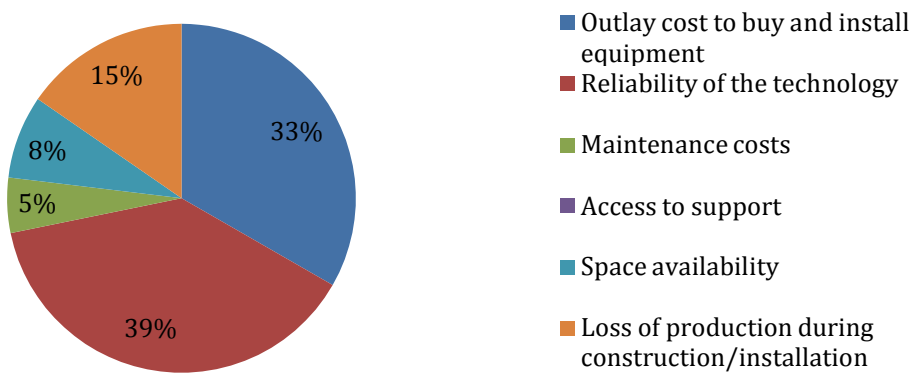


Fig 4. Most important cost and constraint factor.

Results show that with regard to staff training and skills, of the companies surveyed 53.8% of companies stated that "retention of skilled staff", 46.2% "having suitable staff to train", 38.5% "time needed to train staff to used new equipment", and 30.8% "cost of training" were all "very important" when deciding to implement new technology (Table 3). The most frequent "Not important" response was for cost of training. Company size was only shown to be significant ($P < 0.05$) for cost of training such that it was more important to small companies, but there was no difference in response between medium and large companies.

Table 3. Level of importance that companies place on staff, skill and training factors when deciding to implement a new technology.

Staff, skill and training factors	Very Important	Important	Somewhat Important	Not Important
Retention of skilled staff	53.8%	30.8%	7.7%	7.7%
Having suitable staff for training	46.2%	33.3%	15.4%	5.1%
Time needed to train staff to use new equipment	38.5%	30.8%	20.5%	10.2%
Cost of training	30.8%	28.2%	25.6%	15.4%

When companies were asked which was the most important factor relating to staff training and skill, "retention of skilled staff" was the most important, followed by "suitability of staff" and "time to train staff" respectively (Fig 5).

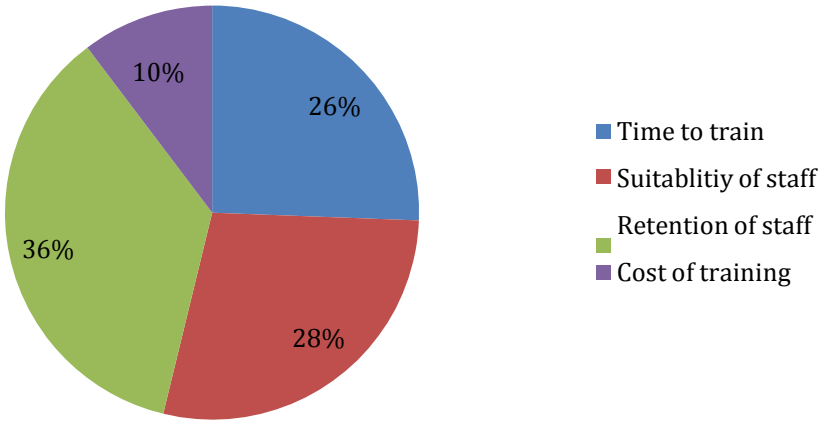


Fig 5. Most important factor relating to staff training and skill.

In an open ended style question, processing companies were asked whether there were any additional factors that were important to them when deciding to implement a new technology. From this 55.6% did not respond to the question, some considered cost and cost benefit analysis of a technology was important (17.8%), 4.4% thought there was a need for producer awareness,

4.4% were concerned about market access and 17.8% could not be categorized and are listed in Table 4.

Table 4. Other on categorized responses for additional factors when deciding to implement a new technology.

Other
Improvement on saleable product
Independent assessment to validate
Accuracy
Availability of parts and service support
Perception of keeping up with everyone else
Fit for purpose
Solves an issue
producer/consumer awareness
productivity gains
upgrade to existing technology

Results indicate that the majority of companies surveyed think that it is very important that technology has been proven to work in other companies first irrespective of time (Table 5) and company size had no ($P > 0.05$) effect on this response.

Table 5. Level of importance that companies place on that technology have been implemented and proven in other companies first.

Importance	Over the past 5 years	Now	Over the next 5 years
Not Important	21.2%	16.2%	21.6%
Somewhat important (helps demonstrate the concept and its value, but not the whole argument)	12.2%	16.2%	24.4%
Important (about 50% of time, technology is based on prior demonstrated experience	24.2%	27.1%	10.8%
Very Important (technology is proven to work commercially elsewhere)	42.4%	40.5%	43.2%

Companies were asked how they view their rate of adoption of new technology and innovation "5 years ago", "now" and "5 years into the future". There was no effect ($P > 0.05$) of company size, but over time there was an effect ($P < 0.05$) such that on average companies saw themselves improving their rate and/or speed of adoption in the future (Table 6).

Table 6. How companies view their rate of adoption of technology and innovation.

	Over the past 5 years	Now	Over the next 5 years
Industry leader (in implementing new technology first)	18.2%	16.7%	34.2%
An early adopter (within first 15% of comparable plants to adopt technology)	12.2%	27.8%	28.6%
In early majority (Within first 50% of comparable plants to adopt technology)	36.4%	33.3%	-
In late majority (within the first 85% of plants to adopt technology)	15.2%	11.1%	28.6%
Within the last 15% of comparable plants to adopt a technology	18.2%	11.1%	8.6%

In an open ended style question companies were asked what the innovation process was within the company. Results were categorized where possible into four response types; cost related, formal innovation process, informal innovation process and other. Over half (51.2%) of companies surveyed do a cost benefit analysis or some form of costing or payback estimations. Of the companies surveyed 69.2% had a formal innovation process, below are two examples of formal innovation process (Table 7).

Table 7. Examples of formal innovation process responses.

Example 1.	Example 2.
Business efficiency unit - which has a chair Encourage plant managers to come up with new ideas Engage with R & D providers Cost benefit analysis Reviewed by an internal committee Then will review outcomes at the end of project	Strategic committee First scout industry show/ other plants R&D into new technology Cost benefit analysis 5 stage process Conception Research and schedule Further score Design Build

An informal process was indicated by 30.8% of the companies surveyed with two example responses shown in Table 8.

Table 8. Examples of informal innovation process responses.

Example 1.	Example 2.
General discussion at "smoko" Encourage our staff and management to come forward with any ideas (small or large) Based around informal discussions	No process Discuss options over morning tea Talk to managers if you have an idea

Other responses that weren't categorized are shown in Table 9.

Table 9. Other responses for company innovation process.

Other responses
Innovation manger has a "ideas forum" 2 times a year / ideas also accepted ***ad hoc***
Small management team- great on coal face but poor on big picture
Research on google, ask around whether it actually works
Logical order of research on information provided by AMPC/MLA needs better search engine equipment evaluations/technical pros and cons

44% percent of companies surveyed had a designated innovation manager within the company (Fig 6a). Company size had an effect ($P < 0.001$) on whether there was an innovation manager within the company, with large companies (≥500 employees) more likely to have an innovation manager within company compared to medium (100-499 employees) and small (≤ 99 employees) sized companies. Medium size companies were more likely to have an innovation manger when compared to small companies.

There were 31% of companies interviewed where innovation is managed by a special department (Fig 6b). Large companies were significantly ($P < 0.008$) more likely to have an innovation department compared to medium and small companies, but there was no difference ($P > 0.05$) between medium and small companies.

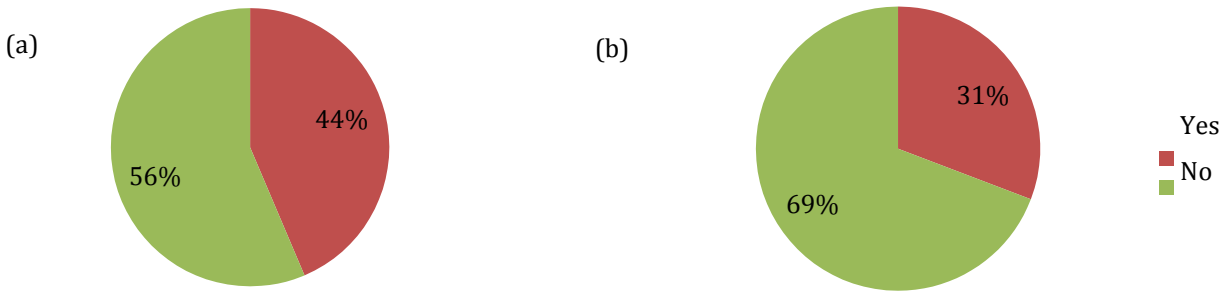


Fig 6 (a) Percentage of companies with an innovation manager and **(b)** Percentage of companies who have an innovation department.

Companies were asked if innovation was carried out using either of the following scenarios "a) several plants owned by the same company" (10.3%) or "b) just one plant" (69.2%) or "c) both (a) and (b)" (20.5%). Company size had no effect ($P > 0.05$). When innovation was carried out 69.2% of companies surveyed had said it was "just this plant" however this response would be reflective that many companies surveyed just own one plant. Companies that responded with "c" may not always roll out the same innovation to all plants.

Company size had no effect ($P > 0.05$) on whether companies implemented a staged innovation process where companies operated on a step by step process with go or no go decision points. Of companies surveyed 83% of companies do use a step by step process (Fig 7).

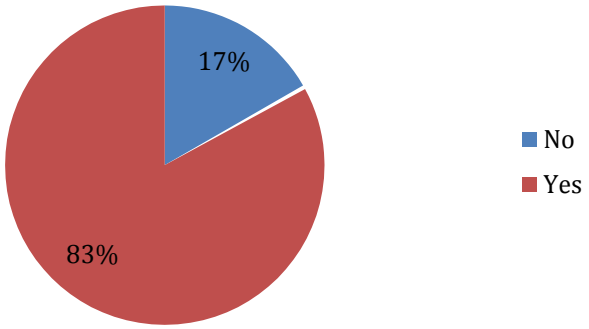


Fig 7. Percentage of companies that have a step by step process with go or no go decision points

Companies were able to select which method(s) they used to fund new innovation and the results are shown in Fig 8. Most companies used profits (74.4%).

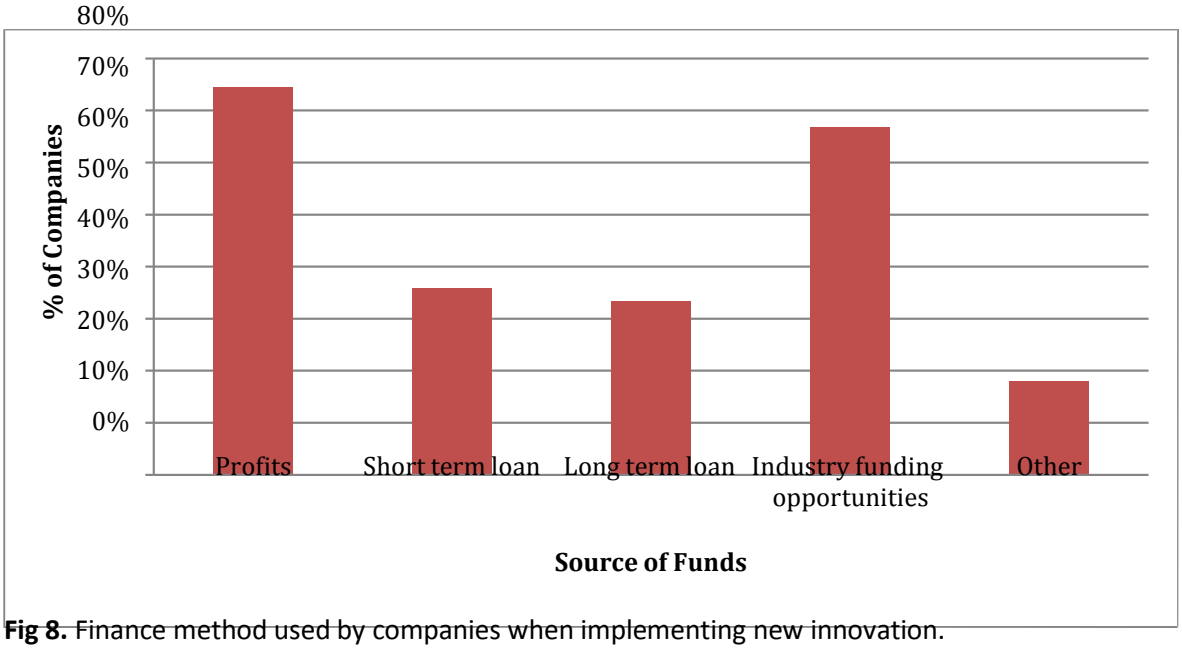


Fig 8. Finance method used by companies when implementing new innovation.

4.2.3. Drivers that influence the adoption and implementation of new technologies

The ability for new technology to reduce labour costs was considered very important by 84.6% of the companies surveyed (Table 10). Resource costs were considered of lesser importance by companies surveyed when deciding whether to implement a new technology in order to reduce operational costs. Company size did have an effect on labour costs ($P < 0.001$) and resource costs ($P < 0.05$) and consumable costs ($P < 0.001$) with all factors considered less important by small companies, but there was no difference between medium and large companies.

Table 10. Level of importance that companies place on reducing operational cost drivers when deciding to implement a new technology.

Cost Drivers	Very Important	Important	Somewhat Important	Not Important
Labour costs	84.6%	10.3%	-	5.1%
Energy Costs	59.0%	30.8%	5.1%	5.1%
Consumable Costs	59.0%	25.6%	10.3%	5.1%
Resource Costs	41.0%	28.2%	20.5%	10.3%

Of the companies surveyed 53.8% showed that upper level management was very responsive in adopting new technology and was the most frequent response. Supervisors were more frequently seen as responsive, processing floor personal were most frequently seen as somewhat responsive and maintenance staff were most frequently seen as responsive to adopting new technology (Table 11). Size of company had no effect ($P > 0.05$) on level of responsiveness of worker attitudes to adopting new technology.

Table 11. Level of responsiveness of worker attitudes are to adopting new technology across a company.

Worker type	Very Responsive	Responsive	Somewhat Responsive	Not Responsive
Upper Level Management	53.8%	33.3%	7.7%	5.2%
Supervisors	28.2%	41.0%	30.8%	-
Processing floor personal	12.8%	25.6%	51.3%	10.3%
Maintenance staff	20.5%	35.9%	30.8%	12.8%

Increasing productivity drivers on the kill chain was considered “very important” most frequently (59.0%) compared to any other stage of production (Table 12), followed by Boning (56.4%), Chilling (48.7%) and inventory management (48.7%). Animal receival was the most frequent “not

important" response (20.5%), followed by lairage (19.9%) and information flows beyond a plant (10.3%).

Boning, packaging and storage all had companies respond with "I don't know" and were additionally the only factors for which company size was significant ($P < 0.001$). Results show that for small companies these factors (boning, packaging and storage) were less important compared to medium and large companies.

Table 12. Level of importance that companies place on increasing productivity drivers at the different stages of production when deciding to implement a new technology.

Productivity drivers	Very Important	Important	Somewhat Important	Not Important	I don't know
Animal receival	28.1%	28.2%	23.1%	20.5%	-
Lairage	25.6%	28.2%	28.2%	19.9%	-
Kill chain	59.0%	33.3%	5.1%	2.6%	-
Chilling	48.7%	30.8%	19.9%	-	2.65
Boning	56.4%	28.6%	2.6%	-	12.8%
Packaging	46.2%	35.9%	7.7%	-	10.3%
Storage	43.6%	38.5%	15.4%	-	2.6%
Dispatch	46.2%	30.8%	17.9%	5.1%	-
Inventory management	48.7%	30.8%	15.4%	5.1%	-
Information flows within a plant	41.0%	35.9%	17.9%	5.1%	-
Information flows beyond plant	30.8%	38.5	20.5%	10.3%	-

In terms of companies been able to increase processing efficiency, 76.9%, 74.4% and 71.8% of companies surveyed selected reducing overall labour costs, minimising contamination on chain and minimising product loss on chain as "very important" (respectively) (Table 13). Company size did have a significant effect on the following processing efficiency productivity drivers including; enhancing value add per worker ($P < 0.05$), minimising product loss boning ($P < 0.001$), maximize product quality ($P < 0.005$), enhance product consistency (weight, shape, size) ($P < 0.001$), and improved sorting of like carcase and cuts ($P < 0.001$), such that these factors were less important for small companies.

Table 13. Level of importance as a percentage (%) that companies place on increasing processing efficiency productivity drivers when deciding to implement a new technology.

Processing efficiency ductivity drivers	Very Important	Important	Somewhat Important	Not Important	I don't know
Reduce overall labour costs	76.9%	20.5%	-	2.6%	-
Minimising contamination on chain	74.4%	25.6%	-	-	-
Minimising product loss chain	71.8%	25.6%	2.6%	-	-
Maximize product quality	56.4%	30.8%	5.1%	5.1%	2.6%
Minimising product loss (boning)	56.4%	28.2%	5.1%	2.6%	7.7%
Minimising product loss (chilling)	53.8%	30.8%	12.8%	-	2.6%
Enhancing productivity per worker	51.3%	46.2%	2.6%	-	-
Enhancing product consistency (weight, shape, size)	41.0%	20.5%	17.9%	12.8%	7.7%
Enhancing value added per worker	28.2%	53.8%	7.7%	2.6%	7.7%
Improve sorting of like carcases and cuts	28.2%	38.5%	15.4%	15.4%	2.6%

When companies were asked how important increasing plant flexibility productivity drivers were to deciding on implementing new technology 69.2% of companies responded that optimizing whole carcase use was "very important" and was the most frequent response, followed by maximize product quality (59.0%) and increasing potential number of markets (51.3%). Increasing product line, chain speed and improved sorting of like carcase and cuts were most frequently selected as "not Important" 23.1%, 17.9% and 17.9% respectively (Table 14). Company size had no significant effect on any plant flexibility productivity drivers except improved sorting of like carcase and cuts ($P < 0.006$) which was significantly less important for small plants.

Table 14. Level of importance as a percentage (%) that companies place on increasing productivity drivers such as plant flexibility when deciding to implement a new technology.

Processing efficiency plant flexibility	Very Important	Important	Somewhat Important	Not Important	I don't know
Optimizing whole carcase use	69.2%	23.1%	2.6%	5.1%	-
Maximise product quality	59.0%	33.3%	5.1%	2.6%	-
Increasing potential number of markets	51.3%	33.3%	7.7%	7.7%	-
Increasing number of potential customers in any market	38.5%	38.5%	17.9%	5.1%	-
Allow Improve sorting of like carcases and cuts	33.3%	35.9%	12.8%	17.9%	-
Increasing chain speed	25.6%	30.9%	25.65	17.95	-
Increasing product lines	12.8%	25.6%	35.95	23.1%	2.6%

When deciding to implement a new technology food safety and shelf life were considered the two most important product quality productivity drivers with 89.7% and 76.9% (respectively) of companies surveyed selecting "very important" (Table 15). Company size had no significant effect ($P > 0.05$) on any product quality productivity drivers.

Table 15. Level of importance as a percentage (%) that companies place on increasing productivity drivers such as product quality when deciding to implement a new technology.

Processing efficiency product quality	Very Important	Important	Somewhat Important
Food safety	89.7%	10.3%	-
Shelf life	76.95	23.1%	-
Visual quality	59.0%	35.9%	5.1%
Eating quality	51.3%	33.3%	15.4%

When regulation productivity drivers were examined all were considered important at some level with workplace health and safety and animal welfare being very important (Table 16). Company size had no effect ($P > 0.05$) on any regulation productivity drivers.

Table 16. Level of importance as a percentage (%) that companies place on increasing Regulation as productivity drivers when deciding to implement a new technology.

Regulation	Very Important	Important	Somewhat Important
Workplace health & safety	94.9%	5.1%	-
Animal welfare	92.3%	7.7%	-
Food safety	89.7%	2.6%	7.7%
Environmental sustainability	61.5%	33.3%	5.1%
Human resource management (labour)	61.5%	33.3%	5.1%

In an open ended style question companies were asked if there were any additional productivity drivers that would influence their decision to implement a new technology or not. Results were categorized where possible (Table 17). Other responses that were not categorized include skill, product presentation, improvement customer acceptance, consumer education – bigger players, whether there is great demand.

Table 17. Additional productivity drivers

Additional productivity drivers	Percentage of companies
No Response	51.3%
Quality assurance	12.8%
Workplace health and safety	10.2%
Reduce environmental impact	5.1%
Profit and efficiency related	17.9%
Maintenance	5.1%
Yield	2.6%
Animal welfare	2.6%
Market access	15.3%

Note: raw data shown and some responses are reflected in other questions

When companies are deciding to implement a new technology the following sources of information are utilised; Australian meat industry sources, what Australian competitors are doing and what is happening overseas are the most frequent "very important" responses (43.6%, 30.8% and 23.1%) respectively (Table 18). It was apparent that news articles have little value to companies when deciding to implement a technology. Company size had no effect ($P > 0.05$) on which source of information was most important when deciding to implement a new technology.

Table 18. Level of importance as a percentage (%) that companies place on where they source information when deciding to implement a new technology.

Source of information	Very Important	Important	Somewhat Important	Not Important
Australian meat industry sources	43.6%	35.9%	10.3%	10.3%
What Australian competitors doing	30.8%	53.8%	7.7%	7.7%
What happens overseas	23.1%	51.3%	15.4%	10.3%
Academic research	20.5%	28.2%	28.2%	23.1%
Consultants	10.3%	30.8%	33.3%	25.6%
Trade magazines and shows	10.3%	25.6%	46.2%	17.9%
News articles	2.6%	23.1%	46.2%	28.2%

4.2.4. Role of a Red Meat Processing Innovation Centre of Excellence in Australia

When companies were asked what the major role of a Red Meat Processing Innovation Centre of Excellence should be technology development, economic evaluation and technology evaluation were the most frequent "very important" response 48.7%, 48.7% and 43.6% respectively (Table 19). When "very important and important" responses are combined over 70% of companies surveyed think a library database, economic evaluation and meat processing and meat science should be a major role and over 80% think industry demonstration and technology evaluation should be a major role and over 90% think technology evaluation should be the major role. The most frequent "not important" response for the major role of a Centre was market research, product innovation, and economic evaluation with 28.2%, 15.4% and 10.3% respectively.

Table 19. Level of importance as a percentage (%) that companies place on the role of a Red Meat Processing Innovation Centre of Excellence in Australia.

Role of Centre	Very Important	Important	Somewhat Important	Not Important	I don't know
Technology development	48.7%	43.6%	2.6%	2.6%	2.6%
Economic evaluation	48.7%	25.6%	15.4%	10.3%	-
Industry demonstration	33.3%	51.3%	10.3%	5.1%	-
Technology evaluation	43.6%	43.6%	10.3%	2.6%	-
Meat processing and meat science research	41.0%	38.5%	10.3%	7.7%	2.6%
Library database	38.5%	33.3%	15.4%	7.7%	5.1%
Product innovation	38.5%	30.7%	10.3%	15.4%	5.1%
Education and training of industry personnel	38.5%	28.2%	28.2%	5.1%	-
Teaching and training of students	35.9%	30.8%	28.2%	5.1%	-
Market research	25.6%	28.2%	17.9%	28.2%	-

In an open ended style question companies were asked if there were any other additional focus areas that they would see as an important role for a Red Meat Processing Innovation Centre of Excellence within Australia. There were 38.5% of companies that did not think there were any additional focus areas for a Centre of Excellence, all other individual responses (raw data) have been grouped and can be found in Appendix 4. Common themes that could be found from this raw data include; Education, training and capability building; information sharing and extension; relevance equality and access; strategic and additional comments.

Of companies surveyed 51.3% selected meat technology for slaughter, boning and chilling as "Very Important" as a role of meat processing and meat science research (Table 20), followed by meat technology for carcase evaluation and online measurements of quality (46.2%) and feedback to producers (46.2%). When "very important and important" responses are combined all meat processing and meat science related research resulted in >70% of companies surveyed selecting these options, except for information storage database with 59.2% of companies surveyed selecting these options.

Table 20. Level of importance as a percentage (%) that companies place on meat processing and meat science research role in a Red Meat Processing Innovation Centre of Excellence in Australia.

Meat processing and meat science research	Very Important	Important	Somewhat Important	Not Important	I don't know
Meat technology for slaughter boning and chilling	51.3%	38.5%	7.7%	2.6%	-
Meat technology for carcase evaluation and online measurements of quality	46.2%	38.5%	10.3%	2.6%	2.6%
Feedback to producers	46.2%	35.6%	15.4%	2.6%	-
Meat science and quality	38.5%	51.3%	5.1%	5.1%	-
Meat technology for manufacturing and fabrication	30.8%	43.6%	15.4%	7.7%	2.6%
Traceability	28.2%	43.6%	17.9%	10.3%	-
Information storage database	25.9%	33.3%	15.4%	12.8%	2.6%

4.2.5. What is needed to gain support for a Red Meat Processing Innovation Centre of Excellence in Australia

Companies were asked how important a Red Meat Processing Innovation Centre of Excellence could be to individual companies in mitigating risk around new technologies by allowing testing and trial implementation within either of the following scenarios a) controlled demonstration processing facility within the Centre; b) organizing demonstrations of new processing technologies within a commercial processor. Of the companies surveyed 41% responded that it was "very important" to have demonstration within a commercial processor and 12.8% responded that it would be "very important" to have a demonstration facility within a Centre. Despite more frequent "important" responses for a demonstration facility within a Centre (46.2%) overall when "Very important and Important" responses are grouped together a greater proportion of companies surveyed supported demonstration within a commercial processor 76.9% compared to 59% for a demonstration facility within a Centre (Fig 9).

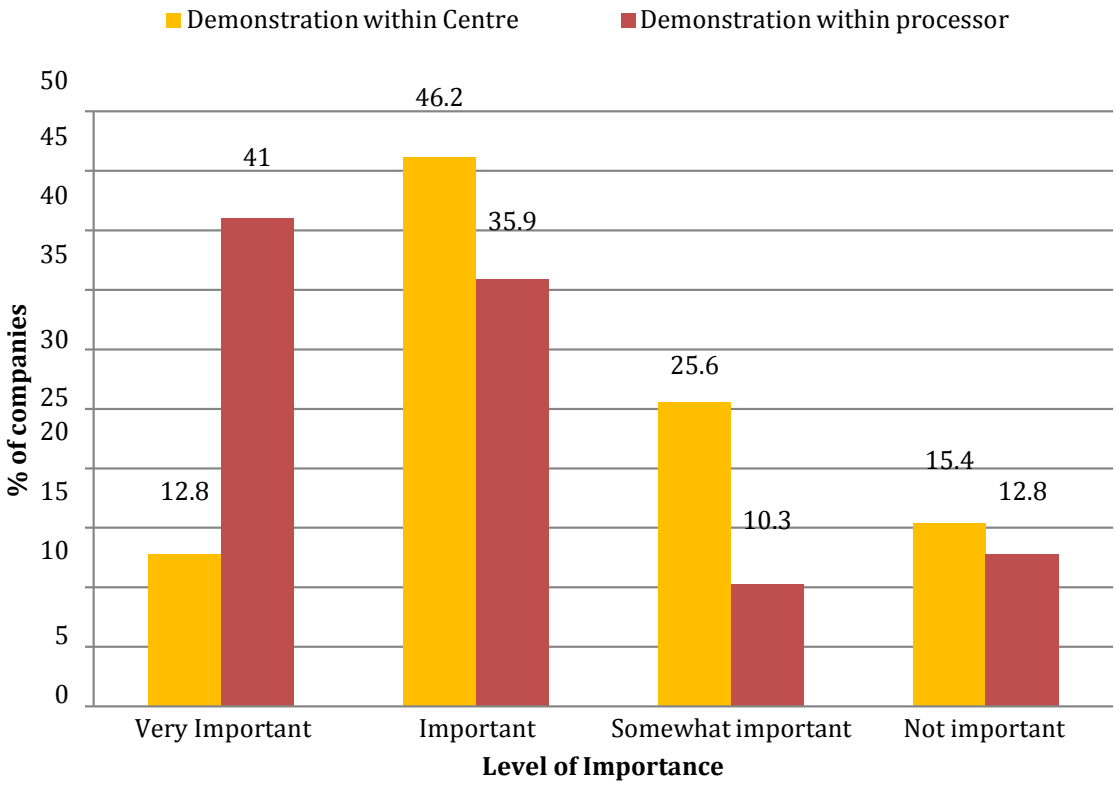


Fig 9. Level of importance a Red Meat Processing Innovation Centre of Excellence can play in mitigating risk.

Development of new technologies (engineering, evaluation, pilot testing and concept evaluation) was shown as the most frequent "very important" response (43.6%) for a potential role of a Red Meat Processing Centre of Excellence. From the results, there is also high level of importance for integrating application of technologies with product quality outcomes and evaluation of technologies under a fit for purpose strategy (Table 21). New product (meat product) and market development were more frequently reported as "not important" 38.4% and 30.8% respectively.

Table 21. Level of importance as a percentage (%) that companies place on each of the potential roles of a Red Meat Processing Innovation Centre of Excellence in Australia.

Meat processing and meat science research	Very Important	Important	Somewhat Important	Not Important	I don't know
Development of new technologies (engineering, evaluation, pilot testing, concept evaluation)	43.6%	35.9%	10.3%	2.6%	7.7%
Evaluation of technologies for fit-for-purpose	35.9%	30.8%	25.7%	7.7%	-
Economic understanding (benefits developing, implementing and managing)	35.9%	23.1%	25.6%	12.8%	2.6%
Integrating application of technologies with product quality outcomes	33.3%	35.9%	15.4%	10.3%	5.1%
Training and education of meat industry personnel regarding new technology	28.25	30.8%	33.3%	7.7%	-
New product (meat product) development	28.2%	10.3%	23.1%	38.4%	-
Market development	25.6%	15.4%	28.6%	30.8%	-

Results show that companies surveyed placed higher importance for a Red Meat Processing Innovation Centre of Excellence to provide proof of principle to processors and this was less important to do for producers, wholesalers, retailers and supermarkets (Table 22).

Table 22. Level of importance as a percentage (%) that companies place on the Red Meat Processing Innovation Centre of Excellence to provide proof of principles to different sectors of industry.

Sector	Very Important	Important	Somewhat Important	Not Important
Processors	51.3%	25.6%	17.9%	5.1%
Producers	12.8%	28.2%	51.3%	7.7%
Wholesalers	10.3%	25.6%	41.0%	23.1%
Retailers and supermarkets	15.4%	23.1%	48.7%	12.8%

In an open ended style question companies were asked what other critical factors a Red Meat Processing Innovation Centre of Excellence within Australia would need to address. There were 7.7% of companies that did not respond to this question and other raw responses have been grouped (people, Collaboration, function, structure, access, roles, needs, don'ts, questions) and raw responses are listed in Appendix 5.

In an open ended style question companies were asked how they would like to be involved with a future Red Meat Processing Innovation Centre of Excellence. All responses are listed below and have been divided into 3 categorise with "Yes" would like to be involved, unsure and no response. Fig 10, illustrates the level of involvement companies surveyed are prepared to have.

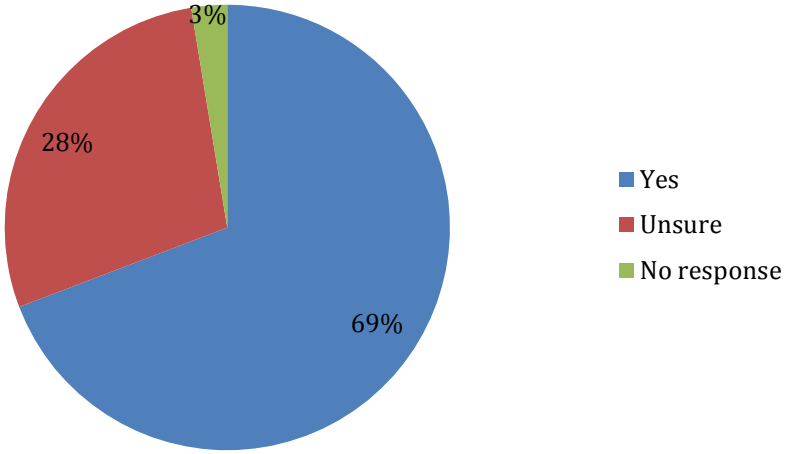


Fig 10. Level of involvement for a Red Meat Processing Innovation Centre of Excellence companies are prepared to have (%).

Results indicate that the majority of companies are prepared to be involved with a Red Meat Processing Innovation Centre of Excellence at some level. From the raw data it can be shown that this level of involvement ranges from consultation and setting of R & D direction to providing facilities for experimental purposes, data collection and information sharing (see Appendix 6).

Companies were asked to select from a list who else they would like to see be involved in a Red Meat Processing Innovation Centre of Excellence within Australia. The majority of industry indicated that federal government, AMPC, other processors, state government, universities, other industry bodies (i.e. MINTRAC), technology companies, international links and consultants all could play a role (Fig 11). Companies were also given the opportunity to nominate any other potential participants which included the following responses; suppliers (i.e. bags), AQIS, TAFE, producers, Division of Workplace Health and Safety.

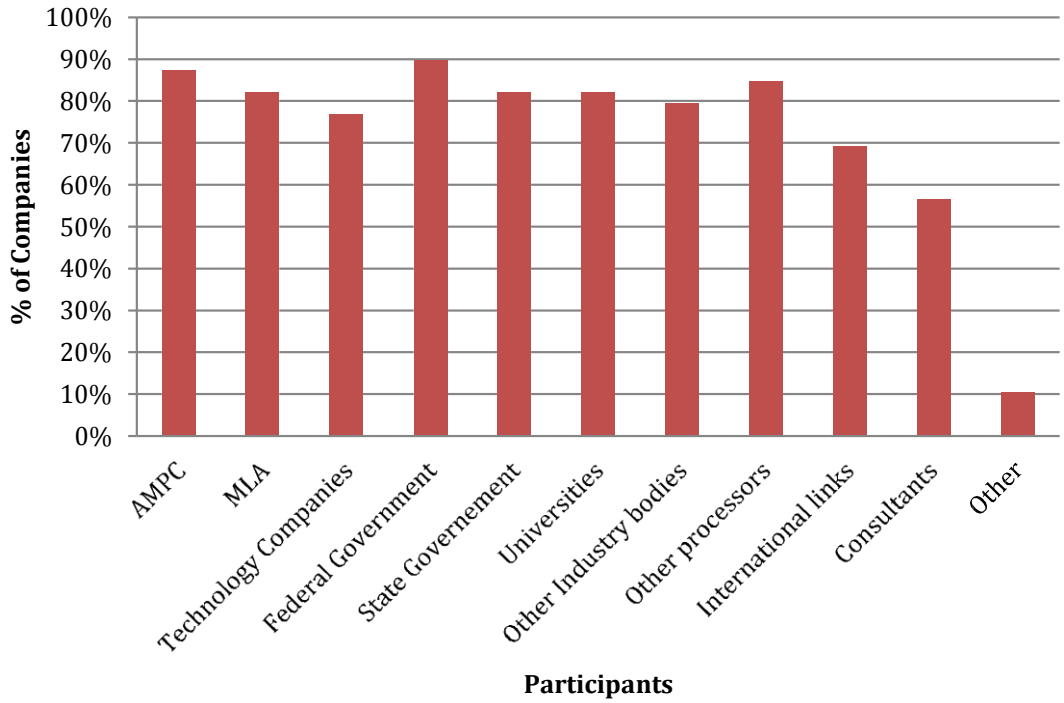


Fig 11. Other participants for a Red Meat Processing Innovation Centre of Excellence

4.3. Discussion - National Industry processor consultation

From the survey data it is clear how diverse the Australian red meat processing industry is in terms of size (range in the number of employees 4-2100), scale of operations (per day through put range; cattle 9 to 6,678; sheep 20 to 21,850; goat 1 to 3200) and differing business models (highly specialised species specific v's multispecies, animal type, method of purchase, end users and conventionally chilled operations vs hot boning). The results from this study strategically captured this diversity, in order to understand whole industry needs, given all models play an important role in the overall success of industry.

4.3.1. Processor perception of high risk and uncertainty around implementing new processing technologies.

All cost and constraint factors including outlay cost to buy and install equipment, reliability of technology, maintenance costs, access to support, space availability and loss of production during construction and installation were seen as mostly either "very important" or "important" when deciding to implement a new technology. Given that there are very few newly built processing plants, space will always be a factor when considering a new technology, but if the technology is proven processors will make room. The considerations around space are often made when considering the outlay cost to buy and install and overall cost benefit analysis. Reliability of technology was reported to be the most important factor. This is an important outcome for the role of a Red Meat Processing Innovation Centre of Excellence, as it was evident during the consultation that companies want assurances before implementing technology and this is supported by recent studies (Toohey and Hopkins 2015;Coleman 2014). It had been suggested

that some aspects of failures in adoption of online measurement technologies such as VIAScan® were related to premature rollout of technology and such perceptions by processors can have a negative influence. Thus a Centre could facilitate innovation by insuring technology is reliable before rolled out commercially.

Results showed that retention of trained staff, and having suitable staff for training, were the two most important personnel-related factors when deciding to implement a new technology. Retention of skilled staff is a common problem within the processing industry, especially in roles such as fitter and turners or electricians because often they can learn their trade with apprenticeships and then move on to other more lucrative industries such as mining. As mentioned in the US-based case studies, moves toward a culture of prestige in the meat processing industry may assist in retention of trained staff within the industry: this however shifts the focus from action by individual companies to whole-of-industry, and would be of particular relevance to an industry Centre of Excellence. There is an opportunity for a Red Meat Processing Innovation Centre of Excellence to increase the retention and draw new skilled staff to the industry by promoting the sustainability of the industry given the increasing demand for meat as a protein source (MLA, 2015). Company size had a significant effect on concerns over the cost of training, being a more important factor for smaller companies when compared to medium and large companies. Partially, this could be due to geographical locations, as often smaller plants can be more isolated, costs can be prohibitive to have staff off site when there is not the workforce that can cover their role. There is scope to consider subsidizing the cost of training for smaller companies to encourage innovation, or investigate the feasibility of an outreach service as a function of a Centre. The sources of this subsidization need not necessarily be from within the meat processing industry and the Centre may be a conduit for actions by other agencies concerned with industrial competitiveness on one hand, and education and regional development on another. A further comment on the survey results on meat processing labour costs is that they reflect to some extent historical industry pre-occupation with labour costs. However, the substantial value evidently placed on staff skills and concerns over staff moving to other companies means that retaining the benefits of innovation is an industry, rather than a company concern.

The majority of the companies surveyed, irrespective of company size, reported that it is very important that technology has been proven to work in other companies first. This response was consistent when personnel were asked how they felt five years ago, now and looking five years into the future. This result indicates that the majority of surveyed companies see themselves as followers rather than leaders in innovation and successful past adoption by a competitor is a principle driver of uptake. This is a clear message that any Centre of Excellence must first move beyond research and into the facilitation of the innovation process. Based on current systems in place it is critical that industry continues to support and potentially invest or broaden initiatives like Plant Initiated Projects and Meat Donor Company projects to continue to facilitate adoption of new technologies within industry by demonstration amongst peers. Additionally once success is achieved there needs to be mechanisms of extension to promote outcomes in both individual businesses and the industry as a whole.

Companies' views on their rate of adoption of technology and innovation were not related to company size. This is most likely a result of the question being asked in the context of "comparable plants": i.e. small companies would not have compared themselves to large ones. There was however a significant difference in how companies viewed their rate of adoption over time (five years ago, now and five years in future) such that on average companies saw themselves improving their rate of adoption in the future. This is a positive outcome for industry as increased innovation is identified as a key strategy to lift long term total factor productivity (Anon, 2014) in the country more generally. A main goal of a potential Red Meat Processing Innovation Centre of Excellence would be to provide varying strategies to facilitate innovation amongst processors. Key to this would be to collaborate with or enhance support to existing strategies such as MLA Collaborative Innovation Strategy program (CISp) which was launched in September 2007 (MLA, 2015) to ensure that there a reinforcing and synergistic relationship rather than duplication. This will be particularly influential in how a Centre of Excellence would engage with the supply chain.

When companies were asked about their innovation process, 69.2% of companies surveyed had a formal innovation process. Unstructured survey responses regarding the innovation process offer insight into the entry points available for a Centre of Excellence promoting and supporting innovation. Although not analysed in the current report it is hypothesized that company size would significantly impact this response such that smaller companies would use informal innovation processes as opposed to formal. This hypothesis is based on the fact that whether companies had an innovation manager was significantly affected by company size with large companies more likely to have such a person and also an innovation department. Most companies reported some form of cost benefit analysis for technology investment, and 85% of companies surveyed implement innovation and new technologies in a step by step process with go or no-go points.

Profits were the most frequently used funding source (74.4%) for company's new innovations. The second most-used method was industry funding opportunities (66.7%). This notable result identifies borrowing risk as a barrier to technology adoption, as well as identifying the key role played by existing industry programmes. A Centre of Excellence might address this result by reducing, mitigating or sharing risk amongst industry participants, building on statements above regarding the tendency of firms to be followers rather than leaders in innovation. There may be funding models which would channel industry resources in such a way as to reduce risk sufficiently to mobilise companies' capital to accelerate innovation. In particular, this would avoid the apparent current anomaly wherein innovation is achieved at the expense of profits, rather than in pursuit of profits, in over 70% of companies.

Although two thirds of companies surveyed use industry funding opportunities, it was highlighted during discussions that not all companies used these methods routinely and some did not completely understand what (for example) plant initiated projects (PIP's) were. Additionally, many companies would not routinely use industry funding opportunities because they were lacking in skill, knowledge or resources effectively to write and prepare applications. There is therefore scope for a potential Red Meat Processing Innovation Centre of Excellence to provide

support in particular to small and medium enterprises (SME's) or where innovation mangers do not exist to generate a higher level of uptake of industry-funded opportunities, targeting innovation rather than research, across the whole of industry. The approach would be most effectively run with programs already in place such as CISp.

4.3.2. Drivers that influence the adoption and implementation of new technologies

It was identified that labour costs are a key driver related to 'costs' for companies to adopt and implement new technologies. Labour cost has been identified in the processing sector as an important factor for over 30 years and was a key driver in the development of Fututech (Pitt, 2007). To maintain our competitiveness on the export market when comparing the cost of labour with our major competitors (e.g. USA, Brazil) labour will be an ongoing driver for innovation. However, a sustained goal of reducing labour costs is unlikely to be successful against such export competitors, nor amongst domestic competitors. Rather, an orientation toward value addition by labour may better support target market positioning. In combination with earlier statements on training and retention of high value staff, there are roles for a Centre of Excellence to play in formulating innovation plans for industry and for individual firms.

Worker attitudes towards adopting new technology are important, and this survey provides some insight into how this might vary within a company or plant depending on role. Over half (53.8%) of companies surveyed considered upper level management to be very responsive, then supervisors were seen as predominately responsive (41%) and processing floor personal predominately somewhat responsive (51.3%). The most frequent response for maintenance staff was responsive (35.9%). There does need to be "buy-in" across the whole company for innovation to be truly embraced and successful. One avenue of staff-oriented strategy for innovation needs to address increasing responsiveness. This affects targeting of innovation activities within companies and the opportunity to encourage a cultural change around innovation. Innovation embodied in equipment may be discouraged by those staff that operate the equipment; innovation in supply chain organization may face barriers amongst those implementing the logistics and information exchange. It is unclear the extent to which new technology is interpreted as labour-reducing and hence undesirable to some staff, but if present this factor would favour a strategic approach which emphasizes value addition and high value use of staff, rather than automation *per se*.

During the consultation it was noted that some companies found it hard to see how new technologies could further enhance their animal receival and lairage stage as a productivity driver. Survey results reflect these factors as being least important. Results show that for small companies boning, packaging and storage were significantly less important when compared to medium and large companies. This is most likely reflective of these stages of production not being seen as applicable to their business; for example, meat sold as whole carcase (sheep and goat) or partially boned beef, rather than boxed meat.

In increasing processing efficiency, reducing overall labour costs, minimising contamination on the chain and minimising product loss on the chain, were seen as the most important factors. These are common issues that would affect most companies irrespective of size or business type. However, other factors such as enhancing value add per worker, minimising product loss in boning, maximizing product quality, enhancing product consistency (weight, shape, size), and improving sorting of like carcase and cuts, were all shown to be less important for small companies than large, and these reflect business types and goals. This reinforces both the conclusion that a Centre of Excellence is likely to face a variety of user demands for innovation solutions, and that the type of strategy to increase innovation will vary both within plant and between companies will vary.

Both product quality (eating quality, food safety, visual quality and shelf life) and regulation (food safety, environmental sustainability, animal welfare, human resource management and WH&S) productivity drivers were predominately reported as very important or important and additionally company size had no effect. Both product quality and regulation are key drivers related to business performance and compliance and hence cannot be compromised. These are areas where significant amounts of research have paved the way for improved industry outcomes. Given that the benefits of such innovation span both public and private interests, there is justification for a Centre of Excellence's compliance-related work to be publicly supported and to work in association with publicly-funded agencies. Other interfaces with public policy such as training, regional development and environmental management will also be to the fore in the design of a Centre of Excellence.

When companies were asked if there were any additional productivity drivers 51.3% said no, indicating that their drivers had been outlined and some reiterated drivers that had been listed (e.g. animal welfare). While market access is a notable inclusion in this list, it is a highly variable issue, ranging from issues of anticompetitive retailer behaviour to international trade, to concerns of regional and rural companies and the sourcing of stock. It is anticipated that this would be a major driver of innovation, albeit from a range of motivations to which a Red Meat Processing Innovation Centre of Excellence would apply itself. However it also needs to be considered if other organisations who already work in this space (i.e. DAFF) would collaborate, and what form the collaboration might take in light of funding considerations and other drivers, such as implementation of the forthcoming (Commonwealth Agricultural Competitiveness White Paper).

Most companies considered Australian meat industry sources, what Australian competitors are doing and what is happening overseas as very important sources information. It was also made apparent that news articles were of little importance to companies. These results need to be considered in light of timing of the dissemination of information: this is critical in terms of what response a company provides. Additionally, outcomes here support earlier results that companies like to see "technologies implemented in other companies first". This confirms that a potential Red Meat Processing Innovation Centre of Excellence should play a role to address such barriers to adoption, and the approach taken will influence the structure of the Centre.

4.3.3. Role of a Red Meat Processing Innovation Centre of Excellence in Australia

Surveyed Companies were asked specific questions to help define roles for a Red Meat Processing Innovation Centre of Excellence. It was identified that technology development, technology evaluation, economic evaluation and meat processing and meat science should be major roles. However it was also identified that economic evaluation was also identified by some as one of the least important roles. In addition from the results, market research and product innovation were also seen as less important roles. In terms of market research and product innovations companies during general discussions indicated that these factors were up to individual companies to do, as this was where they could create competitive advantages. In terms of economic evaluation there were mixed responses, which could be reflective of individual companies' capabilities. There were some sceptics around how applicable economic evaluations can be to individual businesses and some companies are not keen to impart full details about their business for this to occur.

Additional responses from companies regarding other focus areas that industry sees as an important role for a Red Meat Processing Innovation Centre of Excellence within Australia were placed into five groups including; 1) education, training and capability building or sector capacity workforce development; 2) Information sharing and extension; 3) Relevance, equity and access; 4) Strategic comments and 5) Additional comments.

Greater than 70% of all companies surveyed thought that all meat processing and meat science related research was seen as either "very important" or "important" with the exception of an information storage database (59.2%). Although this is still a high percent it is possibly a lack of understanding about what role information storage or databases could play within a Centre of Excellence and how it might benefit individual companies.

4.3.4. What is needed to gain support for a Red Meat Processing Innovation Centre of Excellence in Australia

In terms of mitigating risk 76.9% (with 41% indicating "very important" and 35.9% "important") of companies (76.9%) would prefer to see new technology demonstration take place within a commercial processing plant. This notion has already been identified such that companies look to competitors and overseas to see technologies working commercially. Although 59% (with 12.8% indicating "very important" and 46.2% "important") of said they would like to see new technologies demonstrated within a Centre during the consultation there was much discussion around this answer, and it may depend on the form of the Centre and the nature of the technology. This outcome is most likely a reflection on the fact that a facility within a Centre would not be able to replicate true commercial conditions. The extent to which companies may offer special testing facilities (e.g. a section of chain so designated) is one such discussion point, and availability of such facilities will influence the form of the Centre.

