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Resource-Constrained Innovation: A Viable Strategy for Firms in the Australian Food Processing Industry?

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Abstract

As a strategy to develop new markets, resource-constrained innovation (RCI) is the road less-travelled by Australian food processing firms. Despite the unique challenges of this approach, elsewhere in the world firms are having significant successes. Among scholars, interest in this topic is gaining momentum because of its perceived importance to billions of resource-constrained consumers globally. In this paper we use a qualitative approach by means of semi-structured interviews with industry experts to investigate and report on the low awareness and engagement levels of RCI and the challenges managers face when contemplating RCI. Topping the list are a lack of RCI understanding among managers at all organisational levels; how to avoid damaging existing premium brands when RCI is part of the product-mix; and the sea change in mindset and practice that would be necessary to pursue RCI with reasonable success. To demonstrate the opportunity scope of RCI across the various stages of the food processing value chain, we describe a number of Australian and overseas cases. Our recommendation is not for firms to abandon their current approach of 'bigger and better' when developing premium products and markets, but to simultaneously explore the potential impact of 'smaller but good enough' thinking when addressing the needs of resource-constrained consumers. The insights this paper provides attempt in helping Australian policymakers, industry advisors,

company boards, strategists, company shareholders and investors, and new product development teams with much-needed understanding on how to support, promote and pursue RCI.

Keywords: Resource-constrained innovation, food processing, innovation, frugal innovation, cost innovation, good enough innovation, Australia

1. Introduction

Over the past decade a myriad of studies have emerged on the needs of developing and so-called bottom-of-the-pyramid markets including the opportunities they offer to product developers (Jaques Angot & Plé 2015; Pervez, 2013; Varman, Skålén, & Belk, 2012). Western firms are increasingly targeting emerging markets through what is collectively known as Resource-constrained Innovation (RCI), and they often achieve great success in doing so. Govindarajan & Trimble (2012) and others (Zeschky, Winterhalter, & Gassmann, 2014) suggest that the 'rules' of RCI are significantly different from that of traditional product development. It appears that, to be successful with RCI, engineers and designers need to undergo a huge change in mind-set regarding the application of standard Research and Development (R&D) practices when engaging in RCI. It is advisable that managers across all business disciplines find new approaches to strategy formulation, remote governance, logistics and supply chain management, forging new types of strategic alliances, marketing and financial accounting. This is due to the fact that the established 'best-practice' approaches that are dominant in the developed markets do not work well in developing markets.

Although some Australian firms have embarked on this path, the majority are yet to realise the huge potential of this strategic approach to growing revenue through a combination of product and market development activities that are tailored to the un-served and underserved needs of consumers in emerging markets. The aim of this study is twofold. First, it aims to raise awareness among Australian food processing firms of the types of innovation opportunities that RCI offers, with a mix of Australian and international examples. Secondly, it aims to gather insights into the mindset of managers, the industry's readiness to pursue RCI, and perceived challenges in doing so within the Australian food processing industry. Without such understanding, policymakers, industry advisors, company boards, strategists, company shareholders and investors, and new product development teams will be ill-advised on how to pursue RCI opportunities.

What follows is a brief RCI overview and how it specifically relates to the food processing industry. RCI examples are provided at each stage of the value chain to demonstrate the opportunity scope of RCI. The next section identifies innovations in the food industry over the past decade. These are obtained through a combination primary and secondary desk research. The research methodology is reported and is followed by the analysis, findings, discussion and recommendations.

2. Resource-constrained Innovation

Before we look at RCI examples specific to the food industry, it is important to first define the RCI concept. According to Zeschky et al. (2014, p. 20) RCI is defined as 'innovation for resource-constrained consumers in emerging markets'. To expand further, e-Cunha et al. (2013) explain exactly what the 'resource-constrained' part of RCI means - namely, market conditions where 1) material resources are scarce, 2) when time is scarce, and 3) when affluent customers are scarce. Zeschky and colleagues furthermore distinguish among three types of RCI: Cost Innovation (CI), Good-enough Innovation (GI); and Frugal Innovation (FI). Each of these typologies forms a cascading hierarchy in that each innovation type incorporates the others but requires different technological and organisational capabilities (Zeschky , Widenmayer , & Gassmann 2014; Zeschky et al., 2014).

With cost innovation, the focus is on designing for the lowest cost to meet local economic conditions and environments of an emerging market. It seeks cost advantages through tactics that include process improvements, using readily available components, and through seeking local cost advantages for R&D and production (de Waal, 2016; Zeschky et al., 2014). Good-enough innovation moves beyond transference of an existing product to a low cost environment. Pre-existing products may be re-engineered or adapted to fit specific use requirements not just limited to cost. By using in-depth knowledge of the customer and use environment, the product acquires novelty: value-adding functions are customised, non-essential features reduced or eliminated, whereas ease of use and manual functions are highlighted (Zeschky et al., 2014).

