Determinants of Radical Product Innovation in the New Zealand Food and Beverage Industry

A thesis presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Product Development at Massey University, Manawatu, New Zealand.

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2019

Abstract

This thesis presents an empirical study that investigates the radical product innovation phenomenon in the New Zealand food and beverage industry. Its major objectives are to posit and test determinants of radical product innovation and their relationship in explaining product innovativeness, using the New Zealand food and beverage industry as the study context. The New Zealand food and beverage industry was chosen because of its long history of successful radical product innovation and the importance of that industry to the New Zealand economy.

A conceptual model is proposed, based on the literature and content-validated through field interviews with five New Zealand food and beverage companies known to be innovative. The conceptual model is then theoretically-tested using quantitative data collected from 137 food and beverage companies in New Zealand. The research hypotheses were formulated to validate five posited determinants of radical product innovation, including their interrelationships in explaining and predicting product innovativeness. In addition, the study tests the effect of company characteristics on product innovativeness and projects the salient features of a typical highly innovative New Zealand food and beverage company.

The study confirmed the five posited determinants—top management innovation capability (TMIC), internal innovation capability (IIC), external networking capability (ENC), innovative organisational culture capability (IOCC), and innovative product development capability (IPDC)—are causally related to product innovativeness (PI). Of the 12 hypotheses that constitute the theory, four were not supported by data, in that the direct effects of TMIC on IPDC, IIC on IPDC, and ENC on IPDC were found to be non-significant ($p > 0.05$); also, the direct effect of IIC on ENC was found to be negative. The reasons for these discrepancies are discussed and the results are interpreted from a practical perspective.

In regard to the effect of company characteristics on PI, younger companies as well as larger companies were found to be more innovative than their older and smaller counterparts. The effect of foreign ownership was not supported by data, probably due to a small sample size of overseas owned companies. The study also shows that a highly innovative New Zealand food and beverage company typically scores highly in the scales of the five posited determinants. Young (founded since 2011), and medium to large in size (50+ full-time employees) firms also tend to outperform their counterparts in PI.

Acknowledgements

I am extremely grateful to Professor Allan Anderson for his supervision and patient support. His teaching and expertise in Product Development are what inspired me to study Product Development and start this research.

I also am extremely grateful and very thankful to Dr. Nihal Jayamaha for his statistical expertise and supervision. His guidance and encouragement, particularly near the end, are what allowed me to complete this thesis.

Special thanks to Dr. Aruna Shekar for her supervision and insightful comments, Mr. John Gawith for his supervision during the first year of my programme, and Professor Paul Childerhouse for his input during my research methodology development.

Furthermore, I appreciate that Massey University gave me the Doctoral Scholarship, and the School of Engineering and Advanced Technology accepted me as a student. The Massey staff are always helpful, and I am very grateful for their help, suggestions, and support.

In addition, I owe a big gratitude to the New Zealand food and beverage companies who participated in my interview and online survey. Without their participation, I would not be able to complete my research. I am thankful to the New Zealand Food & Beverage Directory and Kompass for providing me with the company contact information, Ms. Rosemary Hancock for introducing me to the NZIFST member, Mr. Mark Ward for explaining to me the FoodHQ, and many other people in the New Zealand food and beverage industry that I could not mention here for giving me their input, suggestions, and assistance.

Lastly, I would like to thank my parents for their tireless support and encouragement. Without them, I would not be able to complete this research.