Development of new technologies (engineering, evaluation, pilot testing and concept evaluation)

was shown as the most frequent "very important" response (43.6%). Hence these should be identified as important for the industry to support a potential Red Meat Processing Innovation Centre of Excellence, however considerations would need to be made on how this may occur depending on the form of the Centre and this will be outlined in the final report.

There was also a high level of importance for integrating application of technologies with product quality outcomes and evaluation of technologies for a "fit for purpose" (i.e. technology can function under varying conditions such as different chain speeds). When new product (meat product), market development, and economic understanding were investigated these were seen as the least important by the majority of the companies. There was a perception that during discussions companies saw this as where they made their point of difference compared to other companies. Based on industry reports there is scope that these concepts could be more important to export plants in terms of increasing international competitive advantage.

Results show that companies surveyed placed high importance for the Red Meat Processing Innovation Centre of Excellence to provide proof of principle to processors, and there was less enthusiasm about doing the same for producers, wholesalers, retailers and supermarkets. This notion could help narrow the focus of a potential Centre; however there is a risk that some innovations may not reach their maximum potential if other sectors of the industry are not included. Strategic planning and collaboration with appropriate bodies would help facilitate.

A number of key factors were identified based on open ended responses to what other roles a Red Meat Processing Innovation Centre of Excellence within Australia would perform to gain industry support. In terms of structure it was highlighted that collaboration is key. It was thought that it would need to be "be more collaborative and less political" and that a "Cooperative Research Centre (CRC) approach" would be effective. The benefits of CRC's with the encouragement and facilitation of industry led collaboration between industry and research (CRC Recommendations) have been well documented. It was also believed that collaboration between NZ and AUS is important and that we have made some mistakes in the past by not sharing. Previous collaborations have occurred in the past between MLA and Meat and Wool New Zealand and it is recommended that the outcome of this is assessed so as to guide any future collaboration. Notwithstanding the centrality of processor advantage mentioned above, "common issues across the country, with the same outcomes, building consumer confidence in our product, national goals, working together as a whole industry" were mentioned as aspects of a collaborative approach. It was identified that there is a need to have "organized innovation", "strategic planning" and the "development of blue sky research" and additionally "consider investment of a group rather than individual companies". Although it is unlikely that an innovation initiative can address blue sky research, linkages to it will enhance the productivity of both research and innovation.

The importance of people was also highlighted on a number of different levels. Firstly, it was raised that capability building within the industry is important. From those companies that already either had an innovation manager within or support through the CISTs program it was

portrayed that this was a good initiative and should be continued to be supported. However, for those SMEs it was portrayed that there was not enough support and from observations they were most likely companies that had less capability in terms of critical mass and understanding. It was raised that a potential Red Meat Innovation Centre of Excellence could be a potential source of support for this initiative. Additionally their seemed to be a need for better extension mechanisms around creating awareness of technologies and ultimately this can come back to the timing of dissemination of information around technologies (i.e. showcased when not a priority or real issue for individual company).

In determining what form a potential Red Meat Processing Innovation Centre of Excellence might take, **access** needs to be considered to try and ensure maximum usage. Access was also raised as an additional factor that would need to be addressed. Suggestions were outlined about being able to have an outreach program (training, demonstration) time off plant as it was frequently discussed as a cost to processors and sighted as a reason for not being always proactive. Australia is a large country and distance between places can be a barrier. There were concerns that if there was a physical structure it could reduce involvement due to isolation. Lastly it was commented that in today's society research and development doesn't need to be under one roof or focal point.

Some other alternative roles identified as critical for a potential Red Meat Processing Centre of Excellence to address include a cadetship program across companies and Universities. This concept has been proven to work effectively in the USA and has the scope to increase the innovation culture within a company. Accessing the corporate knowledge of older, experienced employees and improving reporting of what has and hasn't worked is important. This concept initially would most likely come down to the need to have right person for this (i.e. know what they are looking for and who would know) and hence would be a challenge, but there is certainly scope to improve on this reporting as we move forward in the future (advances in ICT have already assisted) but the library database concept could allow a more user friendly access.

Other critical factors that were identified as needs included the following; clearly identify needs of innovations, and hence there needs to be a demand and commercially relevant. However at the same time others said that there is a need to be visionary as it has been shown higher risk innovation will result in higher gain. This can be achieved by having a good understanding of plant and industry issues and constraints, compliance and regulation. It was also said that technical support has to be localised, this is important when considerations are made in overseas technology development. In order for any initiative to be successful there is a need to have the right people in the job, skills to co-ordinate, and address different levels and types of management both within plant and between plants.

Companies also expressed the view what they didn't want to see: overwhelmingly it was stated that they didn't want to duplicate existing facilities and hence it is recommended that an understanding of current physical capabilities is obtained when doing full cost analysis on the most appropriate model for a Centre. It was expressed by the majority that they didn't "want see

building" or a "white elephant" or even duplication of current initiatives. A Potential Red Meat Processing Innovation Centre of Excellence could give the opportunity to streamline current processes through increased collaboration. Some companies expressed that there is no need to cross over on what is already commercially viable. Presentation of such a Centre in terms of innovation capacity which interfaces with existing research and training capacity, will therefore be a key communication task.

An overall majority (69%) of companies surveyed are prepared to be involved with a Red Meat Processing Innovation Centre of Excellence at some level. This level of involvement ranges from consultation and setting of R & D direction to trial facilities, data collection and information sharing. There were 28% of companies that were "unsure" and this response was largely due to the fact of the "unknown", not fully understanding what the role and function may be made it difficult for some companies to commit. These responses do indicate that there is a significant amount of support from industry for a CoE.

Based on processing company's response to "who else they would like to see involved with a Red Meat Processing Innovation Centre of Excellence" it would appear that a collaborative approach is supported. The Australian Innovation systems report also discusses how the impact of innovation appears to be hampered by "poor management culture of innovation and collaboration" (Anon, 2014).

4.4. Summary - National Industry processor consultation

Based on the industry consultation key perceptions of risk and uncertainty around innovation, key drivers to innovation, key roles of potential Centre and factors industry will support were identified and are summerised (Table 23). Both the key perceptions of risk and uncertainty (barriers) around innovation and Key drivers to innovation were based on greater the 50% of companies surveyed considering the below trait as "very important". The summary of key roles of a potential Red Meat Processing Innovation Centre of Excellence (Table 23) were based on greater than 60% of companies surveyed viewing these roles as either "very important" or "important".

Table 23. Summary of key outcomes from national industry consultation.

Risks and uncertainty	Drivers	Key Roles	Support
Reliability of technology Access to support Loss of production during installation Cost Retention of skilled staff Finance (Profits or access to industry funds)	Labour costs Energy costs Consumable costs Upper level management Slaughter chain productivity Boning productivity Increase processing efficiency by minimising overall labour costs, contamination on chain, product loss on chain/boning/chilling) Maximise product quality Productivity per worker Optimising whole carcase Increasing potential number of markets Product quality (food safety, shelf life, visual quality, eating quality) Regulation (WH&S, animal welfare, food safety, environmental sustainability, HR)	Technology Development Technology evaluation Industry demonstration Meat processing and meat science research ○ Tech for slaughter/ boning ○ Technology for carcase evaluation and online measurements ○ Feedback to producers ○ Meat science and quality ○ Tech for manufacturing and fabrication ○ Traceability Library database Product innovation Education and training (industry/students) Other includes; ○ Information sharing ○ Extension, ○ Accessible to all ○ Collaborative rather than duplication	Majority prefer to mitigate risk of new technology through demonstration of technologies within a commercial plant compared to within a Centre. The Centre would need to foster the development of new technologies (engineering, evaluation, pilot testing and concept evaluation). The Centre would need to be both visionary and applied. There was significant support for the concept of a Centre. It appeared that based on the legacy of Fututech there was less support for physical structure. Highly supportive of a collaborative approach.

5. National and International processing technology development

This section relates to Activity 2 and 3 in the project methodology and the objective was to conduct a review of national and international processing technology development companies, new product development and the introduction of technology to industry. To address this task AgInfo Pty Ltd were contracted. As part of this process NSW DPI did provide a list of potential companies to AgInfo Pty Ltd. In undertaking the task AgInfo Pty Ltd did stray from the project brief and hence only the relevant findings related to the task will be outlined here. The report from AgInfo Pty Ltd is provided in Appendix 7 and lists a number of companies around the globe. AgInfo Pty Ltd further sub-contracted Dr Greg Sullivan to undertake the review in the US.

A number of critical issues were identified in terms of Australia and companies who operate in the technology development space.

1. There is a small potential market in Australia for developed technology which will limit local innovation.

2. The Australian companies working in developing technology are undergoing consolidation.

3. There are a range of companies that develop technology, from slaughter line and boning robotics to water and waste management. There are also companies that develop further processing machines and others that develop methods to measure carcase and meat quality traits. The challenge in working with such companies is apportioning IP and this will be a real issue in the future. Despite this a number of companies indicated interest in discussing how they could work with a "centre of excellence".

4. The Australian industry must always keep abreast of overseas developments in meat processing, adapting technology where applicable.

5. The Australian processing industry often operates on a low profit margin which limits reinvestment in abattoirs and thus technology.

It should be stated that the concept of a "centre of excellence" is often interpreted in terms of robotics and automation but this is a narrow interpretation that will not be imposed on the current project. Certainly processing is under a continual cost-price squeeze (see Appendix 7 Page 5 AgInfo Pty Ltd report), but it also faces the challenge of needing to improve the measurement of carcases and meat quality traits so increasingly stringent consumer expectations can be met. Further, environmental regulations will continue to demand that processors adopt more water efficient systems and implement waste management systems that reduce pollution.

AgInfo Pty Ltd was also contracted to examine models for the adoption of technology by the processing industry. Although lots of companies were identified (AgInfo Pty Ltd and Dr Greg Sullivan see appendix 7) there was scant information derived on pathways to the adoption of technology. However the concept of "integrators" (a concept used in the US) was raised. In this model the "integrator" works with a range of companies to identity technologies that could meet industry needs. In a limited way the company Robotic Technologies Australia Pty Ltd operates as

an “integrator” linking manufacturing companies to suppliers of robotic solutions, with the provision of technical advice as part of the model. A “centre of excellence” could provide this service to industry.

6. Review of National and International Research Centre’s

This section relates to Activity 4 in the project methodology. A review of previous and current national and international research Centre’s which relate to Red Meat Processing Innovation has been completed. The current International research Centre’s presented are examples of types of research models. Some were visited in person while others were contacted via phone and email. Additionally this section also reviews current initiatives and influencing factors which are seen to be of importance to a potential Red Meat Processing Innovation Centre of Excellence.

6.1. Previous Research Centres

6.1.1. Fututech

Fututech was envisioned as a means of addressing inefficiencies in the Australian meat processing sector in relation to the slaughtering of beef cattle. The Australian Meat Research Council commenced the Fututech concept in the late 1970’s with a focus on automated slaughter technology (Anon, 1996). This work was then funded by the Meat Research Corporation (MRC), which was a Rural Research and Development Corporation which was funded by a 50/50 partnership between the Commonwealth and the cattle and sheep industries (Anon, 1996). Fututech was seen as a radical, disruptive technology which would signal a complete departure from the conventional methods of meat processing (Pitt, 2007). Hence it was an initiative focused on reducing labor costs in meat processing through the introduction of new technology. The aim was to develop an automated slaughtering facility, including automated slaughter chain and mechanical guillotine (Martyn, 2014).

A goal set by CSIRO and Australian Meat and Livestock Research and Development Corporation in 1985 was to reduce production costs by 30% by 1990. In response to this a decision was made to build a prototype at Cannon Hill in November 1989 at a cost of more than $10m (Martyn, 2014). Following trials at Cannon Hill, an agreement was reached to test the commercial application of the technology at Kilcoy in Queensland with a plant being built in 1992. The project however was plagued by problems as it was particularly susceptible to breakdowns (Anon, 1996). Pitt (2007) reported that due to the disruptive nature of the new technology and the major impact it would have on industrial relations agreements, the Fututech initiative was developed under conditions of “extreme secrecy” and access to the research locations was strictly controlled. Hence much of the development was done without hands on industry input. Despite the engineering company commissioned to do the work having large scale global experience (BHP Engineering), detractors of the project highlighted the recruitment of engineers and technicians that lacked meat processing experience as a contributing factor to the lack of success of the project (Martyn, 2014).

Pitt (2007) also identified that the lack of engagement of industry and the extreme secrecy resulted in a lack of ownership by stakeholders and the commitment to support the project began

to decrease. MRC was eventually forced to abandon the $70 million dollar project and ultimately the plant was dismantled and sold off as separate components and trialled at other processors' facilities. Unfortunately this failed attempt of a highly ambitious plan has left industry cautious. Throughout the national processor consultation, Fututech was raised on many occasions and there were many within industry reluctant to pursue a model on this scale given the significant amount of risk.

Based on the information there is on Fututech there are many lessons that can be learned. Overall the Audit report summary (Anon, 1996) showed that there was;

A lack of research rigor

Unqualified costs and benefits

Ill-defined market potential

Poor project management

Essentially this was a 5 year project that never really had a strategic long term plan for implementation into industry. It is apparent that industry needs to be heavily involved in the development of the technology in order for it to be successful. This strategy is to ensure the technology is applicable; it is able to function effectively under commercial conditions and importantly industry has ownership and invested interest. For example, if industry is involved in the conception/brainstorming phase, this denotes their input and imparts a greater vested interest to make ideas work based on the feeling of ownership. An example of industry working alongside research and development was shown at DMRI (reported on later) where a qualified boner is teamed with engineers and they are stationed together. However, notwithstanding the acknowledged role of multi-disciplinarily in meat industry technical advance, Cannon Hill's experience with a non-meat-industry construction partner offers a lesson on its limits. More broadly, the narrow focus on labour cost reduction (perhaps reflecting contemporary concerns) may have generated a greater concern over commercial secrecy than would, for example, the goal of maximizing value per labour unit.

Any future Innovation Centre would need to have its purpose clearly defined. In particular it is important to understand what the size and scale of the market might be when considering the impact of the long term viability of any of the technological advancements (i.e. is there enough business to keep them afloat) and how will it be serviced long term.

6.1.2. CSIRO Cannon Hill

CSIRO is Australia's National premier research organization which delivers science and innovative solutions for industry, society and environment. CSIRO's primary functions are to carry out scientific research for the purpose of assisting Australian industry, furthering the interests of the Australian community, contributing to the achievement of national objectives or the performance of national and international responsibilities; to encourage or facilitate the application or utilisation of the results of scientific research; and to carry out services and make available facilities, in relation to science.

CSIRO Cannon Hill site (near Brisbane) was purpose built in the 1960's. The facilities at this site included; office and laboratory space, computer rooms, greenhouses, glasshouses, insectaries, controlled climate facilities, conference facilities, meeting rooms, an information Centre and other purpose-built buildings which were relevant to the red meat processing industry such as refrigerated transport, food microbiology, process engineering, meat industry services, pilot abattoir and food chemical safety testing.

Historically there were many technologies developed and trialled using the pilot abattoir which was an export approved abattoir. The advantages of the site were that it was located in close proximity to multiple commercial abattoirs and this made it easier to remove waste and by products. The facility did have some minor income streams outside of funded projects where "fee for service work" was conducted mostly focused on development of value added products (D. Ferguson, Pers. Comm). In 2007, there were significant budget cuts by the Commonwealth government and assets were scrutinized across the whole organisation. Given there were three different CSIRO sites around Brisbane, they were all evaluated including the Cannon Hill site. After considerations regarding different assets it was decided that it would be more cost effective to consolidate, hence in 2008 the Cannon Hill facility was closed. The existing facilities were over 40 years old and required significant refurbishment and modification within 5-6 years to meet the basic scientific and safety requirements of the organisation. Normal maintenance was not deemed to be sufficient to bring the facilities to an acceptable standard with the facilities at risk of becoming unsafe and redundant (Anon, 2007).

As a result staff were dispersed with meat science/food science staff either moving to a new facility built at Coopers plains which has strong food microbiology, fresh meat and value adding focus or staff were moved to the CSIRO Food Innovation Centre based at Werribee. Others left the meat science/food science sector altogether and the capability and capacity CSIRO in particular the meat science area has never recovered. This example provides alerts for the current study about vital considerations in both the design and operation of research facilities: the usage of physical pilot plant practice may be both irrelevant for commercial comparison and unsustainable; and the retention of professional and credible staff in functioning teams requires substantial commitment in terms of budget and research subject matter. These statements are reinforced in several of the case studies of foreign organisations that follow.

6.1.3. Meat Training Research Centre Victorian DPI

The Meat Training Research Centre (MTRC) was a three way partnership with Victoria University, Victorian DPI and Ammonia Refrigeration Industry Association. It was built in 1996. The Centre included meat science laboratories, a classroom, extensive refrigeration plant, and a licensed abattoir capable of processing small stock. The MTRC closed in 2014 and a new meat science laboratory has been built at Attwood (near Melbourne), but with no abattoir.

During the consultation phase Wayne Brown from DEDJTR Victoria (who managed MTRC at time of closure) and Matt Kerr (technical officer) were interviewed to firstly understand what the role of the MRTC was and why it is no longer operational. The Centre was used by:-

Victorian University as part of a food technology and food science course.

Ammonium Refrigeration Industry Association who in the early days ran a course for a week once a year.

AUS-MEAT to conduct a course every 4 weeks (this is now facilitated through TAFE)

Scientists in the early stages for R & D performed on pigs and then when the Sheep CRC eventuated there was significant work done with sheep.

When asked specifically about the abattoir the following issues were identified;

It was not utilized regularly (especially in recent times)

There had not been a kill since 2009

It was only for sheep and pigs

Throughput was about 20-25 per day

It was very labour intensive (manual fed)

There was a need to hire people to help run (often ex-slaughter men)

Disposal of meat was a challenge

Once the MRTC was built it was then up to VIC DPI to maintain it. In the early days there was capacity to do a lot of commercial work to offset the costs associated with running the facility, but this diminished over time. MRTC collected fees for delivery of courses, but this income stream was minimal. Success in securing R & D funds gave the Centre some financial certainty as they were able to offset some of the running costs against projects. However due to the nature of funding cycles and the diversity of project types, usage was not consistent from year to year and DEDJTR Victoria no longer saw it as a viable option.

We were unable to establish running costs, but feedback indicated that the costs varied significantly over the years. Fluctuations were generally as a result of major capital expenses (e.g. chiller breakdown). However, the fixed costs (that is costs incurred regardless of whether the plant was in use) were also significant.

In terms of conducting experimental work within the abattoir, some opportunities arose (like bleeding) but it was viewed as more advantageous to experiment in a commercial environment (i.e. spray chilling, electrical stimulation). This in part is due to the fact that technology can be superseded so quickly: as noted above this is a recurrent aspect of brick-and-mortar research facilities. The respondents also noted that in Victoria it would be appropriate to offer easier access to abattoirs for researchers and research end users.

As a result of these experiences, support for the construction of a pilot plant as part of a potential Red Meat Processing Innovation Centre of Excellence would seem mixed at best. Key challenges lay in the commercial viability coupled with concerns in regard to the cost of technological changes in order to remain relevant. A pilot scale abattoir would also most likely not accurately replicate the commercial environment (i.e. chain speed). A serious consideration for AMPC is the business model that would underpin the financial operations of a Centre and the longevity of their financial support or investment.

6.1.4. Meat Industry Research Institute New Zealand (MIRINZ)

In 1955, MIRINZ was established as an independent research association. It was charged with improving the quality of New Zealand export sheep meat. The foundation Director had a philosophy that research into basic meat science, especially muscle structure and function, would provide needed solutions for the meat industry. The facilities included significant engineering and meat science capabilities (capital and staff) (D, Wright, former director) and a small abattoir. It is notable that MIRINZ has never performed an explicit educational role.

Initially, the Institute was funded on the basis of a partnership between Government, the meat processors, and the meat producers - with Government and the industry providing roughly equal contributions. Since 1955, MIRINZ has had to adapt to substantial changes in the way it earns income. Two of these challenges occurred in the late 1980s; firstly the appointment of a Meat Research and Development Council by the Meat Producers Board, and secondly a change in Government's research funding from grants to a more competitive bidding process. Research became based on contracts dealing with issues that were 'non-appropriable' by commercial interests (D, Wright, former director). This is one approach to the ownership, and exclusivity of access to, research results. The separation of company, industry and public interest remains a challenge in the operation of institutions, particularly as applied to innovation.

MIRINZ became a standalone commercial research institute and therefore found it necessary to find new sources of finance, which included doing research for overseas clients and no longer restricting its interests to sheep and beef alone. This commercial expansion was forced on the Institute, as it could no longer rely on either the New Zealand meat sector or the Government to fully support its work. Ironically, the prohibition on serving private needs in New Zealand occasioned its serving private needs abroad. Despite developing into a viable commercial research organisation, uncertainty about research funding and shortfalls in guaranteed contract income led MIRINZ to merge with AgResearch in 1999 (which will be discussed in section 3.2.9). The resulting benefits have been that the MIRINZ 'brand' has continued and meat production and processing have become more integrated.

MIRINZ is best known internationally for its research on meat tenderness and the development of industrial techniques such as electrical stimulation to prevent toughness. Mechanical dressing of carcasses has been another major focus with the result that the New Zealand sheep industry is well known for its highly mechanised integrated carcass processing systems with resulting improvements in cost effectiveness, yields of meat and high hygiene standards. MIRINZ has also made large contributions to both the local and international meat industries in a number of other areas, including new packaging systems and systems to monitor and control storage and transport (D, Wright, former director).

The co-operation of meat sector companies has also played a major role in converting scientific information into technology that could be used in processing plants. Their various contributions include working alongside MIRINZ staff, allocating space and manpower to test ideas, identifying problems needing research solutions, and providing funds to support the Institute.

Although the brand of MIRINZ has been kept intact it has been shown that without ongoing industry funding MIRINZ was not viable as a standalone organisation. MIRINZ in the past has also demonstrated to be highly effective in developing and researching technologies for the meat industry. Since AgResearch took over MIRINZ significant changes have occurred. This is evident by the rapid decline in staff numbers and a scaling back in activity over time (C, Craigie, pers comm). This scaling back would indicate that these areas were not seen as viable by AgResearch. What MIRINZ did particularly well was work side by side with industry effectively.

6.1.5. Summary of Previous Research Centre's

Form

All four previous research Centre's reported here had significant capital in "bricks and mortar". Despite the unprecedented investment in Fututech, there was no benefit reported from this type of structure. The concept of Fututech was to develop a fully automated beef slaughter floor, but outcomes fell well short of this. MTC, CSIRO and MIRINZ were able to show that they all had benefits in;

Developing technologies that were transferred successfully into to industry
Useful for critical experimental collection of samples (bleeding)
Generating small incomes (renting of facilities, commercial test product, project funding)

However both pilot plant facilities at MTC and CSIRO showed that they were not feasible in the long term due to the following reasons;

Aged facilities needed significant work to be viable (CSIRO)
Underutilisation
Slow through put
Labour intensive
Staffing
Removal of product and by-product (MTC)
Maintenance

Before MIRINZ was taken over by AgResearch the pilot plant was still operational however now the facility has been sold and operates as a small commercial abattoir.

Funding

The funding model for each Centre was slightly different, but ultimately they all failed due to the respective Centre's not been able to develop financial independence. Fututech was 50/50 funded with industry and Commonwealth government. MTC, was initially set up by industry, university and state government, but then was maintained by state government and relied on industry funded projects heavily for it viability. CSIRO was a federally funded initiative, but also relied on some industry funds. MIRINZ was initially a government and industry partnership which appeared

to work well whilst there was continuous funding. When a more formal industry body was formed and funding became competitive and based on projects, MIRINZ began to struggle and eventually merged into AgResearch and since then resources and capabilities have been significantly scaled back. In terms of funding, the common outcome is that a continued source of funding is required to keep facilities functioning.

Innovation transfer strategy

Fututech did not appear to have a strategy, other than to demonstrate a fully automated slaughter floor, however due to the lack of success the strategy failed as did the project. Additionally as highlighted there was little hands on industry engagement. Conversely this is what MIRINZ in particular had proven to do successfully and this was identified to come from working alongside groups and having a strong relationship with industry. The CSIRO facility also showed success in development and implementation of technologies, this was most likely aided by their extension group that they had and additionally their close proximately to multiple beef processors.

6.2. Examples of existing Research Centres

A number of international research centres were visited by Justin Roach (AMPC) and Edwina Toohey (NSW DPI) over a two week period to obtain an understanding of what is happening overseas and what research models (or parts thereof) are working and what is not. To achieve this five research centres were visited in Europe and three in the United States. Additionally given our close proximately and relationship with New Zealand a research centre was also included and contacted via telephone by Edwina Toohey.

6.2.1. Institute of Agrifood Research and Technology (IRTA) –Spain

IRTA is a research institute owned by the Government of Catalonia ascribed to the Department of Agriculture. It is regulated by Law 04/2009, passed by the Catalan Parliament on 15 April 2009, and it is ruled by private regulations. The general objectives of the institute are to promote research and technological development in the area of agrifood, to facilitate the transfer of scientific advances and to evaluate its own technological advances whilst seeking the utmost coordination and collaboration between the public and private sectors. Since it was founded, IRTA has sought to establish long-lasting collaboration agreements with other public bodies that operate in Catalonia in the areas of technological research and development. This approach has led to the creation of a consortium network of centres (involving IRTA, universities, CSIC, public- sector bodies, etc.), which is, in effect, an R&D cooperative system.

Legal status

The IRTA is a public law entity with its own legal status, under private sector law with full capacity to manage its own assets for the fulfilment of its duties. The Institute has full functional and management autonomy and remains attached to the department responsible for agriculture and food.

Organisation

The *Governing Council* exercises the governance and administration of the Institute of Agrifood Research and Technology. IRTA reports to the Minister of Agriculture who is the President of the Board. The *Advisory Council* is the technical advisory body of the Institute of Agrifood Research and Technology. Organisational goals include; to become a scientific and technological reference, an engine of innovation and technology transfer, and be a strategic partner of the agrifood industry.

Operational focus

IRTA operates a number of different Centre's strategically placed in locations appropriate for the subject of research undertaken (e.g. they have hubs). It operates under 5 broad areas which includes 18 programs and 38 subprograms. The 5 areas of operation are:

Food Industry
Environment/Climate Change
Plant Production
Animal production
Economics

IRTA works across the whole supply chain from "farm to fork". They demonstrate flexibility to adapt to the changing demands of industry and investment sources: hence they will go where the money is. IRTA provides services in research and development, industry support, contractual research, technology transfer, technical assistance and training with 80% R&D and provision of industry support and 20% professional development and teaching. In terms of animal production their main focus is pigs, accounting for 60% of their work, beef accounts for approximately 20% and poultry and lambs account for the remaining 20%. This is reflective of production levels of these species in Spain. Reducing labour and energy costs is important to the work they do within meat processing.

IRTA employs innovation managers to handle knowledge transfer and broker relationships between IRTA and industry (similar to MLA CISP Managers). This is done on both a national and international level. In terms of the relationship with the processing sector it was identified that "it is always hard" such that large scale processors will continue to invest, small ones are open to new things, however "old" ones won't change. Hence barriers to adoption of new technologies generally relate to the economics and culture of the industry and businesses. Export businesses are reported to be more likely to automate processing tasks.

In the big picture there does appear to be some inefficiency in the way their research is carried out on a fee for service basis. Due to the confidentially agreements between research and the private sector common issues can be raised and examined multiple times without results being openly available (this is a very different concept to state and federal research organisations within Australia). As a result often sample numbers are small and this impacts on the validity of results.

Main influencing factors in the evolution of the organisation

Strategic to partners in agrifood industry hence they provide a lot of fee for service type work. As a result this work can cater to special interest rather than commercial drivers of industry performance.

Industry need – collaborations & tenders

EU – Horizon 2020 is the biggest EU Research and Innovation programme ever with nearly €80 billion of funding available over 7 years (2014 to 2020). It is a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness. The Horizon 2020 is a major influencing factor for IRTA as it has helped shape their strategic direction due to the significant amount of funding available. Horizon 2020 is an important funding mechanism for a range of short and long term projects. Funding rounds are quite general to allow projects to be scoped accordingly.

COST is the longest-running European framework supporting trans-national cooperation among researchers, engineers and scholars across Europe. It is a means to jointly develop ideas and new initiatives across all fields in science and technology. COST is an important funder for IRTA and they are significantly involved in the COST Action FAIM group (Discussed in section 6.3.6).

Evaluation of performance

During the visit to IRTA they outlined the organisations specific process for measuring excellence in their outputs and Key Performance Indicators. These are notably oriented toward research, rather than to innovation. They use 3 indexes as Illustrated in Fig 12, where:

h= scientific output index measures by the Impact factor of a Journal

tt = "The main goal of Technology Transfer: transfer knowledge and technology to the primary sector and industry by increasing our impact in society" measured by

- t^1 – technical dissemination (extension services, technical seminars, consulting etc)
- t^2 – presence in media, journals, TV, radio, etc
- t^3 – research valorization = measures the deficit of scientific programmes.

e = (personal cost + expenses) - income

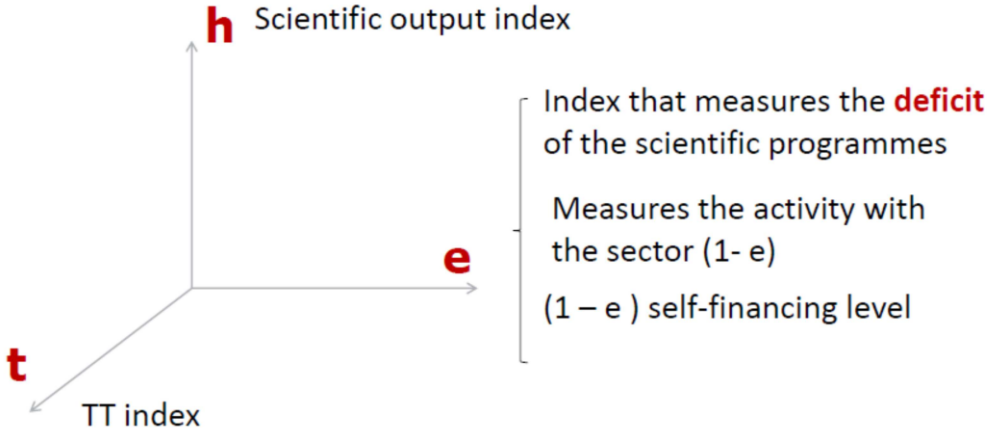


Fig 12. IRTA Key performance indicators

IRTA also showed their Valorization model on assessing risk (Fig 13). Valorization can be defined as "a process of adding value". IRTA describes 3 valorization models, 1) Valorization supplier client – this is a fee for service and low risk, 2) Valorization: shared risk – joint venture and buy in and considered medium risk and 3) Valorization: shared risk and establishment of new company – high risk.

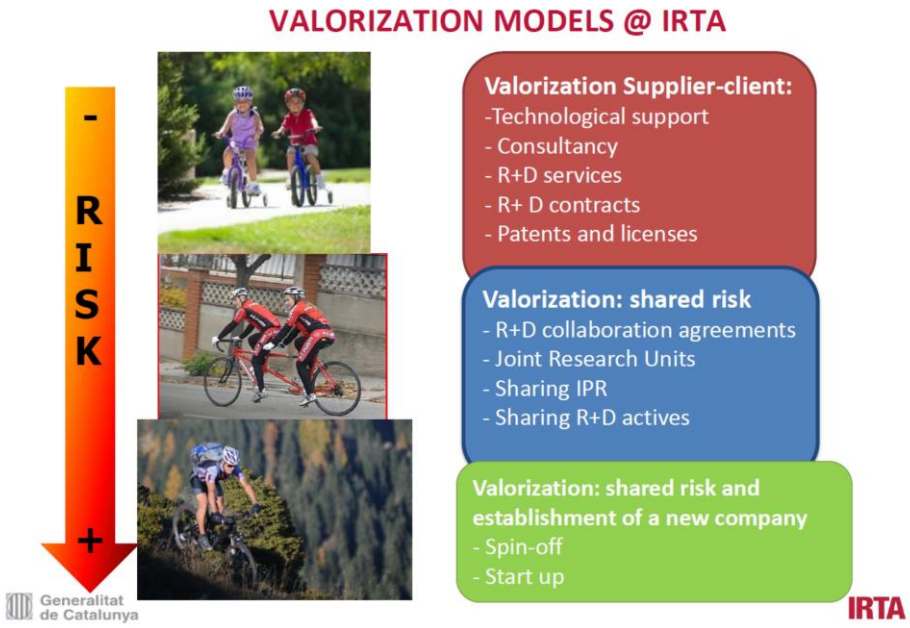


Fig 13. IRTA assessment of risk

Current areas of work

IRTA is currently in a rebuilding phase, responding to funding cuts as previously there was more than one funding provider. IRTA had also recently been acquiring existing research providers' assets due to their closure. IRTA is asset rich, but lack operational funds to maintain/expand. These changes have resulted in IRTA becoming more of a service provider than a leading researcher. Their expertise is offered on a fee for service basis to generate revenue, with many staff on a contract basis. IRTA operates under collaboration agreements with industry. These tend to be on a ¾ year basis and IRTA acts as the R&D supplier to a company. IRTA is more focused on undertaking R&D than providing engineering capability for the development of new technologies to avoid issues with IP. IRTA has undertaken Joint Research Agreements with R&D companies in New Zealand and Uruguay. They did note that in the past they have had better success in collaborating with other Spanish speaking countries because there were fewer language barriers.

IRTA Facilities

Infrastructure is a major strength of IRTA as demonstrated at the Monells Centre. The facilities include research laboratories (food science, meat science, plant science and microbiology), pilot abattoir, other pilot plant facilities (wet rooms) to develop and evaluate machinery (High Pressure Processing, slicers, CT scanner) and sensory testing facilities. The laboratories were used regularly, but the pilot abattoir seemed underutilized and was said to possibly process 300 pigs

per year, but this was really dependent on what project work was happening. There were also issues removing meat and by-product, having suitable staff and sufficient throughput (a quite intensive task). Additionally given that most of their work has come from industry approaching them with issues, often the research is conducted under commercial conditions and then samples are brought back to the lab for processing (a model used by a number of Australian R&D groups). The wet room areas were therefore more utilised to help develop further processing technologies. These facilities were shared with industry (to test and validate equipment) which would co-fund the running costs 50/50. Also given the size and overall diversity of the organization, the industries served, and the various stakeholder bases represented, IRTA is able to spread the costs of the high level of assets over a number of industries reducing their financial exposure.

6.2.2. Teagasc – Ireland

Teagasc is the national body providing integrated research, advisory and training services to the agriculture and food industry and rural communities. Its mission is to support science-based innovation in the agri-food sector and the broader bio economy that will underpin profitability, competitiveness and sustainability. Meat research constitutes 30% of work undertaken by Teagasc with 20 full time researchers appointed to undertake this research. Additionally, 40-60 contract researchers are employed as well as 20-30 PhD students.

Legal status
Teagasc was established in September 1988 under the Agriculture (Research, Training and Advice) Act, 1988.

Organisation
The 11 member Authority is appointed by the Minister for Agriculture, Food and the Marine and has representatives from the farming organisations, the food industry, universities, the Department of Agriculture, Food and the Marine and Teagasc staff. Teagasc employs 1,100 staff at 52 locations throughout Ireland. Part of the mission is to provide science based support for the red meat industries in Ireland. Teagasc has 3 levels:

Research
Education
Advisory

Teagasc is not a levy funded organisation. Major funding comes through Meat Industry Ireland and Enterprise Ireland who fund a broad range of industry R&D. In general services/contracts value approximately €4.4 million annually for the Ashtown Food Centre department within Teagasc. The organisation is funded by; State Grant-in-Aid, fees for research, advisory and training services, income from national and EU competitive research programmes, revenue from farming activities and commodity levies. Teagasc as a whole organisation has an annual operating budget in excess of €160 million and operates in partnership with all sectors of the agriculture and food industry and with rural development agencies. It has developed close alliances with research, advisory and training agencies throughout the world and is continuously seeking to

expand international contacts. Around 75% of Teagasc's yearly budget comes from the Irish exchequer (National Treasury) and EU funding with the balance generated from earned income. Some 40% of the budget is devoted to research with the remainder split half and half between advisory and education services. Interestingly there is a significant proportion of the budget spent on advisory and education activities. This is a potential service a Centre of Excellence could provide to increase the rate of adoption of new technologies.

Operational focus

Meat research constitutes 30% of work undertaken by Teagasc with 20 full time researchers appointed to undertake this research. A major capability decline in Ireland's industry has occurred in process engineering. This is due to a lack of funding as manufacturers now supply directly to meat processing plants. Tyndall National Institute is one of the few that have significant engineering capabilities.

A major barrier to technology adoption is reported to be the conservatism of the industry. Teagasc's transfer model which addresses the barriers to effective technology transfer have included "knowledge management" and having key people and key structures to showcase what Teagasc can offer. They hold a national network forum called "Food Innovation Gateway" every two years, where 20 researchers are selected and developed "in-house" to provide effective communication to industry at the event. A major aim of Teagasc is to partner researchers who can connect with industry and communicate with stakeholders to provide effective extension and knowledge transfer. In the past this has been a major barrier as scientists have been poor communicators to industry. Technology transfer channels include IP explanation, contract research, strategic partnerships, training, services and pilot plant.

Main influencing factors in the evolution of the organisation

Markets have begun to open up for beef following industry disruption (Bovine Spongiform Encephalopathy (BSE) and milk production declining due to a drop in quota prices) which has resulted in an increase in beef production. The industry in Ireland is heavily export orientated (90% of beef is exported and half of this is to the UK and the other half to Europe), hence, they must comply with the regulations of each country they export to. Aligning with Horizon 2020 is important for funding especially given Ireland does not use an industry levy system to derive revenue for R & D.

Current areas of work

Teagasc in collaboration with University College Cork have recently been notified of their successful bid for a Meat Industry Centre of Excellence in Ireland. This Centre will be funded 75% by the Irish Government and 25% by industry. The Centre will most likely be "virtual" in nature with hubs. A major focus of the Irish Centre of Excellence is the supply chain with a key component of the Centre of Excellence being the demonstration of new technologies. However, more details on this will be discussed in the final report as the details of the Centre are currently been finalized. This provides for an interesting discussion of form vs function of such a Centre: specifically whether a demonstration function is best served by a virtual form; and if so how best to enable the information dissemination from such demonstrations.

Facilities

In terms of food science, meat science and technology development, facilities included a veterinary approved abattoir, boning halls, chillers, freezers, cooked meat facilities, smokers, consumer testing, wet areas, food preparation areas, laboratories (food science, meat science, microbiology). These facilities have provided a role in the development and evaluation of various technologies (electrical stimulation, Pi-Vac, HPP). Currently the pilot abattoir is underutilized, partly due to speed and throughput. The pilot plant is designed to slaughter beef and they have the capacity to kill 12 animals per day. It is now used only for proof of concept and all other experiments are conducted commercially. Other issues which impinge on the usefulness of the abattoir include; having the required staff during kills and moving meat and by-products. The cooked meat facilities/wet areas are often hired out by commercial companies who wish to test products under controlled conditions. The laboratories are fully used for meat quality and food safety testing.

6.2.3. SRUC -Scotland's Rural College

Scotland's Rural College delivers comprehensive skills, education and business support for Scotland's land-based industries, founded on world class and sector-leading research, education and consultancy.

Legal status

Academic and government funded not-for-profit business is conducted through SRUC, while commercial (for profit) activities are conducted through SAC Commercial Limited. The SAC Consulting Division's business is addressed by the SAC Commercial Limited Board. The SRUC Board and the SAC Commercial Ltd Board are both chaired by Lord Jamie Lindsay.

Organisation

2014 marked the first full year of SRUC, Scotland's Rural College. During this time considerable progress was made towards bringing together the former land-based colleges of Barony, Elmwood and Oatridge and the Scottish Agricultural College into one organisation. Some of the real benefits of the merger have begun to be realised with a renewed emphasis on the value of the integration of research, education and consultancy activities. SRUC has both consultancy and advisory divisions and is comprised of:

- 6 campuses
- 25 farm and rural business offices
- 8 vet facilities
- 7 research farms

Operated as a public sector entity, SRUC can claim charity status. Consultancy is fee-for-service for which industry members pay directly. Funding arrangements for SRUC include 40% funding from government and 60% funding from outside government e.g. consulting.

Operational focus

SRUC's vision is to lead innovation and sustainable development in agriculture, land and the rural sector. Their global aims are to create SRUC academic resources which have national impact and global influence; to be an international leader in land-based research and consultancy services; to be a sustainable, well-resourced organisation with exemplary environmental credentials and real ownership amongst students; staff and stakeholders and to continue to build on their assets and reputation. SRUC work across 3 research areas:

Land, Economy, Environment and Society
Animal and Vet Science
Future farming systems

SRUC does work across a range of species with beef genetics a key area. Research and extension used to sit under the same section and now have been separated out and this is problematic.

Current areas of work

SRUC reports a focus on blue sky research and particularly on applied research and its benefits to industries. This appears to be serving an awkward mix of public and private interest, and also begs questions about the place of innovation in SRUC's portfolio as there did not seem to be any innovation strategies. SRUC has collaborations with R&D Centre's in over 55 countries (mix of UNI and public sector institutes) and attracts a lot of international students and in general have no issue in finding people to undertake PhDs/scholarships given their location in the UK and EU.

Project/research work tends to be bottom-up funded. Innovate UK is a new group that SRUC intends to work with further into the future to leverage R&D funding. SRUC has many of the issues associated with industry input (e.g. short term view, business-centric thinking) and research in Scotland, like in Australia, is dictated by business needs. Barriers to technology adoption have been identified in terms of fear of lost jobs within industry as crucial. A major issue in the past has been that scientific research has not been undertaken to address industry needs, showing a research lead approach rather than industry lead approach. The structure of a potential Red Meat Processing Centre of Excellence should ensure an industry led approach in collaboration with research providers.

In terms of accelerating adoption rates a key strategy for SRUC is linking business and academia through; knowledge, know-how, innovation; relevance of research; provision of equipment and capital; research funding. Providing effective forums for this to occur are highly critical in the development of any new work.

Facilities

The facilities of SRUC are focused at on-farm and or live animal production as that is SRUC core business. Facilities include, experimental farms (livestock and crop species), plot-scale agronomy trial capability, nitrous oxide emission measurement equipment, individual food intake measurement, facilities for dairy and beef cattle, methane measurement facilities for livestock, suite of techniques for monitoring animal behaviour, CT and ultrasound scanning, animal and crop science laboratory facilities and conference and teaching facilities. The part of SRUC that we

visited was new due to the recent change in structure with the combining of multiple organisations and as such the success of this structure is yet to be verified.

6.2.4. DMRI – Danish Meat Research Institute

The Danish Meat Research Institute (DMRI) is an international leading research and innovation Centre within food of animal origin and a subsection of the Danish Technical Institute (DTI). The purpose of the DMRI is to assist its customers in improving their competitiveness. The Institute adopts an interdisciplinary approach to innovation and to the task of improving the ability of small and medium-sized companies to exploit new technologies and combines state-of-the-art technical facilities to provide leading edge solutions to operational and technical problems.

Legal status

The Danish Technological Institute (DTI) is an independent, not-for-profit institution. It has been approved as a technological service institute by Danish Ministry of Science, Technology and Innovation. The Institute was founded by Gunnar Gregersen in 1906 as an independent institution and is one of the oldest of its type in the world. The Board of Representatives consists of up to 33 members appointed by the leading interest organisations in Denmark.

Organisation

The DTI is divided into seven divisions each representing specialised technological and industrial knowledge; together they constitute a multi-disciplinary competency platform offering world-class development, testing and pilot production facilities. Combined with the close collaboration between the divisions and the business community, their high-technology platform is decisive for their ability to create innovative and technological solutions that work. Key figures 2013 for DMRI include: turnover €17.8 million, Danish commercial turnover €5.2 million, R&D activities €11.8 million, Performance contracts €0.8 million; with 120 employees.

It is important to note that the Danish agricultural sector (particularly the pork and dairy) operate essentially in a vertically-integrated manner occasioned by farmer co-operatives' ownership through all stages excluding retail. Retail influence is however constrained by the dominance of exports in Danish production.

Operational focus

The aim of DMRI is to develop solutions for the meat industry and provide domestic and international consultancy and training within process design, productivity improvement, product quality and hygiene to abattoirs and processing companies. DMRI also focuses on methods and technologies for efficient production of safe meat products of high quality at competitive prices. The majority of R & D has been focused on the pork industry (95%), poultry (3%) and beef (2%).

The primary objective of DTI's ideas and innovation department is to support scientists, inventors, entrepreneurs and innovative companies in conducting efficient development of new products and business ideas. DTI assists the idea owner from the initial stage of idea generation to the final stage of commercialisation. From our visit they stated how "they try to stay ahead of the game

before industry has the problem". This is a very proactive approach to R & D and could be a good philosophy for a Red Meat Processing Innovation Centre of Excellence within Australia. Additionally they have kept a narrow focus as "they can't be good at everything". These focus areas change every 6-7 years to adapt to industry. This would be a challenge for a physical Red Meat Processing Innovation Centre of Excellence given the diversity of issues across the industry. In order to service the whole industry there would need to be a vast set of expertise and hence to achieve this perhaps a multidisciplinary collaborative approach is needed to have the capability within identified focus areas.

DMRI internal projects tend to be initiated on a yearly cycle and project management based on Gantt charts to track progress. This chart was inspired by experience of working within a factory. The model includes maturation, co-creation, partnering, project catalogue, qualification and funding (Fig 14).

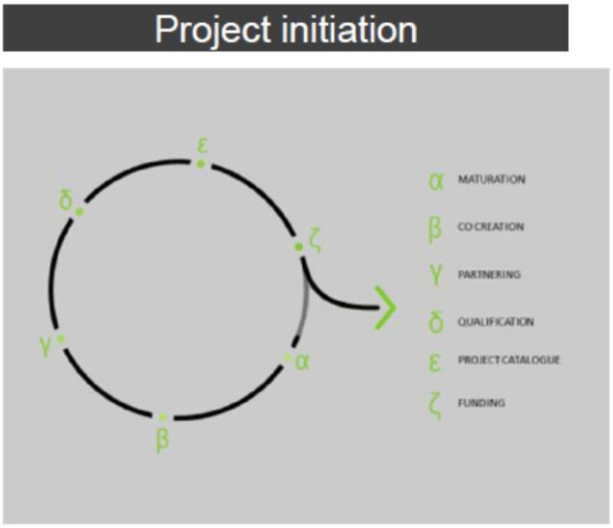


Fig 14. DMRI project initiation

This concept which they term an innovation model is not a project management tool. It identifies the project status and how it aligns and connects to the broader program and industry priorities and more of a stage-gate approach is utilized (Fig 15). Extension is a key component to this model and all projects are organised and delivered through this framework. This standard approach allows a constituent communication of project outputs.

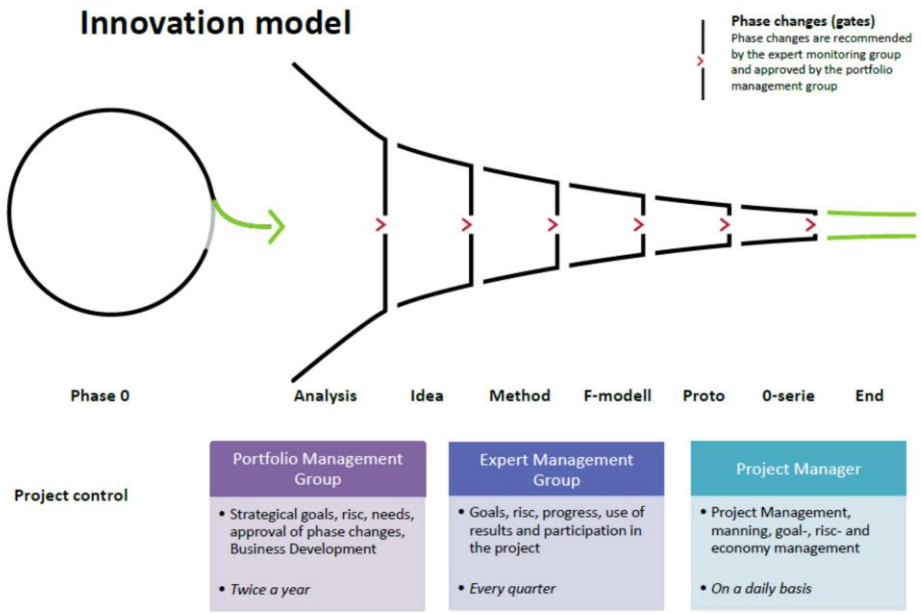


Fig 15. DMRI innovation model

Commercial contracts with industry are based on six concept areas; factory design, yield improvement, process improvement, capacity improvement, quality improvement and development of new equipment. DMRI has focused on having a business model that is stable yet flexible and is designed to be current with industry needs to continue to get buy in. DMRI have identified having critical mass as very important however the number of employees at DMRI has reduced by 50% over the last 10 years while the value of pork has increased. DMRI tend to invest in longer term projects (approx. 75% of project) compared to the current funding process within AMPC where long term projects constitute only 25%.