Frugal Innovation often, though not always, fulfils the same basic purpose as an existing first-world product but is engineered, from scratch, specifically for resource-constrained consumers in emerging markets. To achieve this, frugal innovations often utilise new technology platforms and product architectures and hence are offered at a much lower price from the customer's perspective, typically 10 to 20% of the equivalent premium product, while fulfilling all relevant quality and regulatory standards (Herstatt & Tiwari, 2017; Weyrauch & Herstatt, 2016). They often constitute radical innovations and may contain disruptive elements. Recent research also suggests an increasing relevance of frugal innovations in the context of industrialised countries (Kroll, Gabriel, Braun, & Muller, 2016; Prabhu, 2017; Tiwari, Fischer, & Kalogerakis, 2017; Zweck, Holtmannspötter, Braun, & Hirt, 2017).

3. RCI Examples in the Food Industry

Food processing is concerned with the conversion of raw agricultural and horticultural produce, milk, meat and fish into a commodity suitable for human consumption. It is "[…] a process of value addition to the agricultural or horticultural produce by various methods like grading, sorting and packaging" (Meredien, 2013, p. 4) "[…] a technique of manufacturing and preserving food substances in an effective manner with a view to enhance their shelf life; improve quality as well as make them functionally more useful" (Meredien, 2013, p. 4).

The food processing industry's value chain is depicted in Figure 1 below.

Figure 1: Food Processing Industry Value Chain

Source: (Tiwari, 2017)

In this study, we use Tiwari's, (2017) five stage model of the food processing industry's value chain as shown in Figure 1 as a basis for demonstrating the RCI types.

Phase 1: Production

Case 1-1: The Oggun Tractor in Cuba (Good-enough Innovation)

Cleber, a tiny Alabama-based LLC, have used the principles of frugal innovation to meet the changing needs of agriculture in Cuba (Julia Sagebien & Herrero, 2017). Small-hold and cooperative farmers farm 70% of Cuba's arable land. They faced significant challenges including lack of fertilizer, seeds and fuel, obsolete technology and inefficiencies in transport and distribution. Their problems were compounded by the low average income of Cuban customers, around $25 per month, and a growing tourist sector that expects quality produce. Cleber realised that the onslaught of US tourism was going to hit Cuba hard and they needed to be able to generate better produce at a low cost. They set out to develop 'good enough' solutions to the Cuban produce issue that were affordable and easy to use.

Figure 2: The Oggun Tractor

Source: https://www.rurallifestyledealer.com/articles/6112-the-oggun-model-a-tractor-company-without-dealers

After listening to the Cubans and the Government about their needs, they found that the patents for the Allis Chalmers Model G tractor had expired. They were able to copy the basic design, update some of the technology and use of-the-shelf parts to produce a low cost, quality tractor that was suited to small plots of land. The Oggun tractor (Figure 2) is relatively inexpensive, easy to operate and maintain. As well as a tractor, the Oggun is an excavator and skidsteer loader, which makes it applicable to the growing Cuban construction industry as well as agriculture. Cleber is already receiving enquiries from Latin America, Africa and Asia who are interested in the low cost product, which means that there are growth opportunities into different segments and markets. This simplified product is an example of 'doing more with less'.

Case 1-2: Vertical Farm Systems (Frugal Innovation)

The practice of vertical farming (Figure 3) took off in Australia in 2009 when Vertical Farm Systems Pty Ltd built their first plant in Queensland, Australia ("Vertical farm Systems - Growing for the Future," 2018). Vertical farming is the innovative practice of producing food in vertically stacked layers, surfaces or structures to produce maximum output from minimum input of labour and resources. As it operates independent of skilled labour and does not depend on favourable weather, high soil fertility or high water usage, it is a revolutionary approach to producing high quantities of nutritious and quality fresh food in all seasons. Because vertical farming systems are fully enclosed and climate

controlled, the design completely removes external environment factors such as disease, pest or predator attacks. This innovation is frugal in nature because production overheads are commercially competitive and predictable; minimum overheads and grow costs are maintained through low energy usage, low labour usage, low water usage, reduced washing and processing, and reduced transport costs. Examples of suitable crops include Baby Spinach, Baby Rocket, Loose leaf Lettuce, Endives, Tatsoi and Basil.

Figure 3: Vertical farming in Queensland, Australia

Source: http://www.verticalfarms.com.au/about-us

Case 1-3: Weed-destroying Invention (Cost Innovation and Frugal Innovation)

Ray Harrington, a Western Australian farmer, with the help of the University of Western Australia, developed the Harrington Seed Destructor (Figure 4) that effectively pulverises weed seeds to the point where they are no longer viable (Adams, 2017). His invention addressed the problem of weeds such as annual ryegrass increasingly developing herbicide resistance. Hence, after harvesting, when chaff is spread back over the paddocks, the pulverised seeds won't germinate and provide clean crops as a result. This invention also reduces the reliance on expensive herbicides (cost savings through process innovation) which makes it ultimately a more sustainable solution to the problem. Other principles of frugal innovation is the utilisation of cage mill technology adapted from the mining industry and can be machine can be retro-fitted into modern grain harvesters – 'make work with what is at hand'.

