The University of Tasmania's Pathways to Market (PTM) was one of the Australian Research Council's first Industrial Transformation Research Hubs.

It was one of the first projects in the world to focus specifically on the opportunities provided to agriculture from effective use of 'big data'.

We're interested in how 'big data' and the Internet of Things affect the way our premium produce is grown, transported and purchased. Pathways to Market is a proven exemplar for Australian agriculture and related industries of how to build international competitiveness through targeting niche markets with premium products and rigorous attention to product quality, provenance and food safety. We focus on the entire value chain to deliver enhanced value.

In today's competitive global markets, the unit of competition is the whole value chain rather than individual businesses. Every product is only as competitive as the chain that produces and delivers it to market. We are showing how science can deliver value to consumers and value chain partners that will improve global competitiveness and access to markets.

Pathways to Market is focused on premium food exports, specifically to Asia and the US. From a
production perspective, we’re looking at aspects of food quality, traceability, and the natural capital of the production environment, all of which involve additional sensing capability.

The combination of private, public and real-time sensed data with the Internet of Things (IoT) and Decision Support Systems (DSSs) is revolutionising food production and marketing, delivering enhanced value to consumers at lower cost to suppliers.

Many of the DSSs being brought to agriculture are simply pretty interfaces that aggregate some descriptive data on a screen or perhaps provide predictive projections of the future.

The real power comes from ‘prescriptive modelling’ or simulations that enable managers to evaluate alternatives.

So, if integrated, modern DSS/IoT tools are to transform food production they must be underpinned by good science.

The key to the achievements so far in this project has been the outstanding vision, commitment, collaboration and funding of its commercial partners HW Greenham & Sons and Southern Rock Lobster Limited, combined with funding from the ARC and collaboration from UniSA, the University of Sydney, the NAB, ABS and ABARES.

- Dr Laurie Bonney, PTM Director
Pathways to Market is leading Australian agriculture with new on-farm and seafood sensor and traceability technology. However, there’s a need to find cost-efficient and effective means of uplifting data from hundreds of sensors in a supply chain to the Cloud so that it can be used by managers for decision-making.

There are many technologies for ‘telemetry’ or transmitting data to a distant receiving station, so Pathways is conducting more world-first research to compare the performance of some of the leading telemetry technologies.

Nano-satellites potentially offer many advantages over alternative technologies for rural areas. Fleet Space Technologies, recently named as the second-best space start-up in the world, is an Adelaide-based Australian cubesat company.

Pathways to Market has formed a collaboration with Fleet to include a satellite telemetry option for rural data communications. This will enable choices for farmers and value chain managers about the most cost-effective means of uplifting data to the Cloud taking into account topography, climatic conditions, distance and interference from other radio transmissions.

This work will be incorporated into Professor Tamplin’s food stability sensor to provide real-time monitoring, GPS positioning and shelf-life prediction for food products all the way to international markets (See Page 14).
Pathways to Market's applied research projects are revolutionising the businesses of industry partners.
OPTIMISING REVENUE FROM CONSUMER VALUE

PATHWAYS TO MARKET CONTRIBUTES TO OUR UNDERSTANDING OF HOW CONSUMERS’ VALUE JUDGEMENTS FOR BEEF PRODUCTS ARE FORMED

Pathways to Market through its partnership with UniSA’s Institute for Choice (I4C) set out to understand why people make the choices they do when purchasing beef products and predict what choices they’ll make in the future. Understanding the causal factors underpinning these decisions can assist the modern food industry, by reducing failure rates when introducing new beef products to the supermarket shelves and by increasing beef consumption.

The United States is an important importer of Australian meat. In 2016, 24% of Australian beef exports were to the US, worth AU$1.7 billion to the Australian economy. Australian beef exports valued at AU$1.8 billion but

we face strong competition from Canada and New Zealand in the US beef market.

Pathways’ aim was to assist our partner, HW Greenham & Sons, to maintain their pre-eminent position as Australia’s premium beef producer and exporter of high quality beef to the USA.

This work has now been completed and has contributed to Greenham’s understanding of how consumers’ value judgements for beef products are formed by studying consumers’ decision-making over intrinsic and extrinsic information cues on several beef products. The work has answered fundamental questions about the preferences and willingness-to-pay of consumers in Australia and the United States for food labelling information, including food provenance, and product appearance and packaging. We also investigated seasonality effects on purchase likelihood of different beef products in the US.
It allows Greenhams to then create beef products with specific attributes, arrange these on a supermarket shelf and to run hypothetical “what if” scenarios to forecast revenue and unit sales based on the purchase probabilities for a defined set of prices and product attributes, compared to other competitive product offerings. In the US version of the DSS, the purchase probabilities are also determined by season.