Current areas of work

DMRI is focused on research that will 'change the game' i.e. disruptive research and this notion is supported by a department of industry report in Australia which concludes there is greater return on new to market innovation (Anon, 2014). It was estimated that DMRI research outcomes have saved the Danish meat industry more than €300 million per year.

A levy funding committee including industry members and scientists is used to identify research priorities however this group does not have the final say on what is put to tender or funded. The Institute is dependent on significant government funding, however they aim to grow the consulting and fee for service streams where 57% comes from levy and associated funding ($6 levy per head) and 42% from contracting e.g. consulting.

FAIM (Section 6.3.6) has been beneficial to DMRI through the exchange of know-how between individuals. DMRI develop monthly profit/loss information to ensure sustainability and efficiency of staff. DMRI believe industry collaboration is "key" to any research project undertaken.

Facilities

DMRI had recently downsized and moved to a new facility. They have access to meat science and consumer testing facilities, a full commercial kitchen, chillers and freezers, engineering workshop, office space and library. An interesting "knowledge transfer" concept was the use of office space (in terms of technology development) where boners and engineers shared a common office allowing for cross pollination of ideas. Another interesting concept was a "mobile truck" that contained a variety of different equipment such as a CT scanner, this concept allows the technology to be taken to commercial abattoirs to either be developed, trialed, or used (the University of Melbourne has a similar mobile truck with a DEXA). Depending on whether technology was unloaded or product tested within the truck would depend on the level of commercial replication and is something that could be considered for a Red Meat Processing Innovation Centre of Excellence.

Overall there are many aspects of DMRI that have been proven to be successful for the organisation. These include; CO_2 stunning, automation of slaughter and boning in the pork industry and more recently meat quality measurement and CT scanning. DMRI has a unique advantage in being able to draw on skills and expertise from other industries that fall under DTI and also that is mainly works with the pig industry. Additionally it appears they have a high critical mass of expertise which evolves over time. This critical mass (of staff and resources) is largely a function of the longstanding reputation of DTI and DMRI being established over 100 years ago. To achieve this level of critical mass under one roof could be a challenge for a physical Red Meat Processing Innovation Centre of Excellence in Australia. A further attribute of DRMI is its inherent alignment with production agriculture by way of the vertically-integrated meat industry: this allows exploitation of co-innovation and within-value-chain relationships which can enhance the quality, extent and rate of innovation. In terms of the automation of slaughter technology in pork this has largely been achieved because of the uniformity of the product coming in and hence is far less complex product to deal with compared to sheep and beef.

6.2.5. Georgia Tech

The Food Processing Technology Division (FPTD) develops innovative technology systems to enhance the productivity and competitiveness of Georgia's food processing industry. The Georgia Tech Research Institute, FPTD works collaboratively with university and industry partners on projects involving robotics, advanced sensors, environmental treatment, and worker and food safety technologies.

Legal status

The Food Processing Technology Division is part of the of the Aerospace, Transportation and Advanced Systems Laboratory at the Georgia Tech Research Institute, the nonprofit applied research arm of Georgia Tech.

Organisation

The Georgia Tech Research Institute (GTRI) employs nearly 1600 highly-skilled people and conducts more than $200 million in government and industry sponsored research each year.

During the fiscal year that ended June 30, 2014, GTRI recorded revenue from contracts, grants, and other sources totalling $305 million, compared with $300 million for the previous fiscal year and undertook a range of defence related projects accounted for 90% of their activity and agriculture related work accounted for 10% of their activity.

GTRI is a non-profit applied research and development organization. All proceeds from contract research and development are invested into the enhancement of capabilities and facilities to further GTRI's educational and scientific mission. Investment break-up is education (5%), outreach (10%), research (75%) and technology assistance (5-10%). GTRI is funded through 50% University/Government contracts and 50% consultancy contracts.

Operational focus

FPTD's vision is to be the technology innovation and development provider that enables Georgia to be the undisputed leader in poultry, agribusiness and food processing. The goal of FPTD is to transition technologies from concept to commercialisation, as quickly and economically as possible. Georgia Tech has developed four contract mechanisms that enable industry to engage with researchers at all stages of R&D. These agreements were carefully crafted to streamline the contracting process and provide straightforward intellectual property terms for companies engaging in collaborative research.

The four contracting mechanisms are as follows, and they exhibit varying adherence to innovation support:

Basic Research: Explore fundamental challenges in a technical area,
Applied Research: Identify solutions to real-world challenges,
Demonstration: Improve an existing technology
Specialized testing: test new and existing products.

Research is split across 2 components; firstly exploratory research that is high risk/high reward disruptive research (often they will fund 6-10 projects per year). FPTD will generally provide seed funding (Ave $40K) for proof of concept then if successful this would feed into a full research programme with longer term goals, but be less risky given the proof of concept stage. The second component of research is standard research and is generally based on one year contracts and this is the most common form of funding. The form of funding however was seen as very short sighted and restricted the ability to solve bigger picture problems as well as being quite inefficient. Issues associated with industry based research are similar to those experienced in Australia, in that industry is set in its ways and often too narrowly focused on short term small gains. This concept has been shown to achieve less return on investment within Australia (Anon, 2014). A Red Meat Processing Centre of excellence could act as a mechanism for encouraging longer term blue sky programs for greater long term industry gains.

Education of the stakeholders is generally done using field days and additional outreach services including the publication of Poultry Tech, Poultry World and National Safety. Within the poultry Tech publication, researchers' photos are placed with stories to lift profiles. The technical assistance program is focused on a defined small industry problems, this service can be provided

at a moment's notice. An example might be 1-2 days' work plus a report and they have 5 main people that service this area.

Advisory committees guide investments made by the institute. These groups are made up of researchers and industry representatives. How the advisory committee is set up for any potential work conducted by a potential Red Meat Processing Innovation Centre of Excellence is an important consideration. Based on visiting GTRI, having both industry and research representatives has been critical to their success. GTRI investments are long term based and aligned 5, 10 and 30 year strategies.

Current context

Georgia Tech operates with other universities through partnership agreements, the engineering program is a new initiative and mainly focused on poultry given the location in the US. FPTD has been in operation for approximately 10 years with state of the art engineering facilities and falls under the umbrella of the broader Agricultural Technology Research Program.

Disruptive research is critical for further advancement of this institute and the industry in the US. The poultry 2030 vision (a US program) is a clear guiding initiative for future investment in the industry. Test-beds are utilised to determine the value technological R&D will have for an industry. The institute acts as not only the engineer, but also the selling force marketing engineering solutions to industry. It appears that having a successful outreach program is an important key to any Centre of Excellence model as it proves the worth of the Centre to its constituents.

Regarding IP management, any technology developed by the Institute must stay with the University. This can then be licensed to companies to use, but clearly enters the University's balance sheet and becomes a saleable asset. This is a Federal mandate so Universities do not become competitors to industry.

There is no levy funding available for chicken, but there is a tariff on beef, pork and dairy producers. Fees go to a check off system which funds state interests and research of a short term nature.

Facilities

The FPTD was relocated to a new purpose built facility 10 years ago and includes office space, teaching facilities and a multi-purpose engineering and technology testing facility and post graduate student facilities. These rooms surrounded a big workshop area which could be viewed through glass all around the building. The workshop is available to engineers and students and to some commercial companies. The overall design and working function of the facility appeared to be well utilised and was simplistic as previously mentioned and although they are able to use the facility as a test – bed they still raised issues in transferring these technologies to industry.

6.2.6. Texas A & M

The Texas A&M University System was officially established in 1948 and has evolved into one of the largest systems of higher education in the US, with a state-wide network of 11 universities, including their flagship, Texas A&M University, and ten regional universities across the state. The Texas A&M System, has a total operating budget of $3.8 billion. The Animal Science department strives to meet the needs of all stakeholders by providing outstanding teaching, research and extension programs.

Legal status

The Texas A&M System is governed by a nine-member Board of Regents, appointed by the governor and confirmed by the Texas Senate for six-year terms. A non-voting student member was added in 2006. The A&M System chancellor oversees the day-to-day administration, and each of the A&M System's 19 members has a president, CEO or director. The Board of Directors of the Agricultural and Mechanical College of Texas initiated the development of the Animal Husbandry Department in 1903. In 1965, the department became more encompassing and was renamed the Department of Animal Science.

Organisation

Texas A&M was established under the states land-grant system meaning that the university is an institution that has been designated by its state legislature or Congress to receive the benefits of the Morrill Acts of 1862 and 1890. The original mission of these institutions, as set forth in the first Morrill Act, was to teach agriculture, military tactics and the mechanical arts as well as classical studies so that members of the working classes could obtain a practical education. The A&M System's agencies, which conduct research and bring practical applications of research findings to the people of Texas, also came out of the land-grant system. There is now at least one land-grant institution in every state and territory of the United States, as well as in the District of Columbia.

Operational focus

Disciplines within the department include reproductive physiology, animal breeding and genetics, food science, microbiology, equine science, dairy science, animal nutrition and meat science. The department responds to the Texas animal industry through research and education programs in equine, beef, dairy, swine, sheep and goats. Income sources for Texas A&M include consultancy, on-site butchery provides turnover, delivery of information courses such as beef industry 101, and Texas BBQ industry training.

Many of the animal science faculty staff, hold joint appointments with the Texas A&M AgriLife Research and Extension arm of the land-grant system in agriculture. Texas A&M AgriLife Research and Extension Centres conduct basic and applied research to improve the productivity, efficiency, and profitability of agriculture while helping to conserve natural resources and protect the environment. A new program has been developed to help bridge the gap between companies and universities so all parties are better integrated and know what each other are doing. The faculty's focus is the training and education of students seeking careers in meat and livestock

industries. There has been a greater push on internships which is a great opportunity for the student to get a taste of different roles within abattoirs or industry and employees get an opportunity to know students. The Masters of Agriculture Program is the flagship program of the faculty (it is specifically more hands-on than other programs and particularly relevant to meat processing). It also encourages students to stay in the industry. Approximately 50% of PhD students coming out of the faculty are transferring directly into the industry with many embedded within abattoirs. This appears to be an excellent initiative and should be considered as a possible function of a Red Meat Processing Innovation Centre of Excellence, in order to increase capability and skill across the industry. A graduate or cadetship program could be designed to enhance capability in areas of industry where Australia may seem weak and create a passion for the industry during early studies. A Red Meat Processing Innovation Centre of Excellence could facilitate strategic alignments between various universities and processors and this could be a mechanism which further drives innovation within plants and it is understood that this is a recent initiative of AMPC.

Current areas of work

As a result of the check off system (which is a US state levy system where $1 USD levies are paid per head for any animal sold), government imperatives and strategies have a major impact on how and what Institutes can invest research time in because they are the ones that are funding the work. Investment in automation and processing efficiencies has slowed because there has been a reduced uptake by industry. This notion was supported by a US processor who had initially adopted robotic automation technology (for splitting carcases) which now have removed them due the higher running cost compared to manual labour. Semi-automation and manual assist technologies continue to be important especially where improvements can be made in WH&S. Current work been carried out by Texas A&M has been focused on genomics which has been driven by certain processors to achieve consistency in product.

Extension of R&D is key for the Institute through the AgriLife extension which was set up over 100 years ago to help the general public with food related issues. This program utilises extension agents set up in different counties addressing count specific priorities and issues. The Institute excels at delivering information to the general public on the importance of the beef industry to the economy and provides extension sessions on the beef industry. This has been successful in increasing acceptance of Cryovac packaged meat in the US market.

Committees have been established through industry funded levies for exchanging research ideas (i.e American Meat Science Association to be discussed Section 6.3.7). These ideas feed into the work undertaken by the faculty. Voluntary levies have been collected since the early 1990's. The check off system is critical in supplying government funding to R&D. The committee controlling the check off levy is made up of academic researchers and industry. The National cattlemen's association has had major input into research initiatives in the past which have tended to be very short sighted.

A new direction of R & D has been in genomics and genetics for feed efficiency and meat quality and this work has been driven by the processors especially those with vertical integration. This is a forward thinking notion which has the ability to increase productivity across the whole industry. A consideration for the design of the institution is the extent to which the whole-industry commitment is occasioned by ownership in terms of vertical integration, and indeed whether it can be achieved without it.

Facilities

The Rosenthal Meat Science and Technology Center (RMSTC) was a purpose built Centre to provide a facility to conduct teaching, research, and public service activities of the Department of Animal Science. As such, it is a comprehensive facility, devoted to the development of science and the application of that science to the solutions of problems in animal and meat science.

The facility was built with donated funds and is becoming an aged facility now. It contains lecture rooms where carcases can be brought in for teaching purposes, wet rooms for boning and value adding, cooking facilities for value adding and consumer testing, meat science and microbiology laboratories and a pilot abattoir which is less frequently used due to the mass expansion of the overall university and hence increased urban encroachment.

The abattoir is solely operated for teaching, education and research and kills approximately 1000 head per year. At the side of the abattoir there is a butcher shop which is open to the public and sells the meat and is staffed mainly by students. The size and scale of the university alone helps support a facility like this one with 59,000 students enrolled. This service is unlikely to be self-sufficient, but is a draw card to bring students to the university and is highly valued for its teaching capability.

Texas A&M do have significant facilities with good utilisation, however they have the critical mass (people, size and scale of industry) to support the initiative. Meat Science in Texas and in America is a very prestigious group to be a part of. University courses have many interactions with meat science throughout the whole degree, which is a very different concept compared to Australia. Most animal science/agricultural science courses within Australia have a subject or part of a subject dedicated to meat sciences and then those students are eligible to compete in a National meat judging competition (which has grown each year) which if selected can complete in the American university competition. The American meat judging system has multiple competitions, which are highly competitive and often those students selected in university teams are highly sought-after for employment after graduation by industry as they have proven a high work ethic and commitment. It can be said that there is a real meat science and industry culture in the US possibly as a result of the critical mass.

6.2.7. Colorado State University

The Department of Animal Sciences has the unique mission of serving Colorado's large and diverse livestock industries. Research, teaching and extension/outreach activities in the Department of Animal Sciences focus on developing industry leaders and improving profitable production of horses and food animals through the application of science and technology, resource management and food product enhancement. There is an emphasis on addressing societal issues concerning food safety, product quality and value, animal care and management, and environmental impacts of animal agriculture.

Legal status

The faculty is Board managed and undertake government contract research, private consultancy research and fee-for-service work.

Organisation

The Center for Meat Safety & Quality (CMSQ) consists of a multi-disciplinary group of scientists, staff and students that have a common goal of addressing global issues related to meat safety and quality. The CMSQ is positioned, staffed and equipped to respond rapidly and competently to meat safety and quality issues with research and education, no matter where the need may arise. A new pilot plant and training facility will facilitate hands on learning for the world's industry.

Operational focus

The Program in Meat Science at Colorado State University conducts and publishes applied industry research addressing significant and timely issues related to the global competitiveness of red meats, including red meat safety and product quality, and efforts to export more red meat products to international markets. Results and conclusions of these projects are beneficial to the red meat industry, consumers and regulatory agencies in the United States and around the world.

The CMSQ has 7.5 FTE all meat science and food safety focused. CSU works mostly with beef (70%), pork and lamb (25%) and is starting to do more work in the poultry industry. Almost all work is contract based and project funding comes from, the 50% industry check-off (state levy system) funding, 10% from corporate sponsorship (i.e. Zoetis, JBS) and 40% from Federal funding.

CSU has federally funded research associated with antimicrobial resistance, food safety and STECs. They also continue to have a focus on meat science and more recently international trade research. Their outreach program is both federally and state funded, however support for this has been declining and there are less extension specialists now. In terms of overall agriculture this trend is the same within Australia. It was indicated that despite working well in collaboration with big plants like JBS, Cargill, Tyson and National beef their communication with smaller plants is "not been done very well", due to the fact they really don't have the capability to achieve this. The level of communication across the whole industry is something that might need to be considered as a function of a potential Red Meat Processing Innovation Centre of Excellence to help facilitate innovation across industry, not just amongst certain sectors.

Current areas or work

CSU is currently in the process of developing a multi-million dollar Global Food Innovation Centre and has adopted a 15 year approach. Funds for this establishment have been raised through State funding, Agricultural University foundation and industry support partners such as JBS. This industry partnership is one example of the opportunity there has been for a long association between JBS and CSU in part due to their geographical locations (JBS head office and CSU 20 minutes apart) and the long association of CSU with the Monfort family who previously owned abattoirs that are now owned by other companies such as JBS. The ongoing financial support of JBS will be important to the Centre. There is hope to also get investment and support from other major players such as Cargill and Tyson.

A major goal of the Centre is for CSU to continue to educate the next generation of meat science leaders. It will provide a world class facility for research, education, and innovation while keeping true to the land grant mission and agricultural roots of CSU. The Centre will be multidisciplinary in nature covering all aspects of the production, food and consumer continuum including; animal handling and well-being, nutrition and health, food safety and security, value add and culinary development and international collaboration. Colorado State University and Charles Sturt University (CSU2) have a memorandum of understanding, but are yet to have any formal links and CSU2 relies on NSW DPI for Meat Science supervision of post-graduate students. CSU collaborates often with the Texas Universities (A&M and Tech).

The new Global Food Centre will add to the current capabilities significantly with culinary training, product R&D, and retail food service sales and testing. However it will be managed within the Centre for Meat Safety and Quality (as has been the case in the past with their previous outdated facilities) and hence will operate in the same manner as stated above. This means that the Centre will continue to rely on contract based and project funding as previously stated (50% industry check-off state levy system funding, 10% corporate sponsorship (i.e. Zoetis, JBS) and 40% Federal funding). Additionally the Centre's ongoing costs will be met by "gifted" money made to the Centre, continued research funding, and industry partners. Also, given a key focus of the Centre is teaching it would be supported by the university as the new facilities will be a major draw card for students in a competitive market. The Centre will continue to follow the same governance with an eight person steering committee with a range of expertise; this group has a chair person and an administrative advisor. Focus areas are ultimately set by funding providers as previously indicated. The mechanism for the transition of innovation is derived through established alliances with companies who collaborate on most applied research and often these collaborations occur across more than one company. A current example is a project that is underway to develop new water-saving technologies for applying intervention chemicals to beef, pork and poultry; partners in this alliance include JBS, Pilgrim's Pride, Washington Beef, and Birko Corporation. It was stated that in recent times there is very little research that CSU conducts is completed 'on an island'; they generally work with several collaborators and sometimes several scientists with an array of expertise to address complex issues.

Facilities

The facility is still in the construction phase, Fig 16 gives a schematic view of what in the end the facility will look like and an additional insert indicates the estimated costing of the Centre development (Fig 17).

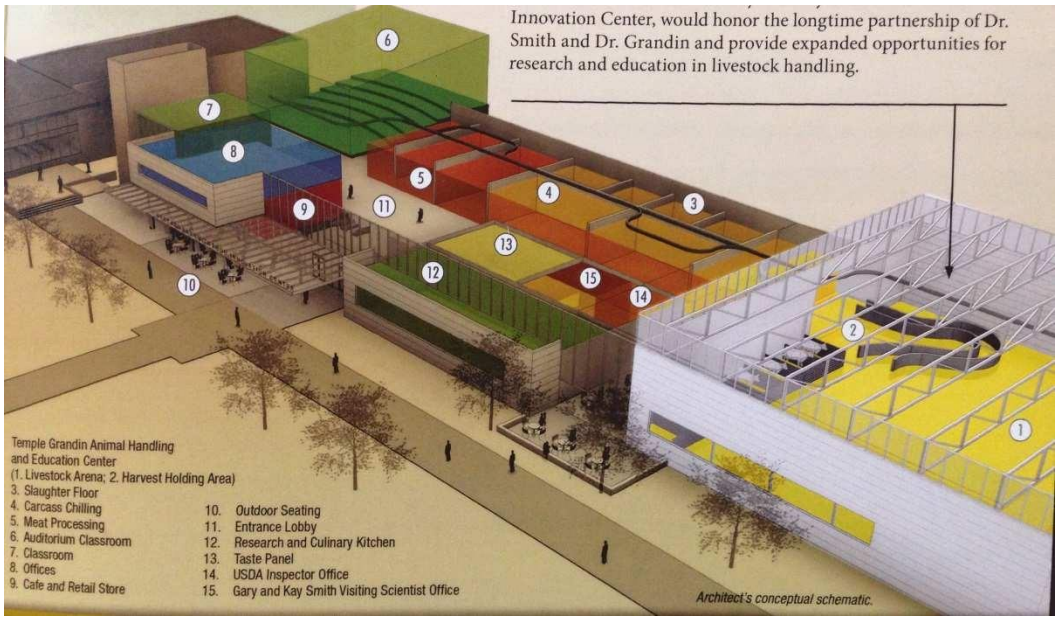


Fig 16. Schematic view of the CSU Global Food Innovation Centre.

Estimated Naming Areas and Gift Levels for the Gary and Kay Smith Global Food Innovation Center

Temple Grandin Animal Handling and Education Center	$5 million
Auditorium Classroom – 180 seat	$2 million
Meat Processing Area – Harvesting	$1.5 million
Meat Processing Area – Fabrication	$1.5 million
Retail Meat and Dairy Store and Café	$1.25 million
Ready-to-Eat and Value-Added Processing	$1 million
Atrium/Entrance Lobby	$1 million
Culinary Research Area	$1 million
Meat Demo Classroom – 130 seat	$500,000
Poultry Processing	$350,000
Harvest Holding Area	$300,000
Executive Board Room	$250,000
Sensory Analysis Room	$250,000
Wet Lab (2)	$200,000
Dairy Value-Added Research Area	$175,000
Office Reception Space	$150,000
Processing-Research Cutting (2)	$150,000
Processing-Dry Aging Room	$100,000
Gary Smith Visiting Scientist Office	$100,000

Maintaining Future Excellence: 10 percent of every gift will fund an endowment to support building maintenance and improvements in perpetuity.

Fig 17. Estimated costing

As a way of raising funds for the Centre, previous students and affiliations of CSU were asked if they would like to "gift" towards the Centre with 10% used for the ongoing maintenance and improvements of the Centre. Such revenue raising is not uncommon in the US, but would be hard to replicate within Australia.

6.2.8. Grimsby Institute - Food Refrigeration & Process Engineering Research Centre (FRPERC)

The purpose of FRPERC is to seek the attainment of knowledge through research for government and industry and to transfer this knowledge through publications, conferences, direct work with industry and training and education for industry.

Legal status

The Grimsby Institute Group (GIG) is one of England's largest providers of Further and Higher Education. With a rich history of developing innovative training and education solutions for the community, the Group comprises of the Grimsby Institute, University Centre Grimsby (UCG), Yorkshire Coast College (YCC) in Scarborough, Lincolnshire Regional College (LRC) in Skegness, The Academy Grimsby (TAG), which offers an alternative educational route for gifted 14-16 year olds, and Lincolnshire Rural Activities Centre (LRAC) in Louth. This structure is similar to what could be termed a National Network concept.

Organisation

The Food Refrigeration & Process Engineering Research Centre (FRPERC) was transferred to Grimsby Institute after 18 years operating as part of the University of Bristol. The FRPERC was established in 1991. The staff had previously been members of the Institute of Food Research – Bristol Laboratory (formally the Meat Research Institute before that) founded in 1967 and this is essentially now a small group.

Operational focus

A core role of FRPERC is delivering education and training. FRPERC aims to use its skills and knowledge to benefit both industry and students. Additionally, FRPERC takes part in collaborative, directly funded and confidential research.

1. Collaborative research - FRPERC frequently collaborates with one or more groups from industry and other academic or research based institutions to complete research projects. This model of research is actively encouraged by government funding bodies.

2. Directly funded research (Public) - FRPERC can work directly for funding bodies or companies without any other partners. These projects tend to be more specific, innovative, or pure science based than collaborative research.

3. Consultancy and confidential research (Private) - FRPERC can also carry out research for companies that require research to be carried out on their behalf, including confidential work, where they do not want to share the findings with other partners or potential competitors.

Focused on science that will provide commercial benefits, the meat research that is conducted is driven by industry needs and requirements. FRPERC is funded 40% consultancy, 40% public research (government) and 20% education initiatives (training). Original research was funded through industry levies, but this has since been removed.

Due to geographical location FRPERC has done a lot of work in the fish industry as it is based at a major port for export and hence all major UK processors are based here. This highlights the importance of geographical location which considering a physical building for a potential new Centre. FRPERC provide demonstrated skills in refrigeration and processing technology, but have very low capacity.

Current areas of work

Membership models for identifying broad industry investment initiatives were identified as a good option for R&D priority setting. These involve members of different industries coming together to brainstorm and identify key issues that affect all primary and manufacturing industries. This is not funded by a levy, but instead a membership fee for businesses to be part of the organisation. Membership then allows access to research outcomes and priority setting sessions.

As a result of the move from Bristol to Grimsby there was a loss of key staff who also took with them knowledge and experience within industry. It was noted that there are capability shortcomings that have also occurred as a result of general government cost-cutting across the UK. Many R&D Centre's simply do not have the staffing levels and access to capital to undertake high level engineering research. Grimsby is looking at partnering with the University of Lincolnshire to overcome this issue. Similar issues exist in Australia regarding high level researchers in the food industry e.g. plenty of scholarships on offer, but few jobs after completion. Strategies are needed to increase capability across the sector at all levels and not just to focus on supporting PhD's, but also have strategies for middle stage (after PhD) to ensure there are employment opportunities.

As a side note it was discussed how CenFRA (UK's Centre of excellence for all robotics and automation activities relating to the food and drink industry) is a good example of how CoE's can fail. It was a government funded initiative in the initial stage that was intended to become self-sufficient, but this did not eventuate as commercial outcomes envisaged did not eventuate (potentially like Fututech). The Centre was not ready to commence 100% operation when opened and hence didn't become fully effective for approximately 5 years and the consultancy approach did not include fee-for-service to help sustainability of the Centre. It does appear that this was not a very strategic model for a Centre or well supported during critical stages or well managed. Given the nature of what CenFRA does it was attempted to visit them, but this proved unsuccessful due to a lack of response, but follow up phone calls and emails have been sent to enquire further, but there has been no acknowledgement of correspondence and is unclear if the Centre is in operation at all.

Facilities

Due to the low critical mass (of staff) it was apparent that there were limited facilities available to staff on site in terms of engineering production etc. This was seen as a contrasted compared to previous facilities that staff had access to when based at Bristol. Given there was a big focus on students there was ample resources to support them.

6.2.9. AgResearch

AgResearch is a Crown Research Institute and partners with the pastoral sector to identify and deliver the innovation that is needed to create value for the country.

Legal status

AgResearch Limited is New Zealand's largest Crown Research Institute (CRI) by revenue. As an independent, Crown-owned research and development company, with the Minister of Science and Innovation and the Minister of Finance as shareholders, AgResearch is owned by the people of New Zealand and works for the benefit of New Zealand.

Organisation

AgResearch has approximately 850 staff spread across four campuses and farms in the Waikato, Manawatu, Canterbury and Otago. Agriculture is New Zealand's largest export income earner, and AgResearch plays a key role in delivering new knowledge and technologies which underpin the pastoral, agri-food and agri-technology value chains. They aim to achieve this by working closely with sector partners and its strategy is outlined in a Statement of Corporate Intent.

AgResearch is a multidisciplinary organisation serving the all sectors of New Zealand agriculture with a diverse range of capabilities. The AgResearch group that is related to red meat processing is AgResearch MIRINZ which has specialists in food safety, meat science, energy and processing, non-invasive measurement and bioprocessing. This group is derived from the Food & Bio-based Products group of AgResearch. These capability areas are essential to effective and efficient processing of meat and other food products.

Current areas of work and Facilities

In July 2006 the Food, Metabolism & Microbiology Section of the Food & Textiles Group of AgResearch Ltd was officially launched. This Section included AgResearch MIRINZ-based teams focused on ensuring quality, consistency, and safety of meat products. The Sections' focus areas are Food Safety, Energy & Processing, Microbiology, Meat Science, and Nutrition and Metabolism.

AgResearch MIRINZ has gone through significant change over the past 50 years, and the core research areas have shifted accordingly (as shown in Section 3.1.4). The work at AgResearch MIRINZ encompasses parts of the pastoral sector value-adding chain from farm to fork, pasture to plate, and grass to glass. More recent changes have included the sale of their abattoir facility at Ruakura to specialist meat processing company Wilson Hellaby. The sale was concluded on 1

December 2014 for an undisclosed price. It was sighted that this was to "enhance the long-term viability of the operation and ensure the retention of jobs for our abattoir staff," and it is hoped that the commercial company can achieve this and further improve the facility's operational performance and market share.

The Ruakura abattoir was upgraded to a commercial abattoir 17 years ago and has gradually shifted from being predominantly for science use to a commercial killing business, with relatively small volumes used for science. Most of the R & D was already being conducted in other commercial abattoirs as it was more applicable to "real industry" in terms of newer technology and faster throughput. Other facilities currently at the AgResearch MIRINZ include freezers, chillers, meat science and food safety labs. However there are plans to fully relocate this site to Palmerston North to increase critical mass in one location for the development the New Zealand Food Safety Science and Research Centre. It will remain to be seen how successful this move will be given the Hamilton site is so well established and there is a real risk of set-backs in skill and capability if staff choose not to relocate as previously seen with CSIRO Cannon Hill and FRPEC. Additionally further information regarding this relatively new initiative will also be assessed in more detail for the final report.

6.2.10. Summary of Current Research Centre's

Form

All current research Centre's evaluated in this milestone had "bricks and mortar". Table 24 shows what types of facilities are within each Centre. Other concepts that are not listed in the table are that Teagasc has a mobile trailer and DMRI has a mobile truck that can transport equipment/technologies from plant to plant.

Table 24. Summary of Centre's facilities

Centre	Pilot Plant	Wet area	Meat lab	Food safety	Engineering	Education Training
IRTA	✓	✓	✓	✓	✘	✓
Teagasc	✓	✓	✓	✓	✘	✓
SRUC	✘	✘	✘	✓	✘	✓
DMRI	✘	✓	✓	✓	✓	✘
FRPEC	✘	✘	✘	✘	✓	✓
Georgia Tech	✘	✓	✘	✘	✓	✓
Texas A&M	✓	✓	✓	✓	✘ **	✓
CSU	✓	✓	✓	✘ **	✓	
AgResearch	✓ *	✓	✓	✓	✓	

*No longer have, ** Capability in other departments within organisation.

In terms of Centre's which currently have **pilot plants**, IRTA, Teagasc and AgResearch facilities were all reported to be underutilised for various reasons including;

Speed/throughput

Species specific (small stock/ large stock)

Staffing for sporadic use

Removal of meat product and by-product

Much work is contracted by industry and work is conducted under commercial conditions

As mentioned AgResearch has recently sold their pilot plant facility and now has a MoU with the new owners for experimental use. It was also noted that much R & D is conducted in bigger plants to replicate commercial conditions.

Texas A&M and CSU both have pilot plants which has a major focus on teaching. CSU is undergoing a significant upgrade currently and is building a whole new pilot plant as part of an integrated food facility. The primary focus is to teach and train the next generation of meat scientists. Texas A&M utilisation (~ 1000 head/yr) is decreasing partly due to the urban encroachment of the expanding university and hence they are considering relocation. Both universities have fewer burdens as students are often the labour units with support staff and product is sold through butchers shops.

Wet Areas were used by IRTA, Teagasc, DMRI, Georgia Tech, Texas A&M, CSU and AgResearch. These facilities tended to be more utilised as they are more versatile and are excellent facilities to test a variety of technologies for example;

High Pressure Processing

Slicers

PiVac

CT scanners

Robotics (Georgia Tech, DMRI)

Value added products

In most cases this is where Centre's were able to generate small incomes by hiring out wet rooms to private companies to evaluate and test equipment.

Centres which had **Meat laboratories, food safety, engineering** and **education and training** facilities were all very well utilised as they are core to their operations. Due to the diversity of some of the Centre's (e.g. IRTA, Teagasc, AgResearch) they are able to offset some of the costs of some of their facilities (e.g. food safety, education and training) across a range of industries (e.g. horticulture, dairy) which mitigates the risk and increases usage. In terms of **engineering** both CSU and Texas A&M have access to these skills through other departments with the respective universities. IRTA, Teagasc and others had shown that they had partnered with engineering companies to develop and evaluate technologies.

Funding

All Centres' funding structures were slightly different. However, all were reliant on funding to be viable, meaning that not one facility was self-sufficient to remain cost neutral. There were combinations of Federal, State, EU and industry funding. Income streams were derived through; consulting, hiring of facilities and IP, but, these income streams did not fully support the operating costs.

Innovation transfer strategies

The strategies that individual centre's use has been summarised in Table 25. Common strategies that appear across multiple Centres are;

Industry engagement (networks, training, workshops, demonstrations, partnerships)

Collaboration (industry/other R&D organisations)

Extension

These concepts are not new and are often in place, however the degree of success of these strategies can be largely dependent on who might do these things. A good example of taking these strategies to another level is the Teagasc approach where researchers are selected and given the appropriate training to effectively communicate to industry through the Food Innovation Gateway workshops that are held.

Table 25. Innovation transfer strategies for individual Centre's

Centre	Innovation transfer strategy	Comments
IRTA	- Operational focus is flexible will go where funding is available - Innovation mangers to specifically handle knowledge transfer nationally and internationally - Evaluation of performance (Fig 2&3)	- Inefficiency's in R&D - Gives understanding of industry bridges gaps - Gives accountability
Teagasc	- Major focus on "knowledge management" - Involves key people that have effective communication with industry - National network forum - Effective extension - Collaborative agreements and partnerships - Training,workshopsanddemonstrations	- Engagement with industry
DMRI	- Small focus areas - Provide support from initial stage to final commercialisation - Project initiation (Fig 4) - Cross pollination of skills (e.g. engineers working alongside boners) NOTE: DMRI are in unique situation where they function in a vertically integrated supply with very few stakeholders, hence early industry engagement is critical.	- Gives clarity - Consistent involvement - Involves collaboration with industry and is critical in Innovation Transfer
SRCU	- Did not appear to have any clear strategies but have just gone through major restructure where extension was separated for R&D and appeared problematic. - Although current research has been driven from bottom up	- Extension appears important
Georgia Tech	- Have different contracting methods which result in varying level of adherence to innovation - Focus on education of stakeholders via field days and newsletters (with researcher profiles)	- This is largely reflective of the level of risk (blue sky higher risk of failure) - Extension critical - Raising researcher profiles gives industry points of contact when they have issues.
Texas A&M	- Building capability within industry - Texas A&M AgriLife Extension - UseindustrynetworkingforumslikeAMSA	- Help facilitate innovation through greater understanding
CSU	- Development of alliances and collaboration with industryandotherresearchproviders	- Industry driven research - Collaboration
Grimsby Institute	- Use a membership model (via payment) which allows members to help develop priority areas andaccessresults.	- Similar to current AMPC model
AgResearch	- Traditionally MIRINZ had an excellent reputation of working effectively with industry - Extensionandcollaborationwithindustry	- Extension and collaboration with industry

6.3. Current Initiatives and influencing factors

This section has been included to describe some of the bigger picture initiatives that have been occurring within Australia and around the world. One report highlights how innovation is affected and influenced within an Australian context. Some show national type initiatives of which components could be of value to a Red Meat Processing Innovation Centre of Excellence and others are more mechanisms for networking and exchange of ideas to help bridge the gap between industry sectors and R & D. From this section considerations should be made around either how a potential Red Meat Processing Innovation Centre of Excellence may be able to use either findings for these current trends and influencing factors or how it might be able to link into some of these initiatives.

6.3.1. Australian Innovation System Report, Department of Industry

A recent review by the office of the chief economist "the Australian Innovation System Report (2014)" provides insight into the key drivers for innovation in the Australian economy and how these impact on our overall competitiveness. Data showed that in 2012-13, 42% of employing businesses were deemed to be innovative. As a driver of business performance, innovative Australian businesses reported that they are:

31% more likely to increase income and 46 % more likely to report increased profitability;
Twice as likely to export and five times more likely to increase the number of export markets targeted;
Twice as likely to report increased productivity, employment and training;
Three times more likely to increase investment in ICT; and
Three times more likely to increase the range of goods and services offered.

The report also demonstrated the link between business innovation and export activity across all business ages and sizes. Results showed that the more a business innovates the more likely it is to be exporting. In 2011-12, innovative small to medium-sized enterprises (SMEs) median export income was $20,142 in comparison to $1,874 for SMEs that didn't innovate.

It was reported that despite the evidence indicating the positive impact innovation has on business performance, Australian exporters are on average not high adopters of innovation by OECD standards. Our large businesses account for around 66% of investment in research and development (R&D), 44% of industry value-adding and around 95% of exports. However, Australian large businesses rank 21st out of 32 OECD countries on the proportion of businesses innovating, and are well below other less developed resource-exporting countries like Brazil and South Africa.

In contrast to large firms, Australian SMEs are innovative by OECD standards, ranking 5th out of 29 OECD countries on the proportion of businesses innovating. This is a positive result, given that SMEs account for 56% of industry value-adding. Australian SME manufacturers were ranked 5th in the OECD for innovation. The report indicated that there is evidence that there are many examples of Australia's innovative SMEs supporting large Australian exporters through local supply chains, but more could be done to help these businesses overcome barriers to trade and

access global value chains. This could be of interest for the Red Meat Industry to assist in effective pathways for SME's to access global value chains.

When it comes to international competitiveness, not all innovation is the same. It is evident that *new-to-market* innovation has more impact on the competitive advantage of a business than the adoption of innovations already in the market (*new-to-firm innovation*). This *new to market* innovation benefit can help capture new markets, increases market share and facilitate participation in a global supply chain. To truly make an impact on innovation this is where a Red Meat Processing Centre of Excellence could facilitate greatest change based on the figures.

Australia's overall rates of innovation are moderate compared to a range of European Union (EU) countries. Generally we rank poorly against EU countries on *new to market* innovation. Australia is primarily a nation of adopters and modifiers operating behind the innovation frontier. This notion is partly supported in the national industry consultation results where companies like to see technology implemented by other companies first.

The report highlighted that to increase total factor productivity and ultimately maintain our high standard of living, Australian industry needs to invest in innovation across all domestic and exporting sectors. This is an important consideration for a potential Red Meat Processing Innovation Centre of Excellence with Australia to be inclusive across all aspects across industry. The scale and impact of innovation appears to be hampered by a poor management culture of innovation and collaboration, and shortages in a range of skills. This notion was evident in a recent report by Toohey & Hopkins (2015) in terms of the adoption rates of online measurement technologies that have been scientifically proven. Hence there is evidence that this could be an important role for a Centre and there would be a need to collaborate with existing programs in order not to duplicate programs.

In summary a range of reports were sighted to argue that the reason for Australia's moderate to low performance on innovation, particularly new to market innovation, is a poor business innovation culture, in association with an average to poor management performance. More specifically, the literature suggests that the main impediments to Australia's innovation system are:

Poor networking and collaboration
Poor levels of venture and private equity capital investment in innovation
Some fragmented and/or obstructive government policies or regulations, such as tax treatment of employee share schemes, government procurement of innovation and low incentives for research commercialisation/collaboration in the public research sector
A small geographically isolated economy dominated by small businesses and/or lifestyle entrepreneurs that are seeking local competitive advantage through cost reduction rather than pushing the innovation frontier to capture world markets through value creation
Poor business culture of innovation and risk aversion in Australia

Relatively poor business management capability, leading to underinvestment in innovation and related activities.

Many of these points have been identified during the National industry consultation as highly relevant to the red meat processing industry and hence should be key factors that are addressed by a potential Red Meat Processing Innovation Centre of Excellence within Australia.

6.3.2. Industry Growth Centre's (Australia)

In a recent announcement the $188.5 million Industry Growth Centres Initiative will establish five Growth Centres in key growth sectors: advanced manufacturing; food and agribusiness; medical technologies and pharmaceuticals; mining equipment, technology and services; and oil, gas and energy resources. They will set strategies and deliver outcomes under the four themes of encouraging collaboration and the commercialisation, enhancing workforce skills, identifying opportunities to reduce regulatory burden, and improving capabilities to engage with international markets. These growth centre's will also comprise of; Industry Growth Project Fund, Industry Growth Network, Commercialisation Fund, delivered through Entrepreneurs' Infrastructure Programme and will complement and leverage existing State and Territory innovation and collaboration programmes

The industry growth centres are non-profit businesses staffed by a small and experienced management team with shared back office services for all Centres. They will be governed by a strategic industry–led five person board tasked specifically to develop and implement a competitiveness agenda. An overarching board will provide external advice to the Minister on strategic policy matters and performance related to the Industry Growth Centres. Each Industry Growth Centre will have operational funding of $3.5 million per annum to support basic activities and services. The Industry Growth Centres will be funded for a four-year period and are then expected to be self-sufficient, however it is not clear how they will achieve this as yet. Industry Growth Centres will engage with the sector to establish a national network.

The Initiative will have a focus on science and research and aligns with the Australia's Chief Scientist recommendations outlined in the position paper, Science, Technology, Engineering and Mathematics: Australia's Future. The Initiative will: Increase the transfer of knowledge between researchers and business by fostering collaboration, increase industry demand driven research by the identification of industry knowledge priorities to inform national research priorities and improve the translation of publically funded research into commercial outcomes to help drive innovation.

The Initiative will establish a $63 million Industry Growth Project Fund. The project fund will: be established for exclusive use by the Industry Growth Centres, be awarded through a merit based process, support large scale collaborative projects to provide targeted actions to build capability and competitiveness of the sector, benefit the sector as a whole and not just project participants, focus on market, value chain or technology issues, not fund basic or discovery type research, and

require matched industry funding. Further consultation will occur in 2015 and anyone can be involved in the engagement process and when the Industry Growth Centres are operational.

Anyone has the opportunity to shape the implementation of the Growth Centres by providing feedback through the Consultation Hub. The results of the consultation will be used to develop guidance material for the implementation of the Initiative and to help Chairs and Facilitators determine the workable and effective scope of each Growth Centre.

It would be important for a potential Red Meat Processing Innovation Centre to be able to link with any relevant Industry Growth Centre to potentially access other funding streams, collaborate with relevant participants and increase critical mass (people and facilities).

6.3.3. Cooperative Research Centre's (CRC)

The CRC programme is known and highly regarded internationally and hence the concept could be considered as the basis for a potential Red Meat Processing Centre of Excellence bearing in mind recent recommendations (Anon, 2015). The CRC programme accounts for only 1.6 per cent of Australian Government spending on science, research and innovation, yet the programme occupies an important place in building scale, scope, and duration of collaborative activity and increasing the range of partners involved. It also plays a valuable role in providing industry-relevant research training.

The recently announced *Industry Innovation and Competitiveness Agenda* (the Agenda) and the related *Boosting the Commercial Returns of Research* strategy clearly articulate the Commonwealth government's desire to better translate research into commercial outcomes, with the latter stating that 'we must build better bridges between research and industry'. Industry- research collaboration is crucial for increased innovation within Australia and to be a competitive and forward-looking.

The CRC Programme can be the engine of innovative research to support the work of the Industry Growth Centres (Section 6.3.2) and develop ideas identified by industry and Growth Centres, commercialise them, and take them to domestic and international markets. In a recent review of CRC's, two successful international models were highlighted to be of interest; Catapult Centres in the United Kingdom and Germany's Fraunhofer Institutes and hence short summaries have been provided in sections 6.3.4 and 6.3.5 respectively.

The review of the CRC programme recommends the continuation of the programme, but with a clear focus on industry-led research. The review agrees with many stakeholders that the purpose of the programme has become muddied over time and has become an 'everything to everyone' initiative and that 'end-user driven research', as stated in the current programme objective, is too broad. 'End-user' means any public or private organisation, government department or agency, not for profit, community organisation or individual with the ability to utilise research outputs.

This raises a question about the suitability of the CRC model for the promotion of innovation: often this requires the same collaborative and long term relationship between researchers and end users, but additionally requires individually-appealing ownership and exclusivity arrangements and relates strongly to various aspects of technology, marketing and supply chain relationships. However it could be seen that in the case for a Red Meat Processing Innovation Centre of Excellence "processors" would predominately be the end users and perhaps give greater clarity.

There was some stakeholder feedback from industry participants in previous CRCs that a weakness in the programme was the potential for research agendas to be dominated by researchers with 'pet interests'. These stakeholders also stated that there was insufficient emphasis on commercial outcomes. Given the concept of a Red Meat Processing Innovation Centre of Excellence, commercial outcomes would be of highest priority however compared to the current structure and how R & D is determined it could be argued that a better balance is needed and priority areas should be set with well-informed knowledge between both industry and academia.

To better support the government's priorities for applied science and research, the programme objectives should be amended to put industry front and centre. The focus should be on solving industry problems and encouraging industry to take the lead in collaborative research and development activities.

Industry stakeholders agreed the most successful CRCs are those where industry is involved at the outset of the project and where the research programme is driven by challenges identified by industry. A number of submissions noted the advantage of projects being informed by road mapping exercises on research and development by industry peak bodies. Advantages cited included relevance, shared vision and take up of outcomes.

6.3.4. Catapult UK

Although this concept is initiated at a government level some goals and philosophes may be valuable points of consideration for a Red Meat Processing Innovation Centre of Excellence. The Catapult centres are a network of world-leading centres designed to transform the UK's capability for innovation in seven specific areas and help drive future economic growth. The Catapult network are a series of physical centres where the very best of the UK's businesses, scientists and engineers work side by side on late-stage research and development, transforming high potential ideas into new products and services to generate economic growth.

The Catapult network has been established by Innovate UK as one of the ways to support innovation by UK businesses. They do this by providing access to expert technical capabilities, equipment, and other resources required to take innovative ideas from concept to reality.

Operational focus

1. Connecting business and research
   Catapults are not-for-profit, independent physical centres which connect businesses with the UK's research and academic communities.

2. Turning commercial ideas into reality
   The Catapults are transforming the UK's capability for innovation in specific industry areas. They turn commercial ideas into a reality, support businesses to access global growth markets, anchor high value jobs and attract inward investment from globally mobile technology businesses.

3. Meet the need of growth-hungry businesses
   Hundreds of thousands of businesses in the UK are keen for growth and capable of bringing new products and services to market. However only a few have all the resources, expertise, equipment or contacts they need to develop their ideas into new products and services.

   The Catapult vision is to bridge the gap between these ambitious businesses and the expertise of the UK's world-class research communities. Catapults exist to:

   Reduce the risk of innovation
   Accelerate the pace of business development
   Create sustainable jobs and growth
   Develop the UK's skills and knowledge base and its global competitiveness

4. Businesses large and small can benefit
   Catapult centres are there for all businesses - large and small - looking to undertake late stage research and development and commercialise traditional academic research.

Catapults are backed by considerable amounts of investment, which come from a combination of core Technology Strategy Board (TSB) support and competitively won business and public sector funding. Once established they generate funding broadly equally from three sources, core public funding via TSB, public/provide R&D projects private sector Rand D contract research. Total revenue (across 7 catapults) ~£20-30m pa (or greater) equates to 100-200 staff and £10-15m pa from businesses.

An example of a current Catapult which would have synergies to the red meat processing industry is the manufacturing technology centre in Warwick/Coventry (T Wess pers comm). They have funding from government and also funding from subscription and direct work paid for by companies. In terms of the mechanism for bringing these businesses together without compromising confidentiality and privacy this is often handled on a case by case. Precompetitive work is usually by central agreement from the subscription partners and is published and made available to all partners. An individual partner can then access this to take it forward and develop IP around it which they can protect. Potentially to lock others out the partners may put a patent

around the work, elect an organisation to be lead and then license each partner. With industry this is quite common and there are examples such as the Allegheny Technologies Incorporated (ATI) for oil and gas and also Campden BRI (Food and drink Innovation) and The Wielding Institute (TWI).

Professor Wess (pers Comm) highlighted that there are issues now arising with Universities which are being criticised for overvaluing their IP and being overly protective. Some universities are now having a "don't own IP" issue as it is an onerous to protect and it slows down innovation and others are getting frozen out as they have a restrictive IP policy. One group has handed any IP over to a third party and this seems to be working well. This later concept is one now being used by universities within Australia such as the University of Queensland.

6.3.5. Fraunhofer Institutes

Fraunhofer Institutes have been operating since 1973. In general they conduct applied research in specific fields such as health, security and energy based on priorities determined by government and industry partners. The Institutes have forged strong collaborative partnerships between industry, universities and other research organisations by bringing parties together to address key research challenges. The Institutes are cooperatively funded by government and industry and are managed by a governing board that includes industry representatives (Fig. 18.).