Figure 4: The Harrington Seed Destructor

Source: http://www.abc.net.au/news/2017-06-17/australian-farmers-invention-draws-world-interest/8619826

Phase 2: Handling and Storage

Case 2-1 Chotukool fridge (Good-enough Innovation)

The Chotukool fridge (Figure 5) aims to reduce food wastage in India ("Chotukool: Keeping things cool with frugal innovation," 2013). 80% of Indian households don't have access to a refrigerator, particularly in rural areas. The 45 litre plastic fridge can cool food to 8-10 degrees and is powered by a 12 volt battery. It was specifically designed as a 'good enough' product to meet the daily needs of people who cannot afford refrigerators with unnecessary functionality that would drive up the price. The focus on core functionality that is affordable has resulted in some changes to the traditional refrigerator design. The traditional domestic fridge compressor technology has been replaced with a thermoelectric or solid state cooling system. It has a top, rather than front opening, to reduce the cool air lost when it's opened.

Figure 5: Chotukool Fridge

Source: http://coldstarlogistics.com/blog/chotukool/

Addressing this unmet need created a new market and some surprising uses. Small shops and kiosk owners are using the Chotukool fridge to increase their earning potential. Rather than traditional distribution methods the India Post network, around four times larger than the best logistic suppliers, was used for distribution. Marketing was done by word of mouth, which was slow, but more appropriate for the varying messages that were important in the different regions of India. The intention with the next version is to bring the temperature down to 2-8 degrees. This would mean that small quantities of medicines and vaccines would be stored creating new markets and opportunities.

Phase 3: Processing and Packaging

Case 3-1 Cheetah tomato dryer (Cost and Frugal Innovation in Processing)

In Tanzania's Iringa region, a dry and dusty farming area, Cheetah, a non-profit organisation is working with poor Tanzanian farming communities to improve their ability to earn an income from farming (Murphy, 2013). Tomatoes are one of the staple crops. However, it is estimated that around 40% of the crops are lost. This is partly due to poor storage and a lack of places to sell the tomatoes. A frugal approach to the issue resulted in the development of a solar-based food dryer (Figure 6), meaning that crops can be dried quickly and stored more easily at home.

The dryer is used for tomatoes, onions and eggplants as expected, and one woman is using it to dry fish, which is a surprising use. Cheetah intended that the dryer be shared amongst a few farmers; however, it has been shown that larger groups, around 25 people, are pitching in to make the purchase more affordable. As drying takes a day and a half, the group meets monthly to work out a schedule for sharing the dryer. Because the dryer depends on the sun, cloudy days can affect the schedule. The dryer focuses on core functionality, is robust and environmentally and monetarily affordable. This frugal approach to improving processing is making a difference in Tanzanian farming communities.

Figure 6: Cheetah Tomato Dryer

Source: http://www.humanosphere.org/environment/2013/10/finding-a-business-solution-to-tanzanias-agriculture-problem/

Case 3-2 Mushroom Farming (Cost Innovation in Processing)

A team of young Australian entrepreneurs from Fremantle launched their business taking coffee ground from Australian cafes and using it to grow gourmet mushrooms ("Mushrooms are our future," 2017). This is frugal innovation in action - utilising coffee waste as basis for their organic mushroom farms located at unused commercial spaces in town. After harvesting the mushroom infested coffee grindings is distributed as a soil amendment for local gardeners. In doing so they help reduce waste and landfill, while simultaneously providing sustainable living in the modern world. The company has also developed a mail-order kit for growing your own mushrooms at home (Figure 7).

Figure 7: Life Cykle's Home Grown Mushroom Box

Source: https://lifecykel.com/

Case 3-3 Danone Yoghurt Pouch (Frugal Innovation in packaging)

Danone is a multinational agri-food company that is taking what it learns from developing countries and applying the knowledge to markets in developed countries, such as Poland and France (Faivre-Tavignot, 2016). Their goal is to reconcile the fight against poverty with the profit motive. They have challenged their traditional approach to innovation by observing and listening to consumers in developing countries. As a result they implemented several bottom-up initiatives to learn from and implement lessons from resource-constrained innovation.