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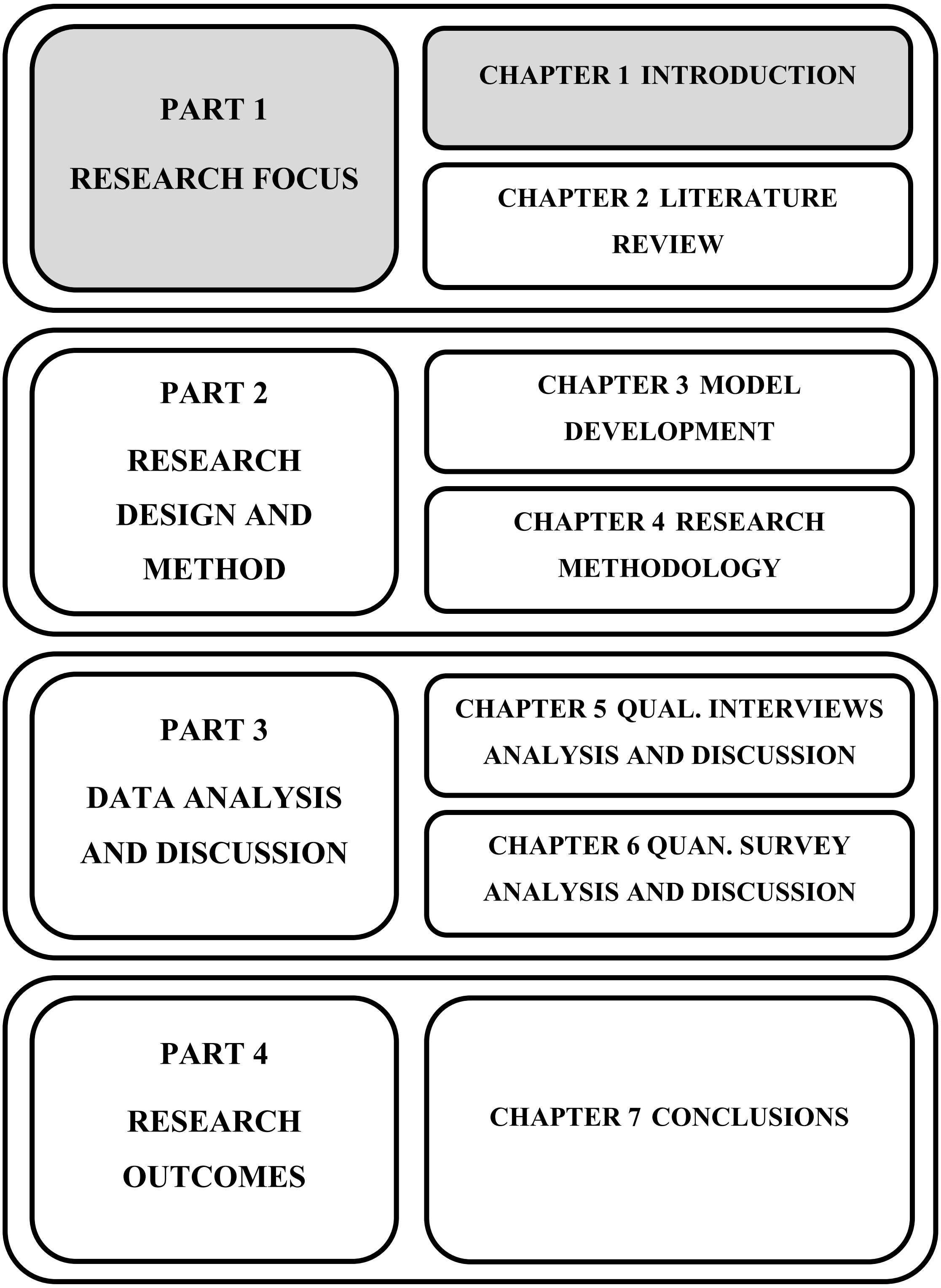
PART 1: RESEARCH FOCUS



CHAPTER 1 INTRODUCTION

1.1 Chapter Overview

This chapter provides an overview of the research. First, the research background is explained in section 1.2. The research aim and research objectives are then outlined in section 1.3 and 1.4 respectively. Afterwards, the research questions are discussed in section 1.5 and the methodology used to answer them is summarised in section 1.6. Finally, the thesis structure explaining each chapter of the thesis is presented in section 1.7.