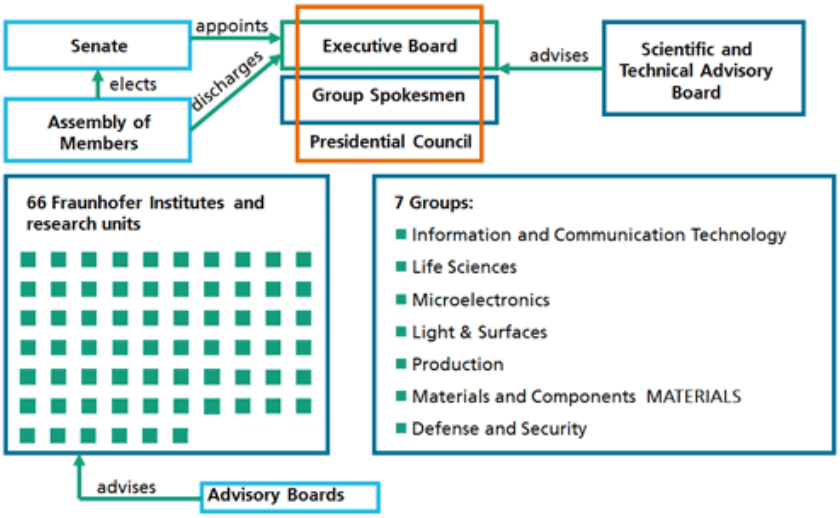


Fig 18. Franhofer institutes organisational structure (source; Franhofer institutes, 2015). Fraunhofer

Institutes are made up of regional structures with a global effect – the concept of innovation clusters. They aim to link skills and pool resources to meet the challenges posed by globalization and the increasing dynamism of structural change. Knowledge-based industries, in particular, develop very successfully in regional clusters, which facilitate knowledge exchange and generate a critical mass of skills that complement one another. Geographical proximity between research organizations, investors and companies can produce networks that lead to new business ideas and the foundation of new enterprises. The concept termed regional innovation clusters could be highly suitable in an Australian context given barriers highlighted due to geographical

locations and being able to address critical mass. Regional innovation clusters bridge the gap between industry and scientific research. Successful clusters can stimulate the competition on the market, and at the same time create fruitful collaborations which ultimately benefit everyone involved e.g Silicon Valley. Seventy percent of funding is generated through contract research and 30% through government funding.

6.3.6. COST – European Cooperation in Science and Technology / FAIM – Farm Animal Imaging

COST is the longest-running European framework supporting trans-national cooperation among researchers, engineers and scholars across Europe. It is a means to jointly develop ideas and new initiatives across all fields in science and technology, including social sciences and humanities, through pan-European networking of nationally funded research activities. Based on a European intergovernmental framework for cooperation in science and technology, COST has been contributing - since its creation in 1971 - to closing the gap between science, policy makers and society throughout Europe and beyond. As a precursor of advanced multidisciplinary research, COST plays a very important role in building a European Research Area (ERA).

COST does not fund research itself, but provides support for networking activities carried out within COST Actions. COST Actions are bottom-up science and technology networks open to researchers and stakeholders, with four-year duration and a minimum participation of five COST Countries.

COST Actions are active through a range of networking tools, such as meetings, workshops, conferences, training schools, short-term scientific missions (STSMs) and dissemination activities**.** COST Actions are open to researchers from universities, public and private research institutions, as well as to NGOs, industry and SMEs**.** A Memorandum of Understanding (MoU) provides the formal basis for COST Action. COST Actions are also open to international cooperation, by allowing the participation of researchers from Near Neighbour Countries and International Partner Countries on the basis of mutual benefit. This has seen several Australian scientists invited to speak at conferences supported by the COST Action.

The Farm Animal Imaging (FAIM) is an example of a current COST Action that relates to the Red Meat Processing industry. This COST Action (FAIM) brings together 120 experts from 19 (25) EU countries (and beyond). It comprises of four working groups;

1) Body composition
2) Meat quality
3) Algorithms
4) Traceability

Each of these working groups have sub-groups and the concept is around the exchange of ideas between academia, industry and technology providers, in order to identify common issues amongst countries and develop strategies to address these. This networking concept is one that a

Red meat Processing Innovation Centre of Excellence could consider to help set strategic direction and additionally through greater interaction increase a greater understanding of what the issues really are. The concept is not unlike previous Australian initiatives such and “Meat 93” and Meat 95” and in more recent times the AMPC conference had aspects of this concept. However a point of difference is that groups formed under the COST Action have a four year life.

6.3.7. American Meat Science Association (AMSA)

The AMSA has been established for half a century in meat science, beginning with the first Reciprocal Meat Conference held in 1948. Its unique role is to provide the forum for all interests in meat, commercial, academic, government and consumer, to come together in a reasoned, scientifically-based atmosphere and address the needs of the processing and marketing segments of industry, the consuming public, its own members and others in the biological and nutritional sciences.

The AMSA Board of Directors is elected by the membership of the association. Each year, a nominations committee puts forward at least two candidates for each position being elected. The board consists of the Executive Committee (President-Elect, President, Past President and Treasurer) and nine directors. The directors serve two-year terms. The Executive Director is the chief staff officer of the association and serves as an *ex-officio* member of the board. AMSA fosters community and professional development among individuals who create and apply science to efficiently provide safe and high quality meat, defined as red meat (beef, pork and lamb) and poultry, fish/seafood and meat from other managed species.

AMSA brings those in the meat science field together through ways that encourage community and professional development with over 1000 meat scientists representing major university research and teaching institutions and meat processing companies in the United States and internationally (some Australian meat scientists are members of AMSA). AMSA is a uniquely far- reaching conduit for academic and professional collaboration and learning. This provides another successful networking initiative to help try and bridge gaps between industry and research to help stimulate innovation.

6.3.8. Summary of current initiatives and influencing factors

The six current trends show diversity in investment (Table 26). Industry Growth Centre’s (Australia) is a new concept where the physical structures are yet to be built. However the Industry Growth Centre’s, Catapult UK and Fraunhofer Institutes are all Government initiatives with significant financial backing which has resulted in physical structures. There are 5 broad areas under the industry growth Centre’s and hence the risk around these is offset by diverse use from multiple sectors. The same philosophy applies to Catapult and Fraunhofer Institutes. The Cost-FAIM and AMSA are both networks and hence are 100% virtual. These networks don’t actually fund any research, but fund the gathering of industry, technology providers, engineers and academia.

CRC's are virtual in a sense that they don't really invest in capital, but essentially they do strategically partner with industry and research providers which can be seen as hubs as they provide physical infrastructure essential for CRC's to function. The CRC's have been shown to be a successful mechanism for innovation with minimal expenditure. Additionally they have been shown to be successful in building skills and capability within different sectors including the red meat industry.

Table 26. Form of current Initiatives

Centre	Bricks and mortar	Virtual	Hubs	Number of locations
Industry Growth Centre's	✓	✘	*	5
CRC				-
Catapult UK			*	7
Fraunhofer Institutes	✓		*	7
Cost-FAIM				N/A
AMSA				N/A

* Although they do have a core bricks and Mortar and major function of these Centre's are to collaborate with industry and R & D providers

Common strategies which all of these initiatives rely on are;

- Industry led research
- Long term strategic priorities
- Bridge gap between research and industry
- Increase knowledge transfer between research and industry
- Increase capability and critical mass
- Collaboration

The ultimate goal amongst these Centres is to translate research into commercial outcomes thus increasing the rate of innovation. This goal seems agreeable with the ultimate goal of a potential Red Meat Processing Innovation Centre of Excellence (CoE). Hence, the above strategies should be applied to a potential CoE and it is demonstrated that these strategies can be applied with various levels of investment.

7. Value chain analysis of issues around the viability of a CoE

7.1. Introduction

This section relates to Activity 5 in the project methodology and addresses issues surrounding viability of the proposed Centre of Excellence for Red Meat Processing Innovation, with particular reference to costs and benefits accruing to participants in the red meat value chain. This section discusses factors affecting the adoption of new technology, and innovation in particular contexts in the red meat industry. The conclusions are used to decompose the data collected from the

survey of meat processing firms presented in Section 4, so as to illuminate the firms' and the industry's needs in innovation, particularly that involving co-innovation along the value chain. These findings are expressed in terms relevant to the design of a proposed Centre. The goals of this section are to;

Identify the mechanisms by which a Centre of Excellence for Red Meat Processing Innovation can enhance innovation in the red meat industry beyond that achieved by existing initiatives;

Identify costs and benefits of the operation of a Centre of Excellence for Red Meat Processing Innovation, in terms of overcoming barriers to technology uptake by Australian red meat processors; and

Outline design elements of a Centre of Excellence for Red Meat Processing Innovation which would enhance benefit/cost ratios.

Part 7.2 of this report identifies the nature of benefits and costs of red meat industry innovation, particularly the wide variety of value chain participants and interest groups that benefit. This is followed by an assessment of the gap between research and innovation across some relevant research topics, and the correspondence between those research topics and the thematic areas revealed by the survey of processing firms. Factor analysis of Section 4's survey data is used to present and compare areas of research and innovation emphasis. The nature of technology uptake is described in terms of possible entry points for change, and part 7.3 reports on recent work on technology uptake, and co-innovation in the value chain, related to the Australian red meat industry. This section concludes with an overview of two approaches to innovation-enhancing change within the meat industry innovation system, with particular attention to the functions of innovation-facilitating agents akin to a proposed Centre of Excellence for Red Meat Processing Innovation. Part 7.4 presents an analysis of the data collected from the survey of meat processing firms presented in Section 4. These are used in a factor analysis to identify thematic areas of interest to firms surveyed, and to compare the emphasis placed on these thematic areas by subdivisions of firms based on their orientation toward key issues in innovation. These findings are expressed in terms the design of a proposed Centre, which are included in part 7.5.

7.2. Costs and benefits of adoption of new technology

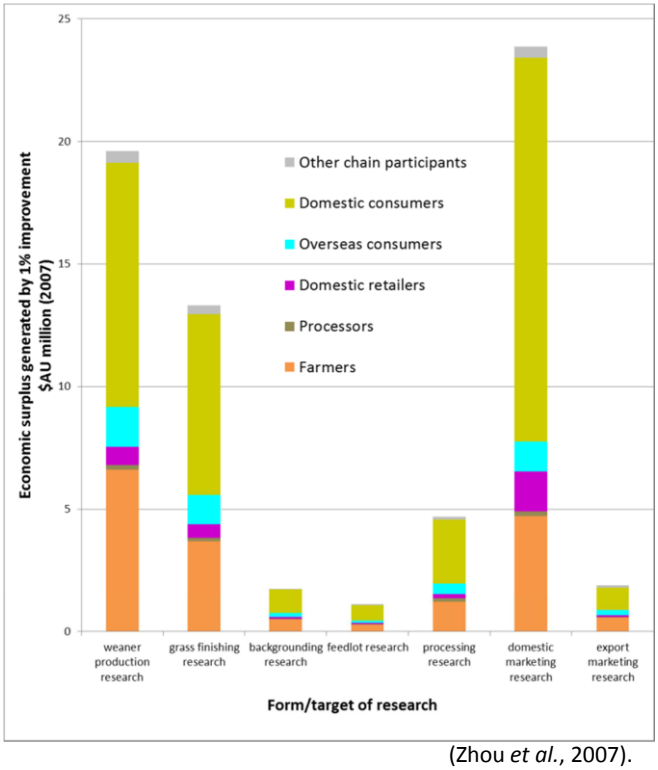
7.2.1. Allocation of costs and benefits in the primary industry value chain

Measurement of the benefit to producers and consumers of research into Australian primary products has a long history (Alston *et al.*, 1995). Using economic surplus as revealed by shifts in the supply (associated with cost-related research) and demand (associated with market-related research), applications to Australia's multi-stage red meat and wool production and marketing systems involve curve-shifting-type models, including that used by Zhou *et al.* (2001) and Mounter *et al.* (2008). These models represent technological advances (and/or market expansion) as a consequence of research, and track the ways in which benefits are distributed as markets adjust in terms of price and quantity.

Amongst numerous research-induced scenarios (Fig 19), Zhou's *et al.* (2001) results show that a 1% reduction in beef processing costs generates a projected economic surplus of $AUS 4.69 mill., but more particularly that this surplus is shared by all beef supply chain participants. In the case of research into beef processing, just 3% of the projected benefit accrued to meat processors (Fig

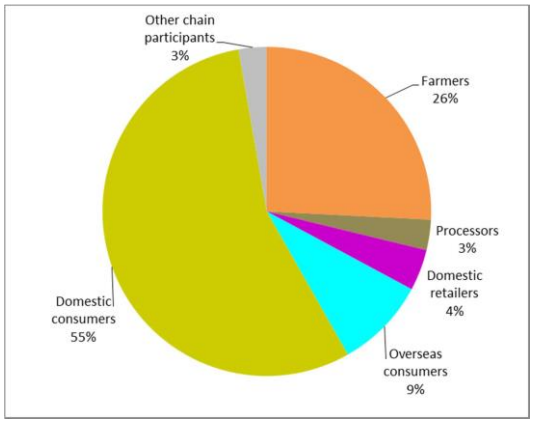
20). In all cases, the main beneficiaries are consumers (by way of lowered prices) and producers (by way of increased volumes supplied).

Figure 19. Projected benefits to 7 beef supply chain participants from a 1% improvement due to research in beef.



(Zhou *et al.*, 2007).

Figure 20. Allocation of projected benefits to beef supply chain participants from a 1% improvement due to research in beef processing



(Zhou *et al.*, 2007).

Table 26 presents results of a later study which projected the benefits of research in the sheep industry (Mounter *et al.*, 2008). Results from selected scenarios involving sheep meat processing and marketing research, and sheep meat demand promotions, are presented. Sheep meat processors' gains are highest from domestic demand promotion, followed by those from sheep meat processing research. Across all scenarios, processors' shares of the benefits of the research range from 8 to 13% of all benefits generated, with the highest share generated by research into sheep meat processing.

Table 26. Projected benefits from sheep meat-related research, and promotion

	Sheep meat processing research		Domestic lamb marketing research		Export lamb promotion		Domestic lamb promotion	
	$AU mill.	*% of total benefit*	$AU mill.	*% of total benefit*	$AU mill.	*% of total benefit*	$AU mill.	*% of total benefit*
Producers	1.45	*22%*	0.74	*16%*	1.66	*26%*	2.72	*19%*
Sheep meat processors	0.84	*13%*	0.35	*8%*	0.76	*12%*	1.27	*9%*
Sheep meat exporters	0.02	*0%*	0	*0%*	0.03	*0%*	0.01	*0%*
Domestic sheep meat retailers	0.36	*6%*	0.61	*13%*	0.21	*3%*	1.5	*10%*
Overseas consumers	1.74	*27%*	0.59	*13%*	2.38	*38%*	2.15	*15%*
Domestic consumers	2.04	*31%*	2.2	*49%*	1.21	*19%*	6.89	*47%*
Other chain participants	0.06	*1%*	0.04	*1%*	0.07	*1%*	0.07	*0%*
Total benefit	6.51	*100%*	4.53	*100%*	6.32	*100%*	14.61	*100%*

(Mounter et al., 2008)

The limitations of this analysis are two-fold: (1) the cost of generating such change is not estimated, precluding a cost-benefit analysis approach. However, numerous extensions of the results provide substantial insights in this regard; and (2) the distinction between innovation and research is lost, and so results are, loosely, projected benefits of research. These two limitations are related, in particular that the extent to which effort affecting technology or marketing uptake (one element of cost) generates specific amounts of economic surplus, is not measured. This is a vital consideration in discussion of the design of a proposed Centre, the specific role of which is to enhance uptake and adoption.

7.2.2. Gaps between research and innovation

7.2.2.1. Definitional items

In Section 4, innovation and research were contrasted in terms of flows of resources toward separate purposes. A further contrast is recognized in terms of the processes of research and innovation within firms, industries and the economy as a whole. At a macroeconomic analytic level, ex post measurement of innovation has featured a "residual" productivity increase which is unexplained by increases in input use. In markets and industries, research outcomes are modelled either as technological changes which alter supply arrangements to the extent of lowering costs; or as demand changes. Hence, analysis of the impacts of innovation and research has blurred the boundaries between the two, often within a general approach to Research and Development (R&D). Direct measures of innovation outcomes such as new product introductions and/or sales, are primarily used at firm level. Recognition and assessment of the innovation process, or measures of firms' inherent "innovativeness" also feature in the management literature.

7.2.2.2. Empirical evidence for the red meat industry

Moreland (2010) has claimed that an abundance of important and significant new technology has not been adopted by the Australian red meat processing industry. We present one form of supporting empirical evidence to support the existence of a gap between research and uptake. Figure 3 presents a comparison of published Research 2005-2014, and patents relating to red meat over the same period. The graph compares World and Australian published research related to the beef and sheep meat industry, and World patents. Data were extracted from Scopus , using search items "beef", "mutton", "sheep meat" and "red meat".

An expected result is that the most frequently-occurring outcomes relate to agricultural and biological sciences, medicine (human and animal/veterinary) and biochemistry, genetics and molecular biology. Where patent activity exceeds published research (e.g. immunology and microbiology, chemistry, chemical engineering, energy and material science), two explanations are possible. First, the research being undertaking may not lend itself to patenting, and may be diffused and disseminated by other means. This is a strong potential explanation for the very limited patenting in relation to veterinary science. An alternative explanation is that a significant amount of academic research that is relevant to the red meat industry (as evidenced by strong patenting activity) is not reflected in published research. This may apply to immunology and microbiology (as applied to livestock), chemistry and chemical engineering, and materials science.

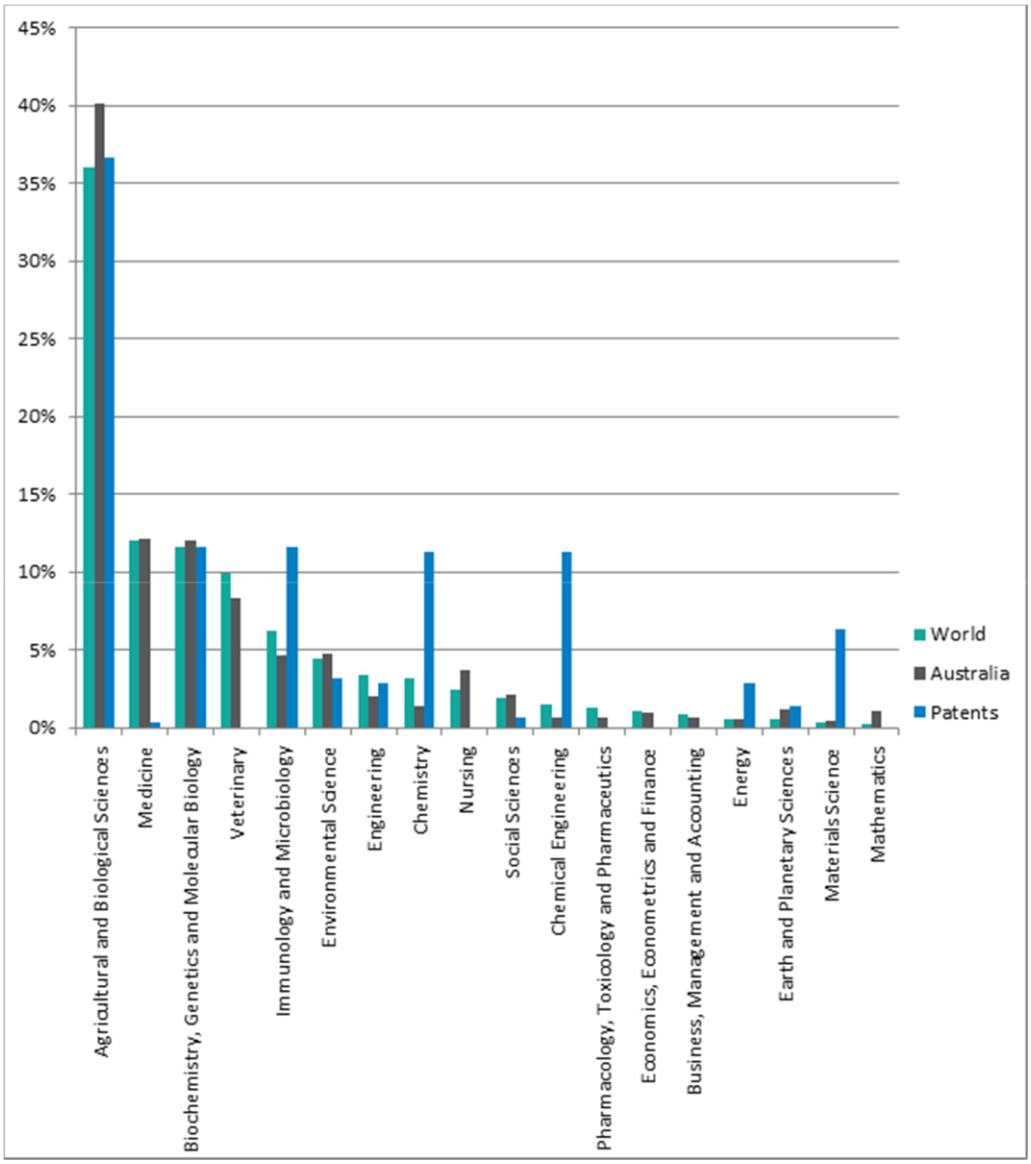


Figure 21. Comparison of outcomes of academic research and patenting in red meat subjects

Exploring patents in these areas allows an examination of what patents are covering, that is not covered in published research. Patenting in immunology and microbiology spans work relating to on-farm biocides, genetic evaluation of herd characteristics associated with desirable product outcomes and the management of pathogens. Relevant patents in chemistry and chemical engineering relate to livestock feed and nutrients, chemicals for the management of meat processing and additives and processes of relevance to meat processing for market. Relevant patents in materials science relate to packaging materials for shelf life quality enhancement and duration extension, packaging of waste and materials that are effective in the preparation of meat products for the table.

These results are illustrative and exploratory rather than explanatory, but provide some indication of a disconnect between the innovation demands of the red meat industry and the research currently being undertaken in Australia and elsewhere as measured by peer-reviewed and published academic work. It is further worth comparing these results with the findings from the study's survey in relation to the expectations of red meat processors.

7.2.2.3. Analysis of survey results, regarding thematic areas for a Centre

The survey of processing plants used data collected in face-to-face interviews with personnel from 39 companies representing 50 abattoirs across Australia. Detail of the survey was reported in the milestone 4 report.

Factor analysis was used to reduce the responses from a large number of questions into five key themes. Factor analysis is a statistical technique using covariance analysis to explore how responders tend to answer certain groups of questions, and whether they do so in a similar manner. Once these statistically correlated questions were observed, a secondary check was undertaken to ensure that the common themes or factors made intuitive sense. Furthermore, questions that were very similar in content were dropped for the purposes of simplicity and clarity of presentation. Once the shortened list of statistically and intuitively related items was finalized, and grouped into thematic clusters, these groups were utilized as Thematic Areas. The average response for groups of questions was calculated for each survey respondent. Table 27 presents the key content of the questions that loaded onto the five derived thematic areas.

Table 27. Emergent thematic areas, related to Centre function.

Factor: thematic area into which questions fall	Constituent question in survey questionnaire, indicating preferred focus of proposed Centre
1. New Technology Development	New Technology Development
	Red Meat Processing Innovation Centre Library
	New Product Development
	Technology for Processing Manufacturing and Fabrication
2. Value Chain Research	Market Research
	Wholesaler Relevant Research
	Retailer Relevant Research
	Market Development Relevant Research
3. New Technology Evaluation and Demonstration	New Technology Evaluation
	Economic Evaluation of New Technology
	Industry Demonstration
4. Meat Science	Meat Processing and Science Research
	Meat Science and Quality
	Meat Technology Development
5. Education and Training	Education and Training of Industry Personnel
	Student Training
	Training and Education Research

Figure 22 presents these findings along a scale of 1 – not important, 2 – somewhat important, 3 – important and 4 – very important for the five thematic areas of innovation and technology adoption needs, which emerged from the study's survey of meat processing firms. Scores in figure 4 represent the averages of the scores across the questions included in the loading. These thematic areas will be utilized further below, and are presented here for comparison with the topics of research currently being undertaken in Australian universities and research institutes (as suggested by published research) discussed above.

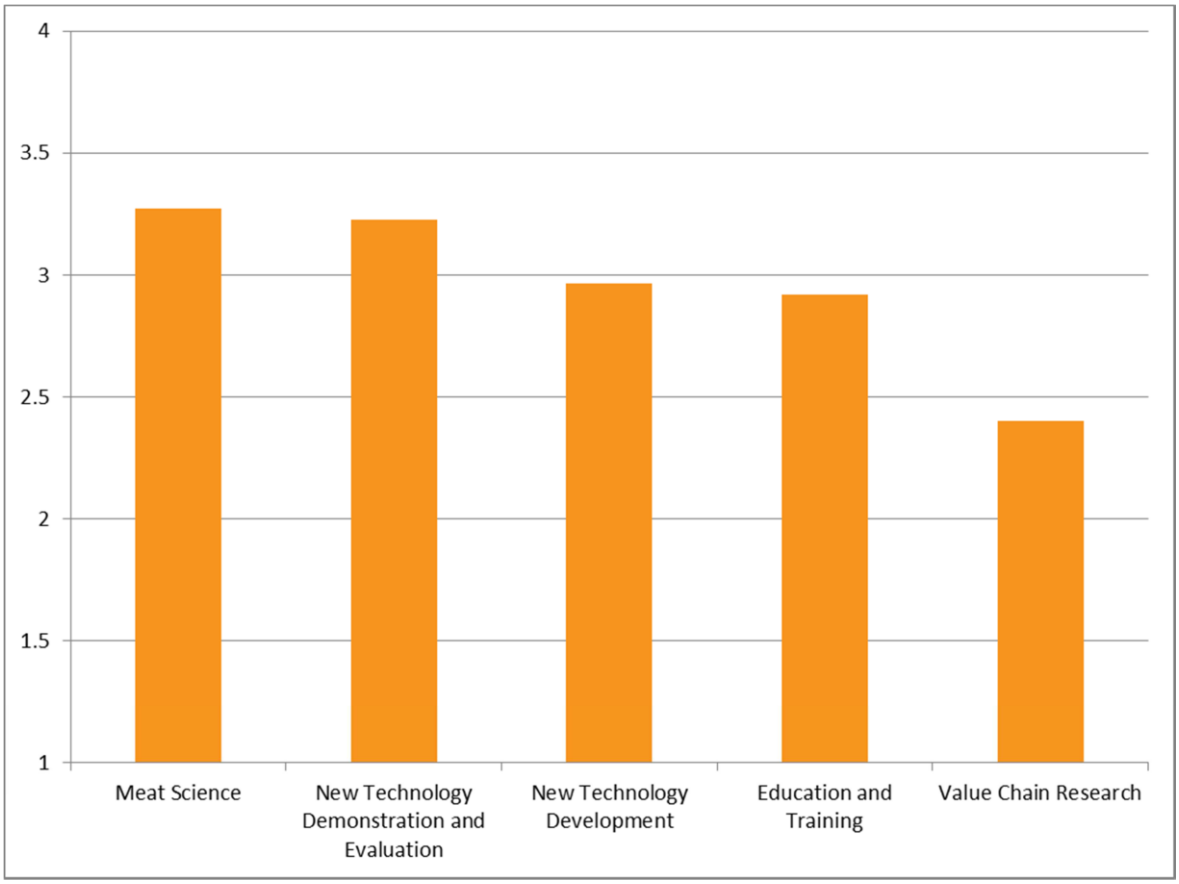


Figure 22. Average responses across five thematic areas (Survey from current study)

The thematic areas presented in figure 22 are not well aligned with the research outcomes displayed in figure 21. In particular, (i) new technology development, evaluation and demonstration, and (ii) value chain research are poorly presented amongst published work. This reinforces the findings from the Scopus and patenting analysis in relation to shortages in chemical engineering and materials science research, patentable technology relating to genetics and microbiology and (to a lesser extent) engineering. All of these themes fit within the new technology development arenas. Figure 21 also shows that at least some Australian red meat processors are supportive of greater research in issues relating to value chain integration and communication – both upstream to producers and downstream to customers. However, very little of this market facing and applied research is being undertaken in Australia or elsewhere.

7.2.3. Entry points for enhancing technology uptake

7.2.3.1. A model of adoption identifying intervention points

The pattern of adoption of new technologies is usually represented as a sigmoid curve which describes the % of participants adopting over a time period. The sigmoid shape reflects the cumulative, yet uneven, nature of adoption. Further, it is usually incomplete: less than 100% of participants adopt the technology even after very long delays (figure 23). This enables an analyst to identify early or late adopters, and non-adopters (figure 24). Three mechanisms of adoption promotion then appear (figure 25): raising the adoption ceiling; accelerating adoption timing; and changing the adoption profile.

Figure 23. Sigmoid adoption curve.

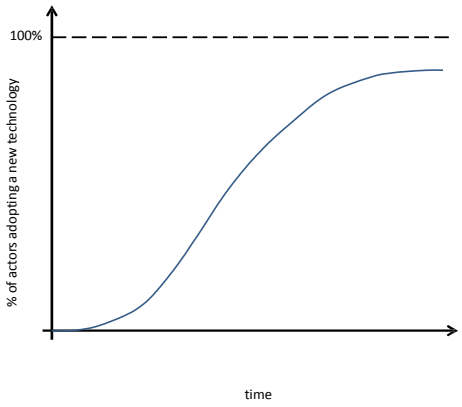


Figure 24. Adoption curve with categories of adopters of technology.

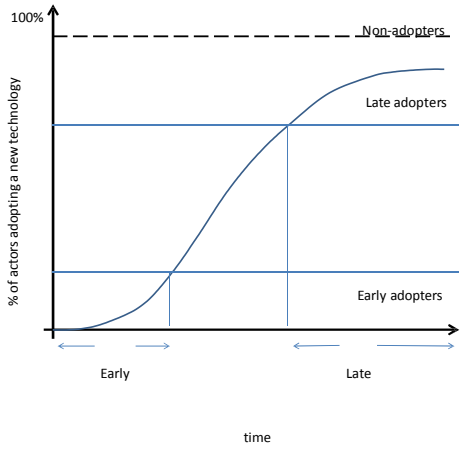
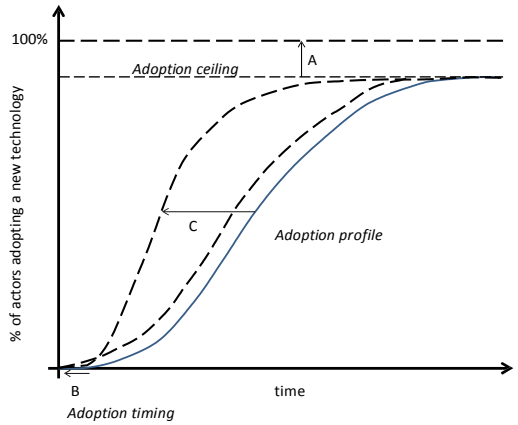


Figure 25. Sigmoid adoption curve with potential intervention mechanisms to increase or accelerate adoption



A: Raising the adoption ceiling. This increases the level of adoption, up to a maximum of 100%.

B: Changing the adoption timing. This accelerates adoption by shortening the delay before adoption for all participants, while maintaining the original sigmoid curve.

C: Changing the adoption profile. This changes the sigmoid curve, indicating that although numbers of early adopters may be unchanged numbers, the adopters that follow do so more quickly, and this can also apply to late adopters.

7.2.3.2. The nature of costs and benefits of innovation

CRRDC (2010) highlights the substantial benefits generated by the uptake of Australian primary industry research, notably arising from public investment in "rural" Research and Development. CRRDC emphasized the element of public good in the output of such research, and the consequent barriers confronting its funding from private investment. CRRDC identifies both public goods (non-excludable, non-rival) along with industry goods (somewhat excludable, mostly non-rival) in its discussion. AMPC (2010) points out the complexity of calculating and implementing public and private, and more importantly "industry", shares of investment and return. This identifies the requirement for funding approaches which (1) facilitate collaboration for co-innovation and (2) provide an environment in which private investment is stimulated.

CRRDC (2010) further discusses spillovers of research-related benefits within and beyond industries, and the extent to which firm size, geographic location, target market and commodity group affect the magnitude and direction of these spillovers. It also emphasizes the global nature of product innovation in some key sectors (e.g. agricultural chemicals) and the roles that are required at national level (certification by government in this case). CRRDC identifies the maintenance of research capacity and capability as an additional product of the national research system that generates public, private and industry benefit.

7.3. Technology adoption and the Australian red meat industry

7.3.1. Factors affecting adoption within innovation systems

7.3.1.1. Facilitation of adoption

"Innovation systems" (Lundvall, 1992) are usually seen as the backdrop to innovation within firms and industries, depicted at a national level. The innovation system is populated by producers of research, adopters of innovation, and facilitative actors in between. These facilitative actors include universities, purpose-defined institutes, facilitative government agencies, industry groups, and others including a proposed Centre of Excellence for Red Meat Processing Innovation.

In a straightforward description of innovation systems, Howells and Bessant (2012) identify networks, clusters and collaborations amongst firms as resources upon which firms and industries can draw for the acceleration of innovation. This "resource-based view" of the firm will be expanded further below in addressing which particular resources may be present, absent, or in need of strengthening to boost the firm's uptake and adoption of technology. In an application to the Australian beef industry, Storer *et al.* (2014) expand such resource considerations to the entire supply chain within which a firm operates, which is the so-called "relational view of the firm": essentially that such innovation accelerating resources may be present and available within the firm's network of commercial partners, but not necessarily within the firm itself. Lavie (2006) presents a model of relation-based profitability within value chains. He notes that firms, when allying, maintain their own resource stock, but also blend their resources to create 'shared resources' which in turn create appropriable benefits to be shared among the partner firms. He notes that interconnected firms extract value from resources that are not fully owned or controlled internally, with such synergies providing a strong rationale for value-chain collaborations. Furthermore, a second form of rent, or profit, emerges. This relates to spillovers of knowledge between collaborating firms. This can be likened to knowledge about best practice

shared between partners, improving the performance of the learning firm without any cost to the firm releasing the knowledge or technology.

Networking amongst Australian meat industry firms (e.g. AMPC), and with research organizations (e.g. CRCs), has delivered substantive and successful research partnerships. However, the extent to which these have utilized or enhanced processing firms' innovation-related resources and value chain relationships is unclear.

7.3.1.2. Changing sources of new technology as an innovation system driver

Sun *et al.* (2014) describe the Australian beef industry's innovation system, but only for the production stage of the supply chain. These authors observe that beef production has, in the past, generated its innovation internally by way of "agriculture, scientific research and outsourcing" but more recently has shifted to a model of innovation which is purchased "off the shelf". They discuss the implications of this change within an innovation system characterized by complex dynamics between participants (such as farms and breeders) and on individual farms. Although there is limited consideration of the off-farm participants, the work identifies the importance of variation in geography, firm size and firm type in establishing the dynamic relationships which enable innovation. Information flows – primarily between participants at different stages in the supply chain - are seen as essential in closing "gaps" which prevent technology uptake. In addition, the form and extent of innovation in industries has been shown to shift the location preferences of industries (Howells and Bessant, 2012) and with it the associated patterns of employment and raw material supply.

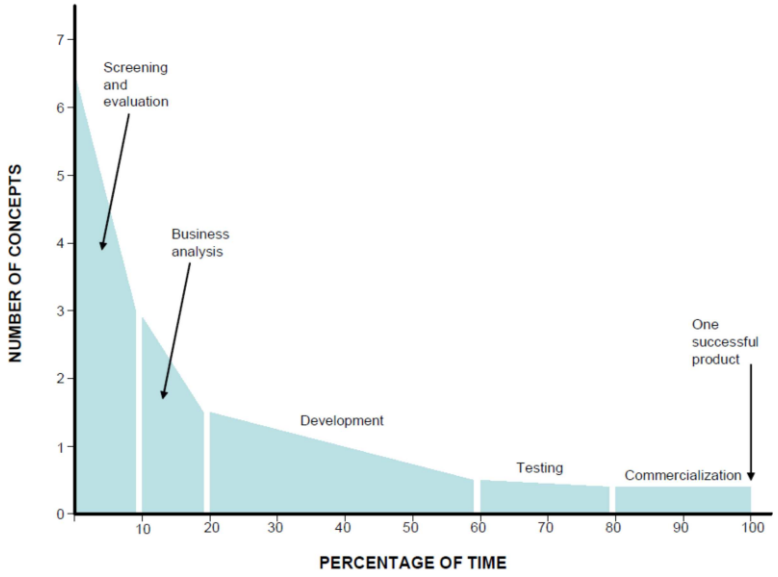
As sources of innovation become more diverse, and arise in more diverse sets of industries, adoption by Australian red meat processors face increasingly demanding information needs about all states of new technologies: ranging from their very existence, through to suitability in particular uses for particular firms in particular plants. Issues such as the complexity of the technologies and their ability to be trialled prior to uptake, are likely to create gaps between technologies' emergence and application in the red meat industry.

7.3.1.3. Systems as recipients of facilitative assistance

Pitt (2007) develops and uses a single framework of "innovation and entrepreneurship" for the Australian red meat industry within an innovation system. She interprets lack of adoption of new technologies as "failures" in the Australian innovation system, and advocates corrections in the form of organizational change and leadership by Meat and Livestock Australia (MLA). These feature improvements in the innovation culture by way of policy change and capacity building, as well collective action. Bruns (2010) interprets the German pork industry's innovation system as a market wherein innovation related services are demanded and supplied: this author rejects the "system failure" and "gap" explanations for poor uptake of new technologies. Rather, Bruns (2010) proposes a brokerage mechanism whereby providers of innovation can be matched with its users, so that this market can better function.

7.3.2. Within-firm mechanisms of innovation

Descriptions of innovation processes within firms generally depict a step-by-step procedure which generates an attrition of concepts, ideas or new products (see example depicted by Booz, Allen and Hamilton (1982) in fig 26). Accordingly, firms' management structures supporting innovation are generally depicted as a stage-gate decision process (Baker, 2007) which complements the attrition process.



(Booz, Allen and Hamilton, 2002)

Fig 26. Attrition in new product concepts

The extent to which firms formalize and empower the processes and structures of innovation has been shown to vary widely across firms (Griffin, 1997), and has been used as an explanation for observed variation in innovation. Moreland (2010) uses this approach to analyze the uptake of new technologies in the Australian beef industry. Moreland (2010) points out that large research investments in new product development and in advanced processing are frequently not reflected in their adoption by firms, and suggests that this is due to aspects of multiple layers of complementarity amongst the firms, the innovations, and the products which together constitute "innovation fit". Innovation fit is defined as "the extent of alignment between the perceived innovation characteristics and the requirements of end users". These characteristics and requirements are summarized by Moreland into a typology including "complexity", "observability" and "trial-ability".

The management insight offered by Moreland (2010) is that information dissemination mechanisms, both within and beyond the firm, can provide the stage gates (referred to as "review points") referred to above. Information flows are advocated as being catalytic to early identification of innovation fit by way of the review points, and an associated acceleration of decisions on adoption.

It is notable that studies of innovation outcomes overwhelmingly feature new product development, rather than process, market or organizational forms of innovation. Evanschitzky *et*

al. (2012) present an extensive review and re-estimation of a great bulk of literature which attempts to explain new product development across a range of industries. Self-evident variables such as product success and market characteristics naturally feature as contributing to success of new product introductions. Firms' internal decision and information flow processes, efforts in pre-development tasks, the presence of purpose-dedicated innovation personnel and management's involvement in innovation, as well as customer involvement, are all found to be significant contributors to successful new product development. Overall, these authors conclude that although these factors remain important determinants of new product development success, their influences are declining in favour of new variables which include firms' external relations, the organizational design and climate of the firm, and relevant measures of "culture" which refer to national environments and norms. Further, an increasingly important determinant of success for new product development was found to be the likelihood of a competitive response from within the industry: where competing firms seem likely to introduce similar new products, the probability of success of new products increases. Firm size and the degree of centralization of the innovation process in firms, were found not to be significant explanations of new products' success.

Storer *et al.* (2014) compared cohorts of innovative, as opposed to non-innovative, firms in the Australian beef industry. This distinction was made according to firms' utilisation/non-utilisation of recently available IT-enabled data products and services. These authors examined value chain aspects of innovation (see below), but also addressed the fundamental question of profitability as a driver for technology adoption. They found, first, that firms adopting the identified technologies acknowledged doing so in expectation of future profits. Secondly, they found that non-innovative firms had significantly higher expectations regarding the profitability of innovations, than did innovative ones.

7.3.3. Within-value chain mechanisms of innovation

Yeniyurt *et al.* (2014) examined the influence of co-innovation (that is, participation in innovation by multiple supply chain partners) on new product development and sales performance of the related firms in the automotive industry. The study used multiple measures of success in new product development: appearance of new products; and also sales performance by both the supplier and the buyer. Although many studies have examined buyer involvement in new product development by suppliers, this study addressed the converse arrangement which is relevant to Australian red meat: namely the involvement of suppliers (red meat processors) in buyers' (meat retailers) new product development. Unsurprisingly, buyer-supplier working relations, degree of dependence from each side (in terms of available alternative partners), and timing and sequencing were found to be significant determinants of success. Also as expected, trust, expectations of profitability, and the success of the innovation were found to favour supplier involvement in new product development by the buyer. The influence of dependence was more complex: buyer dependence on a supplier reduces incentives for supplier involvement in buyer innovation; while supplier dependence on the buyer increases such incentives.

Further, timing and sequencing of actions took account of the cumulative nature of relationships between firms: the first collaborative co-innovation job is probably the hardest, and is conducted in the absence of trust and good experience. Conversely, first-time interactions were found to feature a shortage of supplier funds and high levels of uncertainty. A further telling result is that suppliers identified the fixed cost nature of innovation expenditures as a barrier to such investment (Yeniyurt *et al.*, 2014).

Further examination of relations between firms and their effect on innovation is presented by Castaner *et al.* (2014). These authors found that product innovation in the aircraft manufacturing industry featured a "make or ally" decision: whether or not to engage with supply chain partners. A strongly intuitive result is that the key determinants of the decision surrounded (1) the resource endowments of the leading firm – essentially whether it needs a partner and (2) the ability of the two firms to establish and implement suitable governance arrangements. Large firms were found to be more likely to engage in co-innovation than small, and experience with products (demand characteristics, complexity, and key resources) greatly favoured collaboration in new product development.

Supplier commitment to the overarching goal of value addition by way of long term relationships is discussed by Lees and Nuthall (2015) in a study of New Zealand agribusiness firms. These authors state explicitly a key feature of value chain partners' incentives: suppliers seek access to high value markets that only buyers can provide; while buyers seek to generate a range of differentiated products which can be supported only by products of high and consistent quality, for which they rely upon suppliers. Factors contributing to collaboration are reported as certainty in pricing, level of price and the quality of relationships. Leaving aside value addition, earlier New Zealand work by McDermott *et al.* (2004) had identified largely similar explanations for sheep and beef producers' selection of buyer, wherein the overarching explanation was the availability of kill space within seasons.

Returning to the Australian beef industry, Storer *et al.* (2014) mainly addressed firms' strategic supply chain management, and strategic supply chain capability, as explanations for adoption of technology. Notably the technologies examined are "industry led" in nature (including those related to breeding, and MSA eating quality measures), and also apply particularly to supply chain behaviour: that is the relations and transactions between firms rather than the processes within the firm.

Pethick *et al.* (2011) lists three aspects of Australian lamb quality (lean meat yield, eating quality, human nutritional value) which offer potential for expansion of the industry's offering to consumers, and which are able to be enhanced by firms' uptake of technological advance. The benefits and costs of such adoption were not assessed, nor the extent to which they would accrue to the various value chain participants and beyond to public goods. Ding *et al.* (2014) presents a particular innovation outcome (food quality in the Australian beef industry) as a use or application of innovation, and identifies key supply chain attributes which positively influence it: the presence of some form of strategic alliance; trust and commitment amongst participants; and most importantly the quality of information being transmitted along the supply chain. Storer *et al.* (2014) emphasize key attributes of the Australian beef industry's suppliers (producers and processors): high volume and low margin; facing both domestic and foreign competition; declining access to human capital; and fluctuations in both climate and international trading conditions. The authors note that these characteristics pre-dispose toward opportunistic supply chain behaviour – toward a 1-off transaction-based model and an absence of the long term relationships that might contribute toward progress in industry-wide goals such as product quality. A further finding of the study is that neither innovative nor non-innovative firms acknowledged that supply chain integration as important in either supply chain strategy, or in delivery of benefits from adoption of the technologies in question.

7.3.4. Institutional aspects of accelerating adoption

7.3.4.1. Response to "System failure"

As described above, Pitt (2007) identifies system failures in the Australian red meat industry (including, but not limited to, processing), and advocates responses to correct such failures. Each identified failure is associated by Pitt (2007) with certain causal aspects, and a summary of Pitt's work is presented in table 28. Pitt's proposed responses are presented in a "response framework" column.

Table 28. Proposed responses to red meat innovation system failure

Failure	Causal aspects	Response framework
Infrastructure failure	Scale Time frame Firms' inability to appropriate benefits of innovation	Collaborative/collective action to achieve scale Public sector involvement in the sense of market failure correction
Adaptive failures (by Transition and Lock-in)	Required rate or scope of change exceeds firms' experience or capacities to adapt and perform Where systems' norms prevent firms' action	Capacity building Shifting of system's norms
Institutional failures	Non-conducive policy or commercial procedures	Changed policy Changed commercial procedures
Interaction failures	Absence of Industry-science linkages Co-innovation along the supply chain Collaboration amongst firms Sector-level communication on open innovation Shared vision of innovation	Enhanced information flows Facilitated communications along several channels
Sector or culture failures	Absence of an appropriate culture for innovation	Changed culture Risk management or mitigation

Adapted from Pitt (2007)

Pitt's proposed responses entail collaborative action and public sector involvement to correct for problems with scale, absence of whole-value-chain commitment, and lack of appropriability of benefits. Enhanced information and communication flows, and "changed culture" (possibly emphasizing risk mitigation and policy) are proposed to strengthen several sets of linkages within the red meat innovation system. There is also a call for changed policy. Emergent roles for a proposed Red Meat Processing Centre of Excellence can be summarized as:

a mechanism for collaborative action on innovation

provision of a new set of "norms" for the innovation system, particularly addressing firms' needs and aspirations by enhancing "innovation fit" (after Moreland, 2010)

capacity building in the management of innovation adoption at firm and system levels.

7.3.4.2. Response to "demand and supply gaps"

Bruns (2010) introduces demand for, and supply of, "innovation services" as part of the innovation system in the German pork processing industry. Unlike Pitt's description of a system failure, Bruns (2010) characterizes a market for innovation services and describes its demand and supply elements, and the facilitation needed to make the market work. Selected aspects of Brun's work are presented in table 29, with proposed responses presented in a "response

framework" column.

Table 29. Proposed responses to supply and demand for innovation services within the system

Element	Activity set addressed	Response framework
Demand for support in innovation	Increases with Size of any collaborating consortium Absence of innovation capacity (staff and structures) within the firm Lack of knowledge of new markets to be targeted as part of innovation Lack of strategic alliance between supply chain participants Lack of experience in initiating and funding innovation projects	Identification of firms needing assistance
Supply of innovation design activities	Design of innovation activities Evaluation and idea selection Identification of resources and strategic issues	Consultancy-based support
Realization of innovation activities	Facilitation of IP solutions Assistance with internal firms' management Business planning	Brokerage between suppliers and users of innovation services
Dissemination	Skill building Information flow Public Relations	Separation of training and information flow from public relations Public relations to fall within industry strategy
Networking	Facilitation of SC relationships Lobbying	Brokerage between suppliers and users of innovation services

Adapted from Bruns (2010)

Bruns' (2010) response framework centres on an "innovation broker": a third party participant that brings together users and providers of meat processing industry innovation. The broker addresses issues at several levels, for example collaborating firms are accommodated not only with regard to their innovation needs, but also to the organizational aspects of a collaborating consortium of firms. The broker's suite of services accommodates both individual firms' needs (e.g. skill building, innovation planning) and systematic issues such as IP, information flow and public relations. A notable inclusion is the broker's role in facilitation of relationships within the supply chain. A proactive role is envisaged in terms of identifying firms needing assistance, and innovation project development and decision support.