While Danone's core business is fresh dairy products they had a strategy to reach 1 billion consumers. They realised their current products were not really suitable for very low-income areas in tropical or hot areas. Consequently, they developed yoghurt to meet the taste and nutritional needs of children and to fight malnutrition in both Bangladesh and Senegal. Their R&D efforts resulted in a pouch or type of carton (Figure 8) that was made from local grain and a small amount of milk, which meant that it could be stored at room temperature and had a long shelf life. They also introduced micro-factories, which are small sized factories that employ locals to develop products by hand to maximise the number of jobs. These factories are powered by energy sources such as rain and sun. They used a network of 'shokti ladies', who sell products on commission door-to-door and rickshaws for distribution. Their frugal innovations have produced a resource-efficient and user-friendly product that provides growth opportunities for the company, as well as a resource constrained innovation approach.

Figure 8: The Danone Pouch

Source: https://groceries.asda.com/product/kids-yogurts/danone-disney-frozen-strawberry-yogurt-pouches/910002416317

Phase 4: Marketing and Distribution

Case 4-1 Unilever Europe – Low-cost, single-serve marketing

Unilever sells its products globally, with over half of its business conducted in developing countries ("Unilever Cuts Package Sizes in Euro Crisis," 2012). However, the economic situation in the US and Europe has meant that in some areas people have less disposable income or are dealing with unemployment. Unilever realised the strategies used in developing countries, such as small, affordable sizes of their products, were now relevant to parts of Europe undergoing economic difficulties. The company was inspired by the sachet-size detergent and soap products (Figure 9) that have been sold to cost-conscious consumers in countries such as India. With this marketing approach they start with a price point in mind that customers can afford, then work along the supply chain to see if they can make a profitable business from it. This cost innovation approach helps protect Unilever business where there is economic downturn in traditionally strong markets. The principle where RCIs trickle their way back from being successful in developing markets to first-world markets, is known as reverse innovation (Govindarajan & Trimble, 2012).

Figure 9: Unilever Sachets

Source: https://www.triplepundit.com/2017/05/unilever-test-new-sachet-recycling-technology/

Applying marketing strategies used in developing countries to developed countries has resulted in Unilever maintaining relevance to people with increasingly limited budgets. Focussing on core products in smaller, more affordable sizes is a cost- innovation approach to enduring in developed markets.

Case 4-2 Smashed Avocado

A decade ago the avocado, also known as an avocado pear or alligator pear, were just another nutritious fruit. Because of the arguably frugal inception of 'smashed avocado on toast' (Figure 10), avocados have since ascended from being the "poor man's butter to food of the elite café class, families and super health conscious" (Walmsley, 2017). This has sparked mass demand for the fruit to be used in many forms all over the world - "now it's smashed avocado for breakfast, avocado smoothie for morning tea, avocado in sushi for lunch, avocado in tacos for dinner and… wait for it… avocado brownies for dessert" (Finkel, 2017). Consequently, turnover in the Australian avocado industry grew from $340 million to $920 million over the last decade. This is a frugal innovation success story that proves that significant value can be added by the most modest means; in this case, recipes that fuelled the uptake of avocados in ways people never thought possible.

Figure 10: Smashed Avocado on Toast

Source: https://www.bbc.com/food/recipes/smashed_avocado_on_toast_89082

Phase 5: Consumption

Case 5-1 Philips Noodle machines – frugal innovation / reverse innovation

Phillips' Kitchen Appliances Innovation and Development team based in Shanghai saw an opening in the market to help Chinese people maintain their ancient tradition of noodle making that was disappearing (Ali Khan & Shan, 2016). They developed a noodle/pasta machine (Figure 11) aimed at bringing these skills back for a new generation. This market was concerned about food safety and healthy ingredients. After a successful introduction into China, the noodle maker was introduced to Japan. Unlike China, the Japanese markets purchase noodles from restaurants or supermarkets, as they don't have the skills to make noodles at home. Phillips went on to enter the North American, Australian, European and South American markets with the pasta maker machine. While 40,000 units were sold in China, 200,000 units were sold in the rest of the world, with North America being the largest market. This is another example of reverse innovation where a multinational organisation

started with the developing Chinese market and from there expanding into developed markets. A robust and user-friendly product was targeted at new segments and markets to tap into the growing demand for health and affordability.