There are three key outputs that users of the DSS can generate:

- Understand what price point will optimise revenue and units of stock sold
- Understand consumer purchase likelihood for a product configuration, the quantity they will purchase and market share as a result.
- Brand premiums: Understand the price premium a brand can charge for a product

This work is complemented by that of UTAS Dr Winyu Chinthammit with his ‘Google Analytics on steroids’ (see Page 10.)
Peter Greenham, Managing Director of HW Greenham & Sons, a sixth-generation family company at Smithton and Tongala in Victoria, had a far-sighted vision for his premium brand ‘Cape Grim’, which has customers throughout Australia and internationally in Japan, Korea, Thailand, China, Singapore, Hong Kong, Russia, Nepal, South Africa, Seychelles, USA and the Maldives.

“Pathways to Market is revolutionising my business and my suppliers’ businesses,” he says.

“I’m very happy with my co-development relationship with UTAS.

“We are entering the phase of the development where we will soon be transitioning the DSS across to be managed by our own digital partners and scaling it out to our other suppliers.”

BUILDING CHAIN CO-INNOVATION

PETER GREENHAM, MANAGING DIRECTOR OF HW GREENHAM & SONS, IS USING HIS DASHBOARD TO ENABLE OVER 70 OF HIS STRATEGIC TASMANIAN FARM SUPPLIERS TO MONITOR ON-FARM CATTLE BREEDING AND FATTENING PERFORMANCE AS WELL AS THEIR ENVIRONMENTAL MANAGEMENT

This enables suppliers to improve the performance of their own businesses and, through collaborative innovation or ‘co-innovation’ with other chain members, create value that benefits everyone in the chain and deliver superior products to Cape Grim consumers.

Co-innovation has been shown world-wide to improve:

- Integration between chain partners
- Performance in DIFOT to customers and value to consumers
- Resilience to withstand unexpected shocks
- Agility to position your business quickly
- Competitive advantage
Whole-of-chain Decision Support Systems

Prescriptive decision support ‘dashboards’ developed by UTAS’ Sense-T engineers and UniSA’s Institute for Choice are providing decision options for farm, processing and retail management.

They integrate proprietary and public databases such as that from the Bureau of Meteorology and land/soil capability mapping with data from sensors on-farm, in processing plants, logistics providers, wholesalers and retail stores for management decision-making.

PTM Director Dr Laurie Bonney said the impacts go well beyond the usual visualisation of aggregated data or simple predictive data and scientific modelling capability into the hands of value chain managers throughout the chain system. This enables them to make the best possible business decisions and monitor the effects in real-time.

Dr Bonney said this was the critical difference between ‘pretty computer interfaces’ and effective decision-support tools.

He warned however that, just like any tool, it’s how they’re used to create value for the business that is the critical factor.

Dr Bonney said that, just as Peter Greenham had done, DSSs can be used to facilitate collaboration and innovation between the chain partners to solve their shared problems, thus optimising value creation for consumers and the revenue to be shared by the chain partners. He stressed however, that the ‘human factor’ is the key to improving value chain performance through co-innovation.
Researchers are mining the rich data available on social media channels in a bid to create a tool that can predict consumer engagement with products.

The Pathways to Market project – a non-survey based method API for social media – has been described as Google Analytics or Buffer on steroids.

Project lead Dr Winyu Chinthammit says current tools to measure online and social media consumer engagement track only what has already occurred, such as the number of website visits per day or the number of likes and comments per social media post.

This research aims to go beyond engagement visualisation tools to create a model that can predict the level of consumer engagement on specific content for a particular group of consumers such as the premium beef consumer.

“Our conceptual model will take into account multiple dimensional relationships including engagement of individual users versus and within groups of users and consumer engagement across a range of different content categories, Dr Chinthammit says.

“With the model, online and social media content can be customised to optimise consumer engagement. Importantly, our model-driven tool can also identify relevant content from other online and social media sources that can help improve the consumer engagement of the content in focus.

“Our key goal is to improve the consumer engagement with the product content.”

The work will provide product marketers with valuable information.

“We are looking at types of consumers, what do they like? Are there identifiable groups of consumers who like similar content? We are mining content to see what’s interesting to premium beef consumers, for example, and how people engage on social media. We’re analysing behaviors to come up with a model to improve engagement with that consumer by predicting the level of engagement of certain content.”

Uncovering what affects user behavior combined with learning on how people interact and their preferences will enable the researchers to derive key components in the model.