7.4. Insight from survey results, for design of the proposed Centre

7.4.1. Decomposition of survey material into Thematic Areas

As described above, factor analysis was used to reduce the responses from a large number of questions into five thematic areas. These are:

New Technology Development

Value Chain Research

New Technology Evaluation and Demonstration

Meat Science

Education and Training

7.4.2. Firms' expectations of benefits across the thematic areas of Centre operation

7.4.2.1. Customer focus

The sample was split between those firms that reported as 'Very Important' the issues of "increasing customer numbers" and "increasing the number of markets served" when making choices regarding the introduction of new technology; and those that did not report these issues as 'Very Important'.

The first group (21 of 39 firms) is labelled 'Higher Customer Focus'. A consistent pattern is evident: higher customer focused firms are more demanding of a proposed Centre in all of the thematic areas, with the variance between groups most pronounced in their desire that a Centre focus on (a) new technology demonstration and evaluation and (b) value chain research (see Fig 27).

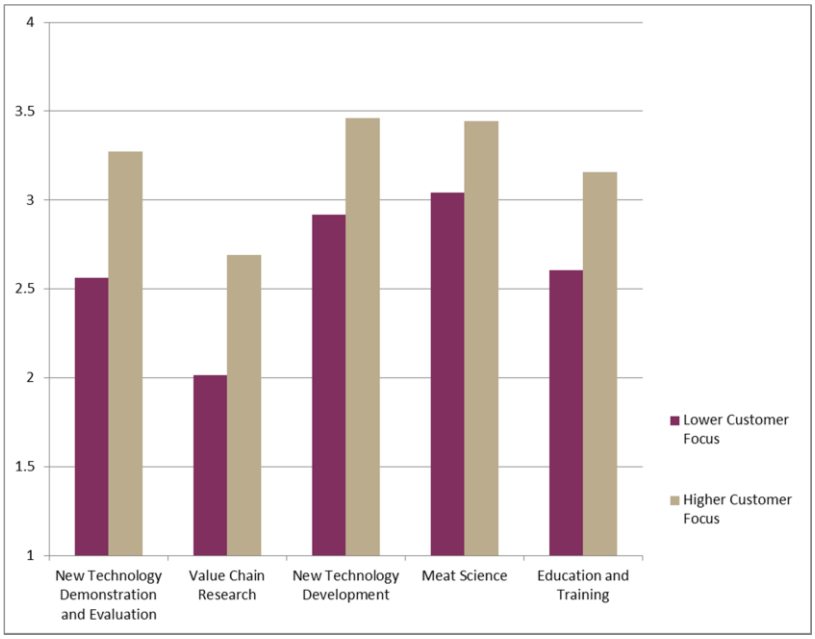


Fig 27. Expectations about thematic focus of the firms: comparison of firms with high and low customer focus (Survey data)

Firms with a higher customer focus place a greater focus on the potential benefits of the Centre. They are supportive of its proposed benefits across a number of thematic areas and have higher expectations of what it can achieve in all areas, than do firms with lower customer focus. Firms with the lower customer focus exhibited their greatest expectations of the Centre in the thematic areas of new technology development and meat science.

7.4.2.2. Innovation focus

The sample was split between those firms that reported as being an 'Early adopter' or 'industry leader' of new technology over the last 5 years, currently or over the next five years; and those that did not. The first group (5 of 39 firms, or some 15% of the sample) is labelled 'Higher Innovation Focus' (see Fig 28).

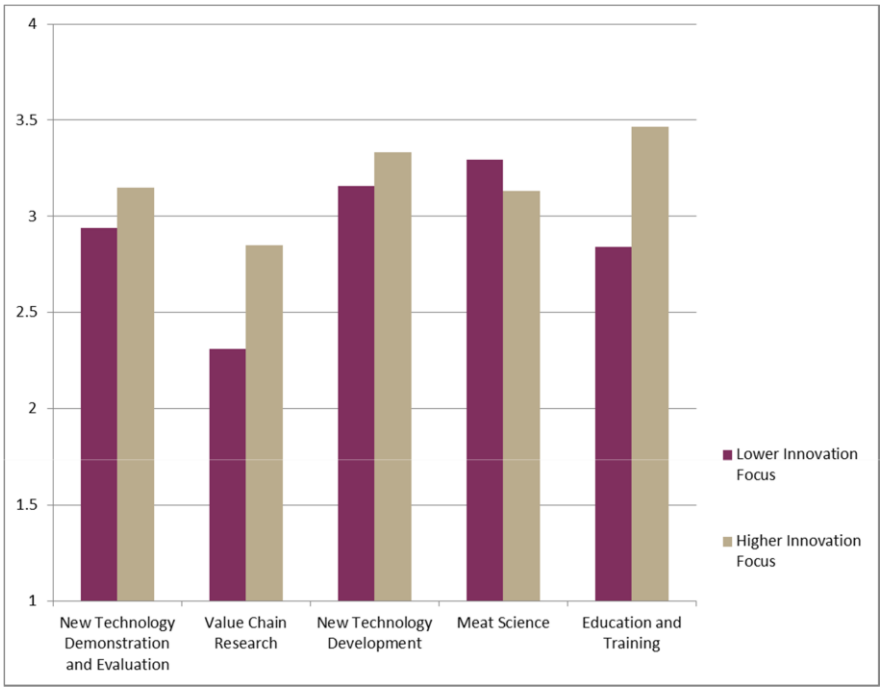


Fig 28. Expectations about thematic focus of the firms: comparison of firms with high and low innovation focus (Survey data)

Generally, higher innovation focus firms were more demanding of the proposed Centre in the areas of value chain research, and in education and training. A possible explanation of this finding is that firms that invest in leading edge technologies have a strong stake in ensuring both upstream (producers) and downstream (wholesalers and retailers) are able to be effectively integrated with these new technological investments.

Firms with a higher innovation focus also place emphasis on the potential of a proposed Centre to develop new skills and to research the development of skills and education arrangements for the industry. This is consistent with the notion of innovation absorptive capacity (Cohen and Levinthal, 1990) with these authors noting the importance of higher levels skills and expertise within firms that sought to adopt or develop new technological innovations.

A further notable result is that firms with lower innovation focus were most demanding of the proposed Centre in terms of new technology development and meat science. The thematic area of meat science featured the firms with lower innovation focus having higher expectations of the Centre than did those with higher innovation focus.

7.4.2.3. Value chain focus

The sample was then split between those firms that were reported as 'Very Important' or 'Important' for the question "How important could such a Centre be in proof of principle to (a) producers, (b) wholesalers and (c) retailers and supermarkets". Firms that scored 'Important' or 'Very important' on these questions we termed 'Higher Value Chain Focus' (11 firms), while those that reported otherwise were termed 'Lower Value Chain Focus'.

Processors that see the potential of the proposed Centre for upstream and downstream value chain participants will be more attuned to the benefits available from better integration between farmers and consumers, mediated by processors, wholesalers and retailers. A consistent finding (fig 29) is that high value chain focus firms are more demanding of the potential for the Centre to add value across all thematic areas. This is most notable in value chain research (as expected), but it also evident in relation to new technology demonstration and evaluation, and to a lesser extent for new technology development, meat science and education and training.

Firms with a higher value chain focus tend to see their role within the industry as complementary to their associated upstream and downstream partner firms. Seeing a Centre of Excellence emerge as an integrated value chain hub and communication catalyst across all levels of production would be a strong perceived benefit envisaged by this group.

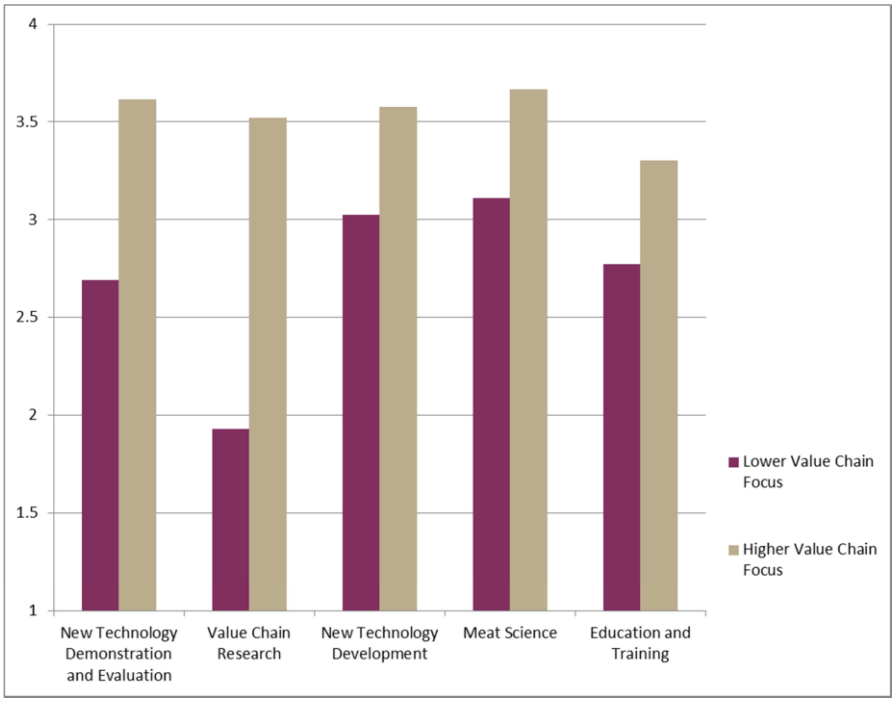


Fig 29. Expectations about thematic focus of the firms: comparison of firms with high and low value chain focus (Survey data)

7.5. Conclusions

7.5.1. Benefits and costs of innovation in red meat processing

7.5.1.1. Form and configuration of costs and benefits

Costs associated with innovation are largely fixed and immediate, while benefits accrue over time and are variable in nature. In addition to the inherent uncertainty surrounding the timing and magnitude of the benefits of an innovation, many cost items (especially reorganization and information systems) associated with innovation are also subject to such uncertainties. Substantial evidence identifies this cost and benefit configuration as a barrier to innovation by firms. Collaborative action (which shares costs), and information flows are the standard form of response by innovation facilitating bodies. Although information sharing is a robust response to the uncertainty identified above, this study has revealed firms' tendencies to wait-and-see before adopting innovations, particularly by observing competitors' actions on a case-by-case basis.

The benefits of research into meat processing are spread across all value chain participants, primarily consumers and producers. This is true of all red meat sector expenditures, including demand shifting actions such as product promotion. Existing estimates of such transfers do not capture a number of public goods such as improved nutrition, public health, food safety, animal welfare, the environment, and the enhanced image of Australian products in export markets. The generation of such public goods is reflected in government participation in funding red meat industry R&D, albeit on a co-funding basis at an arbitrary level.

Industry benefits fall between public and private benefits of innovation. They are non-appropriable outside the red meat industry, but non-excludable within it. Information generation, advisory services, and training similarly supply industry benefits. However, the impact of provision of industry goods on technology uptake remains unclear. In particular, the boundary between private (to firms or plants) and industry good is poorly defined so that competitively driven incentives outweigh an inherent industry interest. By definition, if not by design, wait-and-see behaviour by firms regarding new technologies characterizes industry benefits.

Entry points for enhancing innovation have been described in terms of manipulating the sigmoid adoption curve: increasing the total number of firms adopting; early adopters' adopting even earlier; and late adopters' adopting earlier so as to change the sigmoid profile itself. This study concludes that each one of these entry points can be used by an industry oriented Centre of Excellence in Red Meat Processing Innovation. Further, the functions of the Centre will need to be tailored to the needs of subsets of processing firms. Those firms might be identified and targeted as "subindustries" with specific objectives. Alternatively, a range of services might be defined targeting, to one degree or another, firms' diverse perceptions of the fit of specific innovations to their businesses or the extent to which the innovation system serves their purposes.

A Centre of Excellence in Red Meat Processing Innovation could be charged with improving the performance of the innovation system. This entails recognizing the system's functions and failings, and correcting them for red meat processors. This study concludes that the innovation system functions in terms of supply of, and demand for, innovation in a market setting, and that

brokerage is necessary to improve the performance of this market.

7.5.1.2. Co-innovation

Involvement of multiple value chain participants in innovation is widely acknowledged as a driver of innovation success, particularly in the realm of new product development. A fundamental synergy exists along the value chain, in that manufacturers (including red meat processors) seek higher value markets which only retailers or foreign importers can access, and those customer facing value chain participants seek the high and consistent product quality which is accessible only from manufacturers. The prevailing Australian red meat innovation system apparently does not provide the incentives for this synergy to facilitate co-innovation along the value chain despite the existence of a number of relevant industry goods (e.g. MSA quality grading and genetic advance, to name just two). This study concludes that a major focus of innovation in the Australian red meat industry is primarily within-firm, targeting technical elements which reduce costs (i.e. process innovation) rather than value addition associated with new products and new markets.

The significant barriers to innovation already mentioned (size and configuration of costs, risks) are exacerbated where innovation actions extend across the gap between firms and stages of the value chain. The proposed brokerage role of the Centre of Excellence in Red Meat Processing Innovation could extend to understanding and mobilizing the incentives of the diverse innovation partners so as to generate joint action within the value chain and publicize and promote it within and beyond the industry. Particularly in respect of these new avenues of innovation, promotion within the industry will accelerate industry uptake at all three entry points outlined above. Promotion beyond the industry will address public relations aspects of new technologies (which may for example reduce labour costs but call for enhanced skill levels) and innovation outcomes (such as animal welfare or environmental benefits).

7.5.2. Functions of a Centre of Excellence in Red Meat Processing Innovation

7.5.2.1. Recognition of diverse innovation focus

Exploratory analysis of the study's survey data reveals five thematic areas of technology uptake and innovation:

New Technology Development

Value Chain Research

New Technology Evaluation and Demonstration

Meat Science

Education and Training

In these five thematic areas, evidence from international research data bases suggests that in relevant topics (red meat, beef, sheep meat), frequency of research output departs markedly

from that of patent registration. This is to say that the Australian innovation system is not balancing supply with demand. This reinforces the brokerage arguments made above, and further suggests that some thematic areas of innovation will require greater brokerage efforts than others.

Some commentators claim that meat industry innovation may well be changing from a largely within-industry process to one that is pre-formulated, possibly in other sectors, or delivered as an adaptation of existing technologies. This draws into sharper relief a view of innovation as the interaction of supply and demand, with a brokerage role providing not only the facilitation of market forces but also a surveillance service across innovation themes like those outlined above, or others defined by users. A Centre of Excellence in Red Meat Processing Innovation would regularly update its listing and description of these thematic areas and identify supply of, and demand for, innovation within thematic areas. Communication with processing firms, as well as with other value chain participants and their representatives, would then identify causes of slow adoption and provide appropriate brokerage services.

A Centre of Excellence in Red Meat Processing Innovation could additionally be complementary to existing service providers, as for example defined by the thematic areas identified. Meat science, and training and education, are services provided by a number of existing organizations in purpose-built facilities, under longstanding arrangements both with meat processing firms and the industry as a whole. The proposed brokerage role could first strengthen connections between users and providers – particularly those already established – while also identifying gaps and prospective service providers to fill them. Two such gaps are identified in this report: value chain- oriented research which is seemingly rarely observed; and new technology evaluation and demonstration, which take place in an *ad hoc* fashion as firms wait for their competitors to adopt and then decide to copy them or not.

7.5.2.2. Recognition of diverse firms' innovation motivation

Exploratory analysis of the study's survey data revealed substantial differences in firms' expectations of the proposed Centre of Excellence in Red Meat Processing Innovation. The analysis was limited to just three orientations in this regard, representing aspects of the red meat innovation system likely to be constraining uptake of new technology:

Customer orientation

Innovation orientation

Value addition orientation

Firms identified as having (and not having) these orientations were then compared in terms of their responses to questions in the survey that together comprise the thematic areas described above.

Firms identified as customer-oriented (around 50% of the surveyed firms) had higher expectations of the proposed Centre across all five thematic areas. This makes these firms a principal part of

the client base. The largest deviations from non-customer-oriented firms are associated with the thematic areas of value chain research, new technology development and skills development. This is to say that firms looking forward toward the customers and markets, rather than internal processing efficiency, are oriented to value addition and skills development as well as new technology.

Firms identified as innovation-oriented (around 15% of the surveyed firms) had higher expectations of a proposed Centre across four thematic areas only: non-innovation-oriented firms had higher expectations of the Centre with regard to meat science. Intuitively, innovation- oriented firms might be thought of as the principal client base for the Centre. However, past research has recorded Australian red meat industry firms which are identified as non-innovators, but which held expectations of profits from innovation that were higher than those identified as innovators. Meat science innovation may then be a subject that is viewed differently by different types of firms, in terms of the fit to firms' businesses, the role of the Centre, and the current portfolio and nature of on-going research work. Lastly, innovation-oriented firms had markedly higher expectations than did other firms with regard to training and education: possibly reflecting their dissatisfaction with existing training providers in terms of the skills which facilitate innovation.

Firms identified as value chain-oriented (around 25% of the surveyed firms) had higher expectations of the proposed Centre across all five thematic areas. This may well indicate dissatisfaction with the existing innovation system's accommodation of co-innovation and whole value chain innovation outcomes. The largest deviations from otherwise-oriented firms were in (predictably) value chain research and new technology development. This result also questions the validity of terms such as "new technology", which to value chain-oriented firms would feature advanced ICT in terms of information processing and collaboration with trading partners such as retailers. Conversely, firms oriented toward internal efficiency would embrace new technologies associated with low cost methods for performing specific tasks which are equally demanding of new technology as ICT.

7.5.2.3. Key design features

This study concludes that to deliver the appropriate costs and benefits, in the context of the red meat value chain, the design of a proposed Centre of Excellence in Red Meat Processing Innovation could have several features.

The Centre could be a provider of information, in a number of thematic areas akin to the ones identified in this report. In addition to a library-like curation role, the Centre could be proactive in defining both the demand for and supply of this information. This requires a mode of operation that includes information product development, and surveillance of the innovation system within and beyond the boundaries of red meat processing. Action within such boundaries will keep a Centre up to date, and action beyond the boundaries will tap ideas and information sources that will anticipate future innovation opportunities particularly those involving adaptation new technology from other industrial sectors.

The Centre could manage collaboration in pursuit of sharing the fixed costs of innovation amongst multiple firms. This is a role already played by red meat industry organizations, although not explicitly in innovation management. Key tasks would include defining the innovation agenda suggested both by the supply of innovation (i.e. what is available) and the demand for innovation (i.e. what the industry, or a coalition of firms, needs). They would also include identifying for firms the extent of appropriability and excludability of costs and benefits, thus allowing firms to opt in or out of Centre activities.

The Centre would need to complement existing research and innovation facilities and services. Aside from avoiding duplication, this functionality involves decomposition of innovation opportunities into tasks associated with R&D, adoption, and innovation management. A checklist approach would enable identification of relevant on-going or completed work, and the Centre's attention could be on commissioning work to fill identified gaps, and the tasks required within individual firms.

The Centre could complement existing training and skills development initiatives. The Centre could identify future training needs on a general basis for curriculum development and focus, as well as those specific to firms and to individual technologies and equipment.

The Centre could be a facilitator of co-innovation. It could identify and interpret trends at the consumer end of the value chain, and present them to red meat processors as opportunities. Further, it could identify potential partners in retail, distribution, production or services, and broker innovation action. Where relations amongst value chain participants are contentious, the Centre could liaise with sector organizations or third parties.

The Centre could be a communications and public relations provider for red meat processing industry innovation. Among other tasks, it could constantly identify and emphasize the substantial benefit of Australian red meat processing innovation to value chain partners, to Australian society, and to the World. This is seen as complementary to MLA actions, rather than overlap or duplication.

The Centre could identify, investigate and exploit opportunities for funding of activities associated with red meat industry innovation. This could extend beyond its own client base into the brokerage of associated organizations and individuals, for example bringing together research providers with research funding agencies on topics relevant to red meat processing innovation. The Centre could also align itself with large scale industry-oriented research initiatives such as CRCs.

The Centre could lead innovation thinking and action on topics and themes that firms within the industry do not. This would include, but not be limited to, a consumer focus for processing, and co-innovation along the value chain where processing is an essential aspect of customer value.

8. Discussion

The industry consultation indicated that in order to get buy in across the whole industry there would be a need for some blue sky research as this would be beyond individual company capability. The Australian Innovation System report highlighted that "New to Market" was where the most significant financial gains are likely to be made and hence in order to achieve this, a proportion of funding could be allocated to blue sky research. DRMI and Georgia Tech allocate this way with DMRI investing a significant percentage of funds to this activity. Georgia Tech. takes a more conservative approach and provides seed funding for developing proof of concept to reduce risk prior to proceeding to a full scale research and innovation project. Defining key objectives in terms of how research will feed innovation and where those responsibilities lie will affect the suitability of models and the scope of what can be achieved.

Does the Australian Red meat processing industry have a size and scale to support a standalone initiative? MIRINZ as an example, despite having successful innovations could not stand alone. Would the ability for the Centre to stand alone be a long term goal of the Centre? A long term financial investment would need to be considered so there is not an underutilised or outdated facility (if bricks), like has occurred in Europe with CenFRA. With MIRINZ it would appear that IP was not enough. Hence the size and scale of the Australian and even New Zealand meat industry is another consideration when determining the potential financial benefits.

Many facilities which have contained pilot processing plants have either ceased (DEPI Werribee, CSIRO Cannon Hill) for various reasons (cost of running, not viable if not always in use, staffing, removal of product) or appear underutilised (Teagasc, IRTA). Often where there is lots of infrastructure, the risk is usually offset by the fact that they support other industries and in most cases other food industries (i.e. IRTA, Teagasc, AgResearch, DMRI through DTI). There has been a consistent trend of downsizing and consolidation (SRUC, Grimsby) of capabilities with the exception of Colorado State University (CSU).

It is unlikely that the CSU model could be applied here. This partially comes back to the difference in size and scale of the industries (animals, people and money). The land-grant university system is a model we can't replicate. Although our levy system is similar to their check-off, they are on a much larger scale. As illustrated in the report, CSU is currently building a globally recognised food innovation centre. This has been a long term (14 years) initiative where significant proportion of funds have been gifted and part of each gift is set aside for the long term running costs of the facility and is additionally backed by private companies, something hard to replicate. The Centre also does not have a sole focus on Research and Innovation, but is more about education of the next generation of people for the meat and food industry.

What we can take away from the USA irrespective of a Centre of Excellence, is how successful universities are at integrating graduates into the processing industry. Many ex-CSU students feed into large companies like JBS. This has been demonstrated to be achieved through an internship program where student and companies get to "try before they commit", building knowledge and skill. It was evident that there is a strong passionate culture for the industry within the

universities. Students that commit to either the meat or livestock judging teams are highly sort after by the industry, it is extremely competitive to make the teams and often a high work ethic is demonstrated.

A potential Red Meat Processing Innovation Centre of Excellence could play a role in developing an internship, cadetship, and/or graduate programmes to better highlight the potential career path within industry (if industry see that there is). This can get "buy in" early from students and a passion for the industry. This initiative should be supported across the whole industry, increasing the potential to build capability and expertise in areas where the industry may appear weak (i.e. engineering). The likely flow on effect is a cultural change towards innovation within companies due to increased understanding. This initiative was also highlighted as an additional role of a potential Centre during the industry consultation.

Additionally both Texas A&M and CSU has shown that extension and education to the supply chain are important (successful education of consumers regarding cryovac). This was also evident at IRTA, Tegasc, and SRUC. These organisations are spread across many sectors and hence have greater capability and requirement to service the whole chain. From the industry consultation it was less important to provide proof of concept to producers and end users. However outcomes from the value chain analysis highlighted the importance of value chain research. There may be a need for a possible Centre to facilitate collaboration with organisations (state governments, MLA) and private parties (consultants) to aid in extension up and down the chain for some innovations to reach their potential (i.e. new packaging to increase shelf life or information regarding genetic performance).

In terms of extension and education from the industry consultation and supported by the value chain analysis there was a demand for a better level of support in trying to access information (library database) and there was a perceived barrier to accessing industry funding (more related to SME's) and covering the cost of training. However it was also noted that the current CISp group was well supported by those who had access and hence their maybe scope to build on this group and or collaborate especially with regard to SMEs and the transfer of information of current issues.

The legacy of Fututech has raised many concerns about the risks of a bricks and mortar Centre. However in terms of innovation and adoption there was a clear trend irrespective of company size that companies like the technology working in other plants first and thus they look to what their Australian competitors and overseas are doing when looking at new technology. To some extent this denotes a need for a Centre to have these capabilities to showcase this, and may support innovation. The reality is that unless it is commercial in size it will never fully be proven and will only be a proof of concept. Based on investigation into other Centre's a pilot plant is unlikely to be feasible, due to cost of overheads per unit processed, staffing, removal of product and waste and low utilisation rates. However there is certainly scope to be able to deliver on this need using other models such as one that would contain "hubs". These "hubs" may be current research facilities (i.e. CSIRO Food Innovation Centre Werribee). The combinations of the outcomes from the national industry consultation and the recent review of capabilities may give clarity in

potential demonstration “hubs” and hence optimal utilisation of existing applicable infrastructure that could support a potential Red Meat Processing Innovation Centre of Excellence.

In order to achieve greater innovation there is scope for a potential Red Meat Processing Innovation Centre of Excellence to support for initiatives already in place like PIP’s and MDC to help demonstrate technology, however perhaps greater access under controlled scenarios (concept quality video demonstrations). Based on the industry consultation there is scope to partner with companies to provide a “test-bed”. For example a small plant close to Sydney already provides a technology company space to test and perfect equipment. This arrangement is of little impact on the business as it is small and flexible. There would be scope to identify other industry partners (small, medium and large) around the country to either allow in-plant testing and development or demonstration. This concept is similar to AgResearch who recently (2014) sold off their experimental plant to private company but has a MoU to conduct R&D. It was also noted that much work was done in bigger plants now. The level of usage and type of usage is an important point of such considerations.

It has been well demonstrated that industry involvement is critical. Fututech showed negative effects when industry was isolated from the development, conversely DMRI facilitate interactions within their structure between research and industry. Recent reports such as the CRC review and recommendations and review of Australian Innovation system have highlighted that in order for successful innovation to occur, research needs to be industry led and continued engagement is required. Mechanisms on how successful industry and research interaction can occur were shown throughout this report including network type meetings (FAIM and ASMS). Ireland’s more recent strategies for industry engagement have been selective on the right academics and given them skills to effectively present results and new innovation to industry within the food innovation gateway. During the industry consultations previous initiatives like Meat 93 and 95 were valued and there have been others similar, but nothing that has built up reputation that has stood the test of time. Current initiatives like MINTRAC QA & M meetings are effective, but are targeted as is the innovation network meetings, but both can be useful resources and tools. All of these methods educate, provided critical interaction on up to date developments not just within Australia but globally.

This report has shown some global initiatives to outline a wider perspective or what has been occurring within Australia and around the world. This included the innovation Industry report which highlighted the importance of Australian industry investing in innovation across all domestic and exporting sectors to increase total factor productivity and ultimately maintain our high standard of living. The national initiatives like CRC’s are well recognised and the philosophy behind them could have many applications as there are many similarities between this and international approaches such as Catapult UK and Fraunhofer Institutes. From this, consideration should be made around how a potential Red Meat Processing Innovation Centre of Excellence can use these concepts or link into some of these initiatives. It would be of value to actively understand what role the newly announced Food Industry growth Centre may have in the red meat processing industry.

9. Potential Models for a Red Meat Processing innovation Centre of Excellence

To define what a Centre of Excellence is can be quite varied and complex and is often dependent on the original goals. The European Union offered a potential definition as being a "form where R & D is performed at world standard, in terms of measurable scientific production (including training) and or technological innovation" (Anon, 2015b). Others have defined Centre of Excellence as "a team of people that promote collaboration and use best practices around a specific focus area to drive business or customer-valued results" (Strickler, 2008). It has also been said that the term Centre of Excellence has been used too frequently with Centre's falling well below definitions such as world standard. Hence irrespective of the form below are some key features that need to be part of the concept (Anon, 2015b) and are all factors which have been identified through this project.

- A "critical mass" of high level scientists and/or technology developers;
- A well-identified structure (mostly based on existing structures) having its own research agenda;
- Capable of integrating connected fields and to associate complementary skills;
- Capable of maintaining a high rate of exchange of qualified human resources;
- A dynamic role in the surrounding innovation system (adding value to knowledge);
- High levels of international visibility and scientific and/or industrial connectivity;
- A reasonable stability of funding and operating conditions over time (the basis for investing in people and building partnerships);
- Strong governance with a representation of industry and academia

When considering a Centre of Excellence there are essentially 3 types of potential models;

1. Bricks and mortar
2. Virtual
3. Hubs – (combination of 1 & 2)

9.1. Bricks and Mortar

Bricks and mortar or a physical structure where capability is housed under one roof is a traditional form of a Centre of Excellence. This more often best caters for and applies to monodisciplinary research such as that conducted at the Isaac Newton Institute for Mathematical Sciences. This report has shown many examples of bricks and mortar research type facilities (MIRINZ, ITRA, Teagasc).

9.2. Virtual

A Virtual Center of Excellence is a fairly new organisational concept. Its overarching aim is to combine the capabilities, knowledge and expertise from diverse players beyond their typical

geographical and organisational boundaries to create something accomplished and distinct within its domain. The two important features of a Virtual Centre of Excellence are the creation of a panel of experts, and providing for the best use of resources by facilitating collaboration. There are a few ways in which a virtual CoE can be defined and in the case of the present study this model is defined as the use of people, but not infrastructure. Examples of virtual models shown in this report include Cost Action FAIM and AMSA.

9.3. Hubs

Having Hubs, is essentially like having a combination of both bricks and mortar and virtual. The hub and spoke is basically a centralised/decentralised model for measurement. It is used in the context of multi-location souring wherein a central consolidator called a "hub" or in this case a Centre of Excellence which provides a single face to the customer while seamless extensions called "spokes" (R & D providers, technology companies, industry partners) are leveraged to provide services distributed across multiple locations. This model maximises the opportunity of sourcing the highest level of capability (infrastructure and personal) across a diverse range of locations and facilities and collaboration across the "spokes". Examples of this type of model presented in this report include CRC's and to an extent Catapults, and Fraunhofer institutes.

9.4. SWOT analysis of the different models

In order to compare the three proposed models (bricks and mortar, virtual and Hubs) a simple Strengths, Weaknesses, Opportunity and Threat (SWOT) analysis was conducted to provide a simplistic summary in terms of a Red Meat Processing Innovation Centre of Excellence. These SWOT analyses were completed based on findings from this feasibility study.

Table 30. SWOT analysis Bricks and Mortar

Strengths	**Weaknesses**
• Physical Presence • Common ground for Industry (demonstration) • Provides a test bed for technology • "lunch time" correspondence	• High Capital expenditure • High Operational expenditure • Less flexible (technically / structure) • Access/location will be limiting/ $ • Does not replicate commercial conditions • Staffing (having the best) • Less likely to be supported by industry
Opportunities	**Threats**
• International recognition • Mitigate risk	• Underutilisation "White Elephant" • Industry disconnect • Building capability under one roof • Sustainability/relevance over time • Potential duplication of existing structures • High overall risk

Table 31. SWOT analysis for Virtual

Strengths	Weaknesses
• Low Capital expenditure • Low Operational expenditure • Flexible (technically / structure) • Access (good) • Staffing (have access to the best) • Overall low Risk • Collaborative	• No Physical Presence • No by chance correspondence • Don't seem to conduct research more network
Opportunities	**Threats**
• International recognition • Develop linkages with national and international; - R&D providers, - Peak industry bodies - Industry.	• Communication breakdown needs strong governance and leadership • No capacity for industry demonstration • No capacity test bed facilities for technology

Table 32. SWOT Analysis for Hubs

Strengths	Weaknesses
• Low Capital expenditure • Low Operational expenditure • Flexible (technically / structure) • Access (good) • Staffing (have access to the best) • Collaborative • Uses existing infrastructure • Overall low Risk • Local knowledge	• Not everything is under one roof
Opportunities	**Threats**
• International recognition • Development strategic partnerships • Develop linkages with national and international; - R&D providers, - Peak industry bodies - Industry. • Co investment (government, industry) • Greater diversity and spread risk	• Requires strong governance to ensure effective collaboration.

10. Conclusions

The outcomes from the industry consultation indicate that there is significant support for a potential Red Meat Processing Innovation Centre of Excellence within Australia. It can also be determined that from all aspects of this report that a "bricks and mortar" type model would appear to be the least viable option (with particular reference to a pilot plant) and least supported by industry. Based on current initiatives and influencing factors a "Hub" or "Virtual" type model is likely to be an effective and efficient way to increase innovation and mitigate risk while maximising capability (infrastructure and personal). Irrespective of which model is used it was determined that the role of the Centre could be broken down into 5 thematic areas including; new technology development, meat science, new technology evaluation and demonstration, education and training and value chain research.

11. Recommendations

Based on information provided in this report it is recommended that any potential Centre of Excellence would need to incorporate the following;

Industry led

Combination of blue sky and applied research

Have long term strategic priorities

The potential Centre should not duplicate but facilitate (use existing facilities, infrastructure, people and initiatives)

Overall increase capability and critical mass within the sector

It would need to be accessible and use various strategies for disseminate information including extension type service

The potential centre would need to facilitate the collective action on fixed costs

Enhance public relations by identifying and emphasising public benefits

Bridge the gap between industry and research and increase the knowledge transfer between research and industry

Brokerage:

- Identifying supply of and demand for innovation
- Identifying co-innovation partners by way of needs and "fit", and associated contracting
- Beyond trading partners and into research funding

The potential Centre would act as an agent of "culture change" for factors such as co-innovation, customer focus.

Above all the potential Centre would need **strong governance** that has a **combination** of both sound **industry** and **academic** knowledge.

12. Acknowledgements

To all the people who have provided verbal comment on current and previous research Centre's including; Wayne Brown and Matt Kerr (DEPI Vic), Drewe Feguson, Rod Smith (CSIRO), Dr Robyn Warner (University of Melbourne), Dr John Thompson (formerly UNE), Dr Cameron Craigie (AgResearch), Professor Tim Wess (CSU) and Arthur Pitt (former MIRINZ). To all the companies that gave up their valuable time to partake in the national industry consultation, these comments are highly valuable to help shape the potential future and is greatly valued. Justin Roach (AMPC) for his contribution to the international consultation and gathering of notes and discussions around findings. Megan Callinan from 3xP for all the behind the scenes work of document preparation before the overseas trip, editing and bringing some different perspectives from outside the meat industry.

13. Bibliography

Alston, J.M., G.W. Norton, and P.G. Pardey (1995) *Science Under Scarcity: Principles and Practice or Agricultural Research Evaluation and Priority Setting* Ithaca, Cornell University Press.

American Meat Science Association (2015), *Accessed Online 3rd June 2015* http://www.meatscience.org/

AMPC (2010) Australian Meat Processor Corporation submission to the Productivity Commission Review of Rural Research and Development Corporations

Anon, (1996). Audit Report No. 21 1995-96, The Meat Research Corporation Management of project FUTUTECH.

Anon, (2007). CSIRO collocation with Queensland Government on the Ecosciences and Health and Food Science precincts, Brisbane Queensland. Statement of Evidence to the Parliamentary committee on public works.

Anon, (2014). *Australian Innovation System Report*, prepared by; Office of the Chief Economist. Department of Industry, Commonwealth of Australia.

Anon, (2015a). Growth through Innovation and Collaboration – A Review of the Cooperative Research Centres Programme. ISBN 978-1-925092-53-0.

Anon, (2015b). Actions for Centres of Excellence with a European dimension. European Union, (1995-2015).http://ec.europa.eu/research/era/pdf/centres.pdf

Baker, D. (2007) *New product introductions in the food industry: results from a Danish survey*. Copenhagen: Department of Economics, University of Copenhagen. (Report / Institute of Food and Resource Economics; No.189).

Booz, Allen and Hamilton (1982) *New product development for the 1980s* New York.

Bruns, M. (2010) *Inter-organisational innovation processes in the agrifood industry: An approach to improving management support services applied to the meat industry*. PhD thesis, University of Bonn.

Castaner, X., L. Mulotte, B. Garrette and P. Dussauge (2014) :Governance mode vs. Governance fit: performance implications of make-or-ally choices for product innovation in the worldwide aircraft industry, 1942–2000" *Strategic Management Journal* 35: 1386–1397.

Catapult (2015). *Accessed Online 3rd June 2015* https://www.catapult.org.uk

Cohen, W. M., & Levinthal, D. A. (1990) "Absorptive capacity: a new perspective on learning and innovation" *Administrative Science Quarterly* 128-152.

Coleman, G (2014). Issues relevant to the adoption of technology in the meat processing industry. MLA Final Report.

CRRDC (2010) Submission by the Council of Rural Research and Development Corporations to the Productivity Commission Inquiry into the Australian Government Research and Development Corporations Model

Ding, M., J. Ferry, K. Parton and M. Matanda (2014),"Relationships between quality of information sharing and supply chain food quality in the Australian beef processing industry" *The International Journal of Logistics Management* 25 (1): 85-108.

European Cooperation in Science and Technology (COST) Farm Animal Imaging (FAIM) (2015). *Accessed Online 25th May 2015* http://www.cost-faim.eu/index.html

Evanschitzky, H., M. Eisend, R. Calantone and Y. Jiang (2012) "Success Factors of Product Innovation: An Updated Meta-Analysis" *Journal of Product Innovation Management* 29 (1): 21–37.

Fraunhofer Institutes (2015). *Accessed Online 6th June 2015.* https://www.fraunhofer.de/en.html

Griffin, A. (1997): "PDMA Research on New Product Development Practices: Updating Trends and Benchmarking Best Practices" *Journal of Product Innovation Management* 14 (4): 429-458).

Howells, J. and J. Bessant (2012) "Introduction: Innovation and Economic geography: a review and analysis" *Journal of Economic Geography* 12: 929–942

Industry Growth Centres (2015). *Accessed 25th June 2015.* http://www.business.gov.au/advice-and-support/IndustryGrowthCentres/Pages/default.aspx

Lavie, D. (2006) "The Competitive Advantage of Interconnected Firms: An Extension of the Resource-Based View" *Academy of Management Review* 31 (3): 638-658.

Lees, N. and P. Nuthall (2015) "Case study analysis on supplier commitment to added value agri-food supply chains in New Zealand" *Agricultural and Food Economics*. DOI 10.1186/s40100-014-0024-z

Lundvall, B. (ed.) (1992) *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning* London: Pinter Publishers.

Martyn, S (2014). World on a plate – a history of meat processing in Australia. ISBN978-0-646-91070-3.

McDermott, A., Lovatt, S. J., and S. Koslow, S. (2004) "Supply chain performance measures for producers and processors of premium beef cuts: a conjoint analysis" *Chain and Network Science* 7 (1): 33-43.

MLA, (2015). World Protein Consumption. *Accessed Online 10th June 2015.*

Moreland, H. (2010) "Multi-criteria Assessment of Innovative Technology in the Beef Industry" *Modern Applied Science* 4 (12): 17-25.

Mounter, S., G. Griffith, R. Piggott, E. Fleming and X. Zhao (2008) "Potential Returns to the Australian Sheep and Wool Industries from Effective R&D and Promotion Investments and their Sensitivities to Assumed Elasticity Values" *Australasian Agribusiness Review* 16:1

Oxford dictionary (2015) *Accessed online 5th June 2015*
http://www.oxforddictionaries.com/definition/english

Pethick, D., A. Ball, R. Banks and J. Hocquette (2011) "Current and future issues facing red meat quality in a competitive market and how to manage continuous improvement" *Animal Production Science* 51: 13–18.

Pitt, C. (2007) *Leading innovation and entrepreneurship: an action research study in the Australian red meat industry*. PhD thesis, Southern Cross University.

Saracco, R (2014). "The Saga of research and innovation" *eitDigital. Accessed online*

Storer, M., P. Hyland, M. Ferrer, R. Santa and A. Griffiths (2014),"Strategic supply chain management factors influencing agribusiness innovation utilization", *The International Journal of Logistics Management* 25 (3): 487-521.

Sun, D., P. Hyland and O. Bosche (2001) "A Systemic View of Innovation Adoption in the Australian Beef Industry" *Systems Research and Behavioral Science* [number not yet assigned]

Toohey, E.S. & Hopkins, D. L. (2015). The value of online measurement technology – a processor perspective. Final Report A.MQA. 0015, MLA, Sydney, Australia.

Yeniyurt, S., J. Henke and G. Yalcinkaya (2014) "A longitudinal analysis of supplier involvement in buyers' new product development: working relations, inter-dependence, co-innovation, and performance outcomes" *Journal of the of the Academy of Marketing Science* 42: 291–308

Zhao, X. G. Griffith and J. Mullen (2001) "Farmer Returns from New Technologies in the Australian Beef Industry: On-farm Research versus Off-farm Research" *Australian Agribusiness Review* 9: 1.

14. Appendixes

Appendix 1 – Reference panel Agenda and meeting notes

AMPC Industry Centre of Excellence Processor Panel Meeting

10am to 3:30pm

Location: Randwick Room, Level 1; Sydney Ariport Stamford
Attendees: Justin Roach, Matt McDonagh, Edwina Toohey, Derek Baker, David Lind, John McGuren, Stephen Kelly, Will Barton, Mick Bird, Murray Miller, Dale Smith

Unable to attend: Farron Fletcher, John Berry, John Hayes, Terry Nolan, Justin Gathercole, David Foote

10.00 – 10.30	**Arrive**	Randwick Room
10.30 – 11.00	**Overview of Panel roles and responsibilities** Matthew McDonagh, Justin Roach	Randwick Room
11.00 – 11.30	**Overview of the ICE project feasibility study and background** Matthew McDonagh, David Lind	Randwick Room
11.30 – 13.00	**Trial run of the industry bench-marking study to be conducted within the project** Edwina Toohey, Derek Baker	Randwick Room
13.00 – 14.00	**Review of the industry bench-marking study to be conducted within the project** Edwina Toohey, Derek Baker	Randwick Room
14.00 – 14.30	**Preliminary input into the scope and role of a future centre within Australia** Matthew McDonagh, Justin Roach	Randwick Room
14.30 – 15.30	**Refine the way forward at the end of current project (pending recommendations)** David Lind, Matthew McDonagh	Randwick Room

Meeting notes

Specific comments

Will: Acronym "ICE" for Innovation Centre of Excellence is not suitable.

Justin: Seeking out all-of-industry benefits.

David: Would like the panel to help articulate why we need change, why we need to do this project in the first place… essentially a 10-year view of where the industry is going to be and how to get there.

David: There is government interest in which manufacturing industries in Australia are sustainable.

Mick: Can we share foreign experience? Referred to Derek Baker.

Mick: Intellectual Property (IP) as a barrier to the joint effort.

Will: Discussion of the applicability of technologies imported from other industries. Robotics' sensors as an example.

Derek Baker, David: Centre can be a sandbox-type setup to test and demonstrate.

Derek Baker: Time horizon as a market failure. Long term considerations be converted by the Centre.

Matt: Centre to be there to do industry's bidding.

David: "the burning platform". Why we should not continue doing what we are doing…

Justin: AMPC's interests are in innovation – not only technology but also innovative capacities and practices, as well as personnel.

David: The Centre needs to eventually develop a global reputation/leadership.

Will: Identifies the patchy nature of cross-plant transfer of information. Each plant is different.

Mick: It would be good to get a body to help do the legwork on which plants/practices are useful to other plants.

Will: Again returns to the question of IP… what will be shared and not shared? Also, could the Centre maintain a register of technologies in use/being changed over time. This, as an information base.

Dale: What is the scope/shape of the Centre with respect to stages of processing? Matt says all stages. Derek Baker says also influences from beyond the processor.

Will: Can we separate the common problems from the real competitiveness issue that firms want to address themselves?

Dale: What is the finding model. Derek Baker and Matt defer to results of business case and options for business models.

REVIEW OF QUESTIONAIRE:

Dale 3. Position within the company…"Plant manager" proposed.

Will 4. "lost production… " is missing in options.

Will 6. Clarification on access to staff suitable for training.

Will. 5 and 7: ranking rather than single most important.

David: Section 5 is too proprietary.

Will: Section 5 is a change of tempo… needs an introduction.

Will: 55 Is this raw material suppliers (producers) or is it technology suppliers?

Will: Q 8. Validation of independent estimates of cost benefits of new technology. Three issues: (i) trust of the agenda; (ii) transparency and the nature of the model; (iii) capacity to stock the model with parameters from the firm/plant.

Will: 39 onwards… "would" is odd. Can this be changed to an impression of potential "could" maybe?

Will: 29. Maybe just make the list in 28 longer?

Will: 63. "Partnerships" is a bad word. Maybe "involvement". Maybe replace it all with 65.

Justin: Questionnaire needs an introduction section

Dale + Will: section 1… what about the cycles of R&D… we need a retrospective AND a forward-looking view. Q 9. maybe past 5 years; now; next five years.

Dale: Section 2, Q 19 etc… something about the attitude of the workforce to new technology… this is a limiting factor. Something about how receptive is executive; management; maintenance; floor staff. In different questions.

Will: as above, can we enter a question on how each of those levels of management would feel about the Centre of Excellence.

General: there is a lack of meat processing expertise to provide a consulting service.

Dale: 24 and 25 seem like duplication – drop 25 or say predicting/managing in 24. Dale: depreciation is important in innovation. Will suggests that this is on the margin. David: 27: need to add "consultants". Matt: a supplementary question on how good is the information flow from those sources.

General: 28 and 29 (see above). Need to add the other functions (consultancy and library setup). Also, need to open up 29 to "key gaps" or "main themes".

General: Section 5. Not invasive, but there is a need to provide an intro section. David to takes some advice on this.

Q 59. Needs changing to "improve employee productivity" (get rid of labour productivity). "minimizing additional labour requirements"

Section 6 goes to end of section 4, and an additional Q is to be added to 65 regards who is to be involved.

NEXT STEPS – some re-writing and then re-circulation, by early next week.

Ideas on Centre of Excellence:

Dale: independence of advice

Mick: a go-to person

Will: people with rules of thumb on processing engineering etc. Experts on call?

Derek Baker: a library facility?

Appendix 2 – Survey

Red Meat Processing Innovation Centre of Excellence Feasibility Study

The Australian Meat Processor Corporation (AMPC) has recently commissioned a feasibility study to determine the merit or otherwise of establishing a Red Meat Processing Innovation Centre of Excellence in Australia. This Centre would be of international significance and comparable to those already in operation within major competitor nations.
The focus of the study will be to identify industry needs for such a Centre and if such a need exists, to determine the potential role and scope. It is envisaged that the Red Meat Processing Innovation Centre of Excellence would help industry address fundamental issues around enabling innovation and its uptake within industry. In addition to technology development and transfer, the study will look at how such a Centre could assist industry in overcoming constraints to productivity, profitability, product development, organisational change and product marketing.

A component of this feasibility study is this national benchmarking study is to determine current industry issues associated with technology transfer and adoption and to determine the future needs and opportunities regarding improved technology transfer for the red meat processing industry. We are seeking your support for this project and ask that you complete the benchmarking study survey below.

AMPC greatly appreciates your contribution in assessing the merits or otherwise of the concept of such a Centre of Excellence. If you need any support with understanding or completing the benchmarking survey please do not hesitate in contact Edwina Toohey on 0447 218 040 or edwina.toohey@dpi.nsw.gov.au

*Required

Background Information

Confidentiality

This is a confidential benchmarking study survey. Any information you provide will not be linked to your company, nor will the outcomes of the study be linked to the individual responses of your company. Your company's participation in the study will be kept strictly confidential.

Company Name?

Position within company?

Company Location?

Section 1: Perception of high risk and uncertainly around implementing new processing technologies.

The aim of this section is to identify the innovation process at your company

Within your company, how important are the following cost and constraint factors when deciding to purchase and implement new technologies? *

	Very Important	Important	Somewhat Important	Not Important	I don't know
The outlay cost to buy and install the equipment					
Reliability of the technology					
Maintenance costs					
Access to support					
Space availability					
loss of production during construction/installation					

Of these factors, which one is the most important? *

Within your company, when deciding whether to implement new technologies, how important are the following factors relating to staff, training and skill? *

	Very Important	Important	Somewhat Important	Not Important	I don't know
Time needed to train staff to use new equipment					
having staff that are suitable for training					
Retention of skilled staff trained to use the equipment					
Cost of training					

Within your company, when deciding whether to implement new technologies, which of these factors is the most important?*

Are there any additional factors that are important to your company with regard to the decision to implement new technologies? *

Within your company, how important is it for new technologies to have been implemented and proven in other companies first?

	Over the past 5 years	Now	Over the next 5 years
Not important			
Somewhat important - helps to demonstrate the concept and its value, but is not the whole argument			
Important - about 50% of time, technology implementation is based on prior demonstrated experience and results			
Very important - that technology is proven to work commercially elsewhere			

With regard to uptake of technology and innovation, do you see your company as?