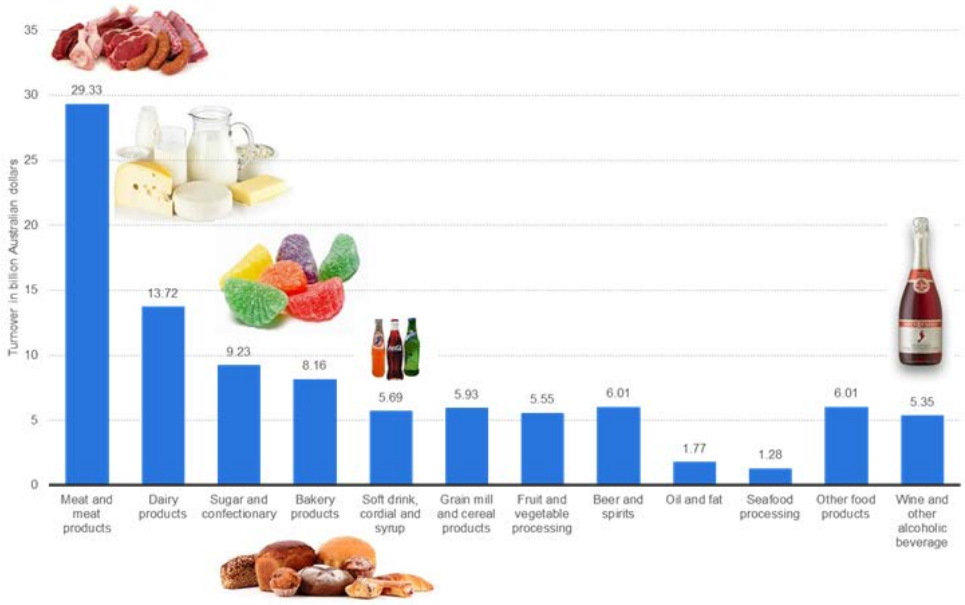
Figure 11: Philips Noodle Machine for Japan

Source: https://www.myer.com.au

4. Food Innovation in the Australian Food processing industry over the last decade

The meat and meat products category is by far the largest sector in dollar terms in the Australian food processing industry (Figure 12). At roughly half the size, dairy products are the next largest sector, followed by sugar and confectionery, and bakery products.

Figure 12: Turnover of the food and beverage manufacturing sector in Australia in 2014-2015, by product class (in billion Australian dollars)



Source: Adapted from EY; Australian Bureau of Statistics; AFGC ID 632825

There is limited academic research available on recent innovations in the Australian Food Processing Industry. While the Australian Food Processing Industry is engaged in innovation, it has not been the focus for this industry over the last ten years. Christopher Su, Business Development Manager, Commonwealth Scientific and Industrial Research Organisation (CSIRO) suggested in a phone conversation on 18 February 2018 (Su, 2018) that there is scope for increased industry innovation to better compete in US, European and Asian countries.

According to Fryer & Versteeg (2008) the key drivers of innovation within the Food Processing Industry are safety, health and wellbeing, improved quality, convenience, price and sustainability. Increases in population, climate change, changing consumer needs and increased global competition create challenges and opportunities for innovation in this Industry. The large number of sub-sectors in the Australian Food Processing Industry means that there is not just one way of solving the challenges that each sub-sector faces, as issues are often specific to a particular sector situation ("Food Processing Industry Strategy Group," 2012; Sun & Bosch, 2012). However, it's now recognised that innovation is important to the Food Processing Industry to meet consumer demand and remain competitive (Bigliardi & Galati, 2013).

Innovation within the fruit sector industry over the last decade has primarily addressed packaging and labelling rather than product innovation (Hattersly, 2013). The Australian dairy industry has relied on existing knowledge regarding its products, focusing more on supply chain and marketing innovation than technology innovation (Su, 2018).

Process innovation often requires significant investment in new plant and processes to meet consumer needs (Fryer & Versteeg, 2008; Trienekens & Zuurbier, 2008). While there has been considerable research into new product and process technologies within the Food Processing Industry, the results are yet to gain senior management acceptance and be applied to commercial situations. When innovations offer multiple benefits with clear financial return it's more likely they will gain commercial acceptance rather than the current trend of minor changes to existing technologies (Fryer & Versteeg, 2008).

Many Australian and international industries utilise food by-products to create functional and nutraceutical[1] ingredients for much greater profit than that of the original food crop (Davies & Kitchen, 2015). Functional foods are described as food products fortified in some way to increase nutrition, resulting in increased health or decreased disease in the body (Bigliardi & Galati, 2013).

Rising obesity levels, population diversity and growth has increased interest in health and nutrition which are driving the market for functional food in Australia ("Functional and Luxury Foods Market Analysis," 2015). The Australian market is emerging, however the demand for functional food is enormous in Asia, particularly in China and Singapore (Su, 2018). Functional foods are seen as a long-term trend with great market potential for different industry sectors, with innovations such as

[1] Nutraceutical: defined as a food, or parts of a food, that provide medical or health benefits, including the prevention and treatment of disease. Source: https://www.pharmaceutical-journal.com/1-what-is-a-nutraceutical/20002095.article?firstPass=false

combining dairy and non-dairy ingredients for nutritional value (Augustin, Udabage, Juliano, & Clarke, 2013; Bigliardi & Galati, 2013).

Australia already produces high quality meat, so the focus of industry innovation is on meat processing and exports to Asia. CSIRO are conducting strategic research projects to make meat more acceptable to the elderly in both texture and digestive ability and to transport chilled meat over long distances while retaining quality (Su, 2018).