“User behaviour is the key to what makes it tick,” Dr Chinthammit says. “We can potentially hone in on a particular group, understand their behaviors and potentially influence their behavior.”

The final goal of the project is to create a mobile application, which is a platform to launch highly engaged content to the targeted group of consumers.
The EU defines ‘traceability’ as the “ability to track any food, feed or food-producing animal or substance that will be used for human consumption through all the stages of production, processing and distribution”. The Southern Rock Lobster component of PTM will develop a practical traceability system for this premium export that will add value for Tasmanian, Victorian and South Australian fishermen and reduce risk to the industry and consumers.
TRACEABILITY SYSTEMS FOR WILD CAUGHT LOBSTER

A major PTM project is creating a traceability system to track and monitor Southern Rock Lobster that will be transferable to other perishables.

The project targets issues of resource management and food safety, as well as addressing a range of supply chain requirements, including those of regulators, buyers/importers and end-point consumers.

Lead researcher Dr Luke Mirowski says it’s the first traceability system for any live caught fish in Australia and has major benefits.

“It’s a practical research and development project focussed on the traceability of southern rock lobsters coming out of Australia and going into China,” he says. “Traceability is important here because when the product hits Chinese shores it loses context around where it’s come from, how long it’s been in the supply chain and its true value.” The majority of fish is sold as a live product into the Chinese market. “This is particularly important in light of the Chinese Australia Free Trade Agreement which may significantly alter the commercial and regulatory environment,” Dr Mirowski says.

“We are working with all stakeholders in the supply chain including major rock lobster exporters in Australia to develop proof of concept technologies to show the industry how to better brand their product and provide provenance to stand out in the market and gain a competitive advantage.”

Other objectives of the project are sustainability and safety. By leveraging traceability technologies, management of the valuable catch can be more precise. The end result is a more resilient industry and a reduction in supply chain shocks.

“At the moment the catchments are quite large,” Dr Mirowski says. “With these technologies, we can say where the product comes from; if there’s an algal bloom, we’re aiming to pinpoint it to a catch-zone rather than the whole State. Toxic algal blooms are quite unique to Tasmanian waters but the Tasmanian product is mixed with interstate product, so contamination in Tasmania can shut down the entire industry.”

The principles can be applied to all perishables – including other major Tasmanian exports such as beef, oysters, abalone, and salmon. There are several practical sub projects underway, including tagging rock lobsters using QR codes; investigating water quality in the ocean, on the boat and in the factory – to provide assurances around safety and freshness; and whether a rock lobster can be authenticated based on spine patterns.

“We’re looking at whether you can be in Shanghai and take a photo on your mobile phone of the lobster in front of you and get confirmation back that it was caught in Tasmania, put in a box and sent to China,” Dr Mirowski says. “We could develop an app that will tell you whether it’s 100% Australian, from Tasmania and where and when it was caught. There might be enough detail on the spine pattern to make it feasible, which would make tagging technologies obsolete.”

Providing industry solutions is always front-of-mind.
MEASURING NATURAL CAPITAL

Accounting for any changes in the status of natural capital (the ecosystem) is fundamental to efforts to determine how natural resources and environmental assets are being used in production systems, particularly in agriculture.

Another ambitious component of the ARC Pathways to Market program at UTAS has been Natural Capital Accounting research conducted by Assoc Prof Tihomir Ancev at the University of Sydney with Pathways’ post-doc Dr Samad Azad.

This work has tackled the ‘Holy Grail’ of environmental management; an index which measures the status of the ‘natural capital’. PTM Director Dr Laurie Bonney said this has been a challenge for natural resource economists all over the world for many decades and Prof Ancev and Dr Azad have made significant steps forward that will be useful for the strategic monitoring of our ecosystems by agencies such as the ABS and ABARES.

Combined with the near-future for the sensing of critical anions and cations in our waterways, also being developed by Pathways to Market, landscape managers will soon have new technology to combine with qualitative measures to support brand integrity of Tasmania’s high quality produce.

NEW HARVEST TECHNOLOGY WATER SENSORS, ACCURATE TO PPB, TO ASSIST BRAND INTEGRITY FOR CAPE GRIM PREMIUM BEEF

Streams, rivers and lakes are the veins and arteries of the environmental landscape. Monitoring the water quality of these waterways is like taking a blood test to monitor the health of the human body. With increased concern for the health of global waterways, water quality monitoring is a market that will continue to grow.

No current solution exists for effective real time monitoring of dissolved inorganic nitrogen, a key parameter for worldwide fresh water quality monitoring.