1.2 Research Background

New Zealand is a small island country located in the Southwest Pacific Ocean. The country is relatively isolated from major markets such as Europe, USA, or China. However, because of its temperate climate, fertile soil, and long coastline, New Zealand has an excellent environment for agricultural and horticultural production. The favourable environment, combined with New Zealand expertise and innovative ideas in food and beverage production, have allowed New Zealand to become a major global food and beverage supplier (Coriolis & MBIE, 2014; Riddet Institute, 2011). New Zealand is the world's largest exporter of dairy products and lamb, and also a major exporter of beef, kiwifruit, apples, and seafood (Wilkinson, Morris, & Hall, 2015).

The food and beverage industry has a major role in the New Zealand economy. The industry produces and exports a variety of food and beverage products to all over the world. In 2015, the industry accounted for around 46% of New Zealand's total export value (The Treasury, 2016). The industry is defined here as the companies in New Zealand that are manufacturing, processing, producing, or wholesaling food and beverage products.

Many successful New Zealand food and beverage companies earn revenue from new products. For example, Fonterra, a New Zealand multinational dairy co-operative and New Zealand's largest company, is responsible for 25% of New Zealand's total export earnings (Fonterra, 2018). The company recognises that new and innovative dairy products are important for its competitiveness and growth. It has the world's leading dairy Research and Development Centre in Palmerston North, New Zealand. The Centre, working together with its overseas sister centres in Melbourne, Amsterdam, Chicago, Shanghai, and Singapore, has developed many world first dairy products such as spreadable butter, Anlene™ range of bone nutrition products, functional milk protein concentrates, ClearProtein™, and Textured White Base™ ingredients (Fonterra, 2016). Furthermore, the company has an "open innovation" policy, which encourages contribution from its external partners to develop new products and technologies and has active research partnerships with many universities and research facilities around the world (Fonterra, 2016).

Another innovative New Zealand company is Zespri International Limited. Zespri is the world's largest marketer of kiwifruit. This company, like Fonterra, is a co-operative owned by local kiwifruit growers. The company also recognises the importance of product innovation in meeting changing consumer demands and driving growth. Working with local research organisations, the company continues to research and develop new varieties of kiwifruit and to improve the current varieties' taste and resistance to diseases. Its most notable product innovation is the Zespri Gold, a variety of golden kiwifruit. Launched in 2000, the game-changing golden kiwifruit variety has added nearly $4 billion to the New Zealand economy (Zespri, 2015).

The last example of New Zealand companies that focuses on innovation is Silver Fern Farms. The company is the leading processor, marketer, and exporter of lamb, beef, and venison in New Zealand. It is 50% owned by local sheep, cattle, and deer farmers and the other 50% is owned by Shanghai Maling from China. The company recognises the importance of product innovation in driving profitability. The company uses its own "Plate to Pasture" strategy to develop new products (Silver Fern Farms, 2018, para. 2). The strategy allows the company to identify consumer needs and then to develop innovative products to meet those needs. This has allowed the company to achieve higher returns. Some product innovations from the strategy are the chilled products, branded food service range, and value added retail products which added up to 19% of the company's total global sales in 2015 and are important growth drivers for the company (Silver Fern Farms, 2018).

The above examples show that product innovation is essential for the success of these companies. Product innovation or the introduction of a new good or service is important for company success because it maintains company competitive advantage and generates new growth (Cooper, 2011; Lee & Markham, 2016).

Product innovation can be classified based on its degree of product innovativeness into incremental and radical product innovation (Garcia & Calantone, 2002). Incremental product innovation is a new product with a low degree of innovativeness. It represents a minor improvement in product performance or change relative to previous products. Incremental product innovation as a result of *routine innovation* is important because it allows companies to maintain their competitive advantage through continuous product performance improvement (Pisano, 2015).

On the other hand, radical product innovation applies to new product that involves a high degree of innovativeness. It represents a significant improvement in product performance or departure from previous products. Development of radical product innovation, like incremental product innovation, is important in maintaining competitive advantage (Pisano, 2015). However, because of its high degree of innovativeness, it often leads to superior product advantage or an entirely new product category (Golder, Shacham, & Mitra, 2009; Kleinschmidt & Cooper, 1991; Leifer et al., 2000). Superior product advantage is a major factor for product success (Cooper & Kleinschmidt, 1987; McNally, Cavusgil, & Calantone, 2010) and the new product category leads to a new growth opportunity for the innovating company (Cooper, 2011). Equally important, companies that fail to introduce or respond to radical product innovations are often replaced by more innovative competitors (Abernathy & Clark, 1985; Foster, 1986; Utterback, 1994). This makes radical product innovation important for long term business success and survival.