While Australians love sugar, there is a growing consumer health demand for low GI (glycaemic index) sugars that is still palatable. Consumer interest in sugar alternatives has increased, particularly natural alternatives for both snack foods and beverages (Lamisere, 2015). There is a large Asian demand for milk drinks without sugar. This is important for Asia due to genetic issues for processing sugars resulting in increased diabetes (Su, 2018). Producing milk drinks with less sugar requires different processing skills to those currently used in Australia and CSIRO is researching advanced technology that separates the sugar but still results in a sweet tasting product (Su, 2018). CSIRO is undertaking research on how to reduce sugar absorption in our bodies while still retaining an enjoyable sweet food taste. As this is a challenge not only for Australia, it has a large potential commercial gain for the industry (Su, 2018).

Innovation research in Australia's fruit and vegetable sector is primarily about waste. In Australia fruit and vegetable waste is significant, largely due to stringent supermarket standards. One item that has a small number of blemishes can mean that the entire carton will be rejected (Su, 2018). CSIRO are researching how to reduce this wastage and improve income for growers by turning produce into nutrient and fibre rich powder for use in food and beauty products, where the price can be five to six times better than the original produce price (Su, 2018).

The shelf life of food products can be extended by innovative technologies such as HPP (high pressure processing), shockwave, microwave and ultrasound treatments (Tyers, 2017). The cost of equipment and installation is likely to be the greatest limiting factor to using these technologies (Jermann, Koutchma, Margas, Leadley, & Ros-Polski, 2015). There have been developments internationally in using intelligent and active packaging, particularly in the meat industry. Safety and shelf life can be improved by intelligent packaging, packages that monitor conditions, make decisions and communicate with consumers, and active packaging (a barrier to food that interacts with the external environment to control the atmosphere within the package). These packaging innovations open opportunities to improve the microbial safety of food (Fang, Zhao, Warner, & Johnson, 2017).

Other developments such as nanotechnology are not yet prevalent in Australia but may increase as issues about trust and safety improve consumer acceptability of these technologies (Fryer & Versteeg, 2008). Nanotechnologies are ultra-small technologies used to manipulate materials. Research is being undertaken in the use of nanotechnologies in the food industry, however it is a relatively new direction ("Nanotechnology and Food," 2016). While this technology has been used to revolutionise the health, textile and information technology sectors, opportunities are seen in the food industry, particularly the dairy sector (Qureshi et al., 2012).

5. Methodology

We followed a qualitative research approach for generating empirical insights into the Australian food processing industry, by means of an industry workshop (stage 1) and in-depth interviews (stage 2) with participants in the weeks that followed. Stage 1 began with the industry-specific workshop in collaboration with the RMIT School of Management, RMIT Food Research and Innovation Centre (FRIC), and the Center for Frugal Innovation of Hamburg University of Technology (Germany). FRIC's database was used to identify potentially interesting industry experts representing business firms, industry associations, government institutions and academics.

The workshop took place with 20 participants on October 23, 2017 in the premises of FRIC. The workshop itself consisted of four stages. Participants were first asked to participate in a short survey that captured their familiarity with and the understanding of frugal innovation, their perception of its potential relevance to Australia's food processing industry and the challenges associated with its implementation. Three presentations by international subject-matter experts were delivered so as to familiarise the participants with the established global perspective in an interactive section with open discussion. This was followed by three focus group discussions. The insights generated in the focus groups were documented and the participants again took part in a post-workshop survey whose structure was similar to the pre-workshop survey. This way, changes in perception of the participants after information exchange and group discussion could be tracked. The workshop results were utilised to generated preliminary insights and identify relevant research questions. For a detailed report of stage 1 results, please refer to Tiwari and de Waal (2018).

Table 1: Interviewee details and affiliation

Interviewee	Interviewee designation	Company type
1	Products Development and Compliance Manager	Multinational dairy co-operative
2	Head Chef	Bakery group
3	Independent Food Industry Consultant	Industry consultancy
4	Manager: Product Development and Testing	Supermarket
5	Food Processing Engineer	Regional food producing and distribution company
6	Food Innovation Consultant	FMCG and Agribusiness Innovation Consultancy

In this study we report on the findings of the second stage research which comprised of six in-depth expert interviews (see Table 1) we conducted after the workshop. Before commencing the study, ethics approval was obtained and in reporting of findings anonymity is retained. The interviews took between 60 and 90 minutes. We followed a semi-structured interview approach around seven themes (see Section 6) that may impact managers' ability to derive informed implications of RCI related to the formulation of innovation strategy. Our qualitative data analysis followed a manual thematic analysis

in which we examined and recorded data within the themes (or "patterns") (Braun & Clarke, 2006) and is reported in the Online Appendix[2].

6. Discussion and Strategic Implications

We base the following discussion of the findings around seven themes that emerged from the industry workshop that preceded the interviews.