Pathways to Market, in partnership with Grey Innovation, a Melbourne based engineering and commercialisation group, have developed breakthrough technology for monitoring agricultural runoff and pollution dissolved in water. Using research conducted by Professor Michael Breadmore of the University of Tasmania, Grey Innovation has developed the basis of a new water quality monitoring services business; Harvest Technology Group. The Harvest water quality monitoring technology has been successfully field tested and is ready for further development and cost-reduction.

Just prior to Christmas 2017, Grey Innovation and Pathways staff conducted successful Alpha Prototype field trials in the Derwent Valley, Tasmania. About an hour out of Hobart, the Alpha Prototype trials successfully detected phosphate and dissolved inorganic nitrogen (nitrate, nitrite, and ammonium) with a high level of sensitivity.

With future water quality market requirements increasing rapidly, the Harvest technology will fulfil an immediate unmet need in providing an accurate, real-time monitoring solution to replace current monitoring programs. Current markets include councils, and local water authorities who are looking to increase sampling frequency and locations, as well as reduce the costs associated with manual monitoring. Industry groups and producers have a vested interest in the Harvest technology to monitor water quality, demonstrate environmental compliance, and maintain brand integrity.

Harvest Technology is already gaining large interest from parties throughout Australia and New Zealand. With world-wide applications, Harvest Technology Group will continue to grow as governments spend heavily to increase the accuracy, and frequency of water quality monitoring.
SECURITY IN FOOD QUALITY

COMPANIES SHIPPING PERISHABLE FOOD PRODUCTS CAN REDUCE RISK OF SPOILAGE FROM A VALUABLE TOOL DEVELOPED BY PTM RESEARCHERS

They've generated data-driven models to predict the safety and quality of food products as they move through the supply chain, from the farm gate to the consumer.

The model predicts the growth of microorganisms such as bacteria in vacuum-packed premium beef, and has been validated in both simulated and actual commercial supply chains.

Project director, Professor Mark Tamplin, says it has huge potential.

“For simulated conditions, meat packs were subjected to static and fluctuating temperatures to simulate increases in temperature during loading operations and potentially abusive temperatures,” Dr Tamplin says.

“For commercial supply chains, temperature sensors were positioned in consignment containers and count levels determined for product prior to shipment. At the end of shipment, sensors were retrieved and count levels measured. The results validated the use of a laboratory-generated model in actual commercial supply chains, providing industry with relevant tools for supply chain risk management.”

The profiles show companies the microbiological status of the product in their shipping systems and how to make improvements at certain points along the supply chain.

"In the future, we want to demonstrate how you can use predictive models with sensors for real time measurement – uploading the information into a mobile phone system with a range of different telemetries such as LoRa technology or satellite communications for example, where information feeds into a proprietary cloud that can then be accessed,” Dr Tamplin says. “You can watch your product move over a map, hover your mouse over it and see the temperature at any point along that route in real time. We’re showing how a sensor in the supply chain can be a value-add.”

Alongside consumer health benefits, come big dollar gains for any perishables.

“If a company ships a meat product to a country and it gets rejected, it falls back on the company,” Dr Tamplin says. “We’ve been able to save companies money as well as reduce their insurance rates. We’ve said ‘give us your time temperature profile and we can put it into our model and show you what went wrong, where and when. It’s very powerful.’

PTM Director, Assoc Prof Laurie Bonney, says this complementary effect of the technological developments by the project was the most exciting aspect. "Combining Prof Tamplin’s work with telemetry and computer modelling brings an unprecedented capability for lead suppliers to manage their products on retailers’ shelves to optimise profit in real-time."
Pathways' Mobile Telemetry Research Trailer

Pathways is very fortunate to have the collaboration of David Jones and his wife Dr Joanna Jones (from the Tasmanian Institute of Agriculture) on their Hamilton dairy and grazing property.

To minimize the impact of our research on their property and to maximize the protection (from animals) and mobility of our research equipment, Sense-T engineers led by Simon Edwards have set up the equipment in a car trailer. This will enable the Pathways team to conduct telemetry research anywhere in the State quickly and easily.

The next phase of the Pathways telemetry research is seeking industry and corporate co-investors to conduct broader scale research into multiple telemetry technologies for different applications in different rural environments.

“Each telemetry technology has different capabilities for data transfer and these need to be understood so farmers and agribusinesses can get the best performance from their investment in sensing,” Dr Bonney says. “We’ve already experienced a situation in our pilot radio survey where the project team in two locations, separated by several hundred metres but with direct line of sight, could not establish a signal between them. Topography, micro-climatic conditions and interference from signal reflections and other transmissions make it essential to understand ‘fitness-for-purpose’ with telemetry solutions”.

Enquiries from additional parties interested in realising the benefits of the research are welcome. Please contact:

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