	Over last 5 years	Now	In next 5 years
An industry leader in implementing new technology first			
An early adopter (within the first 15% of comparable plants to adopt a technology)			
In the early majority (within the first 50% of comparable plants to adopt a technology)			
In the late majority (within the first 85% of comparable plants to adopt a technology)			
Within the last 15% of comparable plants to adopt a technology			

What is the innovation process within your company?

We have a designated innovation manager within the company?

Innovation is managed by a special department?

Innovation is managed and carried out across

- A. Several plants that belong to the same company
- B. Just this plant
- C. Both "A" and "B"

We operate by a system whereby ideas and initiatives are steadily developed in a step-by-step process subjected to go or no go decision points at each stage?

How do you finance any new innovation?

- Profits
- Short term loan
- Long term loan
- Industry funding opportunities
- Other:

Section 2: Drivers that influence the adoption and implementation of new technologies.

The aim of this section is to understand your company's drivers of adoption to new technology

Within your company, when considering a new technology, how important is it that the technology reduces operational cost drivers such as? *

	Very Important	Important	Somewhat Important	Not Important	I don't know
Labour costs					
Energy costs					
Resource costs (water)					
Consumable costs					

Within your company, when considering a new technology, how responsive are worker attitudes to adopting new technology? *

	Very responsive	Responsive	Somewhat Responsive	Not Responsive	I don't know
Upper level management					
Supervisors					
Processing floor personnel					
Maintenance staff					

Within your company, when considering a new technology, how important is it that the technology increases productivity drivers at various stages of production, including; *

	Very Important	Important	Somewhat Important	Not Important	I don't know
Animal receival					
Lairage					
Kill chain					
Chilling					
Boning					
Packaging					
Storage					
Dispatch					
Inventory management					
Information flows within a plant					
Information flows beyond the plant					

Within your company, when considering a new technology, how important is it that the technology increases productivity drivers such as processing efficiency by; *

	Very Important	Important	Somewhat Important	Not important	I don't know
Minimising product loss on the chain	(C)	CC)	e	o	(C)
Minimising contamination on the chain	(C)	Co	(0	(C)	e
Reducing overall labour costs	Cc)	([)	CO	CO	(I)
Enhancing productivity per worker	6	(C)	(C)	(C)	CC)
Enhancing value added per worker	(C)	(E)	(0	(C)	(C)
Minimising product loss (chilling)	(C)	e)	e	(c)	Co
Minimising product loss (boning)	o	(0	e	(C)	Co
Enhancing product consistency (weight, shape, size)	(C)	(C)	CO	(C)	o
Maximising product quality	CD	Cc)	CO	CO	CO
Improving sorting of like carcases and cuts	(C)	6	CC)	(C)	(C)

Within your company, when considering a new technology, how important is it that the technology increases productivity drivers such as plant flexibility by; *

	Very Important	Important	Somewhat Important	Not Important	I don't know
Increasing the number of potential customers in any market					
Increasing the potential number of markets					
Optimising whole carcase use					
Maximising product quality					
Allowing improved sorting of like carcases and or cuts					
Increasing chain speed					
Increasing product lines					

Within your company, when considering a new technology, how important is it that the technology increases value and profit drivers such as increasing product quality via improving; *

	Very Important	Important	Somewhat Important	Not Important	I don't know
Eating quality	○	○	○	○	○
Food safety	○	○	○	○	○
Visual quality	○	○	○	○	○
Shelf life	○	○	○	○	○

Are there any other profit drivers for increasing product value not listed above which would be important to your business when considering a new technology? *

Within your company, when considering a new technology, how important is regulation in terms of? *

	Very Important	Important	Somewhat Important	Not Important	I don't know
Food safety	○	○	○	○	○
Environmental sustainability	○	○	○	○	○
Animal welfare	○	○	○	○	○
Human resource management (labour)	○	○	○	○	○
Workplace Health & Safety	○	○	○	○	○

Within your company, when considering a new technology, how important are the following sources of information? *

	Very Important	Important	Somewhat Important	Not Important	I don't know
Academic research	(C)	(C)	Cc)	(E)	Co
Australian meat industry sources	(o	CC)	CC)	(o	(C)
Trade magazines/shows	t)	e	Cc)	6	Cc)
News articles	(C)	(c)	e)	Ce)	(C)
What we see happening overseas	(0	(0	CC)	Cc)	Co
What we see our Australian competitors doing	(o	(o	(c)	e	Cc)
Consultants	(C)	CC)	Cc)	6	Cc)

Section 3: The role of a Red Meat Processing Innovation Centre of Excellence in Australia

What should be the major focus of a Red Meat Processing Innovation Centre of Excellence? *

	Very Important	Important	Somewhat Important	Not Important	I don't know
Industry demonstration	(f-)	e	(o	(C)	(C)
Technology evaluation	(C)	e)	(o	e)	e)
Economic evaluation	Co	(C)	(0	e	(0
Technology development	(0	e	CO	CC)	(C)
Education and training of industry personnel					
Teaching and training of students					
Meat processing / meat science research	t)	e	(o	t)	CO
Product Innovation	Cc)	e)	Cc)	(E)	(C)
Market Research	tt)	(F-)	(I)	e	(0
Library/database	{)	e	<0	0	CO

Are there any additional focus areas that your company would see as a important role of a Red Meat Processing Innovation Centre of Excellence?

How important would you see the role of a Red Meat Processing Innovation Centre of Excellence in providing meat processing and meat science related research?

	Very Important	Important	Somewhat Important	Not Important	I don't know
Meat Science and quality					
Meat technology for manufacturing and fabrication					
Meat technology for slaughter, boning and chilling					
Meat technology for carcase evaluation and online measurements of quality					
Traceability					
Feedback to producers					
Information storage/database					

Section 4: What is needed to gain support for a Red Meat Processing Innovation Centre of Excellence in Australia

How important could such a centres role be to your company in mitigating risk around new technologies by allowing testing and trial implementation within either of the following scenarios; *

	Very Important	Important	Somewhat important	Not Important	I don't know
Controlled demonstration processing facility within the centre					
Organising demonstrations of new processing technologies within commercial processors					

How important could such a centres role be in developing the economic understanding of the relative benefits of developing, implementing and managing new technologies?

Very Important	Important	Somewhat important	Not important	I don't know

How important could such a centres role be in integrating the application of new technologies with product quality outcomes?

Very Important	Important	Somewhat important	Not important	I don't know

How important could such a centres role be in evaluating new technologies and determining fit-for-purpose across a range of production systems such as chain speed?

Very Important	Important	Somewhat important	Not important	I don't know

How important could such a centres role be in new product (meat product) development?

Very Important	Important	Somewhat important	Not important	I don't know

How important could such a centre in proof of principle to; *

	Very Important	Important	Somewhat Important	Not Important	I don't know
Processors	(C)	(0	Cc)	(0	(C)
Producers	(C)	(C)	o	(C)	(C)
Wholesalers	e	(C)	e	e	(C)
Retailers and supermarkets	CC)	(C)	(C)	e	e

How important could such a centres role be in the development of new technologies, including engineering, technology evaluation, pilot testing, concept evaluation?

Very Important	Important	Somewhat important	Not important	I don't know

How important could such a centres role be in market development?

Very Important	Important	Somewhat important	Not important	I don't know

How important could the centre role be in the training and education of meat industry personnel regarding new technologies?

Very Important	Important	Somewhat important	Not important	I don't know

Considering your responses throughout this benchmarking study, what are the critical factors that you think such a centre would need to address?

How would your company like to be involved with a future Red Meat processing innovation centre?

Who else would you like to see involved with a future Red Meat processing innovation centre?

- [ ] Technology company's
- [ ] AMPC
- [ ] MLA
- [ ] Federal government
- [ ] State government
- [ ] Universities
- [ ] Other industry bodies e.g. MINTRAC
- [ ] Other processors
- [ ] International links
- [ ] Consultants
- [ ] Other:

Submit

100%: You made it.

Appendix 3 – Letter to Companies

AUSTRALIAN MEAT PROCESSOR CORPORATION

T (02) 8908 5500 F (02) 9436 0343 E ADMIN@AMPC.COM.AU WWW.AMPC.COM.AU

Suite 1, Level 5, 110 Walker Street, North Sydney, NSW 2060 | PO Box 6418, North Sydney, NSW 2059

AMPC

Dear AMPC member,

Re: Request for participationin a feasibilitystudy for a Red Meat Processing Innovation Centre of Excellence in Australia

I am writing to invite you to participate in an important AMPC research study that will examine the feasibility of establishing a Red Meat Processing Innovation Centre of Excellence in Australia.

AMPC has recently contracted the NSW Department of Primary Industries to undertake a feasibility study to determine the merits or otherwise of establishing a Red Meat Processing Innovation Centre of Excellence in Australia. This Centre would be of international significance and comparable to those already in operation within major competitor nations.

The focus of this study will be to identify industry needs for such a Centre and if such a need exists, to determine the potential role and scope. It is postulated that a Red Meat Processing Innovation Centre of Excellence could help industry address the substantial risks that processors face in transferring innovation from the laboratory or engineering workshop to the processing floor. In addition to the development and transfer of transformational technologies, the study will look at how such a Centre can enable Australian processors to obtain global competitive advantage in areas such as product & process development, systems design, organisational change and product marketing.

The initial phase of this feasibility study will be to conduct a National benchmarking survey of industry needs that might be addressed by the Centre. With that in mind we are seeking your support, together with that of other processing businesses, to participate in a short survey to determine the broad range of industry priorities that an Industry Centre of Excellence could potentially address. Please note that data provided by your business will be treated in the strictest confidence.

A representative of the NSW Department of Primary Industries will be in contact with you shortly to explain the process in more detail, arrange a time to discuss the survey and confirm your participation.

If you are not able to participate can you please contact me as soon as possible so that I can seek another participant for this research project.

AMPC greatly appreciates your support of this important processor RD&E initiative.

Kind Regards,

Mr. Justin Roach
AMPC Program Manager
Tel: (02) 8908 5500
Email: j.roach@ampc.com.au

ABN 67 082 373 448

Appendix 4 - Additional focus areas for a Red Meat Processing Innovation Centre of Excellence within Australia.

Education, training and capability building –Sector capacity Workforce development

Expand on the library/database concept
Provide new MLA/AMPC mangers and plant innovation managers with education and training on previous work so they can understand processing history.
Enhance & support innovation managers give them theory
Video library of production equipment systems across Australia and the world
Capture historical information from industry comparative assessment of equipment
Producer awareness campaigns
Consumer education
Pathway to new people into industry
Education
Learning centre

Information sharing and extension role

Communication pathway out of information current online - information not used and does not reach target audience more strategic Extension – service
Information accessible to innovation make any new info user friendly and common terminology
Have industry expert knowledge to conduct plant visit to provide recommendations of what might work for industry
Meat industry trade type shows like that of "Meat 95" which brought together many people from whole industry.
Industry - commercial demonstrations
Access/introduction services and available funding industry/government

Relevance, equity and access

Make whole industry feel equal
Have a focus for smaller plants
Ease of access
Accessible to all
Fair to every processor- funding distribution proportional to levies paid

Strategic comments

If developed needs to lead the way
Board of Integrity/balance of books
Need to have the right qualified people running it, commercial practical knowledge with a cross section of the people with a good knowledge of the industry, needs to be well thought out.

Building capability in R & D
Centre for Blue Sky
Co-operative research Centre type model would be effective with strategic development of issues.
Approval, validation, efficient use of R & D funds
Proper research of individual problems
Key Themes, proportion current issues and proportion blue sky
Standardize the industry and combine state regulation
Collaborative group-small, small office ran from all industries.

Additional comments

If going to be called excellent it has to be that needs to be relevant
Someone needs to do it but not duplicate it
No (other focus areas) really need to see more information on what it will look like and its importance seems just another cost to industry.
Not really (any other focus areas) how it work?
Should be Non-physical assets - no new ones needed use what we have

Appendix 5 - Other critical factors a Red Meat Processing Innovation Centre of Excellence within Australia would need to address (Raw data)

People

Support Innovation managers
Improving awareness of technologies,
Capability building within Australia
Potential to fund a person to help/support application
SME's group innovation support / extension
Keep it simple to reduce paper work

Collaboration, function and structure

Collaboration is key reaching R and D and processors
Has to be more collaborative and less political as everyone has different set of challenges for the Centre to accommodate
CRC approach
Collaboration with NZ and AUS have made some mistakes in the past due to not sharing
Consider investment of a group rather than individual companies
Organized innovation
Strategic planning
Things across the country, same outcomes, building consumer confidence in our product, national goals, working together as a whole industry
Development of blue sky research

Access

Be able to have an outreach program for smaller plants that can't always get to a central location

Understand distance between places
Access whether remote or other enough technology to make it happen
Research and Development doesn't need to be under one roof focal point
Whether everyone can access it- isolation of WA

Roles

Customer education/End user education
Education
Training/ Cost of training
Database Food
Safety Market
Access Decrease
labour
Good meat quality outcomes
Types of products to take on
Practical outcomes that deliver
Development of technology and product quality
Improvement of processing efficiency, validation
Test bed for new technology
Commercial testing so you are not wasting peoples time and money
Keep it simple stupid- commercialisation
Innovation that decreases running costs
Through technology decrease manufacturing costs
Increase total carcase value

Alternative roles

Cadetship program with company and Universities
Standardisation of federal
Availability of new technology
Separate Australian industry from international competitors
Market point of view that there recognised value market
Promote red meat more
More emphasis needs to be placed on market/education of meat/products

- how to
- Schools
- Could do it with health education

Understanding changing consumer needs, emerging markets, explore adopt new technology to maximise growth
Access info out of older guys before they leave industry / Reporting what has and hasn't worked
Comparative analysis
Issues common to industry addressed development of a trust relationship with processors
frequent user for problem solving

Needs

Identify needs of innovations
Needs to be supported by all of industry
User friendly/supported by industry
Needs to be demand
Technical support needs to be localised
Needs to be completely transparent
The right people in the job, skills to co-ordinate, address different degrees of plant management
Level playing field
Commercial relevance
Visionary - right terminology
Understand plant user and industry issues technology that need to be developed
Good understanding of industry constraints and compliance and regulation

Don'ts

Don't duplicate any existing facility
Don't cross over what is commercially available
Don't want see this building
No duplication needed
Don't want to see a white elephant
No one in MLA should be allowed to apply
Going outside the scope- should be developing tech to assist not the market
Not be involved in the market
Good to wait till after inquiry with MLA/AMPC and if any decision be made. We yet frightened every processor input by how much been wasted.

Questions?

Cost, size?
Will industry support medium to long term?
Finance - who will pay?
If it were to be bricks and mortar is it going to be used efficiently, it has to be utilised, is it going to gather dust?

Appendix 6 – How companies would like to be involved with a potential Red Meat Processing Centre of Excellence (raw data)

Yes would like to be involved

Active in consultation process to implementation
Active participation, data storing, test and trials
Any way possible, trials, information sharing
Be supportive towards it
CEO would be very interested
All in – Consultation

Could be experimental abattoir, great location close to Sydney, happy to provide training space
Would be happy to be like a CRC founding member, Research - development - extension – processor
Happy to be involved in trial
Happy to have some involvement
Happy to sit on panels, would be supportive
Help set R & D direction, obtaining development and use of technology and training
If paying for it they want to be involved
Information workshop
Innovation is way forward and would like to be industry
Interested
Involved in the development of ideas
Open to it
Share some learnings
Technology can be trailed here
They would like to be involved and know what happens
To be part of blue sky
Very much with demonstrations, happy to be involved wherever you can, into co-funded work
Would be
Would like to have access to it, needs to be relevant to all markets
Yes
Yes, would like to innovate

Unsure

Depends on structure / worthwhile for industry
Depends on what content
Depends what the focus is on.
First get idea of how it would work, would have to fit, lack of maturity of industry
Will come and be involved, may not be active
Kept up to date
No idea- at this stage need more information
Depends on where the focus is on what role and involvement we would have
Wait and see - early adopter
Would observe if successful would be like to
Needs to be run by Federal government, meat safe/safe food should be nationwide with new set of rules, how we ever going to make this work if don't fix miss branding in meat

No response

No response

Appendix 7

agInfo Pty Ltd

Prepared for

NSW Department of Primary Industries

February 2015

Review of National and International processing technology development companies.

NEW PRODUCT DEVELOPMENT AND THE INTRODUCTION OF TECHNOLOGY TO THE INDUSTRY

Table of Contents

_Toc411765294
Executive Summary 143
Scope of the Report 144
Research Institutes – what works 144
Global experience 144
USA 145
Denmark 145
Germany 145
Survey of Meat Processors Australia 145
The widest view of technology companies 146
A range of Australian institutions 147
The Australian and New Zealand tech company landscape - Small market - Meat companies - short payback 147
Scott Technology Limited 147
Robotic Technologies Australia 148
Australian Robotics and Automation Association 148
CST Wastewater Solutions 148
Technology scan and survey and why it was conducted largely via telephone and meetings with email follow up 158
References: 158
Meat technology website references 159

Executive Summary

A survey and scan of technology companies was conducted in USA, Europe and Japan with a focus on USA using a US based consultant with experience in meat science and agricultural economics, Gregory Sullivan. Dr Sullivan has a wide network of contacts and is a highly experience international agricultural development consultant.

In addition, consultation was carried out in Australia with companies active in the technology space as well as some consultation with meat processors in Queensland, NSW and Victoria spread across beef and sheepmeat supply chains. Prior to commencing the USA Europe telephone contact, an extensive period of desk research was carried out to list appropriate technology companies, with emphasis on Europe. Europe was considered to be more active in advanced automation and labour saving technologies based on our understanding of work carried out in Germany and Denmark in the pork and chicken industries. Full details are contained in this report in the website reference links and summaries.

Research Institutes in Europe and USA were evaluated to understand working models that may assist consideration of the Australian red meat centre of excellence feasibility study. A number of Australian examples of institutes and research models were also assessed as were global cooperating research groups such as the Global Research Alliance. The basis of the Global Research Alliance is collaboration and several countries are involved including CSIRO from Australia. Australia also has Food Industry Australia, an industry-led, government funded initiative, to accelerate commercially-driven collaboration and innovation in the Australian food and beverage industry. A German example of a large research institute is Fraunhofer-Gesellschaf which claims to be Europe's largest application oriented research organisation. It has 67 research units.

The Australian decline in manufacturing industry sets the backdrop for meat processing in Australia and while the meat industry is a relatively large employer it faces increased competition from low wage countries with expanded cattle numbers, such as Brazil. The Australian meat industry is also facing a range of issues such as occupational health and safety, skill shortages, food safety and worker preferences against the low temperatures and less favoured work environments of meat processing and these will continue to drive innovation, automation and robotics.

Scott Technology, CST Wastewater Systems, Adaptive Innovation Corp, JLS Automation Sales and Robotic, Luceo Inspection, and Makekawa are among companies interested in discussions with the centre of excellence feasibility study team.

There is only one Australian company (New Zealand owned) left in the space of automation and robotics. That company, Scott Technology, has stated that it is no longer prepared to allow other parties, e.g. MLA or AMPC to own intellectual property that is generated by R&D projects. It is seeking to drive commercial arrangements between large processor companies.

Australia should look at the USA model of integrator. Integrators work with a range of suppliers, not just robotics and automation companies. This will lessen reliance on one supplying company such as Scott Technology, who has neither the size, resources nor interest to continue to invest in automation and robotic development applications in Australian meat processing without exclusive ownership of intellectual property and without commercial returns on capital invested. We have identified Robotic Technologies Australia as a potential partner in the meat industry and

it works with some of the leading robotic and automation companies we have identified in Japan, USA and Europe including: Kawasaki, Staubli, Kyokutoh, Servo-Robot, Nitta and Pro-face.

Scope of the Report

A list of national, Asia-Pacific, USA and European companies that are involved in development of red meat processing technologies and innovations for the red meat processing sector. Focus on companies that develop technologies to improve the efficiency, throughput and labour efficiency of red meat processing and how this is applicable to the Australian Industry.

Results of the consultation process.

Summary of findings.

Future trends and barriers.

Opportunities and key partnerships within the context of establishing a red meat processing innovation centre within Australia.

Research Institutes – what works

We have included a review of research institutes around the world in the widest sense to see what sort of model an Australian Red Meat Centre of Excellence could adopt. In doing so, we have reviewed the highly successful Danish meat research institute as well as other models in Germany and generally from around the world.

One interesting model that has come to light is the work done by Regional Development Australia to promote regional growth and development initiatives. Out of this initiative, has come Food Industry Australia" an industry-led, government funded initiative to accelerate commercially-driven collaboration and innovation in the Australian food and beverage industry.'' It would certainly be worth exploring cooperation with this organisation by AMPC, NSW DPI and other stakeholders.

An idea that may gain traction is a virtual institute which is not located in one city or town but harnesses the strengths of collaboration.

In any study of collaboration in R, D &E, it would be vital to consult with the Australian Research Council. The ARC's mission is to deliver policy and programs that advance Australian research and innovation globally and benefit the community. The experience in the group may assist in reviewing the AMPC R, D & E operating model and add value to deliberations on the centre of excellence.

Global experience

In looking at Danish industry, we have identified the Global Research Alliance. It is focused on development imperatives with the aim to use science, innovation and technology to address a range of critical global development goals. The alliance brings together USA, India, South Africa, Australia, Denmark, Germany, Malaysia, the Netherlands and Finland.

In Australia's case, we note these comments from CSIRO. "CSIRO recognises the importance of international collaboration and partnerships in meeting challenges and delivering impact on behalf of Australia" Dr Megan Clark, CSIRO Chief Executive. In addition, Professor Ian Chubb, Chief Scientist Australia, identified the key role of Australia to play in the international domain.

"Australia has a long history of innovation, drawn from the harsh environmental challenges we've faced. Our participation in the Global Research Alliance, through CSIRO, leverages our potential to implement our international strategies and make a substantial contribution on a global scale," Professor Chubb said.

"Science and innovation go hand in hand to develop appropriate and affordable solutions that will improve the quality of life. And the Global Research Alliance is the vehicle that can deliver this equality of access."

USA

In all scanning, one organisation appears that reveals more about collaboration and thus we have identified a USA non-profit organisation called Battelle, who use the catch phrase, ''The Business of Innovation''. Battelle has grown out of the great US tradition of philanthropy. It was established by the Battelle Memorial Institute. BattelleManufacturing and their Agribusiness unit would be well worth a closer look.

Denmark

The Danish Meat Research Institute (DMRI) is well known and collaboration has existed with Australian research for some years. DMRI is however, part of a larger research group called the Danish Technological Institute. A closer look at the institute as a whole may reveal ideas, experience and methods of collaboration and pooling of skills and resulting achievements.

Germany

Fraunhofer-Gesellschaf claims to be Europe's largest application oriented research organisation. It has 67 research units and works in the following areas: Information and Communication Technology, Life Sciences, Microelectronics, Light and Surfaces, Production, Materials and Components and Defence and Security.

Another German institute is FörderergesellschaftfürFleischforschunge.V. The English translation of its name is the Conveyor Company for Meat Research Association. It focuses on meat science but there are units which collaborate on areas such as stunning in cattle and animal welfare generally.

There is also the Max Rubner-Institut, Federal Research Institute of Nutrition and Food. This organisation focuses on food safety with emphasis on all meat and foodstuffs. Their ambit is: '' the entire vertical meat production chain from farm to fork is decisive for the department's organizational structure.''

Survey of Meat Processors Australia

The following meat processors were contacted and discussions arranged. A meeting was held with Mr David Foote, CEO, Australian Country Choice Brisbane. He suggested I discuss the project with Innovations Manager, Matthew Hutton. Mr Hutton and I discussed the project in general over the telephone and I also met Peter Milzewski, Operations Manager at ACC Cannon Hill. Peter and Matthew are keen supporters of the AMPC initiative. I had a telephone discussion with Mr Roger Fletcher, Fletcher International, Dubbo, who is not a supporter of compulsory AMPC levies and prefers to initiate his own in house projects. I will attempt to meet with him in the near future. Terry Nolan from Nolan Meats, Gympie was also an enthusiastic supporter of the AMPC initiative and would like to learn more about it. Mr Frank Herd was also interviewed by telephone and while he is installing some automation in relation to robotic sheep carcase cutting, is not familiar with the project in general. Mr Stephen Kelly, NH Foods, indicated he saw the focus of the study as establishing the types of meat research institutes overseas that worked and

recommended I follow up the Danish Meat Research Institute, who he saw as an excellent model. I tried unsuccessfully to contact Mr Gary Burridge from Thomas Foods International. Mr Burridge is an engineer by training and would be a good resource to tap.

The widest view of technology companies

This applies to both the whole meat processing area from lairage through to cold storage, handling and logistics and global manufacturing industry and the labour saving technologies and efficiencies that have been discovered, developed and applied to improved and more sustainable operations. This takes place in a range of operating environments and at a time of enhanced global competitive pressures.

During a survey of Australian meat processors as part of a paper on meat processing for the RMAC Meat Industry Strategic Plan process, the author identified an almost uniform agreement by Australian companies that the Commonwealth Government should move meat processing under the Federal Department of Industry. They say the handling of the meat industry under the Federal Agriculture Portfolio is inappropriate and does not address the 21st century needs of meat processing as a large manufacturing industry in this country.

A recent paper on the importance of manufacturing in Australia by Peter Gahan, University of Melbourne refers to attempts to transform and make the sector more productive. This is an urgent need and innovation and automation play a part. [1]

The following paragraph compares the size of Australian manufacturing industry with OECD member countries.

Based on OECD labour market statistics[2] Australia had 918,000 persons employed in manufacturing in the third quarter of 2014, which fell slightly to 915,000 in Q4 2014. This corresponds with Australia's population and economic situation, and includes the growth of the mining sector and closures announced by the motor industry. Our manufacturing workforce is far smaller than other comparable countries. For example, Canada had 1,746,000 employed in manufacturing in Q4 2013. Looking at the OECD overall, the USA had 14,941,000 employed in manufacturing in the same period. OECD total 70,907,000. Germany 7,756,000, UK 3,018,000, the Netherlands 773,000, Denmark 325,000, France 3,201,000, Italy 4,206,000. More importantly the growth in Australian unit labour costs accelerated in the period 2002-2007 in the range of 2-4.6% per year, but has been more subdued since the GFC in 2008-2009. Unit labour rates actually fell in some of the OECD countries including Germany and Denmark due to ongoing European recession since the GFC and more serious issues in Greece, Spain, Portugal and Ireland. Korea and Japan have seen slower rates of growth and Australia's lower inflation period of the last few years has been matched by more subdued labour unit cost increases. The USA has seen negative or small unit labour cost increases in the past few years, but employment trends have picked up in recent times.

These factors and a range of issues such as occupational health and safety, food safety concerns and worker preferences against the low temperatures and less favoured work environments of meat processing will continue to drive innovation, automation and robotics.

[1] Why the Australian economy still needs manufacturing October 2014 http://theconversation.com/why-the-australian-economy-still-needs-manufacturing-31913

[2] OECD StatExtracts Short-Term Labour Market Statistics: Employment-by economic activity. Accessed website Feb 2015. http://stats.oecd.org/index.aspx?queryid=38899

Even in a relatively low labour cost country such as Spain, increasing labour costs and skill shortages in regional areas, has driven one innovative firm, El Dulze, a large scale lettuce packing factory, to install 68FANUCRobotics robots to provide an operating capacity of 550,000 lettuces per day. This example highlights the need to look at technology applications widely and to reach out to the whole gamut of processing, manufacturing and handling.

Collaboration and some of the ideas discussed earlier can also be fostered and assisted by reference to work by Howard Gardner, Professor at the Harvard Graduate School of Education [3] He refers to

''The Disciplinary Mind: the mastery of major schools of thought, including science, mathematics, and history, and of at least one professional craft.

The Synthesizing Mind: the ability to integrate ideas from different disciplines or spheres into a coherent whole and to communicate that integration to others.

The Creating Mind: the capacity to uncover and clarify new problems, questions, and phenomena.''

A range of Australian institutions

To illustrate the point that a wide view of technology will be beneficial, we have identified a number of Australian institutions that could be consulted.

Victoria University: Institute for Supply Chain and Logistics

UTS: Engineering and Information Technology Innovation in Practice

UNSW: School of Mechanical and Manufacturing Engineering

The University of Sydney: Australian Centre For Field Robotics

The Defence Science and Technology Organisation (DSTO)

An international organisation that would be worth reviewing is the International Federation of Robotics (IFR).[4]

The Australian and New Zealand tech company landscape - Small market - Meat companies - short payback

Scott Technology Limited is a New Zealand publicly listed company with annual revenue from last Annual Report of NZ$60.32 million.[5] Its revenue is greatest in North America with a figure of $25.95 million and a significant reliance on whitegoods and appliances, but also sales streams in mining, industrial automation and superconductivity. Australia is the second largest market with

[3] Five Minds for the Future outlines the specific cognitive abilities that will be sought and cultivated by leaders in the years ahead. Five Minds for the Future, Howard Gardner–January 6, 2009

[4] Since 1st April 2008 the IFR Secretariat has been hosted by the VDMA, the German machinery association in Frankfurt/Germany.

[5] Scott Technology Limited, Annual Report, 2014

revenue of $12.27 million, with activities in the meat industry, mining and industrial automation. Chairman is Stuart McLauchlan and Managing Director Chris Hopkins.

Scott Technology in Australia is led by Sean Starling. Sean is a very energetic and enthusiastic supporter of innovation in the meat processing industry having set up a large number of the programs when working as Manager of Innovation for the MLA Off-Farm Program area several years ago. He has been with Scott's since about 2009 and succeeded in pushing the projects and installations that were started under his leadership at MLA. Their history of automation and engineering goes back 100 years and most of the technology they have worked on in recent years, and a large part of their revenue, is generated by appliance automation (refrigerators and whitegoods) and smart technologies. Scott's are definitely interested in a Centre of Excellence in principle. The issue may be in ownership or sharing of IP. Scott Technologies have adopted a more commercial stance in relation to ownership of intellectual property when they have invested substantial sums of capital and funds in proving technologies from pilot scale in factory to larger scale trials in company premises. Scott's in particular indicated that they are unable to service all enquiries from Australian meat processors as meat is a smaller sector of their corporate business.

On 4 December 2014, Scott Technology via investors' section of their website notifiedthemarket of the acquisition of MAR (Machinery & Automation) in Australia [6] A more recent announcement has indicated that MAR has total employees of 60 and annual turnover of AUD$20 million. The release indicated that Clyde Campbell, founder and CEO of MAR in Australia in 1987 will take up the appointment of Regional Director for Scott. MAR is still led by the founder but the merger with Scott Technology indicates that they are keen to partner and seek cooperation, particularly in an environment where some of the large scale beef cutting installations have not turned into sales with the short payback periods sought from major companies such as JBS. However, the merger will lessen competition in the very small Australian market and it is all the more important for Australia to reach out to overseas companies and suppliers of a diverse range of technologies and products.

Robotic Technologies Australia

We have only recently identified this company as a potential partner in the meat industry and the company website indicates it operates on the basis of a US model we discuss later in this report as an ''integrator''. Information provided indicates the company works with some of the leading robotic and automation companies we have identified in Japan, USA and Europe including: Kawasaki, Staubli, Kyokutoh, Servo-Robot, Nitta and Pro-face.

Australian Robotics and Automation Association

It would definitely be worthwhile networking with the Australian Robotics and Automation Association as well as some of the research institutes in Australia we identified earlier. The ARAA Council includes a number of academics throughout Australia and New Zealand and includes representation by the CSIRO ICT group.

CST Wastewater Solutions

Michael Bambridge from CST Wastewater Solutions in Sydney is interested to know more and be involved in discussions about the meat industry centre of excellence program and feasibility. CST have succeeded in working with NH Foods at their Oakey Abattoir to install an innovative solution for wastewater. They are keen to discuss Australian initiatives in meat processing innovation and have linkages with a major European wastewater company called GWE.

[6] 2014-12-04-Acquisition of Machinery Automation & Robotics Pty Ltd

Other technology and supplier companies identified but not contacted in Australia include Thorsys, Cedar Creek Company and Food Equipment Australia.

The key learning from interviews conducted with Australian technology providers and meat processors is the relative small size of the Australian market and especially the Australian meat market in terms of global protein production. Australia is a large exporter of red meat, but world trade is only a small percentage of global meat production and the large integrated poultry and pork industries in Europe and USA deal with consistent volumes from intensively fed systems with very short growing cycles for poultry and very consistent sized carcases and product from the pork industries in Europe and USA.

To provide a perspective on the relative size of global production of meat protein and trade, we consulted the FAO report. [7] World Production of bovine meat 68.3 million tonnes, poultry meat 107.6 million tonnes, pigmeat 116.1 million tonnes and ovine meat 14 million tonnes. This compares with trade in bovine meat of 9.3 million tonnes, poultry meat 13.5 million tonnes, pigmeat 7.5 million tonnes and ovine meat 1 million tonnes. Most of the growth is in developing countries. Thus the attraction of global and international companies to activities in Australia is limited, but there are integrators and innovative service companies who can leverage their business with global manufacturing and may in turn be the best targets for the Australian red meat centre of excellence.

Companies interested in the red meat centre of excellence and why. Where to from here

COMPANIES POTENTIALLY INTERESTED IN MEAT INDUSTRY CENTRE OF EXCELLENCE, PARTNERING		
COMPANY	SPECIALISATION	COUNTRY
Scott Technology	Robotics and automation	Australia, New Zealand
Machinery and Automation	Robotics and automation	Australia
CST Wastewater Systems	Waste water and related	Australia
Global Water Engineering GWE	Waste water and related	Hong Kong and global
Harpak-Ulma	Case packing, logistics automation	USA
Concept Systems Inc	Automation control systems, vision aid	USA
Adaptative Innovation Corp	Integrator	USA
JLS Automation Sales and Robotic	Automation and robotics	USA

Other companies contacted who were interested to know more included: Foss Meat Technology and, Mayekawa (Japanese Robotics Company).

Luceo Inspection is very interested in the concept and discussions and is based in France. Their service is: “optical inspection for the automotive and food industry, Luceo has developed a genuine technological advance in the core business of contact-free inspection based on machine vision for food processes.”

TREIF Asia German Center Treif are major suppliers in the meat cutting technology area and their representative in Indonesia is interested to learn more of the project and provide input and advice.

[7] ~~Food and Agriculture Organisation~~ of United Nations (FAO) Food Outlook October 2014 - Meat and Meat Products.

Australian company, Initmedia and Management for Technology, led by Des Bowler, is very interested in the project. He has substantial experience in all facets of meat processing and innovation. Specialisations have included:

Best practice model for electronic submission of government forms
Traceability
The value proposition of food integrity programs
Beef and veal hook track process flow

The interest from Scott Technology and MAR is not surprising given their close involvement with a range of projects and installations over the past several years. However, globally these companies are relatively small and are now keen to profit from years of investment and R&D as well as finding they do not have the capacity to service all enquiries from the Australian meat sector. As the relationship with Australian meat companies and Scott Technology is commercialised, it would be prudent to explore the USA and any other country's experience with integrators who partner with robotics, automation and engineering companies to deliver outcomes. Thus the model of a meat industry centre of excellence may need to return to a basic consideration of what sort of institution is required in Australia now and into the future and the AMPC and industry can learn more by seeking out contacts and ideas from successful institutions overseas.

Additional Information on companies

MILMEQ

http://www.milmeq.com/home.aspx

The company began operations in 1952 and was known as Refrigeration Engineering. The company was established as a result of the New Zealand primary produce markets requiring focus on refrigeration engineering to assist with making their products available to the global market.

Early engineering solutions at the beginning of the company included the design and manufacture of evaporators for blast freezing of meat. 1955 saw the opportunity for the owners to expand the business operations to include the wholesale of components for refrigeration. The market demand for refrigeration components was small during this time but the growth that developed over the next few decades was as a result of the emphasis on service, quality stock and the provision of technical advice.

The decade of the 60's witnessed the growth in reputation for the refrigeration engineering contracting strengths and this was recognised by very large contracts for greenfield plants as well as upgrades and expansions to existing plants across New Zealand. During the next two decades, three divisions within the company were clearly identified as offering industrial refrigeration systems, industrial mechanical systems and wholesale of components for commercial refrigeration and air conditioning.

1991 introduced the acquisition of Millers Mechanical to the company which added the unique engineering skill set for the design of robust processing systems for sheep and cattle. 1992 was the initiation of the Brisbane based operation with the objective of marketing the range of unique engineering skills of both the contracting Refrigeration Engineering units as well as the newly acquired Millers Mechanical. This operation was called Realcold Milmech to encompass both the chilling and freezing and primary food processing competencies.

Realcold Milmech made a rapid entry into the Australian market due to the similarities with New Zealand and the requirement for primary product to be exported to overseas destinations. With this understanding the company developed the Plate Freezer and Multiple Retention Tunnel (MRT) to compliment the range of chilling and freezing systems already available through the New Zealand developments. In 1997 Refrigeration Engineering developed the wholesale opportunity within consumables for meat processing. As a result Argus Realcold was setup in both the New Zealand and Australia market. For the wholesale operations the decision was made in 2000 to acquire a similar business in Australia called Refrigeration Equipment Sales (RES).

Legal status

The company began operations in 1952 and was known as Refrigeration Engineering. A major restructure was initiated in 2009 to divide the contracting and wholesale business units. This saw the merge of the wholesale business of Realcold Components (New Zealand) and RES (Australia). This new entity renamed as Realcold. For the company operations within engineering contracting for industrial systems, the merge of four business units, Realcold Industrial, Realcold Mechanical, Millers Mechanical and Realcold Milmech was completed and our company renamed as Milmeq.

Milmeq remains a world class supplier of quality engineered systems providing enhanced Primary Food Processing, Materials Handling and Chilling and Freezing operations. The new company name Milmeq changed 4 April 2011.

Organisation

Milmeq develops, designs and delivers systems for customers with food processing operations in countries all around the world. Their vision is to continue to offer our technology and expertise on a global level whilst remaining in touch with local knowledge and understanding for each project and installation.

Operational focus

Their core market and focus for the development of our systems is primary food processors. This is includes those within meat, poultry, dairy, seafood and horticulture.

Current context

Engineering for the future is a value and approach adopted throughout the company. This relates to the primary food markets we cater to and the provision of good quality food product available to consumers. We understand our role in the supply chain of maintaining a reliable food chain and ensuring a robust platform for future generations of processors and consumers.

Their commitment to engineering for the future in line with customer key objectives and strategy relates to the supply of robust, future proof systems that provide flexibility to processors in response to the constantly changing landscape of food processing. This can entail the considerations at the development and design stages for future upgrade options, extension possibilities, maintenance programmes, change in product SKUs required, change in product packaging expectations.

<u>Newtechnologies</u>

On 25th of March Milmeq was proudly announced as the winner for Excellence in Innovation at the New Zealand International Business Awards organised by NZTE.

"The standard of this year's entries was consistently high, which made Milmeq's entry all the more remarkable. The company operates in New Zealand's primary food processing industry, an

industry that is still very traditional in its approach. Milmeq has achieved substantial international growth by deeply embedding innovation processes across its approach to food processing, material handling, and freezing. A strong focus on health and safety and intellectual property management were additional highpoints."

Having been in operation over 60 years, Milmeq has developed a number of relationships and partnerships with companies and industry associations around the world.

Materials handling "SARS" https://www.youtube.com/watch?v=cjBbPUCCc_Q
http://www.ammonia21.com/articles/4932/trends_in_use_of_large_scale_plate_freezers_in_australia

Widely adopted by the Australian export meat industry, plate freezers use 20 to 30% less energy to freeze a unit of product in comparison to an air blast freezer. New developments to allow reduction of the ammonia charge and the accommodation of multiple size packaging will contribute to further energy reductions and broaden the application of plate freezers to other industry sectors

Current trends and opportunities in large plate freezer technology

While the use of plate freezers already saves a considerable amount of energy compared to other technologies such as air blast freezers, there are ways to further improve the energy efficiency. Currently, two main trends in relation to the energy efficiency improvement of plate freezers in Australia include naked block freezing and single station opening. These are both ongoing projects; however, they have been proceeding slowly at present.

Naked block freezing: Bare product freezing allows for lower energy use, minimal packaging requirements and avoidance of plastic inclusions in the frozen product.

Single station opening: In a single station opening unit only the station being loaded is open – all other stations remain closed with the plates in full contact with the product. The short lifting stroke in this design results in an increase in the stacking density of the freezer and leads to a smaller enclosure volume for a given product capacity.

Large refrigerant charge size for plate freezers and limitations in freezing multiple package sizes are two of the main challenges limiting the wider adoption of plate freezers. Nevertheless the industry is advancing in finding solutions:

Refrigerant charge reduction: Compared to an air blast freezer evaporator, a plate freezer would require a large ammonia charge for the same product quantity. However, a number of heat transfer fluids are available allowing the use of a reduced ammonia charge, which is confined to the plant room and heat exchangers. The work on introducing heat transfer fluids to large-scale plate freezers continues.

Multiple package sizes: Work on the single station opening plate freezer design has shown the possibility of adapting the design to accommodate multiple package sizes in a large-scale plate freezer. The development of plate freezers able to accommodate a range of carton sizes will make the energy and carbon reduction benefits of plate freezers available to a wider range of processors.

Brian'scomments: There is still major issues with poly entrapment in beef processed for grinding in pattie plants around the world and especially in USA. Our client McDonald's Asia Pacific

Consortium who controls the McDonalds supply chain out of Australia and NZ have also spent a lot of time on the issue and working with plants. Milneq NZ office very good on abattoir engineering.

APPLIED ROBOTICS
http://www.appliedrobotics.com.au/

Applied Robotics and Apparel Robotics were founded by Dr Paul Wong in 1985. Dr Wong's background is in Mechanical Engineering where he spent his early years in robotics research. His work on robotic assembly is widely cited in seminal publications on Robotics Technology.

Following a number of years in both white goods production technology and medical technology R&D (Fisher Paykel), he was appointed as Officer-in-Charge of the Australian Wool Corporation's Robot Sheep Shearing Programme. Over the next 4 years the Programme produced the world's first sheep shearing robot.

In 1985 Dr Wong recognized the opportunity to develop and commercialise leading edge automation and robotics systems for the handling and processing of difficult workpieces - that is those that are pliable, elastic, flimsy, delicate and porous such as fabrics, textiles, foodstuffs, etc. as opposed to easy to handle metallic and hard plastic workpieces. He established Apparel Robotics and Applied Robotics - companies to address the requirements for difficult workpieces and standard workpieces automation, respectively.

In the last 20 years, the Companies have become a leading supplier of innovative automation and robotics systems with over 350 installed systems in Australia, USA, Europe & Japan. Our clients list include all the major groups and companies in Australia and Fortune 500 companies overseas.

Legal status
Applied Robotics operations comprise two Companies – Applied Robotics and Apparel Robotics – with Apparel Robotics focusing on Automation for the Clothing and Textile industries and Applied Robotics in general manufacturing. Apparel Robotics, through its ground breaking innovations in the early years has developed an international reputation for its R&D achievements in its area of expertise.

Organisation
Applied Robotics has always maintained full in-house capability to better serve our clients, in tight quality control and tight project timelines. Thier engineering design team comprises mechanical, electrical and mechatronics engineers, and a fully equipped workshop is staffed by our own toolmakers, fitters and electricians. It has the capacity to run 4 to 5 major projects simultaneously.

Projects span the spectrum from a single machine or robot workcell to multiple production lines. In all of these Applied Robotics is the principal supplier, producing both the mechanical and controls systems with in-house capability.

Operational focus
Applied Robotics design engineers have background in both robotics R&D (robotic sheep shearing, robotic parts assembly, robotic hand design, etc.) and advanced factory automation machinery

design experience (e.g. NEC Japan, French nuclear industry automation, electronics industry USA), as well as our 350 installed systems in Australia spread over the food, textile, plastics, pharmaceuticals, biochemistry, electronics and metal manufacturing sectors.

Current context
The strategy at Applied Robotics has always been to combine new technologies and novel techniques with proven automation technologies and experience, to tackle our clients' automation tasks in a better way. Consequently, many of our solutions have made available a Quantum Jump in machine capability or performance, offering our clients a world first or a world fastest automation solution. These systems have underpinned our export success to markets in the US, Japan and Europe.

Our largest installation overseas has been the design and supply of multiple machine systems for all discrete products handling for Milliken & Co's new carpet tile plant, in Georgia, USA in 1995/96. Milliken sourced these systems out of Australia because Applied Robotics had unique technologies and the experience to handle, stack and de-stack porous and flimsy carpet tiles at a rate of 4 per second.

Aerospace giant Raytheon Corporation is a licensee of one of our unique technologies for wind speed and direction sensing for over 12 years now. This underpins one of their current product lines in the nautical electronics market.

Over the years Applied Robotics have had extensive collaboration with Universities and CSIRO, in addition to our own in-house efforts, to develop new automation technologies and their implementation into novel machines.

SAGE AUTOMATION
http://www.sageautomation.com/

SAGE Automation is a leading independent system integration company specialising in industrial automation and control systems. SAGE designs, constructs, supports and improves industrial control and automation solutions and provides advanced training to enhance the skills of those who work with this technology every day. Customers include defence, infrastructure, manufacturing, mining and utilities sectors.

STRATEGIC ENGINEERING
http://www.strategiceng.com.au/

Strategic Engineering develops state-of-the-art robotic solutions, and partners with manufacturers to integrate those technologies to provide innovative products and services. Their dynamic team of engineers tackle some of the most difficult automation puzzles to enhance Australia's manufacturing sector. Through a broad range of consulting, engineering services and training, help partners produce better products, reducing risk and improving competitiveness.

Strategic Engineering blends the best minds from scientific and engineering communities to provide valuable insights and ideas on how to implement breakthrough technologies. They are one of Australia's up and coming robotic systems integrators specialising in ABB, KUKA and Denso Robots, and we are committed to providing our customers with quality products and the highest level of ongoing support.

Operational focus
Strategic Engineering Automation and Robotics provide turnkey robotic and automation solutions including:

Industrial Robotics
Vision Systems
Automation & PLC Programming
System Commissioning
Safety Consulting & Risk Assessments

They aim to develop the right solution to satisfy all of your electrical, mechanical or automation requirements.

They have been involved in the successful commissioning of various automation solutions including:

Pick and placing
Sorting
Materials Handling
Palletising
Spraying

AUSTRALIAN CENTRE FOR FIELD ROBOTICS
http://www.acfr.usyd.edu.au/
https://www.youtube.com/user/unisydneyacfr
http://www.acfr.usyd.edu.au/consulting/index.shtml

For over 20 years the ACFR has help transform many Australian industries through the design, development, deployment, integration and commercialisation of field robotic and intelligent systems. The ACFR has considerable expertise in taking strategic and applied research related to field robotics and intelligent field systems through to integration into operation, and has also actively consulted to industry and government.

The ACFR has considerable expertise and experience in the:

design and development of guidance, navigation and control systems;
design and development of automated vehicles, vehicle control, condition monitoring and safety systems;
development of appropriate sensor and embedded computing hardware; development of large scale intelligent software systems;
and demonstration of field robotics and intelligent systems.
They also undertake contract research and development of automated industrial vehicles; cargo handling and haulage systems; automated mining and construction vehicles;
remote undersea platforms and aerospace systems.

UNSW SCHOOL OF MECHANICAL AND MANUFACTURING ENGINEERING
http://www.engineering.unsw.edu.au/mechanical-engineering/?ss=12

Advanced Manufacturing is the development and use of innovative technologies for the fabrication of products.

http://www.engineering.unsw.edu.au/mechanical-engineering/mechanical-engineering/advanced-manufacturing-1

SUSTAINABLE MANUFACTURING AND LIFECYCLE ENGINEERING
https://www.engineering.unsw.edu.au/mechanical-engineering/sustainable-manufacturing-and-life-cycle-engineering-0
Energy and resource efficiency in manufacturing: they develop metering and monitoring techniques, in addition to simulation tools for energy and resource efficiency assessment of manufacturing systems. They are also developing real-time control systems in order to integrate renewable energy supplies (e.g. Combined Heat Power – CHP) with manufacturing plants, thus achieving grid-free operations.