6.1 Research and Development

The food industry worldwide is notorious for its low historical spending on R&D, frequently rating at the bottom of the pile of the top 15 sectors (ElAmin, 2005). More than a decade on our study suggests that things in Australia are not any different, reporting 0.5 per cent and less R&D spending on annual turnover, which is very low but in the same ballpark as the European average of 0.24 per cent and the USA average of 0.35 per cent in 2008 (Fortuin & Omta, 2009). Unlike in high-tech manufacturing industries, product development in the Australian food industry lacks structured and formalised development processes, such as Stage Gate (*Managing the Food Innovation Process*, 2013). We found strong evidence though for customer engagement throughout the development cycle, and outsourcing of customer tasting and testing for small firms that don't possess their own laboratories. Reported success rates for new product introductions by the large retailers are only at approximately 5 per cent, which is very low and suggests insufficient market research and opportunity evaluation. Firms furthermore appear to collaborate very little with one another in developing new products, practicing traditional 'closed innovation' characterised by the absence of knowledge sharing, even between divisions of the same companies in different countries. Our research shows little evidence of firms targeting, or making ambitious, strategic plans to target international markets, especially those in growing and unsaturated economies such as China and India. Instead, they focus their efforts on the Australian market and where applicable, leave new product development (NPD) in new international markets to their overseas divisions.

6.2 Product Positioning

Within our sample firms the dominant product positioning is towards the middle and high ends. While some of the major supermarket chains are developing home brands that target cost-conscious consumers, the question remains if these entry-level offerings can truly be categorised as frugal innovations. The jury is out whether producers are truly taking into account opportunities for innovating across the whole value chain when they develop low-cost products. Packaging, for example, is cited as an area that has received very little attention is Australia.

6.3 Regulatory Factors

The participants in our study have mixed opinions with regard to whether food regulations in Australia are more or less strict than elsewhere in the world, and if the established levels of compliance are hindering the introduction of new products, or contributing towards safe consumption. What seems to be less contentious is the view that some regulations, such as the need to indicate best-before and

[2] Authors (later to be identified). (2018). Online Appendix to: Resource-Constrained Innovation: a Viable Strategy for Firms in the Australian Food Processing Industry? Available at www.sitetobespecified.com.au

use-by dates add little value to consumers and drive up costs, directing limited resources on compliance matters away from NPD, and even worse, contributing to unnecessary food wastage.

6.4 Culture and Strategy Constraints

In conversation with participants there is no doubt that in theory their companies view innovation as important and essential to their survival, but in practice they find it hard to implement. Companies struggle to identify opportunities for innovation. When they do they tend to compete in the 'Red Ocean[3]' as opposed to in areas where there is less completion (Blue Ocean). One participant commented "cheese is cheese", which is very telling of the problems companies are facing in coming up with new ideas. A participant representing a large food supplier even suggested that customers seem to prefer the trusted and familiar products, rather than the new. A participant from a smaller food producer confirmed the value of established products and even describing them as 'immortal', yet also acknowledged that customers are known to get bored with the same products and expect companies to stock shelves with new offerings from time to time. We got the idea that, across the board, innovation strategy is very much biased towards product development – e.g. focusing on ingredients, removing sugars, adding health benefits, catering for niches – and not paying sufficient attention to process innovation and addressing improvements within other areas of the value chain.

6.5 Trends

Participants' companies in this study tend to be very aware of things such as sustainability, being environmental friendly with regard to both products and responsible ways to running their businesses that includes recycling. They are also aware of customer demands for convenience, healthier and more affordable foods, as well as the organic movement. It appears that packaging is not on the agenda as much as it is elsewhere.

6.6 RCI Readiness and Implementation Challenges

The awareness levels of RCI in Australia are very low. Even those companies that show some familiarity with one or more of the three RCI types view it more as a thing of the future. Some participants raised the issue of how firms would deal with incorporating the RCI approach with their existing brands in ways that won't harm their reputation with customers. A concerted effort is required to educate both the market and food producers of how critically important it is for not only Australia, but the rest of the world, to address the very important issues of food security through something like RCI, before it is too late. From our study it became very obvious that Australian food processing firms are struggling with innovation in general, not to mention RCI. Even if they knew about its importance, they would not know where to begin and they lack understanding of what the needs of resource-constrained customers are. Compliance matters and regulations take up too much of their time. Food producers are being viewed as very risk-averse and don't show much initiative towards open innovation. It is true for many small operators that the owners still mostly work 'in' their business, rather than 'on' their businesses as they spend most, if not all of their time, on operational matters. Their focus is on

[3] Red Ocean companies try to outperform their rivals to grab a greater share of existing demand. ... Blue Ocean companies, in contrast, access untapped market space and create demand, and so they have the opportunity for highly profitable growth. Source: http://www.blueoceanstrategyaustralia.com.au/what-is-bos/red-vs-blue/

core business – that is 'today's business' – not taking a longer-term view of how to develop future business. Very worrying is a food consultant's opinion that none of his small clients are good at even their core business and that the worst thing that could happen to them, was to succeed at getting export orders. This does not bode well for food innovation in general and even more so for RCI in food. On a more positive note, in recent times significant amounts of government grant funding has been made available with the aim to support the Australian industry to innovate across the whole value chain. One such example is the Food Agility CRC that received funding of $50 million over five years (Gutierrez, 2017).