This research defines radical product innovation as the introduction of a new product that involves a new-to-market core technology and core value proposition. Generally, radical product innovation in the food and beverage industry is seen as rare, compared to other industries due to relatively low R&D spending, technology intensity, and consumer innovativeness (Barrena-Figueroa & Garcia-Lopez-de-Meneses, 2013; Galizzi & Venturini, 2008; Lagnevik, Sjoholm, Lareke, & Ostberg, 2003).

However, the previous examples of New Zealand companies suggest that the New Zealand food and beverage industry is different. The industry has demonstrated a history of commercially successful radical product innovation as a result of their investment and scientific research in agricultural production and product development (Riddet Institute, 2011). The industry also faces unique New Zealand contextual factors that typically inhibit innovation: small firm size, small local market, and large distance from major markets (Hong, Oxley, McCann, & Le, 2016; OECD, 2007). Indeed, these radical product innovations may help explain New Zealand's world leading positions in various sectors.

The overarching research question for this study is:

> *What are the determinants of radical product innovation in the New Zealand food and beverage industry, and how do they explain product innovativeness?*

Consequently, this research aims to understand the determinants of radical product innovation in the New Zealand food and beverage industry.

1.2.1 The importance and novelty of the study

The research is important in the following three ways.

Firstly, this study is the first to investigate the determinants of radical product innovation in the New Zealand food and beverage industry. Previous studies on product innovation determinants in the industry (in New Zealand) are limited to incremental and moderately innovative product innovations (Khan, 2014; Marsh, 2004; West, 1980). No studies have been conducted on the determinants of radical product innovation in the New Zealand food and beverage industry. As many researchers have suggested, determinants of product innovation are dependent upon the degree of product innovativeness (Garcia & Calantone, 2002; Holahan, Sullivan, & Markham, 2014; Slater, Mohr, & Sengupta, 2014). In other words, what determines food product innovation (and how) needs to be considered in light of the type of innovation being pursued. Therefore, the previously identified determinants of food product innovation in New Zealand may not be applicable for radical food product innovation.

Secondly, New Zealand food and beverage companies can benefit from a greater understanding of radical product innovation determinants. The 2012 Product Development and Management Association's (PDMA) comparative performance assessment study found that many companies across multiple countries and industries struggle with radical product innovation (Markham & Lee, 2013). In addition, New Zealand companies face unique innovation challenges due to its geographical isolation (particularly long distance from major markets) and small population (4.9 million). Small population means a smaller pool of skilled workers competing for comparable jobs, a small local market, and limited capital, which when combined with the geographical isolation, can make it very difficult for New Zealand companies to pursue product innovation, in general (Hong et al., 2016; OECD, 2007). By identifying the determinants, New Zealand food and beverage companies can increase their organisational propensity to pursue radical product innovation. This will hopefully encourage more radical product innovation by New Zealand food and beverage companies.

Thirdly, New Zealand as a whole can benefit from more radical food and beverage product innovation. The New Zealand government has set a goal of tripling New Zealand food and beverage exports over the next 15 years (Wilkinson et al., 2015). To achieve this, the industry needs to develop new high-value export categories of food and beverage products (Coriolis & MBIE, 2014). Anlene™ by Fonterra and Zespri Gold by Zespri are examples of radical product innovations that have created new export categories and generated significant economic value. Compared to other similar food producing countries such as Belgium, Denmark, Italy, and Netherlands, New Zealand still has a potential to double its food production (Wilkinson et al., 2015). Currently, the growth of the Asian middle class and their increasing demand for processed foods (i.e. foods made from a combination of ingredients, rather than one single or predominant ingredient) are creating growth opportunities for New Zealand companies with innovative food and beverage products (Coriolis & MBIE, 2017). Already, fresh cherries, chocolate bars and blocks, breakfast cereal and muesli bars, and other flavoured beverages have been identified as high growth food export categories (Coriolis & MBIE, 2018).