UTS: ENGINEERING AND IT RESEARCH
http://innovation.uts.edu.au/ Research
http://cfsites1.uts.edu.au/find/projects/search.cfm?UnitId=394
some examples:
Development of a Deployable Climbing Robot for the SHB Inspection and Condition Assessment
FPGA Software Development for CSIRO Wireless Communications Projects
The Effect of Connection Flexibility on the Seismic Performance of Industrial Racking Systems - Student: Ahmad Firouzianhaji, A new end use of recycled water for sustainable Australian water

FUNCTIONAL FOOD BAR
http://www.dsto.defence.gov.au/sites/default/files/research_activities/documents/FunctionalFoodBar_fact%20sheet.pdf

MICROWAVE ASSISTED THERMAN STERILISATION
http://www.dsto.defence.gov.au/sites/default/files/research_activities/documents/MATS_fact%20sheet.pdf

AUTONOMOUS NETWORKING (OPAL)
http://www.dsto.defence.gov.au/projects/autonomous-networking-opalOPAL is a self-healing communications network concept using autonomous mobile nodes that exchange with neighbouring nodes the status of the network's health, and adjust their positions to ensure communications on the battlefield are not disrupted. - See more at:
http://www.dsto.defence.gov.au/projects/autonomous-networking-opal#sthash.7iCEmWA6.dpuf

ARC CENTRE OF EXCELLENCE FOR AUTONOMOUS SYSTEMS
http://www.cas.edu.au/home.html

The ARC Centre of Excellence for Autonomous Systems was established in January 2003 under the Australian Research Council's Centres of Excellence programme and concluded at the end of 2010.

Autonomous systems represent the next great step in the fusion of machines, computing, sensing, and software to create intelligent systems capable of interacting with the complexities of the real world. Autonomous systems are the physical embodiment of machine intelligence.

The aim of the Centre is to research and explore the nature of intelligence in problems of perception learning and control, and thus to lay the scientific groundwork for the development and application of intelligent autonomous systems.

Profitability of meat processing & its effect on innovation, R&D and technology take up

Australian meat processing companies filing with ASIC for the 2014 fiscal year generated combined net profits after tax (NPAT) of $150 million. These companies included NH Foods (previously Nippon Meat Packers), Australian Consolidated Investments (Primo), WAMMCO, Kilcoy Pastoral, Midfield Meat and Nolan Meats. JBS Australia filed their 2013 fiscal year ended December report and reported NPAT of $240 million. Combined NPAT for our sample of companies including Thomas Foods, Northern Coop Meat Co and Teys Australia as well as the companies named above was $124 million in 2013. This compares with a combined $8 million in 2012 and combined losses of $10 million in 2011. The profitability cycle in meat processing can change rapidly and is generally unpredictable and tied to weather and seasonal conditions as well as currency factors and global supply and demand of protein. Generally the sector operates on a low profit to sales ratio and often inadequate returns on capital to ensure plants are updated and modern processing technologies are installed to improve efficiencies and global competitiveness.

The Australian meat export sector generated sales of almost $10 billion in the year to June 2014. Annual fiscal beef exports $6.4 billion and sheepmeat and other meats $3.36 billion. Other key rural commodities: wheat $6.084 billion, cotton $2.3 billion, wool $2.45 billion. Australian major export earners: coal $40.066 billion, petroleum $10.418 billion and iron ore $75.951 billion.

The Australia domestic red meat category has been estimated at $8 billion per annum by MLA.

ABARES estimates total employment in the meat sector in 2012 as 32,000 persons. Wages and salaries paid was $1.5552 billion, sales and service income $13.679 billion and industry value added $2.287 billion. The MLA Annual Report in 2013 noted the total value of the red meat and livestock industry as $16.2 billion.

In recent times, particularly 2014, the surge in beef prices in USA and a weakening Australian dollar coincided with a two to three year northern Australian and particularly, Queensland, drought. These events substantially widened processing margins, but the first month of 2015 has seen the return of a decent summer wet season in tropical northern Australia as well as reasonable rainfall in NSW and northern WA. The high slaughter level of cattle, particularly cows, in Queensland in past years, has seen an alarming squeeze on margins of processors, but much healthier long term sustainable prices for cattle producers. Time will tell if processor returns are sustainable at lower levels and provide for continued reinvestment in plant and equipment, including robotics, automation and technology in general.

MLA recent history and company reliance on matching funds

In Australia, industry organisations such as MLA and AMPC, as well as a small number of cooperative innovation companies such as Scott's and Mar, have developed a number of technologies and part technologies as part of the R&D process. Some issues arise when

cooperating meat companies invest substantial sums as part of MLA Donor Company programs in relation to sharing that technology with other potentially interested Australian meat processors.

Mr Chris Ruberg, MLA R&D Program Manager, Processing Technology was generous in providing time for an interview to discuss the broad range of projects managed by MLA. Chris has spent considerable time updating the comprehensive MLA website: Processing efficiency and automation.

Several projects have been reviewed including:

- Product sorting, picking, packing and logistics
- Automated sani-vac or vacuum sanitisation
- Beef hock cutter robotic system
- Manual assist devices have been developed to remove the strain on workers performing boning tasks
- To improve processing efficiencies, addressing labour availability and OH&S and reducing consumption of water and electricity.
- Technology dramatically improves bandsaw safety

In addition, the On-Farm area of MLA through the ''Eating Quality R&D'' section continues to work on meeting the specification of target markets.

The 2014 Senate enquiry into the operation of the Australian grass fed beef levies indicated concerns with the transparency and operations of the MLA Donor Company, but the Federal government through the Minister of Agriculture has yet to make any determination on the Senate enquiry recommendations.

Technology scan and survey and why it was conducted largely via telephone and meetings with email follow up.

An extensive period of desk research was conducted to identify companies and organisations that could be included in survey and as part of the scan of technology companies and potential partners in the red meat centre of excellence project. A USA based consultant, Dr Gregory Sullivan, with a background in meat science and agricultural economics and a network at Texas A&M University, was selected to work with agInfo on the project. Initial research and enquiries indicated that telephone conversations and interviews was the best means of securing information and interest in the project.

References:

Australia's innovation imperative Business Council of Australia Aug 2014 Deloitte Access Economics

Australia's Innovation System 18 March 2014, an inquiry into Australia's innovation system to the Senate Economics References Committee for inquiry and report. http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Economics/Innovation_System

Five Minds for the Future – January 6, 2009 Howard Gardner

OECD-FAO Agricultural Outlook 2014-2023 2014 http://www.agri-outlook.org/

MLA - Product sorting, picking, packing and logistics http://www.mla.com.au/Research-and-development/Search-RD-reports/RD-report-details/Productivity-Off-Farm/Product-sorting-picking-packing-and-logistics/2713

MLA Dual SaniVac (Front/Rear) Productivity (Off Farm) http://www.mla.com.au/Research-and-development/Search-RD-reports/RD-report-details/Productivity-Off-Farm/Dual-SaniVac-Front-Rear/2694

MLA Beef hock cutter robotic system http://www.mla.com.au/Research-and-development/Search-RD-reports/RD-report-details/Productivity-Off-Farm/Beef-hock-cutter-robotic-system/2682

MLA Annual Reports http://www.mla.com.au/About-MLA/Planning-and-reporting/Annual-reporting

IFFA Trade Exhibition and Study Tour May 2014 Project Code: P.PIP.0370 & A.TEC.0115 Prepared by: Study Tour Participants Various Organisations. Published: August 2013. Meat and Livestock Australia Limited

Meat technology website references

AutomatedMaterialHandlingOrderFulfillment... - kivasystems.com Dec 2
[Meattechnology]

JBSOpensModernBeefDistributionCenter... - jbsglobal.com Dec 2
[Meattechnology - Retrotech automation with additional sortation lanes and high-speed palletizers will be installed in February 2014, streamlining the plant's ability to seamlessly deliver products to customers worldwide.]

WelcometotheInternationalProduction... - ippexpo.com Nov 25
[Meattechnology]

LUCEOInspectionWorldwideInspection... - luceo-inspection.com Dec 14
[Meattechnology - Luceo Inspection Worldwide ZART des Perrières 35772 Vern sur Seiche France Tel. : +33 2 99 62 86 11 Fax: +33 2 99 62 72 38]

Americoldupgradesautomationsystem | viastore - viastore.com Dec 2
[Meattechnology]

PatentUS20090214724-Meatpackaging... - google.com Nov 15
[Meattechnology]

CSTEnergyandWater - cstenergyandwater.com Dec 18
[Meattechnology - Mike from Roseville CST]

TD2014/19-Incometax:whatarethe... - ato.gov.au Nov 16
[Meattechnology]

NewWaveofDeftRobotsIsChangingGlobal... - nytimes.com Jan 2
[Meattechnology - Very good, pictures, studies.

WelcometoSASAutomation | RoboticEnd-of-Ar... - sas-automation.com Nov 30
[Meattechnology]

InvestorRelations | Marel - marel.com Dec 28

[Meattechnology]

PatentUS20140035730-Methodforelectronic... - google.com Nov 25

[Meattechnology]

AutomatedStorageandRetrievalSystems(ASRS) - bastiansolutions.com Dec 2

[Meattechnology]

GlobalWaterEngineering - globalwaterengineering.com Dec 17

[Meattechnology - GWE RAPTOR™ waste-to-energy technology wins IChemE Energy Award. Worldwide wastewater treatment and green energy authority Global Water Engineering (GWE) has won a major international chemical engineering award for its process by which it transforms food processing sludge waste from an environmental problem into profitable green energy. GWE Chairman and CEO Mr Jean Pierre Ombregt accepted the IChemE Energy Award from the Institute of Chemical Engineers (IChemE), which represents more than 40,000 chemical engineers worldwide and which staged the 2014 awards in the UK this month this month to recognise and reward chemical engineering innovation and excellence. The IChemE Energy Award – sponsored by PM Group – recognises the best project or process to demonstrate innovation in renewable energy, alternative energy sources, efficient energy use or the development of energy production methods that reduce energy and water intensity. GWE's entry involved a world first with Chok Chai Starch in Thailand, where a GWE RAPTOR™ system is used to convert wet pulp waste product from the processing of cassava roots into biogas (methane) green energy, at their tapioca starch plant in Uthai Thani.]

TIPPERTIE,Inc./Technopack/Alpina - tippertie.com Nov 15

[Meattechnology]

VerticalPlatefreezer - marefsup.nl Dec 14

[Meattechnology]

CiscoandRockwellAutomation-CiscoSystems - cisco.com Nov 30

[Meattechnology]

EffectivenessofUSDAinstrument-based... - nih.gov Nov 30

[Meattechnology]

NewBladeStopGloveCheckRevolutionary... - machineryautomation.com.au - Nov 10

Edit Remove

[Meattechnology]

CedarCreekCompany - cedarcc.com Nov 30

[Meattechnology]

AutomationWorld|Coveringthefield... - automationworld.com Dec 3

[Meattechnology]

BeefPrograms-IMIGlobal - imiglobal.com Dec 19

[Meattechnology - Beef Verification Services From day one, the roots of IMI Global have always been firmly planted within the beef industry. Our expertise in cattle production and related verification and added-value programs and services is

unparalleled. Whether you are simply trying to meet new identification and traceability requirements through the use of EID tags, or are seeking new premium market opportunities through the non-hormone treated cattle program, unique animal welfare and humane handling programs, organic certification,]

SolidWaste»CB&I - shawgrp.com Dec 29
[Meattechnology]

PatentUS8661773-Meatpackaging-Google... - google.com Nov 15
[Meattechnology]

ISA99Committee-Home - isa.org Nov 30
[Meattechnology]

NTF-NewTechnologyFoundation-公益財団... - ntf.or.jp Jan 2
[Meattechnology]

Finalreportdetails|Meat&Livestock... - mla.com.au Dec 7
[Meattechnology - Product sorting, picking, packing and logistics The conventional practice in meat processing chillers is to manually batch product prior to the product being progressed into the boning room. With high volumes of carcases being processed, manual processes can often be unreliable. Chiller automation supported by radio frequency identification RFID is an initiative to streamline this important task and implement more reliable database driven solutions. Carcases are graded and then logically grouped, which then allows boning rosters and schedules to be efficiently executed. The benefits to the supply chain are an improved level of carcase traceability, the potential to make carcase grading data available for further supply chain optimisation, increased consistency of production and thereby increased value of products, with a contribution to labour supply sustainability. Areas include: Chiller automation Trim management and packing Container loading Trim management research A.TEC.0057. This project identified the specifications required by the Australian Meat Industry for packing of CL grades of bulk packed meat, designed a line set up using different components from various suppliers and validated each piece of equipment to ensure it met the specification. Caracase Handling research A.TEC.0055. The first gambrel transfer is a step in the meat processing process where the hoofs of the carcase need to be transferred from an open to a closed position where they are hung on hooks called gambrels.This project describes a possible solution for automating the first gambrel transfer in the processing of lamb and calf carcases at the CRF Colac Otway plant near Melbourne, Australia. Contract No. Title Start date End date Funding type A.TEC.0055 Automated first gambrel transfer 26/09/2008 25/03/2010 Industry A.TEC.0057 FPE Scoping studies 19/10/2007 30/01/2008 Industry A.TEC.0093 Picking, Packing and Materials Handling Review 01/12/2012 31/01/2014 Industry A.TEC.]

E+VTechnologyGmbH&Co.KG - eplusv.de Nov 30
[Meattechnology]

MPSmeatprocessingsystems-MPSGroup - mps-group.nl Dec 2
[Meattechnology]

Internationalconferenceonroboticsautomation - icarcv.org Jan 2
[Meattechnology]

WelcometoSASAutomation|RoboticEnd-of-Ar... - sas-automation.com Nov 30
[Meattechnology]

2014Program-Lambex-AustralianLamb... - lambex.com.au Nov 15
[Meattechnology]

pelting|FoodEquipmentAustralia - fea.net.au Nov 24
[Meattechnology]

OakeyAbattoir'sworldenvironmental... - cstwastewater.com Dec 17
[Meattechnology - Australian Federal Industry Minister Ian Macfarlane, right, performs the launch ceremony, congratulating the General manager of Nippon Meat Packers' Oakey Abattoir Mr Pat Gleeson, centre, and the Managing Director of CST Wastewater Solutions, Mr Michael Bambridge, Right, whose company installed the GWE COHRAL technology. . An environmental initiative that will deliver greater energy security and a cleaner, greener future at one of Australia's largest beef processing plants was launched recently (Friday, March 7) by Australian Federal Industry Minister and MP for Groom Hon Ian Macfarlane. The COHRAL(TM) Covered High Rate Anaerobic Lagoon at Oakey Abattoir on Queensland's Darling Downs will extract green energy biogas from its waste water streams to replace millions of dollars worth of natural gas currently consumed at the abattoir. In addition to lowering the plant's dependence on increasingly expensive supplies of natural gas, the Global Water Engineering anaerobic digestion plant will simultaneously reduce the plant's carbon footprint and produce waste water far cleaner than typical waste lagoons. The plant is expected to repay its cost of construction inside five years through gas purchase savings amounting to many millions of dollars – then continue to deliver benefits and profitability virtually in perpetuity, says Oakey Abattoir Pty Ltd General Manager Mr Pat Gleeson. The installation of the GWE COHRAL(TM) technology by Australian environmental engineering and green energy authority CST Wastewater solutions is the first GWE COHRAL(TM)installation in the world, deploying for the first time in a covered lagoon GWE anaerobic technology proven in more than 300 reactor (tank) installations worldwide.]

Fleischverarbeitung|FestoDeutschland - festo.com Dec 2
[Meattechnology - german equipment etc Contact Germany Festo is a worldwide leader in automation technology and the global leader in technical education and training. The goal: to maximize productivity and competitiveness of customers in factory and process automation. Festo AG & Co. KG 0711/347 - 0 Festo sales Germany 0711/347 - 1111]

JBSOpensModernBeefDistributionCenter... - jbsglobal.com Dec 2
[Meattechnology - Retrotech automation with additional sortation lanes and high-

speed palletizers will be installed in February 2014, streamlining the plant's ability to seamlessly deliver products to customers worldwide.]

IndustrialAutomationCompanies-Robotics... - roboticsbusinessreview.com Dec 30
[Meattechnology]

Annualreporting|Meat&LivestockAustralia - mla.com.au - Dec 7
[Meattechnology - 3.2 Identify and deliver opportunities to increase off-farm productivity and capability Working in partnership with the Australian Meat Processor Corporation (AMPC), individual processors and technology providers, MLA manages an R&D portfolio to improve processing efficiencies, addressing labour availability and OH&S, and increase innovation and capability. Strategies under this objective include: 3.2.1 Develop new technologies and systems that improve productivity and processing efficiencies 3.2.2 Assist processing sector to improve work health and safety 3.2.3 Develop new systems to support processing decision-making 3.2.4 Improve industry capability, knowledge and adoption of new technologies to increase productivity MLA invested $1.8 million in this area during 2013-14 including $0.9 million of processor contributions and $0.9 million of government funds. An additional $10.8 million was invested through the MDC. No producer levies were invested in this area with funding mainly from processor and private funds matched by government funding. These investments enabled collaborations that developed cost effective automation and manual assist technologies, and novel objective measurement systems. Key milestone Result Realise net benefits of $1.0 million per annum from processing technologies developed under this program and for which installation is completed in 2013-14 Achieved LEAP III and LEAP IV systems installed with estimated net benefit of between $1.6 million and $11.9 million Total aggregated net benefit of technologies installed both in 2013-14 and previous years reaches $6 million per annum Achieved An independent evaluation estimated a projected net benefits averaging $7.9 million per annum at 2012 present value Demonstrate in production a new technology capable of eliminating and/or reducing occupational health and safety risks Achieved 25 BladeStop technologies now installed and first beef deloining saw in production use Five off-farm pre commercial]

ResearchManagementSystems - rmsusa.com - Nov 30
[Meattechnology]

Onlineinteractivelabeltool - meatmessaging.com Dec 21
[Meattechnology - Des Bowler]

CarometecFoodTechnologyA/S-News... - carometec.com - Nov 15
[Meattechnology]

FAO/OECD:globalbiofuel-GoogleSearch - google.com - Dec 18
[Meattechnology]

Roboticsformeatprocessing–from... - emeraldinsight.com - Nov 9
[Meattechnology - Abstract: Over the last five years we have successfully researched, designed, developed and commercialised the world’s first lamb and sheep dressing

robots. Two have already been sold to commercial concerns. This has caused a paradigm shift in the way automation in meat processing can be viewed. In this paper we describe the lessons we have learned in robotic automation via projects in Y-cutting, ripdown, brisket clearing, opening cuts, handling of primal cuts and packing bagged meat pieces for lamb and sheep meat. All of these projects have been, or are about to be, trialed in operating plants processing export quality meat. These projects have involved the development of a programmable robot suitable for washdown environments, and of tooling to conduct specific dressing and handling tasks. Latest projects are applying this approach to automating certain beef processing tasks, and a beef processing robot has been constructed and is being installed for trials in an operating plant. The technology behind the robots is described and illustrated in our paper. Also described are the methods we used to ensure commercialisation was an economic success.]

ARCHomePage-AustralianResearchCouncil... - arc.gov.au - Jan 5
[Meattechnology]

SCHUNKGmbH&Co.KG - schunk.com - Jan 2
[Meattechnology - http://www.us.schunk.com
http://www.schunk.com/index_select_your_country2.html?r=1]

VzfSüdGmbH-SchweineZuchtVermarktung - vzf-sued.de - Nov 25
[Meattechnology]

KUKAIndustrialRobots-Applicationsoftware - kuka-robotics.com [Meattechnology - Dec 30
KUKA.FlexPal Editor / KUKA.FlexPal RT KUKA.FlexPal Editor is the configuration tool for your palletizing and de-palletizing tasks. With the Editor you can define the packages, pallets, gripper, slip sheets, layers and stack plans. It includes some additional function e.g. for the working area, move-out and approach definition. KUKA.FlexPal RT is KUKA Technology Software (KTS) for the KR C4 and is required for the easy configuration and commissioning for the palletizing and de-palletizing tasks on the controller side.]

Category:Manufacturing-P2PFoundation - p2pfoundation.net - Dec 3
[Meattechnology -]

MVTecHALCON - halcon.com Dec 7
[Meattechnology - vision systems used with hock cutter JBS Dinmore]

EPCglobal|Products&Solutions|GS1... - gs1.org - Nov 25
[Meattechnology]

Standorte - vionfood.de Dec 2
[Meattechnology]

VerticalPlateFreezers-AdvancedFreezers... - advancedfreezers.nl Dec 14
[Meattechnology]

MPSmeatprocessingsystems-MPSGroup - mps-group.nl Dec 2
[Meattechnology]

Areviewofthedevelopmentanduseof... - nih.gov Nov 30

[Meattechnology]

English-WeissRoboticsGmbH&Co.KG - weiss-robotics.de Jan 2
[Meattechnology - USA]

pelting|FoodEquipmentAustralia - fea.net.au Nov 24
[Meattechnology]

PatentUS5279518-Peltpullerapparatus... - google.com Nov 9
[Meattechnology - Abstract A pelt puller apparatus and method utilizing hydraulic power means for stripping a pelt from an animal carcass suspended by both fore and hind legs in an upside down cradle position. The pelt puller apparatus includes a puller assembly and a kick bar assembly. The puller assembly is generally defined as an L- shaped frame structure and includes a pair of hydraulically operated clamp assemblies for holding the worked up sock portions of the animal pelt. The vertical frame portion of the L-shape framework includes a pair of telescopingly adjustable frame members and a hydraulic power means for providing vertical height adjustment of the clamp assemblies with respect to the animal carcass. The puller assembly framework is connected to an overhead rail system via a wheeled carriage assembly and includes hydraulic power means for providing fore/aft (push/pull) movement to the puller assembly. The kick bar assembly includes a kick bar member and hydraulic power means operative to move the kick bar member between a first, neutral position and a second, extended position. Movement of the kick bar member into the second, extended position provides to the animal's suspended fore legs tension which is opposed by the pull direction of the fore/aft hydraulic power such that removal of the pelt, especially in the delicate shoulder region, is facilitated without damage to carcass or damaging strain to the pelt]

GermanMeat-GermanSuppliers - german-meat.org Nov 8
[Meattechnology]

Robotscutlettucelabourissues-Robotics - fanucrobotics.de Nov 30
[Meattechnology]

AutomaticBagLoader–PackagingEquipment... - cryovac.com Dec 14
[Meattechnology]

ResearchManagementSystems - rmsusa.com Nov 30
[Meattechnology]

NTF-NewTechnologyFoundation-公益財団... - ntf.or.jp Jan 2
[Meattechnology]

cattlecouncil.com.au - cattlecouncil.com.au Nov 15
[Meattechnology]

SchoolofMechanicalandManufacturing... - unsw.edu.au Jan 2
[Meattechnology]

DLR-InstituteofRoboticsandMechatronics... - dlr.de Dec 30
[Meattechnology]

DrDavidRutley|TheUniversityofAdelaide... - adelaide.edu.au Nov 25

[Meattechnology]

Home>ConceptSystemsIncorporated - conceptsystems.com Jan 11
[Meattechnology]

MFIAG-LudwigsburgBenningenArnstadt... - mfi-lb.de Nov 30
[Meattechnology]

ExhibitorDirectory|AUSPACK2015 - auspack.com.au Nov 25
[Meattechnology]

WelcometotheInternationalProduction... - ippexpo.com Nov 25
[Meattechnology]

AutomatedMaterialHandlingOrderFulfillment... - kivasystems.com Dec 2
[Meattechnology]

ProtraceSolutionsInc.-CreatorsofPromptU - protracesolutions.com Dec 14
[Meattechnology]

RockwellAutomationCiscoSystemsStrategic... - rockwellautomation.com Nov 30
[Meattechnology]

TheCATscansearchfortheperfectlamb... - crca.asn.au Nov 15
[Meattechnology]

Finalreportdetails|Meat&Livestock... - mla.com.au Dec 7
[Meattechnology - Outcomes Scott Technology have successfully developed the chining module, and integrated this with the LEAP IV system. A standalone unit is currently under development. Project A.TEC.0104 compared the Scott system with other chining technology options.]

YartooSoftware-CustomAbattoirSoftware - yartoo.com.au Dec 14
[Meattechnology]

Symbotic|IntelligentAutomatedWarehouse... - symbotic.com Jan 2
[Meattechnology - re invent the warehouse]

ResearchManagementSystems - rmsusa.com Nov 30
[Meattechnology]

PatentUS20140035730-Methodforelectronic... - google.com Nov 25
[Meattechnology]

SüdfleischGroup - t1n.org Dec 2
[Meattechnology - Südfleisch GmbH is a wholly-owned subsidiary company of Südfleisch Holding GmbH and with 7 slaughter and carcass-cutting plants operates the fundamental part of the operative slaughter, carcass-cutting and meat trading business of the Südfleisch Group. Südost Fleisch GmbH in Altenburg is a subsidiary of Südfleisch Holding GmbH and in partnership with the producers of the Thuringian region operates one of the most modern slaughter and carcass-cutting plants in Germany. www.suedostfleisch.de Atlas in Minden is a wholly-owned subsidiary of Südfleisch Holding GmbH and operates an pig abbattoir.In addition Atlas runs a slaughter and

livestock business for cattle and pigs. www.atlas-minden.]

Agricultureexpertsappointedtodeliver... - nsw.gov.au Nov 15
[Meattechnology]

Automation&RoboticSolutionsforthe... - machineryautomation.com.au Nov 19
[Meattechnology]

Food-Industrie--Processesandpackaging... - interpack.de Dec 3
[Meattechnology]

Omron,Cyberdynejoinforcesonfactory... - asahi.com Jan 2
[Meattechnology - Omron Corp. will provide motion-detecting sensors for Cyberdyne Inc.'s robotic products, including wearable devices that allow users to emulate the movements of skilled workers at factories and construction sites, the companies said Dec. 24. The sensors can record actions that are more sophisticated than the motions that are currently available using Cyberdyne's robotic power assist device series, called Hybrid Assistive Limb (HAL).]

RetrotechcompletesCargillautomation... - retrotech.com Dec 2
[Meattechnology]

MLAblog|Meat&LivestockAustralia - mla.com.au Nov 15
[Meattechnology]

Automaticretrievalsystems - mhi.org Dec 2
[Meattechnology]

Home-IMIplc - imiplc.com Dec 28
[Meattechnology]

TD2014/19-Incometax:whatarethe... - ato.gov.au Nov 16
[Meattechnology]

JarvisProductsCorpHome - jarvisproducts.com Nov 6
[Meattechnology]

RoboticPackagingSolutions|Processing... - processingmagazine.com Dec 2
[Meattechnology]

VDF-VerbandderFleischwirtschafte.V.... - v-d-f.de Dec 2
[Meattechnology - Address Association of Meat Industry Association Adenauer Allee 118 53113 Bonn Tel .: +49 (0) 228-9 14 24 0 Fax: +49 (0) 228-9 14 24 24 E-mail: info@vdf.de]

NewBladeStopGloveCheckRevolutionary... - machineryautomation.com.au Nov 10
[Meattechnology]

AmericanSensoRx,Inc.,AdvancedPackaging,... - americansensorx.com Dec 28
[Meattechnology]

ITAL-InstitutodeTecnologiadeAlimentos - sp.gov.br Dec 2
[Meattechnology]

holac|SchneidetechnikfürNahrungsmittel - holac.de Dec 14
[Meattechnology - holac Maschinenbau GmbH Nattheimer Straße 104 89520

Heidenheim Telephone+49 7321/9645 -0 Fax+49 7321/9645 -50 E-Mailinfo@holac.de Managing Director Achim Holz Telephone+49 7321/9645 -0 E-Mailholz@holac.de Sales Director Thomas Blümel Telephone+49 (0)7321 9645-19 E-Mailbluemel@holac.d]

GlobalWaterEngineering - globalwaterengineering.com Dec 17

[Meattechnology - GWE RAPTOR™ waste-to-energy technology wins IChemE Energy Award. Worldwide wastewater treatment and green energy authority Global Water Engineering (GWE) has won a major international chemical engineering award for its process by which it transforms food processing sludge waste from an environmental problem into profitable green energy. GWE Chairman and CEO Mr Jean Pierre Ombregt accepted the IChemE Energy Award from the Institute of Chemical Engineers (IChemE), which represents more than 40,000 chemical engineers worldwide and which staged the 2014 awards in the UK this month this month to recognise and reward chemical engineering innovation and excellence. The IChemE Energy Award – sponsored by PM Group – recognises the best project or process to demonstrate innovation in renewable energy, alternative energy sources, efficient energy use or the development of energy production methods that reduce energy and water intensity. GWE's entry involved a world first with Chok Chai Starch in Thailand, where a GWE RAPTOR™ system is used to convert wet pulp waste product from the processing of cassava roots into biogas (methane) green energy, at their tapioca starch plant in Uthai Thani.]

CYBERDYNE - cyberdyne.jp Jan 2

[Meattechnology - CYBERDYNE Inc. is a venture firm which is established by Dr. Yoshiyuki Sankai, University of Tsukuba, Japan, in order to materialize his idea to utilize Robot Suit HAL® for the benefits of humankind in the field of medicine, caregiving, welfare, labor, heavy works, entertainment and so on. Robot Suit HAL® was developed with the technologies created in Sankai Laboratory of Tsukuba University as an application of "Cybernics*" advocated by Prof. Sankai. *Cybernics is a new domain of interdisciplinary research centered on cybernetics, mechatronics, and informatics, and integrates neuroscience, robotics, systems engineering, information technology, "kansei" engineering, ergonomics, physiology, social science, law, ethics, management, economics etc.]

PatentUS5279518-Peltpullerapparatus... - google.com Nov 9

[Meattechnology - Abstract A pelt puller apparatus and method utilizing hydraulic power means for stripping a pelt from an animal carcass suspended by both fore and hind legs in an upside down cradle position. The pelt puller apparatus includes a puller assembly and a kick bar assembly. The puller assembly is generally defined as an L- shaped frame structure and includes a pair of hydraulically operated clamp assemblies for holding the worked up sock portions of the animal pelt. The vertical frame portion of the L-shape framework includes a pair of telescopingly adjustable frame members and a hydraulic power means for providing vertical height adjustment of the clamp assemblies with respect to the animal carcass. The puller assembly framework is connected to an overhead rail system via a wheeled carriage assembly and includes hydraulic power means for providing fore/aft (push/pull) movement to the puller assembly. The kick bar

assembly includes a kick bar member and hydraulic power means operative to move the kick bar member between a first, neutral position and a second, extended position. Movement of the kick bar member into the second, extended position provides to the animal's suspended fore legs tension which is opposed by the pull direction of the fore/aft hydraulic power such that removal of the pelt, especially in the delicate shoulder region, is facilitated without damage to carcass or damaging strain to the pelt]

MAJA-yourpartnerforflakeicemachines... - maja.de Nov 30
[Meattechnology]

ResearchManagementSystems - rmsusa.com Nov 30
[Meattechnology]

AmericanMeatInstitute - meatami.com Nov 21
[Meattechnology

PatentWO2014036547A1-Carcassstabilizer... - google.com Nov 25
[Meattechnology]

WelcometotheInternationalProduction... - ippexpo.com Nov 25
[Meattechnology]

WelcometoICARCV2014 - icarcv.org Jan 2
[Meattechnology]

CarometecFoodTechnologyA/S-News... - carometec.com Nov 15
[Meattechnology]

Technologydramaticallyimprovesbandsaw... - beefcentral.com Dec 7
[Meattechnology - said Chris Ruberg, MLA’s program manager off-farm processing efficiency. Ongoing trials have been taking place at three large processing sites along Eastern Australia – Gundagai Meat Processing and Northern Cooperative Meat Co, Casino (NSW) and Australian Country Choice, Cannon Hill (Qld). ACC has since elected to install ten of the units across its Cannon Hill operations. MLA’s client innovation services general manager, Christine Pitt, said given the nature of the equipment (and the obvious consequences of failure), it was important to be ‘absolutely sure’ that it was going to be able to perform up to expectations in the commercial environment, before release to the market. That was a key reason why it was agreed to install the prototype machines into an additional seven plants, under a final trial through the MLA Donor Company]

CSB-Automation - csb-automation.com Nov 30
[Meattechnology]

Automaticretrievalsystems - mhi.org Dec 2
[Meattechnology]

CompanyPresentation-Foodmate|Poultry... - foodmate.nl Nov 9
[Meattechnology - food mate, largely poultry]

CedarCreekCompany - cedarcc.com Nov 30
[Meattechnology]

Online-CatalogueRobotHandKitEOAT - ass-automation.com Dec 2
[Meattechnology - vision for end of arm in robotics]

HowardGardner|FiveMindsfortheFuture - howardgardner.com Jan 15
[Meattechnology]

ARAA|ThisisthesiteoftheAustralian... - araa.asn.au Jan 2
[Meattechnology]

Home|MAYEKAWAGlobal(MYCOM) - mayekawa.com Dec 14
[Meattechnology - The Japanese company MYCOM have developed an automatic line system with the ability to remove bones from Pork legs at a rate of up to 500 per hour. They also have a line to remove the bones from forequarters]

UsedFoodProcessingEquipmentandMachinery... - mmequip.com Dec 14
[Meattechnology]

automaticunloadingofhalf-carcasses|Vemac - vemacautomazioni.it Nov 30
[Meattechnology]

PatentWO2001067211A2-Aprocessfor... - google.com Nov 15
[Meattechnology]

Symbotic|IntelligentAutomatedWarehouse... - symbotic.com Jan 2
[Meattechnology - re invent the warehouse]

Onlineinteractivelabeltool - meatmessaging.com Dec 21
[Meattechnology - Des Bowler]

IEEE-Theworld'slargestprofessional... - ieee.org Nov 30
[Meattechnology]

PatentCA2706407A1-Automatedmeatbreaking... - google.com Nov 9
[Meattechnology - Abstract An automated system and method for breaking a primal cut of meat into smaller components includes a conveyor for advancing the primal cut from a first end of the system to a second end of the system, at least one automated cutting assembly for performing a first cut and a second cut to separate the primal cut into three sub-components, and a guide for orienting the primal cut on the conveyor. In some embodiments, the guide is configured to align with a spinal groove in the primal cut. In some embodiments, the at least one automated cutting assembly includes a first automated cutting assembly for performing the first cut and a second automated cutting assembly for performing the second cut.]

SCHUNKGmbH&Co.KG - schunk.com Jan 2
[Meattechnology - Australian outfit http://www.us.schunk.com http://www.schunk.com/index_select_your_country2.html?r=1]

PatentUS20140097941-FoodSourceInformatio... - google.com Nov 25
[Meattechnology]

ARAA|ThisisthesiteoftheAustralian... - araa.asn.au Jan 2
[Meattechnology]

Onlineinteractivelabeltool - meatmessaging.com Dec 21
[Meattechnology - Des Bowler]

AutomatedMaterialHandlingOrderFulfillment... - kivasystems.com Dec 2
[Meattechnology]

Products-IFRInternationalFederation... - ifr.org Jan 2
[Meattechnology]

TD2014/19-Incometax:whatarethe... - ato.gov.au Nov 16
[Meattechnology]

Category:Manufacturing-P2PFoundation - p2pfoundation.net Dec 3
[Meattechnology - Stephen Kelly idea maybe. It is peer to peer and open source.]

RetrotechcompletesCargillautomation... - retrotech.com Dec 2
[Meattechnology]

JBSOpensModernBeefDistributionCenter... - jbsglobal.com Dec 2
[Meattechnology - Retrotech automation with additional sortation lanes and high-speed palletizers will be installed in February 2014, streamlining the plant's ability to seamlessly deliver products to customers worldwide.]

Increasingproductivityacrossthesupply... - mla.com.au Dec 7
[Meattechnology - .2 Increasing productivity off-farm Working in partnership with the Australian Meat Processor Corporation, individual processors and technology providers, MLA manages an R&D portfolio to improve processing efficiencies, addressing labour availability and OH&S and reducing consumption of water and electricity. In 2011-12, MLA invested $1 million in this area including no producer levy funds, $0.5 million in government funds and $0.5 in processor contributions. This was 64.9% under the $2.9 million budget. A further $5.3 million was invested through the MLA Donor Company. It enabled collaborations that developed cost effective automation and manual assist technologies, and novel objective measurement systems. Key milestone achievement Realise net benefits of $1 million per annum from processing technologies developed under this program and installed during 2011-12 Achieved – net benefit of $1 million per annum achieved through four technologies Total aggregated net benefit of technologies installed during 2011-12 and previous years reaches $3 million per annum Achieved – total aggregated net benefits of $4 million from 11 technologies Demonstrate in production at least two new technologies/systems capable of improving cost of production and yield to increase net worth of the carcase by $1/ head in sheep and/or beef Achieved – four technologies in production increase net worth of carcase by more than $1 per head Develop technologies and systems capable of eliminating and/or reducing OH&S risks Achieved – four technologies capable of reducing OHS risks Demonstrate in production at least two new technologies that have a main OHS-related benefit Achieved – four technologies developed with main OHS benefit Program highlights MLA completed four research projects into spray chilling, an innovative

method of chilling beef and lamb carcases that significantly reduces shrinking during the typical overnight chilling regime. A pilot trial conducted at two processing companies found s]

News/Events/PressUniofOldenburg - uni-oldenburg.de Jan 2
[Meattechnology - robotics group]

MVTecHALCON - halcon.com Dec 7
[Meattechnology - vision systems used with hock cutter JBS Dinmore]

NewWaveofDeftRobotsIsChangingGlobal... - nytimes.com Jan 2
[Meattechnology - Very good, pictures, studies. Excellent. print this one.]

InstituteforSupplyChainandLogistics... - vu.edu.au Jan 5
[Meattechnology]

Technologydramaticallyimprovesbandsaw... - beefcentral.com Dec 7
[Meattechnology - said Chris Ruberg, MLA's program manager off-farm processing efficiency. Ongoing trials have been taking place at three large processing sites along Eastern Australia – Gundagai Meat Processing and Northern Cooperative Meat Co, Casino (NSW) and Australian Country Choice, Cannon Hill (Qld). ACC has since elected to install ten of the units across its Cannon Hill operations. MLA's client innovation services general manager, Christine Pitt, said given the nature of the equipment (and the obvious consequences of failure), it was important to be 'absolutely sure' that it was going to be able to perform up to expectations in the commercial environment, before release to the market. That was a key reason why it was agreed to install the prototype machines into an additional seven plants, under a final trial through the MLA Donor Company]

Cargillinvests$48Minnewautomation... - bizjournals.com Dec 2
[Meattechnology]

PatentUS8779903-UtilizinganRFID... - google.com Nov 25
[Meattechnology - IBM]

NAWIhasmergedwithSFKLEBLANC - nawi.nl Dec 14
[Meattechnology]

Australia-Contacts-SCOTT®TechnologyLtd. - scott.co.nz Nov 15
[Meattechnology]

Finalreportdetails|Meat&Livestock... - mla.com.au Dec 7
[Meattechnology - Beef hock cutter robotic system Outcomes Although significant challenges were faced, the project has thus proven that it is possible to successfully automate the task of beef hock cutting. The system is commercially availble from MAR, and is best suited to large throughput two shift processors given that the main saving is labour and OH&S costs, rather than yield benefits (see the CBA in project P.PSH.0579). Contract No. Title Start date End date Funding type A.TEC.0078 Operator Controlled Beef Shackling System 25/09/2010 18/08/2011 Industry P.PIP.0164 Robotic Beef Hock Cutting 15/12/2007 04/11/2010 MDC PIP P.PSH.0284 Beef Hock Cutting On Site Sensing Trials 02/05/2007 30/06/2007 MDC PSH P.PSH.0579 Cost benefit analysis for MAR

automation systems 20/11/2010 25/02/2014 MDC PSH P.PSH.0661 MAR010545Q1 - Beef Hock Cutter Upgrade JBS Dinmore 01/06/2013 01/03/2014 MDC PSH This needs some group discussion regards Theo Uhrle Engineering Manager JBS Australia Pty Ltd – Dinmore Processing Plant 2 Lock Way, Riverview Qld 4303 T: +61 7 3810 2191 | F: 3816 0415 E: theo.uhrle@jbssa.com.au W: www.jbssa.com.au]

AboutUs|MAYEKAWAGlobal(MYCOM) - mayekawa.com Dec 17

[Meattechnology - For example in the food market, by synthesizing Mayekawa's expertise in freezing technology with the customers' existing food production process, we are now developing new food processing technologies together with customers to dramatically improve flavors, tastes, colors, and smells of the final products. Another example in the food market is robotics. Mayekawa has been developing robotic equipment for deboning chicken, pork, and beef along with harvesting-robots for strawberries and tomatoes that enhance productivity and working conditions significantly.]

TeknologiskInstitut - teknologisk.dk Nov 9

[Meattechnology]

MULTIVAC-PackagingSystems - multivac.com Dec 14

[Meattechnology]

Finalreportdetails|Meat&Livestock... - mla.com.au Dec 7

[Meattechnology - Dual SaniVac (Front/Rear) Background The dressing of lamb carcases is a repetitive, physically demanding task, with the added challenge of maintaining extremely high levels of hygiene. The nature of livestock means that great care and discipline needs to be applied for long periods in order to achieve the high standard of dressing performance demanded. A number of potential carcase contaminants have a zero tolerance in domestic and export markets. The automated sani-vac or vacuum sanitisation is a process of running a hot steam vacuum wand over the carcase surface with the aid of robot automation. The benefit to the supply chain is significantly improved reliability of steam sanitisation coverage, reduced bacterial counts, improved shelf life, reduced risk of zero tolerance incidents being encountered, and a contribution to labour supply sustainability. Research & Facilitated Adoption <Content to be added> Outcomes & Adoption <Content to be added> Under project P.PSH.0579, an enterprise level value proposition and cost/benefit analysis (CBA) model was funded, based on an in plant SaniVac system. Contract No. Title Start date End date Funding type P.PIP.0159 Robotic Front Vac San 01/05/2007 30/09/2008 MDC PIP P.PIP.0206 Foreleg, Brisket & Neck Dual Robot Sani Vac System 20/04/2009 30/06/2012 MDC PIP P.PIP.0211 Castricum forequarter Robotic Vac San System 01/05/2009 25/10/2010 MDC PIP P.PSH.0280 Robotic Rear Vac San 01/05/2007 21/05/2009 MDC PSH P.PSH.0468 PVE Robot System(s) 1yr Technology Support & Training 15/10/2009 30/06/2011 MDC PSH P.PSH.0474 MAR & MLA Automated Sani Vac & Brisket Cutter Market Readiness 08/04/2009 01/12/2009 MDC PSH P.PSH.0486 PVE Robot Systems Hardware Upgrade 08/04/2009 27/08/2009 MDC PSH P.PSH.0543 MAR 9520Q2 - Neck

Vac San Trial 02/11/2009 25/01/2010 MDC PSH P.PSH.0579 Cost benefit analysis for MAR automation systems 20/11/2010 25/02/2014 MDC PSH P.PSH.0597 9595Q1 – PVE Safety Guarding Upgra]

ExhibitorDirectory|AUSPACK2015 - auspack.com.au Nov 25
[Meattechnology]

DARstockquote-DarlingIngredients... - nasdaq.com Dec 18
[Meattechnology - NASDAQ on Darling Ingredients $19 share. mega outfit in recycling sector.]

CarometecFoodTechnologyA/S-Carometec... - carometec.com Nov 15
[Meattechnology]

Cargill:NewsCenter-NewsReleases... - cargill.com Dec 2
[Meattechnology]

DEPI-SheepNotesNewsletters - depi.vic.gov.au Nov 25
[Meattechnology]

NewBladeStopGloveCheckRevolutionary... - machineryautomation.com.au - Nov 10
Edit Remove
[Meattechnology]

–TheEmergenceofOpenDesignand... - we-magazine.net Dec 3
[Meattechnology]

Kentmaster-CarcassCuttingTools - kentmaster.com Jan 10
[Meattechnology - Tripe washers, Automatic. 2]

RethinkRobotics|AdvancedRobotics... - rethinkrobotics.com Jan 2
[Meattechnology - http://www.rethinkrobotics.com/investors/ Bezos Expeditions Bezos Expeditions is the personal investment company of Jeff Bezos, founder and CEO of Amazon.com. Bezos Expeditions has supported a wide range of innovative and successful technologies and companies in addition to Rethink Robotics, including MakerBot, Twitter, Uber, Business Insider, Basecamp, MFG.com and more. Charles River Ventures Founded in 1970, Charles River Ventures (CRV) is one of the oldest and most successful venture capital firms. Companies like Cascade, CIENA, Chipcom, NetGenesis, Parametric Technology, Sonus, Speechworks, Stratus Computer, Sybase, Vignette and dozens more have gone from idea to reality with the financial, managerial and visionary backing of CRV. The firm's investment returns are consistently among the highest of venture capital firms, giving it one of the best track records in the industry. Charles River Ventures takes a value-added approach to early-stage investing, providing entrepreneurs with access to more than just financial backing. Through combined access to financial capital, the right people and the right resources, CRV helps talented entrepreneurs turn innovative ideas into the category-leading companies. Highland Capital Partners Highland Capital Partners was founded with the mission of helping great people build great companies. Since its inception in 1988, the firm has taken a sector-focused approach to investing in exceptional communications, consumer, digital media, health care and information technology companies. With more than $3 billion of

committed capital and offices in Boston, Silicon Valley, Shanghai and Geneva, Highland has invested in and worked to create such firms as Ask Jeeves, Avid Technology, CheckFree, Conor Medsystems, Continental Cable, lululemon athletica, Lycos, MapQuest, Navic Networks, Ocular Networks, P.A. Semi, Quigo, Starent Networks, Sybase, Telica and VistaPrint. Sigma Partners Sigma Partners was founded in 1984 on the principle that people are the essential e]

Hitthebullseye|Meat&LivestockAustralia - mla.com.au Nov 15
[Meattechnology]

Fleischverarbeitung|FestoDeutschland - festo.com Dec 2
[Meattechnology - german equipment etc Contact Germany Festo is a worldwide leader in automation technology and the global leader in technical education and training. The goal: to maximize productivity and competitiveness of customers in factory and process automation. Festo AG & Co. KG 0711/347 - 0 Festo sales Germany 0711/347 - 1111]

Ollari&Conti|WelcomePage - ollarieconti.it Dec 14
[Meattechnology]

FoodEquipmentAustralia,AbattoirSlaughteri... - fea.net.au Nov 24
[Meattechnology]

SchoolofMechanicalandManufacturing... - unsw.edu.au Jan 2
[Meattechnology]

PatentUS20140097941-FoodSourceInformatio... - google.com Nov 25
[Meattechnology]

Americoldupgradesautomationsystem|viastore - viastore.com Dec 2
[Meattechnology]

Fial-FoodInnovationAustraliaLtd... - fial.com.au Jan 5
[Meattechnology]

Finalreportdetails|Meat&Livestock... - mla.com.au Dec 7
[Meattechnology - Dual SaniVac (Front/Rear) Background The dressing of lamb carcases is a repetitive, physically demanding task, with the added challenge of maintaining extremely high levels of hygiene. The nature of livestock means that great care and discipline needs to be applied for long periods in order to achieve the high standard of dressing performance demanded. A number of potential carcase contaminants have a zero tolerance in domestic and export markets. The automated sani-vac or vacuum sanitisation is a process of running a hot steam vacuum wand over the carcase surface with the aid of robot automation. The benefit to the supply chain is significantly improved reliability of steam sanitisation coverage, reduced bacterial counts, improved shelf life, reduced risk of zero tolerance incidents being encountered, and a contribution to labour supply sustainability. Research & Facilitated Adoption <Content to be added> Outcomes & Adoption <Content to be added> Under project P.PSH.0579, an enterprise level value proposition and cost/benefit analysis (CBA) model was funded, based on an in plant SaniVac system. Contract No. Title Start date End date Funding type P.PIP.0159

Robotic Front Vac San 01/05/2007 30/09/2008 MDC PIP P.PIP.0206 Foreleg, Brisket & Neck Dual Robot Sani Vac System 20/04/2009 30/06/2012 MDC PIP P.PIP.0211 Castricum forequarter Robotic Vac San System 01/05/2009 25/10/2010 MDC PIP P.PSH.0280 Robotic Rear Vac San 01/05/2007 21/05/2009 MDC PSH P.PSH.0468 PVE Robot System(s) 1yr Technology Support & Training 15/10/2009 30/06/2011 MDC PSH P.PSH.0474 MAR & MLA Automated Sani Vac & Brisket Cutter Market Readiness 08/04/2009 01/12/2009 MDC PSH P.PSH.0486 PVE Robot Systems Hardware Upgrade 08/04/2009 27/08/2009 MDC PSH P.PSH.0543 MAR 9520Q2 - Neck Vac San Trial 02/11/2009 25/01/2010 MDC PSH P.PSH.0579 Cost benefit analysis for MAR automation systems 20/11/2010 25/02/2014 MDC PSH P.PSH.0597 9595Q1 – PVE Safety Guarding Upgra]

alexballMLA.com.au-GoogleSearch - google.com.au Nov 15
[Meattechnology]

VDF-VerbandderFleischwirtschafte.V./Home - v-d-f.de Dec 2
[Meattechnology - german meat association The association of the meat industry as leading organization representing the interests of the meat industry companies from almost all areas of livestock and meat sector. The Association represents the company in the acquisition cattle, slaughter, meat cutting and processing through to meat packaging for the consumer, at the wholesale level and the import and export of livestock and meat. In the more than 200 member companies account for more than 90% of all animals slaughtered in Germany and nearly all of the import and export of our sector is handled by member companies. In total, approximately 406,000 people are employed in the livestock and meat in the food industry sector, the largest part in the Meat Industry. Can you ignored the craft and the processing industry, which accounts for the field of slaughter, cutting and wholesale and foreign trade in livestock and meat than 100,000 jobs. The VDF can look back 90 years of association history: In its present form, the Association for the 1 January 2001. He is (founded GAVF 1924) by the merger of the Federation of German Wholesale and Foreign Trade in Livestock and Meat Association and the Federation of shipping slaughterhouses eV (BdV, founded in 1953) emerged. With the merger, the members of the two predecessor organizations to join forces in the meat industry and thus for a strong, focused advocacy decided. In order to protect the interests of our members, we constantly have a variety of compounds, inter alia, in Brussels, Bonn and Berlin. As an intermediary between business and government, we are committed to both public statements and in direct contacts for the interests of our members in all industry sectors concerned. Detailed Performance Overview The Association]

IndustrialAutomationCompanies-Robotics... - roboticsbusinessreview.com - Dec 30
[Meattechnology]

Kiva'swarehouseautomationsystem... - kivasystems.com Dec 2
[Meattechnology - A new vision systems enables the unloading and receipt of an entire trailer of inventory in as little as 30 minutes instead of hours; and new, high-end

graphically oriented computer systems for employees to use while fulfilling orders for customers.]