6.7 Potential Solutions to Problems / Opportunities

The participants to this study were quick to identify very specific opportunities for frugal innovation that include things such as low-cost milk powders, low-cost shredded cheese, more efficient use of fruit and vegetable 'uglies', targeting young families that struggle financially, and a greater exploitation of seafood farming. Some participants identified a serious, almost 'hidden' problem that is not often talked about, namely temperature damage. While no solutions were offered in this regard, this problem poses a huge opportunity for improving the shelf life of products. On the other hand, literature provides some examples of nanotechnology-enabled low-cost, electronic sensors that could provide early warning and prevent food damage (Neethirajan & Jayas, 2011). Others have taken a broader perspective when suggesting new forms of company ownership such as trusts and foundations to address the problem of longevity of firms as a result of ageing owners who do not have exit or succession plans. Companies that face this problem are not in a good position to optimally contribute to the economy or to come up with much needed innovations. Most participants agreed that company-in-isolation approaches must be overcome through greater collaboration and open innovation. Furthermore, fragmented approaches to RCI in only certain areas of the value chain are also not desirable as a holistic approach is required to yield the best results.

7. Conclusion and Recommendations

The study findings show evidence that the Australian food industry, in response to external and profit drivers, is making some effort to innovate – while arguably other factors such as compliance and competing for local market share with lavish marketing campaigns, are taking the main stage. These actions lead to greater food waste and work counter to innovation efforts that aim to yield better efficiencies and productivity. Furthermore, the predominant innovation focus still seems to be the antithesis of RCI – 'doing more' instead of 'doing more with less'. Innovation efforts are often directed to incremental innovations, while those more radical innovations that show potential, struggle along the path to successful commercialisation. The overriding aim with product innovations still appears to favour the premium product, high profit perspective. In Australian companies, the dominant logic is a belief that in order to succeed, new products must have more and better features, and must incorporate state-of-the-art technologies. Examples are fortified food products with better nutritional characteristics; sugarless snacks and beverages that still taste sweet; and the use of nanotechnology to improve food safety aspects.

While firms in their individual contexts may have perfectly legitimate reasons to strive for 'bigger and better', in our view that is just one side of the coin. We've demonstrated throughout the food

processing value chain how RCI efforts result in 'smaller but good enough, thank you very much' solutions that potentially can make a huge impact on a very large portion of the human race. These solutions often, but not always, utilise existing or known technologies as has been the case with the Chotukool fridge and the Oggun Tractor. Low-tech solutions in combination with creativity and pragmatism have the potential to contribute significant economic savings while at the same time having minimal impact on the environment. The solar operated Cheetah tomato dryer is a good case in point. On the other hand, frugal innovations can be also induced by high-tech such as nano-technology, leading to radically new, affordable and resource-efficient products and services. While there is some evidence that Australian food producers and manufacturers are starting to engage with RCI, in our opinion this side of the coin disproportionally loses the toss. There are great opportunities across the entire value chain that deserve some attention.

Given its high importance, food related R&D spending is far too low in Australia. It is advisable that firms set aside special funding to enable dedicated teams to identify and pursue RCI opportunities for both Australian and international markets. This makes economic sense as the so-called M2 (mid-range) and M3 (low-end) market segments are much bigger and faster growing than the M1 (high-end) market segment (*Think Act Frugal Products*, 2015) and ripe for the picking in terms of RCI products and services.

Like elsewhere in the world, obstacles to pursuing RCI are numerous and often very challenging. But that should not come as a surprise to those in the innovation business. Obstacles did not deter the likes of General Electric, the Renault-Nissan Alliance, GlaxoSmithKline, or Unilever. Granted, they are big name companies with relatively less-constrained budgets than smaller players, but great successes are also in the making by entrepreneurial startups as shown by the examples earlier in the report. We are not calling for lesser health and safety compliance measures in the food industry that will put people in harm's way, but the regulatory bodies need to follow a common sense approach when formulating policy that takes into account and minimises food wastage.

In Australia, the RCI awareness level is almost non-existing. It has become necessary, and a matter of urgency, to promote RCI and its potential benefits widely to both producers and consumers. As one interviewee commented, "the last time a frugal mindset prevailed in Australia was during WWII". A sea change in mindset is required within all levels of management. It is time again to think and act frugal.

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