1.3 Research Aim

As mentioned previously, the aim of this research, is to explain the radical product innovation phenomenon in the New Zealand food and beverage industry. It primarily investigates determinants of radical product innovation in New Zealand food and beverage companies.

The research does not cover commercial success factors of radical product innovation because commercial success factors, specifically of radical product innovation, can be highly dependent on market condition, making them outside the scope of this research.

1.4 Research Objectives

The specific research objectives are as follows.

1. To investigate the determinants of radical product innovation in the New Zealand food and beverage industry.
2. To analyse the relationship between the determinants of radical product innovation and product innovativeness.
3. To identify the company characteristics that affect product innovativeness in the New Zealand food and beverage industry.
4. To identify the salient features of a highly innovative New Zealand food and beverage company.

The general research objectives are as follows.

1. To contribute new knowledge to product development discipline on the determinants of radical product innovation in the New Zealand food and beverage industry.
2. To provide managerial recommendations to the New Zealand food and beverage companies on how to encourage more radical product innovation in their organisations.

1.5 Research Questions

The research questions that stem from the overarching research question are as follows.

1.5.1 Research question 1

RQ1 What are the determinants of radical product innovation in the New Zealand food and beverage industry?

This research question is chosen because no previous studies have identified the determinants of radical product innovation in the New Zealand food and beverage industry. By identifying the determinants, New Zealand food and beverage companies can understand radical product innovation, better encouraging radical product innovation in their organisations. This is also in response to the calls by Khan (2014) and Marsh (2004) for a greater understanding of radical product innovation determinants in the New Zealand food and beverage industry. This research question contributes towards achieving specific research objectives 1 and 4.

1.5.2 Research question 2

RQ2 How do the identified determinants of radical product innovation relate to one another in predicting and explaining product innovativeness?

Radical product innovations are rare and not many are successful (Leifer et al., 2000; Markham & Lee, 2013). This is because radical product innovation is difficult, and pioneers face many uncertainties and barriers (O'Connor & Rice, 2013; Sandberg & Aarikka-Stenroos, 2014). There have been many studies conducted to identify radical product innovation determinants (Chandy & Tellis, 1998; Herrmann, Gassmann, & Eisert, 2007; Kyrgidou & Spyropoulou, 2013; Leifer et al., 2000; Slater et al., 2014). However, more studies are needed to understand how these determinants are related to each other in predicting and explaining product innovativeness (Colombo, Krogh, Rossi-Lamastra, & Stephan, 2017; Holahan et al., 2014; Slater et al., 2014). Thus, there is a need for an empirically tested causal model of radical product innovation, involving its determinants (Chang, Chang, Chi, Chen, & Deng, 2012; Slater et al., 2014). The development of a causal model of radical product innovation will lead to a better understanding of the phenomenon for companies to encourage radical product innovation in their organisation. This leads to the second research question which addresses the relationship between the identified radical product innovation determinants and how they are related to one another in predicting and explaining product innovativeness. This research question contributes to achieving specific research objectives 2 and 4.

1.5.3 Research question 3

RQ3 What company characteristics affect product innovativeness in the New Zealand food and beverage industry?

Company characteristics have been considered by several researchers when studying the determinants of radical product innovation (Abernathy & Utterback, 1978; Balasubramanian & Lee, 2008; Chandy & Tellis, 1998; Hayton, George, & Zahra, 2002; Hult, Hurley, & Knight, 2004). In New Zealand, companies face unique innovation challenges due to small company size, small local market, and long distance from major markets caused by the country's geographical isolation and small population (Hong et al., 2016). This raises the question: what company characteristics affect product innovativeness in the New Zealand food and beverage industry? Subquestions of RQ3 are to what extent each characteristic affects product innovativeness (if other things remain the same) and if the findings are different from those done for other countries. RQ3 contributes to achieving specific research objectives 3 and 4.