Robotik&Handhabung-Automationspraxis... - automationspraxis.de Nov 30
[Meattechnology]

NAWIhasmergedwithSFKLEBLANC - nawi.nl Dec 14
[Meattechnology]

News/Events/PressUniofOldenburg - uni-oldenburg.de Jan 2
[Meattechnology - robotics group]

CargilltoinstallnewautomateddistributionSystem... - processingmagazine.com Dec 2
[Meattechnology]

IntroductionDESBOWLERETRAININGGS1 - u-etrain.com Dec 21
[Meattechnology - Nice little online tool]

ExcelBeefAutomatedDistributionSystem... - cisco-eagle.com Dec 2
[Meattechnology]

InternationalFoodTechnology,Additives... - tecnofidta.com Nov 15
[Meattechnology]

LUCEOInspectionWorldwideInspection... - luceo-inspection.com Dec 14
[Meattechnology - Luceo Inspection Worldwide ZART des Perrières 35772 Vern sur Seiche France Tel. : +33 2 99 62 86 11 Fax: +33 2 99 62 72 38]

CSTWastewaterSolutions,WaterTreatment,... - cstwastewater.com Dec 14
[Meattechnology - GWE]

Sydney:NorthRyde,NSW(CSIRONorth... - www.csiro.au Jan 5
[Meattechnology]

TMRobotics(Europe)Ltd.Industrial... - tmrobotics.co.uk Nov 30
[Meattechnology]

PatentWO2011074969A2-Systemandmethod... - google.com Nov 9
[Meattechnology - Marel Abstract The invention pertains to a system for processing a carcass or carcass part of a porcine, bovine, ovine, or caprine slaughter animal, which processing involves a plurality of processing steps, which system comprises: -a primary transport system, which primary transport system comprises: -an overhead conveyor (951), which overhead conveyor comprises a track and a plurality of trolleys, which trolleys are movable along said track, -a plurality of carriers for holding a carcass or carcass part, each of the carriers being connected to one or more trolleys, -a plurality of processing stations (902, 903, 905), which processing stations are arranged along the track, each of the processing stations being adapted to carry out one or more processing steps on a carcass or carcass part, wherein in at least one processing station a step of removing a part of the carcass or carcass part is carried out, -a secondary transport system (911), which secondary transport system is arranged adjacent to the processing station in which said part is removed from the carcass or carcass part, which secondary transport system is adapted to receive said part.]

Scott-AutomatedLambBoningSystem... - youtube.com Nov 9
[Meattechnology - Uploaded on Nov 13, 2011 Scott Meat Processing fully automated lamb boning system in operation at Silver Fern Farms Finegand, New Zealand. The video demonstrates all modules in operation:X-Ray System, Primal System, Forequarter System, Middle System and Hindquarter System. For more information visit: www.scott.co.nz Innovation in Agriculture & Environment Sponsored by Bayer New Zealand HIGHLY COMMENDED: Gallagher Group Ltd with Ring Top Post WINNER: Scott Technology Ltd with the Automated Lamb Boning Room In 2002 Otago-based Scott Technology had a vision to fully automate the lamb boning process. Now the vision has become a reality with a unique x-ray system that automatically scans a carcass and separates it according to the x-ray data. The equipment identifies the features in every product and adjusts cutting parameters appropriately, reducing bacteria and required labour. The Evaluators noted that this was a great example of fulfilling a real industry need. It benefits the NZ economy both through improved productivity and proven export sales and the whole system is grounded in the innovative application of technology.]

RetrotechcompletesCargillautomation... - retrotech.com Dec 2
[Meattechnology]

TheCATscansearchfortheperfectlamb... - crca.asn.au Nov 15
[Meattechnology]

MartinCole:nonthermalfoodprocessing... - www.csiro.au Dec 16
[Meattechnology]

AttecFoodTechnology - attec.dk Dec 14
[Meattechnology]

InvestorRelations|Marel - marel.com Dec 28
[Meattechnology]

Lambprocessorsyieldingefficiences... - stockjournal.com.au Nov 25
[Meattechnology]

SystemIntegrationforproduction-critical... - machineryautomation.com.au Nov 10
[Meattechnology]

ITAL-InstitutodeTecnologiadeAlimentos - sp.gov.br Dec 2
[Meattechnology]

DematecAutomation-AutomationRobotics,... - dematecautomation.com.au - Nov 9
[Meattechnology]

CSTEnergyandWater - cstenergyandwater.com Dec 18
[Meattechnology - Mike from Roseville CST]

IndustrialAutomationServices:Custom... - a-i-corp.com Jan 11
[Meattechnology]

AmericanSensoRx,Inc.,AdvancedPackaging,... - americansensorx.com Dec 28
[Meattechnology]

Robotscutlettucelabourissues-Robotics - fanucrobotics.de Nov 30
[Meattechnology]

RobotTechnologiesAustralia - robottechnologies.com.au Nov 9
[Meattechnology]

Toolholders,HydraulicClamp,Grippers,... - romheld.com.au Jan 2
[Meattechnology]

DeutscheGesellschaftfürRobotik-DGR - robotik-deutschland.de Dec 2
[Meattechnology - German society for robotics]

VzFPrizeNewsletter-VzF-GmbH-Success... - googleusercontent.com Nov 25
[Meattechnology]

ExecutiveCommittee - sheepcrc.org.au Nov 15
[Meattechnology]

Increasingproductivityacrossthesupply... - mla.com.au Dec 7
[Meattechnology - .2 Increasing productivity off-farm Working in partnership with the Australian Meat Processor Corporation, individual processors and technology providers, MLA manages an R&D portfolio to improve processing efficiencies, addressing labour availability and OH&S and reducing consumption of water and electricity. In 2011-12, MLA invested $1 million in this area including no producer levy funds, $0.5 million in government funds and $0.5 in processor contributions. This was 64.9% under the $2.9 million budget. A further $5.3 million was invested through the MLA Donor Company. It enabled collaborations that developed cost effective automation and manual assist technologies, and novel objective measurement systems. Key milestone achievement Realise net benefits of $1 million per annum from processing technologies developed under this program and installed during 2011-12 Achieved – net benefit of $1 million per annum achieved through four technologies Total aggregated net benefit of technologies installed during 2011-12 and previous years reaches $3 million per annum Achieved – total aggregated net benefits of $4 million from 11 technologies Demonstrate in production at least two new technologies/systems capable of improving cost of production and yield to increase net worth of the carcase by $1/ head in sheep and/or beef Achieved – four technologies in production increase net worth of carcase by more than $1 per head Develop technologies and systems capable of eliminating and/or reducing OH&S risks Achieved – four technologies capable of reducing OHS risks Demonstrate in production at least two new technologies that have a main OHS-related benefit Achieved – four technologies developed with main OHS benefit Program highlights MLA completed four research projects into spray chilling, an innovative method of chilling beef and lamb carcases that significantly reduces shrinking during the typical overnight chilling regime. A pilot trial conducted at two processing companies found s]

Vision|TMRobotics - tmrobotics.co.uk Nov 30
[Meattechnology]

TönniesLebensmittelGmbH&Co.KG-About... - toennies.com Dec 2

[Meattechnology - German meat group Tönnies Lebensmittel ensures unique freshness and quality: The most modern technologies for slaughtering, butchering, packaging and logistics Unique processes for cleanliness and hygiene An unbroken cooling and hygiene chain through the use of in-line production Continuous monitoring at all stages of production With almost forty years of experience and technological excellence, TönniesFleisch has achieved a quantum leap in the production of quality meat through the introduction of fully-automated butchering processes. An indispensable prerequisite for fully-automated butchering is detailed information. Using data transferred from the slaughterhouse, a complete data set for each individual pig is provided to the automated butchering system. In conjunction with measuring the individual sections of the carcass, the data obtained is used to optimise the entire butchering process. By objectively evaluating the individual sections of the carcass, the butchering process is optimised. Contact Tönnies Lebensmittel GmbH & Co. KG In der Mark 2 33378 Rheda-Wiedenbrück Tel.: +49 5242 961 - 0 Fax: +49 5242 961 - 135 E-Mail: info(at)toennies.de Our contacts abroad ➡]

CYBERDYNE - cyberdyne.jp Jan 2

[Meattechnology - CYBERDYNE Inc. is a venture firm which is established by Dr. Yoshiyuki Sankai, University of Tsukuba, Japan, in order to materialize his idea to utilize Robot Suit HAL® for the benefits of humankind in the field of medicine, caregiving, welfare, labor, heavy works, entertainment and so on. Robot Suit HAL® was developed with the technologies created in Sankai Laboratory of Tsukuba University as an application of “Cybernics*” advocated by Prof. Sankai. *Cybernics is a new domain of interdisciplinary research centered on cybernetics, mechatronics, and informatics, and integrates neuroscience, robotics, systems engineering, information technology, “kansei” engineering, ergonomics, physiology, social science, law, ethics, management, economics etc.]

KUKAIndustrialRobots-FoodIndustry - kuka-robotics.com Dec 30

[Meattechnology]

VerticalPlateFreezersfromDSI - dsi-as.com Dec 14

[Meattechnology - JBS IFFA tour comment. Is it this company?? From my point of view visit provided the single most system with the WOW factor of the entire trip. We have been looking at plate freezing for nearly 15 years now and have never been able to tick all the boxes on how we could handle fresh product into vertical plates and onto pallets without adding lots of labour costs. This plant was doing 120 metric tonne of product with only 4 units of labour per day. CO2 was the refrigerant running at -40C and achieving a frozen block core temperature of -18C in 90minutes per plate freezer]

UTS:InnovationinPractice - uts.edu.au Jan 2

[Meattechnology]

Onlineinteractivelabeltool - meatmessaging.com Dec 21

[Meattechnology - Des Bowler]

PatentUS20120040597-Carcasscutting... - google.com Nov 25

[Meattechnology - Carcass cutting methods and apparatus US 20120040597 A1 Abstract Methods of automated meat processing including an end to end processing method in which carcasses are cut into major portions at a first robotic processing station and into minor portions at robotic processing sub-stations. In one processing method carcass portions are acquired by a robotic arm, imaged and then cuts performed without transfer. In another a first series of processing steps are performed by rotating carcass portions through a plurality of processing stations and a second series of processing steps are performed as carcass portions are advanced along a linear conveyor. In another processing method a plurality of clamps are employed to stabalise a saddle section during a flap cut. In another processing method split pins are used to position a saddle section for a vertebrae cut. In another method a spinal cord is removed by applying a pressurised fluid stream against one end of the spinal cord and applying suction at the other end of the spinal cord]

Milmeqwebsite—Milmeq—Milmeq - milmeq.com Nov 30

[Meattechnology]

Finalreportdetails|Meat&Livestock... - mla.com.au Dec 7

[Meattechnology - Dual SaniVac (Front/Rear) Background The dressing of lamb carcases is a repetitive, physically demanding task, with the added challenge of maintaining extremely high levels of hygiene. The nature of livestock means that great care and discipline needs to be applied for long periods in order to achieve the high standard of dressing performance demanded. A number of potential carcase contaminants have a zero tolerance in domestic and export markets. The automated sani-vac or vacuum sanitisation is a process of running a hot steam vacuum wand over the carcase surface with the aid of robot automation. The benefit to the supply chain is significantly improved reliability of steam sanitisation coverage, reduced bacterial counts, improved shelf life, reduced risk of zero tolerance incidents being encountered, and a contribution to labour supply sustainability. Research & Facilitated Adoption <Content to be added> Outcomes & Adoption <Content to be added> Under project P.PSH.0579, an enterprise level value proposition and cost/benefit analysis (CBA) model was funded, based on an in plant SaniVac system. Contract No. Title Start date End date Funding type P.PIP.0159 Robotic Front Vac San 01/05/2007 30/09/2008 MDC PIP P.PIP.0206 Foreleg, Brisket & Neck Dual Robot Sani Vac System 20/04/2009 30/06/2012 MDC PIP P.PIP.0211 Castricum forequarter Robotic Vac San System 01/05/2009 25/10/2010 MDC PIP P.PSH.0280 Robotic Rear Vac San 01/05/2007 21/05/2009 MDC PSH P.PSH.0468 PVE Robot System(s) 1yr Technology Support & Training 15/10/2009 30/06/2011 MDC PSH P.PSH.0474 MAR & MLA Automated Sani Vac & Brisket Cutter Market Readiness 08/04/2009 01/12/2009 MDC PSH P.PSH.0486 PVE Robot Systems Hardware Upgrade 08/04/2009 27/08/2009 MDC PSH P.PSH.0543 MAR 9520Q2 - Neck Vac San Trial 02/11/2009 25/01/2010 MDC PSH P.PSH.0579 Cost benefit analysis for MAR automation systems 20/11/2010 25/02/2014 MDC PSH P.PSH.0597 9595Q1 – PVE Safety Guarding Upgra]

automatedbeefprocessing-GoogleSearch - google.com Nov 9
[Meattechnology]

CedarCreekCompany - cedarcc.com Nov 30
[Meattechnology]

Ollari&Conti|WelcomePage - ollarieconti.it Dec 14
[Meattechnology]

CiscoandRockwellAutomation-CiscoSystems - cisco.com Nov 30
[Meattechnology]

IndustrialAutomationServices:Custom... - a-i-corp.com Jan 11
[Meattechnology]

Amazon'snewdirection:Point,click,... - usatoday.com Dec 3
[Meattechnology]

Automation&RoboticSolutionsforthe... - machineryautomation.com.au Nov 19
[Meattechnology]

Kräftegebündelt-DieFleischerei - fleischerei.de Dec 2
[Meattechnology - Remko Rosman, CEO of MPS: "This move us very happy. KJ is the market leader in automated cutting and Entbeinungssysteme for red meat. KJ fits perfectly into the MPS product portfolio and complements the position of MPS as a world leader in the field of battle lines for red meat. In addition, KJ has excellent logistics solutions. Our clear goal is to increase by KJ and the expansion of high-quality product range and service capabilities to provide our customers even better available to "Ulrik Gammelgaard, CEO of KJ, adds:". KJ and our customers are the high degree of financial strength, global presence and innovation of MPS benefit. The completion of the product range and market presence strengthen our collective potential. " MPS Meat Processing Systems claims to be the world leader in the design, manufacture and installation of sophisticated battle systems, Butina CO 2 -Betäubungssysteme and Durand-Schlachtkörpersägemaschinen. In addition, MPS is also a leading provider of portioning, deboning and logistic processing of meat and food products and industrial effluent treatment (Aqua Industrial Water Treatment). www.mps-group.nl]

AS/RSSystems,AutomatedStorageand... - viastore.com Dec 2
[Meattechnology]

KometosOy-Abattoirsandmeatprocessing... - kometos.com Nov 30
[Meattechnology]

ResearchManagementSystems - rmsusa.com Nov 30
[Meattechnology]

HowardGardner|FiveMindsfortheFuture - howardgardner.com Jan 15
[Meattechnology]

AngusAustralia-AngusAustralia - angusaustralia.com.au Nov 15
[Meattechnology]

AutomationFairfromRockwellAutomation - rockwellautomation.com Nov 25

[Meattechnology]

MachineryAutomation&Robotics-Experts... - machineryautomation.com.au - [Meat technology - Machinery Automation and Robotics (MAR) is a world leading provider of meat robot systems. With decades of robotic experience, the team at MAR has extensive experience in the meat industry to fulfill your automation and robotic requirements. With a range of proven meat technology solutions available, MAR can assist with all of your meat cutting, packing, processing and slaughter automation needs. Our products and solutions cater to multiple meat industry segments, including but not limited to: beef technology, poultry technology, lamb and sheep technology along with general small stock technology. Offering a complete service, MAR's innovative meat technology solutions are supplied integrated, installed, commissioned for production and backed by the continued 24 hour support and service. So what benefits can a MAR meat robot system offer? Reduction in the operation and capital costs of meat processing entities Labour cost reduction through implementation of innovative processing technology Improved hygiene and visual appearance through reduced biological load Increased yield through accuracy of innovative processing technology Enhanced shelf-life and appearance resulting from eliminated sawdust, water exposure, surface bone dust and reduction in handling Improved cut surface finishing, repeatability and accuracy of meat automation over systems controlled by hand Increased production and manufacturing flexibility Improved quality of work for employees Improvement in workplace health and safety; elimination of risk of operator strain injury or trauma injury from traditional techniques 24/7 service and support insuring production certainty Proven solutions and expertise] Nov 10

TIPPERTIE,Inc./Technopack/Alpina - tippertie.com Nov 15
[Meattechnology]

SystemIntegrationforproduction-critical... - machineryautomation.com.au Nov 10
[Meattechnology]

DARstockquote-DarlingIngredients... - nasdaq.com Dec 18
[Meattechnology - NASDAQ on Darling Ingredients $19 share. mega outfit in recycling sector.]

RedMeatSupplyChainCommittee - rmscc.com.au Nov 25
[Meattechnology]

Internationalconferenceonroboticsautomation - icarcv.org Jan 2
[Meattechnology]

Milmeqwebsite—Milmeq—Milmeq - milmeq.com Nov 30
[Meattechnology]

OMRONGlobal - omron.com Jan 2
[Meattechnology - motto: we automate http://www.omron.com/products/indu.html Automation Systems include Programmable Controllers that support machine control, and Network/Software products to support easy information exchange with host systems. Machine Automation Controllers Software Networks Programmable Terminals

Programmable Controllers Peripheral Devices Wireless Components RFID Systems http://www.omron.com/r_d/coretech/]

AutomatedDeboningSystemsGainCoMayekawa... - gainco.com Dec 17
[Meattechnology - Nov. 27, 2014 YIELDAS 3000 will be exhibited at "IPPE 2015" (January 27 – 29, 2015, Atlanta, USA). Visit GAINCO's Booth #B-5653. Gainco is named the exclusive authorized distributor of Mayekawa automated deboning equipment to the poultry processing industry in the United States. Sep. 16, 2014 Mayekawa will be exhibiting at "International Indonesia Seafood & Meat Conference and Expo - Focusing on Cold Connection" (October 2 - 4, 2014, Jakarta, Indonesia).]

LUCEOInspectionWorldwideInspection... - luceo-inspection.com Dec 14
[Meattechnology - Luceo Inspection Worldwide ZART des Perrières 35772 Vern sur Seiche France Tel. : +33 2 99 62 86 11 Fax: +33 2 99 62 72 38]

–TheEmergenceofOpenDesignand... - we-magazine.net Dec 3
[Meattechnology]

Tru-TestDataLink|Tru-TestLivestock... - tru-test.com Nov 25
[Meattechnology]

Home>ConceptSystemsIncorporated - conceptsystems.com Jan 11
[Meattechnology]

VDF-VerbandderFleischwirtschafte.V.... - v-d-f.de Dec 2
[Meattechnology - Address Association of Meat Industry Association Adenauer Allee 118 53113 Bonn Tel .: +49 (0) 228-9 14 24 0 Fax: +49 (0) 228-9 14 24 24 E-mail: info@vdf.de]

VerticalPlateFreezersfromDSI - dsi-as.com Dec 14
[Meattechnology - JBS IFFA tour comment. Is it this company?? From my point of view visit provided the single most system with the WOW factor of the entire trip. We have been looking at plate freezing for nearly 15 years now and have never been able to tick all the boxes on how we could handle fresh product into vertical plates and onto pallets without adding lots of labour costs. This plant was doing 120 metric tonne of product with only 4 units of labour per day. CO2 was the refrigerant running at -40C and achieving a frozen block core temperature of -18C in 90minutes per plate freezer]

RockwellAutomation-NewsRoom-RSSContent - corporate-ir.net Dec 2
[Meattechnology]

VzFPrizeNewsletter-VzF-GmbH-Success... - googleusercontent.com Nov 25
[Meattechnology]

PatentUS8661773-Meatpackaging-Google... - google.com Nov 15
[Meattechnology]

WelcometoICARCV2014 - icarcv.org Jan 2
[Meattechnology]

NTF-NewTechnologyFoundation-公益財団... - ntf.or.jp Jan 2
[Meattechnology]

Textile,Connectors,Robotics-mechatronics... - staubli.com Dec 30
[Meattechnology - Labor for these kinds of jobs is hard to find," says Bob Rochelle, Food & Packaging Segment Manager for Stäubli Corporation in Duncan, South Carolina. "Some of the pork and poultry processing plants are in remote areas with limited labor pools."]

RoboticsIndustryInsights-Robotswith... - robotics.org Dec 30
[Meattechnology - Yield Pays Sophisticated sensing technology and robotics also play a role in the high-stakes business of meat processing. In this sector, yield directly impacts the bottom line and efficient deboning is one of the key ingredients to profitability.]

Food-Industrie--Processesandpackaging... - interpack.de Dec 3
[Meattechnology]

Innovationmanagementsoftwareforr&d,... - inova-software.com Dec 28
[Meattechnology]

pelting|FoodEquipmentAustralia - fea.net.au Nov 24
[Meattechnology]

PatentWO2013165260A1-Acarcassprocessing... - google.com Nov 9
[Meattechnology - Abstract A carcass processing machine that has a pair of bone cutting blades (11,12) for cutting portions of bone from vertebra of a rack of a carcass and a pair of meat cutting blades (9, 10) for removing meat from a rack of a carcass. A moveable guide (16, 17) supports a rack of meat and guides it along a feed path into the cutting blades. The guide is moveable to position the carcass relative to the bone cutting blades. The guide may move with respect to the blades such that each meat cutting blade follows a natural shoulder (5, 6) of each vertebrae and positions the transverse processes for cutting by the bone cutting blades.]

Onlineinteractivelabeltool - meatmessaging.com Dec 21
[Meattechnology - Des Bowler]

AutomaticBagLoader–PackagingEquipment... - cryovac.com Dec 14
[Meattechnology]

VzFPrizeNewsletter-VzF-GmbH-Success... - googleusercontent.com Nov 25
[Meattechnology]

Australia-Contacts-SCOTT®TechnologyLtd. - scott.co.nz Nov 15
[Meattechnology]

Bordertownroboticstechnologyawindow... - beefcentral.com Dec 12
[Meattechnology]

LUCEOInspectionWorldwideInspection... - luceo-inspection.com Dec 14
[Meattechnology - Luceo Inspection Worldwide ZART des Perrières 35772 Vern sur Seiche France Tel. : +33 2 99 62 86 11 Fax: +33 2 99 62 72 38]

MULTIVAC-PackagingSystems - multivac.com Dec 14
[Meattechnology]

PatentCA2706407A1-Automatedmeatbreaking... - google.com Nov 9

[Meattechnology - Abstract An automated system and method for breaking a primal cut of meat into smaller components includes a conveyor for advancing the primal cut from a first end of the system to a second end of the system, at least one automated cutting assembly for performing a first cut and a second cut to separate the primal cut into three sub-components, and a guide for orienting the primal cut on the conveyor. In some embodiments, the guide is configured to align with a spinal groove in the primal cut. In some embodiments, the at least one automated cutting assembly includes a first automated cutting assembly for performing the first cut and a second automated cutting assembly for performing the second cut.]

DLR-InstituteofRoboticsandMechatronics... - dlr.de Dec 30
[Meattechnology]

IntroductionDESBOWLERETRAININGGS1 - u-etrain.com Dec 21
[Meattechnology - Nice little online tool]

Toolholders,HydraulicClamp,Grippers,... - romheld.com.au Jan 2
[Meattechnology]

GlobalWaterEngineering - globalwaterengineering.com Dec 17
[Meattechnology - GWE RAPTOR™ waste-to-energy technology wins IChemE Energy Award. Worldwide wastewater treatment and green energy authority Global Water Engineering (GWE) has won a major international chemical engineering award for its process by which it transforms food processing sludge waste from an environmental problem into profitable green energy. GWE Chairman and CEO Mr Jean Pierre Ombregt accepted the IChemE Energy Award from the Institute of Chemical Engineers (IChemE), which represents more than 40,000 chemical engineers worldwide and which staged the 2014 awards in the UK this month this month to recognise and reward chemical engineering innovation and excellence.

CedarCreekCompany - cedarcc.com Nov 30
[Meattechnology]

Schooledinbeefselection-Agriculture... - stockjournal.com.au Nov 25
[Meattechnology]

ThorsysAustralia - thorsys.com.au Dec 14
[Meattechnology]

Textile,Connectors,Robotics-mechatronics... - staubli.com Dec 30
[Meattechnology - Labor for these kinds of jobs is hard to find," says Bob Rochelle, Food & Packaging Segment Manager for Stäubli Corporation in Duncan, South Carolina. "Some of the pork and poultry processing plants are in remote areas with limited labor pools."]

Fleischverarbeitung|FestoDeutschland - festo.com

[Meattechnology - german equipment etc Contact Germany Festo is a worldwide leader in automation technology and the global leader in technical education and training. The goal: to maximize productivity and competitiveness of customers in factory and process automation. Festo AG & Co. KG 0711/347 - 0 Festo sales Germany 0711/347 - 1111]

SCREENING OF A RANGE OF TECHNOLOGIES FOR THE MEAT INDUSTRY IN AUSTRALIA

Prepared by
Gregory Sullivan

1. PURPOSE OF THE RESEARCH

The Australian Meat Processors Corporation (AMPC) is considering how to promote global competitiveness of the meat processing industry in Australia. Initial improvements are in achieving greater efficiency in all stages of meat processing. A priority challenge is to address the cost of labor which is high relative to Brazil and USA beef industries. (Brazil is 1st in beef exports, Australia is 3rd, and the USA is 4th) (FAO Stat).

The AMPC commissioned this research to screen for relevant processing technologies in the United States which could be demonstrated by companies and others in a Red Meat Processing Innovation Center of Excellence (RMIC). The RMIC would be supported by both the government and private sector. Objectives of the RMIC would be to:

- Collaborate on the technical evaluation of new technology opportunities;
- Consider how solutions can be modified for unique Australian market conditions, and
- Support technical collaboration between processors in achieving efficiencies

Contact was made with representatives of companies, universities and other key informants in the US meat industry by phone and email.

2. STATE OF TECHNOLOGY DEVELOPMENT FOR THE BEEF INDUSTRY

2.1. Australia

Australian processors on average contribute only 1.1% to global research and development (R&D), and therefore the industry does not hold a global leadership position in automation of beef manufacturing. Consequently, the beef industry will need to adopt technological opportunities from overseas.

The AMPC recognizes that regular global technology scanning is therefore essential to investigate the opportunities for both services & technology for primary meat processors (slaughter, dressing, boning, packing, and storage) and measurement systems of meat production.

2.2. USA

The US beef industry has been slow to adopt advanced technologies in the slaughter of beef, e.g. robotics. This has been partly because the industry can draw upon a large labor pool. The fully-loaded labor costs are lower compared to Australia and Europe. Increase in the economies of size allows for plants to reduce the cost per head. Example beef plants slaughtering 1,350,000 hd/yr compared to 175,000 hd/year can achieve a cost reduction of $4.80 per head (Omidvar, et al). Plants have made changes in the areas of packaging (tray packs and films) and adopted the use of mechanically de-boned meat technology (MDM). Material handling systems (MHS) controlling products in storage and retrieval systems is an area that has seen exceptional growth for large meat packing companies.

2.3. Europe

The leading global companies in advanced meat technologies are found in Europe. These companies have a long tenure in the application of applied sciences to food processing systems. These companies have subsidiaries/divisions in the USA.

3. SCANNING TECHNOLOGIES FOR THE BEEF PACKING INDUSTRY

A US beef packing plant can be sub-divided into key departments to identify technologies relevant to specific tasks required. Using this differentiation, technologies were identified from field report prepared by representatives from Australian meat plants who visited international shows and meat companies in Europe in 2013. The industry representatives assessed newest technologies and systems that would improve efficiencies in their meat plants. The representatives identified technologies present in Europe which are important to improving efficiencies in Australia. The US screening survey drew upon this report since many of the firms in Europe have offices in the US.

3.1. Beef slaughter, breaking (dismembering) and grading of the carcass

The adoption of robotics for beef slaughter has been low because of large variation in sizes of the animal. Companies target those functions for robotics which have sufficient profitability and short period of payback of the investment. Areas of potential efficiency improvements:

the capacity of a hide-puller can be increased from 80 hides per hour to 120 hides per hour from a single unit
rotary evisceration center
in-line automatic saws for splitting regular carcasses, but manual saws used for high quality carcasses
knife sharpening (fully automatic) for various sizes and shapes of knives
Radio Frequency Identification Device (RFID) to track live animal throughout the processing process
Ergonomic platform so that labor is in the best position to process the carcass to improve labor efficiency
Technologies on the kill floor to reduce pathogens while the carcass is hot and when treatments can have greatest effect on lowering the logs of pathogens. (See CHAD owned by Birko)
E + V carcass grading system
Attec of Denmark is an innovator in lamb processing machinery

In the table below, the costs ($/hd) for three technologies are presented for reducing pathogens. All these technologies can be applied with advanced robotics which would lower the costs of their beef operations.

Technologies	Plant Size		
	Small	Medium Large	Large
Hot water/final carcass wash	$3.58	$0.42	$0.28
Steam pasteurization	$ 3.58 - 7.05	$ .78 - .42	$.46 - .28
Irradiation	$ 12.30	$ 3.90	$ 3.82

Source: Omidvar, et al. 2006.

Companies

EU: MPS (Stork), BANSS (German meat technology), SFK-LeBlanc-Narvic, Attec, BMC/KK, NAWI, Frued (manual cutting tools)
NZ: Scott Technology NZ
Australia: MAR
USA: Jarvis, Kentmaster, Bettcher, IBEX

3.2. Fabrication, boning, cutting and grading

Scanners on the processing line to better guide automatic cutters
Laser pointers to position product for machine cutting (use visual technologies) to reduce use of band saws to cut bone-in steaks
Electronic guide systems for existing bandsaws or new bandsaw systems
Knife sharpening (fully automatic) of various sizes and shape - done automatically
Marel streamline boning line for hindquarters and can be used to fulfill traceability requirements
Marel's trim-line system placed after the stream-line boning system (used for veal)
Marel AEW Delford Bandsaws
E+V Technology GmbH & Co. has the potential to sort raw cuts prior to packaging
Marel with chemical Lean (CL) trim management systems
Automatic In-line measurement of chemical lean (CL) represents a major change to the way the Australian industry has packed trim product, thorough analysis of system functionality via a trial line would be a great step to build industry confidence.
Vision-sensing and robotic cutting of loins, tunnel scanning, removal of chine bone
ATTEC rib remover equipment
Low pressure treatment of bones for MDM
DMRI working on automated visual inspection of bones and trim, lean meat and fat monitoring

Companies

EU: Knecht automatic knife sharpening, Marel Chemical lean (CL) trim management systems, Marel boning line, Torras CL Trim Management System, SFK and ATTEC boning line, Oakley boning line, Frued (circular saws for cutting systems), Marel Trim Management System, Eagle FA (trim blending system), and Foss MeatMaster II
Japan: MYCOM (deboning line for pork)
USA: Bettcher Industries

3.3. Process, fill, pack and label (Sort, pick, storage, retrieval and load out)

Ultra-violet light on conveyor belt for sanitation
Fully automated naked block beef trim packing (250 MT/day capacity) by Nawi Germany
Beef patties forming with less compaction - looks like hand formed, with good eye and bite texture.
Have a master file labeling system for labels for point of sale for retail customer

Stream-lined audit scanning tool between production weight systems and retail point of sale systems
Digi, international company with weight and label equipment
NextGen Fos MM and Eagle FA for fresh meat analysis with full wash down
Meat stringing machines and netting equipment to reduce labor and improve efficiency
Marel DMM low pressure meat separation equipment for veal bones and linked to patties maker
Bizerba Company packing and labeling products.
Sortation and auto-stacking
Sealed Air auto-bagger
Crate washing and automatic storage facilities
Filling and packaging machinery
Measuring CL in the bulk before putting in boxes - Marel trim packing system

Companies

EU: Marel DMM10 with Sepremática de-Sinuer (other DMM models), Marel Trimline packing system, Eagle CL equipment to measure product on the conveyor belt, Marel boning system with traceability, Bizerba packaging and labeling equipment, NAWI robotic loading systems for naked block plate freezing (labor saving, presentation), MPS, Singer and Shon, MFI), MULTIVAC, COV Product Label Applicator
USA: MULTIVAC (German owned)

3.4. Cooling and freezing systems

2 man vertical plate freezer to handle fresh product into vertical plates and onto pallets without extra labor - plant can do 120 mt of product per day with 4 units of labor per day. CO2 refrigerant at -40 C and achieve a frozen core block with -18 C in 90 minutes per plate freezer. Frozen blocks are picked by a robot and placed on a pallet.
Naked block freezing
Vertical and horizontal plate freezers
Blast freezer that can shorten the time to reach internal core temperature. Freezer at -40F.
Faster defrost from 0 F to 32 F in period of 3 days
Spinal chilling and freezing for offal chilling (chill before vacuum packing)

Companies

EU: NAWI automated system of plate freezer filling and packing of 120 mt/day, DSI (Denmark) plate freezers - horizontal and vertical

3.5. Sorting/Storage/retrieval warehousing Automatic Storage and Retrieval System (AS/RS)

AS/RS can be built in existing or new structures to a temperature of -35 F for rack and non-rack supported structures
Picking capacity of 130,000 order lines with 100,000 crates and boxes per day, ca. 630 tons per day. Cutting capacity: ca. 800 pig halves and 35 fattening bulls per hour. Cold store capacity: 4,000 half pigs, 600 beef quarters and 1,000 beef roasts. Transport performance:

3,000 meters of conveyor belt, ca. 7,000 crates per hour. Automatic crate storage: ca. 50,000 storage locations (for EDEKA supermarket)
Load out with IBEX and containers for optimal picking systems
Vision or sensing technologies for cut identification through imaging of cartooned products (CVS), piece count, cut identification, 98% developed
Cut sorting - sort raw cuts before packaging to reduce labor
Sorting and auto-stacking technologies
Computer arm band worn by driver in warehouse with required products and number of boxes for a pallet. Driver provided most efficient route in the warehouse to collect items.
Pick and place - pallet technology for storage using vision guidance for pick and place systems
3-D vision (improved for all around view of the item to pick up products with irregular surfaces. Pork plant in California is using this technology (Adaptive Guidance using vision can take 60,000 data points within a very short time). The large volume of data allows for creating detailed patterns and irregular surfaces for the robot to handle.
Adaptive guidance using vision with the snow flake concept of setting up database. Since every pig is different, then need for adaptive automation. The robot can identify the feature of each piece.
Vision guidance - picture of product on conveyor up-steam, and then the information fed to robot for action to be taken. The processing lines require better lighting to avoid false edges.
Automated guided vehicles.
Mini-load systems or multi-shuttle systems

Companies

EU: Attec,MPS,MFI,Nieros,Tavil,Dia Werke,
USA: Material Handling Industry of America (MHI), a trade association, Westfalia Technologies, Vanderland Industries

3.6. Waste handling

Waste product vacuum transfer systems
Waste water treatment facility
Bio-gas generation plant
“High rated anaerobic lagoon” with flat top cover.
Hot water generated from generator exhaust and sludge dried from the same gasses.
Optimal waste with fat collection
Innovative using renewable biogas covered anaerobic gas into boiler
R&D opportunities – Pinches Consolidated Industries (Keith Engineering SA) 12mths to go

Companies

USA: Darling International (recycling, rendering)
GWE waste water facility

3.7. System Design

Companies called "Integrator - networker" design the systems to address the problem requested by the client. Break down problem into steps.
a. system design

b. fabrication and welding
c. vision reading equipment identified and installed
d. selection of robotics
e. custom tooling
f. wiring
g. software development
h. interface robotics with the processing line
i. testing the system
j. tracking and data collection

Companies

US: Adaptive Innovations Corporation and Concept Systems, Inc.

4. LESSONS LEARNED FROM SCREENING TECHNOLOGIES

A number of technologies are available to enhance the Australian meat processing industry. These innovations cut across all departments in the beef plant from slaughter of animal to the final storage of the boxes of meat. Some technologies were identified in the field report prepared by representatives from the Australian meat industry in August, 2013.

Automation of in-line measurement of CL for packing trim
Labeling of meat by weight and grade for retail point of sale
Vertical plate freezer of blocks to core temperature of -18 C in 90 minutes and then picked by robot

A RMIC could link technology innovating companies (several international companies) with beef plants in Australia. Collaborative efforts can be encouraged by the RMIC that brings plant operators together to evaluate machinery for their plants. Firms with an interest in a specific area of the plant, e.g. rendering animal waste, could be organized by the RMIC and technology improvements put on display with follow-on activities in selected plants.

Representatives of companies showed a general interest in the RMIC, but they wanted to know how the strategic alliance would be organized. A number of US institutions showed an initial interest.

TAMU expressed an interest as a world class research institution
FANUC showed an interest with use of robotics in slaughter, process, pack and store product
JLS Automation Sales and Robotics

Economic analysis of advanced technologies needs to be conducted in financial terms to evaluate their likely adoption by the industry. Meat plant operators work on small margins and will want to see how long it takes to repay a proposed investment.

6. REFERENCE MATERIALS

FAO. Statistics. Rome, Italy

MHI and Deloitte. Innovations that Drive Supply Chain - The 2014 MHI Annual Industry Report. [8]Omidvar, V., D.G. Brewin, and J. Carlberg (2006). Meat Processing in North America: Successes, Failures and Opportunities. So. Ag. Econ. Assoc meeting. Orlando FL

7. INTERVIEW NOTES

7.1.ABBRobotics-NorthAmerica
Mandy Nahas
Auburn Hills, MI
p: 248-391-8622

ABB is a leading supplier of industrial robots, modular manufacturing systems and service. A strong solutions focus helps manufacturers improve productivity, product quality and worker safety. ABB has installed more than 250,000 robots worldwide.

GaryAcuff,Professor
Center for Food Safety
Texas A & M University
College Station, TX

Beef packers would be interested in examining technologies on the slaughter floor for reducing pathogens. The more automatic the process the better. The same goes for sampling and reporting of levels of pathogens. A number of technologies are available but nobody truly knows how to control and measure pathogens. The validation process is necessary. CHAD and Birko are companies that offer technologies to reduce pathogens. It is harder to treat and remove pathogens in the fab room when the meat is cooled. Catching pathogens early is the best practice. Demonstration of different chemicals and their application offers an important role for the RMIC.

AdaptiveInnovationCorporation
Mike Abdella
p: 303-362-0400
c: 303-901-9535
e: mike@a-i-corp.com

This company is what is called an "integrator/networker" which pulls sophisticated hardware from OEM companies and links them together and writes the necessary software for robots to function on food processing line. The company has installed 3-D scanner systems for scanning product items (pigs carcass or a pallet of varying product items). The company does adaptive guidance with vision. The technology is based on the "snow flake" concept where every pig is different. The robot can then distinguish differing characteristics and perform necessary tasks. The technology is especially useful in "pick and place" tasks. The company uses FANUC technologies in their production lines.

BettcherIndustries
Paul Pirozzola, V. P. Marketing
p: 440-204-3246
c: 419-366-7912

[8] https://www.mhi.org/publications/report#download

e: paulp@bettcher.com

Bettcher Industries makes trimmers for defatting and muscle cutting. Their products improve meat yield, product quality, and worker productivity. I spoke with Mr. Pirozzola, VP of Marketing, on his way to Switzerland. We have agreed to speak after his return later this week. I sent him an email.

ConceptSystems
Chandler Gehlhausen
Sales Engineer
p: 866-791-8140
c: 773-919-9761
e: cgehlhausen@conceptsystemsinc.com
and
Mike Lindley
Marketing
Albany, Oregon
866-791-8140
e: mlindley@conceptsystemsinc.com

This company uses automated and control systems, vision aid and use of OEMs to construct processing systems, including the use of robotics in food plants. The quality of the scanning is key to effective use of robotics for pick and pack systems. The company specializes in integrating multi-machines. He stated there are opportunities to collaborate with the RMIC to expose the meat processing sector in Australia to these technologies. I contacted Mike Lindley but no reply to my voice message and email.

JoeCordray,Professor
Department of Animal Science
Iowa State University
e: jcordray@iastate.edu

Some technologies are being introduced in slaughter plants that are ergonomically correct for workers. Laser pointers are being used to direct machines for cutting sub-primals. More efficient fast blast freezer at temperatures of -40 F help to eliminate purge of the product when defrosting. In Iowa, meat packers can find it hard to find the necessary labor in rural areas to operate a 2000 hd/day plant.

DarlingIngredients,Inc.
Doyle Nauman
p: 901-871-0454
e: dnauman@darpro.com

Mr. Nauman reported that Darling is selling rendering systems and equipment in Australia. He said that he would put me in contact with the right person. I sent an email, but no response. I will follow-up.

FANUCAmerica
Troy Slater, Sales
Denver, Colorado

c: 402-650-5242
and
Joe Baldiga, New Business Development
ph: 248-377-7591

FANUC America offers the most complete range of industry-leading products and services for robotics, computable network computing (CNC) systems, and factory automation solutions. The company is dedicated to increasing the competitiveness of manufacturers by creating opportunities to help them maximize their efficiency, reliability, quality, and profitability.

The beef industry has been slow to adopt robotics. This has been partly due to the supply and cost of labor. As supply of labor shifts, this may change in the future. FANUC works closely with "integrator-networker" supplying equipment to their processing systems.

RohanGoodsir
e: rohainOZ@aol.com

Rohan publishes an international newsletter (International Meat News Report) for the meat industry. He has 600 plus companies that receives his daily newsletter.

DanHale,ProfessorofMeatScience
Texas A & M University
College Station, TX
e: dhale@tamu.edu
and
Dr. Russell Cross, Head
Animal Science Department
Texas A & M University
e: dhcross@tamu.edu

Dr. Russell Cross, head of Department of Animal Science, referred me to Dr. Hale. He is a professor in meat science. A few technologies mentioned by him were:

resistance structures for livestock before the kill

better stunning procedures with oversight using video surveillance and review by a third party.

On the processing floor he mentioned the need for technologies which addressed pulling/cutting and saw safety (reduced use of band saws)

Cleaning systems for hides using CHAD technology before opening the cavity of the animal

Better freezing technologies using spiral freezing

Jarvis
Mr. Vincent Volpe, President
e: president4@hotmail.com

Left a voice message and follow with an email. No response yet.

JLSAutomationSalesandRobotics
Carl Souser, President

York, Pennsylvania
ph. 717-505-3911
cell: 717-818-7193
email: csouser@jlsautomation.com

This company purchases basic robots manufactured by ABB and uses them for mainly picking raw, cooked or frozen products packing into packages. (Company does not work in the slaughter and cutting lines). Product items are light weight e.g. sausage, ham steaks. The JLS equipment will interface with a thermo-forming machine with the loading and case packing. JLS does business with firms, such as MAR, in Australia on a project-by-project basis. Companies are not inter- locked except by "gentlemen's agreement." Mr. Souser said most tortillas in Australia are stacked using JLS equipment.

He recognized the problem of high labor costs in Australia plus the social costs (6 weeks vacation) which can make Australia non-competitive in the global market. The mining industry is a major competitor for available labor in Australia. JLS echnologies can reduce labor in the pick and pack of meat products. A new piece of equipment just developed is a "pivit" machine to detect leaking vacuum packages. Technology was on display at the recent PackExpo in Chicago.

He feels that the US industry is beginning to face similar issues in Australia with the recent Affordable Health Care Law. The understanding of robotics is advancing in the USA. Meat packers have difficulty putting a return on investment (ROI) calculation on automated systems. Robots are more accepted in his opinion than before. Processors like to see a short payback period of one year on equipment while his equipment may take 18 to 24 months. He has some customers which will accept a 3 to 5 year payback period.

His firm does not do palletizing of products. He does believe that MAR, now Scott Technologies, does. His firm is an original equipment manufacturer (OEM), and he does not work closely with any "integrator networker" company.

Kentmaster
Nick, Sales Representative

This company sells meat cutting equipment in Australia; however, it is not a large market for them. The person said there was not alot of value in partnering with an innovation center being proposed by AMPC. Interview was stopped.

NorthAmericanMeatInstitute(NAMI)
Barry Carpenter, President and CEO
James Cornett, Senior director of information technology and administration
Scott Goldtree or Percy James
Washington, D.C.
ph. 202-587-4232
e: bcarpenter@meatinstitute.org
e: jcornett@meatinstitute.org

NAMI is the former American Meat Institute and the North American Meat Processors.
Voice message was left for Scott Goldtree. Email was sent to Barry Carpenter requesting a time for a short interview. Waiting for his reply.

SystemsLogistics
Grand Rapids, Michigan
p. 888-233-6796

The company headquarters is Italy, and it specialized in pick and place technologies. In the USA, the company operates under the brand of Modula. Email has been sent but no response yet.

Tuffley,David
School of Information & Communication Technology
Griffiths University
Nathan, Australia
e: D.Tuffley@griffith.edu.au

David reviewed the AMPC website before our skype call and noticed these megatrends for the industry:

rising labor costs,
need for skilled labor
cost of compliance and regulations

In his opinion there needs to be systems thinking approaches for the meat industry to remain competitive in global market. It is important to understand how to integrate people with automation. What is the perception of workers and general public to robotics. For example, the mining industry wants to introduce self-driving trucks but there is a negative perception by the general public. Robots can do jobs people do not want to do or too dangerous. If the issue is presented properly, then public will accept automation.

The objective is to design process systems which are faster and cheaper. It require multi-disciplinary teams to address a system approach. It is necessary to integrate humans and the automation. The two have to meld into a cultural setting and fit within society. There is a need to redesign for the future. Griffith University (GU) does AI and robotic design. He described meat systems in Denmark that are on the cutting edge of technology. Some Aussie companies are providing automation, but industry is still at low level of technology compared to Europe. Asian countries are more accepting of automation. In the US, industry has been slow to adopt robot technology.

Biggest issue in development of automation is vision and scanning. Advances at MIT is resulting is greater spurt in automation - driverless cars. The recent introduction of high definition vision and scanners is allowing for greater high definition and real time processing. There is better collecting and interpreting data is a breakthrough. Two levels:

AI for a specific job - linear and doing one thing, but
Holy Grail is a general purpose AI - versatile, adaptable, and operate in chaotic situations; however, 15 - 20 years off.
More streamlined with economies of scale in larger applications and faster.
MIT has developed an algorithm on how the brain processes information and able to do processing of data in 1/10 of the time. Fits with high speed production lines and automation.
Technologies will advance in vision recognition, laser camera, powerful computers, manufacturing.

David has consulted on IT and worked on the inside with clients to address the needed cultural change in companies. You cannot understand the culture unless working inside the industry to better understand their self-interests. Culture is self-protection and will neutralize change agent. He has an interest to be of assistance. I said that you might call him.

VanderlandeIndustries
Marietta, Georgia
p: 770-250-2800
e: info.us@vanderlande.com

Company specializes in warehouse automation for AS/RS systems. Email was sent but no reply as of yet.

WestfaliaTechnologies(WT)
R & D for New Business Development
e: ogeyer@westfaliaUSA.com

The headquarters of Westfalia is in Germany. It specializes in warehouse automation and designs and installs automated storage solutions for manufacturers and distributors in both conventional existing facilities and new-build facilities. They offer a variety of Automated Storage and Retrieval Systems (AS/RS) in temperatures ranging from -35 F to 110 F for both rack and non-rack supported structures. Systems include: high density multiple deep systems, double deep systems, and single deep systems. I left voice message and sent an email but no response yet.