1.5.4 Research question 4

RQ4 What are the salient features of a highly innovative New Zealand food and beverage company?

Lastly, less innovative New Zealand food and beverage companies can become more innovative by emulating the salient features of a highly innovative New Zealand food and beverage company. In addition, the answer can assist researchers, consultants, and the New Zealand government in identifying innovative New Zealand food and beverage companies to promote. This research question contributes to achieving the specific research objective 4.

Figure 1.1 shows how each research question contributes to achieving the research aim and objectives.

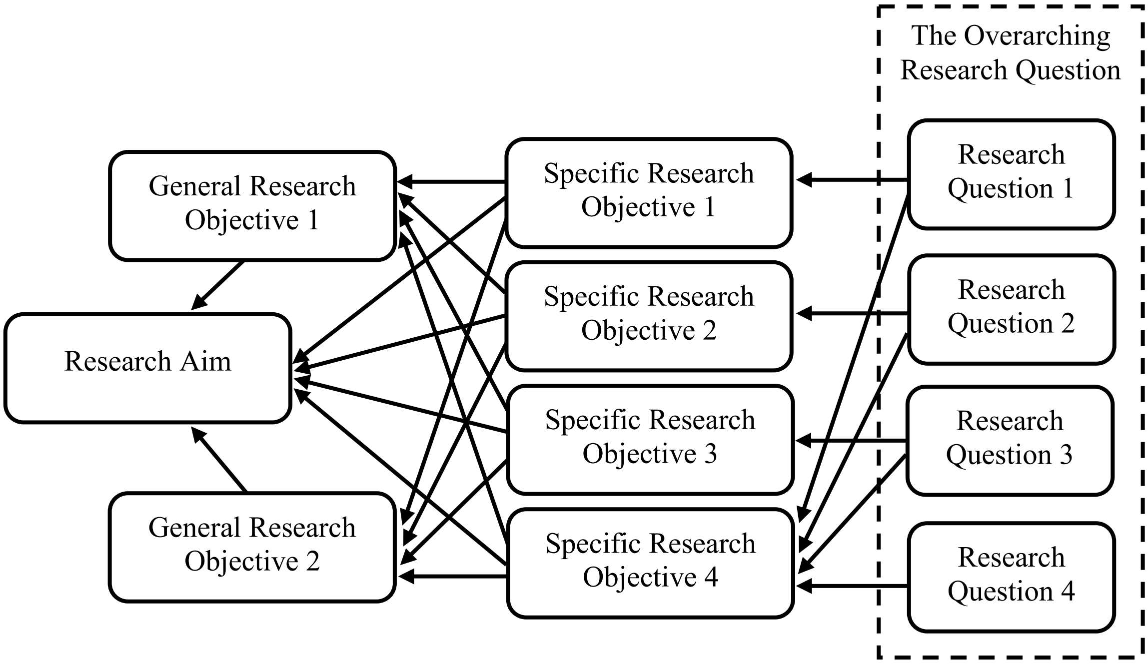


Figure 1.1: Connections between research aim, objectives, and research questions

1.6 Methodology Overview

The methodology used to answer the research questions are summarised as follows.

- To answer research question one (RQ1), the determinants of radical product innovation in the New Zealand food and beverage industry were identified through a comprehensive literature review in Chapter 2 and in Chapter 3 on model development. The identified determinants were content-validated (Chapter 5) through qualitative data obtained through semi-structured interviews (detailed in Chapter 4), involving managers belonging to five seemingly innovative New Zealand food and beverage companies; the theoretical validation of the determinants (construct validity) was accomplished subsequently, through data obtained from an online quantitative survey.
- To answer research question two (RQ2), a causal model hypothesising the interrelationships between the identified determinants and product innovativeness was developed in Chapter 3, based on the extant literature. An online quantitative survey was then created using 7-point Likert scale questions in Chapter 4. The invitation to participate in the online survey was sent through to 1,144 New Zealand food and beverage companies through the contacts mentioned in the New Zealand Food & Beverage Directory. In total, 137 usable responses were received, and the hypothesised model was tested using the partial least squares path modelling (PLSPM) technique in Chapter 6.
- To answer research question three (RQ3), company characteristics that could affect product innovativeness in the New Zealand food and beverage industry were identified (based on the literature), along with the causal direction (Chapter 3). The identified company characteristics were collected via the same survey that was used to test RQ2. The hypotheses were tested using the multifactor analysis of variance technique (general linear model) and compared with overseas findings in Chapter 6.
- To answer research question four (RQ4), the salient features of highly, moderately, and low innovative New Zealand food and beverage companies were identified from the answers to the first three research questions; the findings are presented and discussed for researchers, consultants, and the New Zealand government in Chapter 6.

1.7 Thesis Structure

This thesis is structured into four parts, each containing one or more thesis chapters. The thesis chapters are explained in turn.

Part 1: Research Focus

Chapter 1 introduces the thesis. It covers the research background leading to the research aim, objectives, and questions.

Chapter 2 conducts a comprehensive review of literature related to the research focus: determinants of radical product innovation in the New Zealand food and beverage industry. The research focus consists of three sections: *Radical Product Innovation*, which reviews its definitions, advantages, disadvantages, and determinants; *Food and Beverage Industry*, which explores the nature of radical product innovation in global and New Zealand food and beverage industries; and the *New Zealand Context*, which explains New Zealand's economic background and its innovation performance, strengths, and weaknesses. The literature review is used to justify the research background in Chapter 1 (by identifying the knowledge gaps), prepare the model development in Chapter 3, and support the discussion in Chapter 6.

Part 2: Research Design and Method

Chapter 3 develops three models and hypotheses required to answer the four research questions. The first model is the *Product Innovativeness Model*, which is used to define and measure product innovativeness. The second model is the *Product Innovation Process Model*, which is used to identify different stages in the product innovation process in order to create the interview structure in Chapter 4. The third model is the *Conceptual Model*, which is used to depict and hypothesise the interrelationships between identified determinants of radical product innovation and product innovativeness. Finally, company characteristics that could affect product innovativeness in the New Zealand food and beverage industry are identified and the corresponding hypotheses are proposed.

Chapter 4 explains the research methodology in detail. It starts by outlining different research paradigms commonly used in social research. The researcher's pragmatic research paradigm is then described. The pragmatic research paradigm leads to the use of exploratory sequential mixed methods where qualitative interviews are conducted first as a preparation for a quantitative survey. Qualitative interview design was developed first to help the researcher analytically validate the research hypotheses and operationalise some survey items. Following this, a quantitative survey design was developed to collect quantitative data and test the research hypotheses. Afterwards, generalisation considerations of the research are provided. Finally, ethical considerations relevant to the conduct of the study are included in this chapter.

Part 3: Data Analysis and Discussion

Chapter 5 presents qualitative interviews analysis and discussion. First, it provides company overviews from five food and beverage companies in the Manawatu-Wanganui region of New Zealand that were interviewed. It then provides detailed interview results, analysis, and discussion relevant to the research hypotheses.

Chapter 6 presents quantitative survey analysis and discussion. Data are first screened for unusual data entries, common method bias, and non-normal distribution. Descriptive statistics on respondents and companies are then provided. Afterwards, PLSPM and ANOVA hypothesis test results are analysed in detail. Finally, discussion of the survey findings in regard to answering the four research questions as well as their managerial implications are included.

Part 4: Research Outcomes

Chapter 7 presents the thesis conclusions. It first summarises the research outcomes to demonstrate how research objectives were achieved in answering the research questions. Knowledge contributions to the product development discipline and managerial recommendations to the New Zealand food and beverage companies are then provided to achieve the two general research objectives. Finally, research limitations and future research recommendations are outlined in this chapter.

Figure 1.2 depicts a structure of the thesis. The arrows represent the thesis flow from introduction to conclusions.

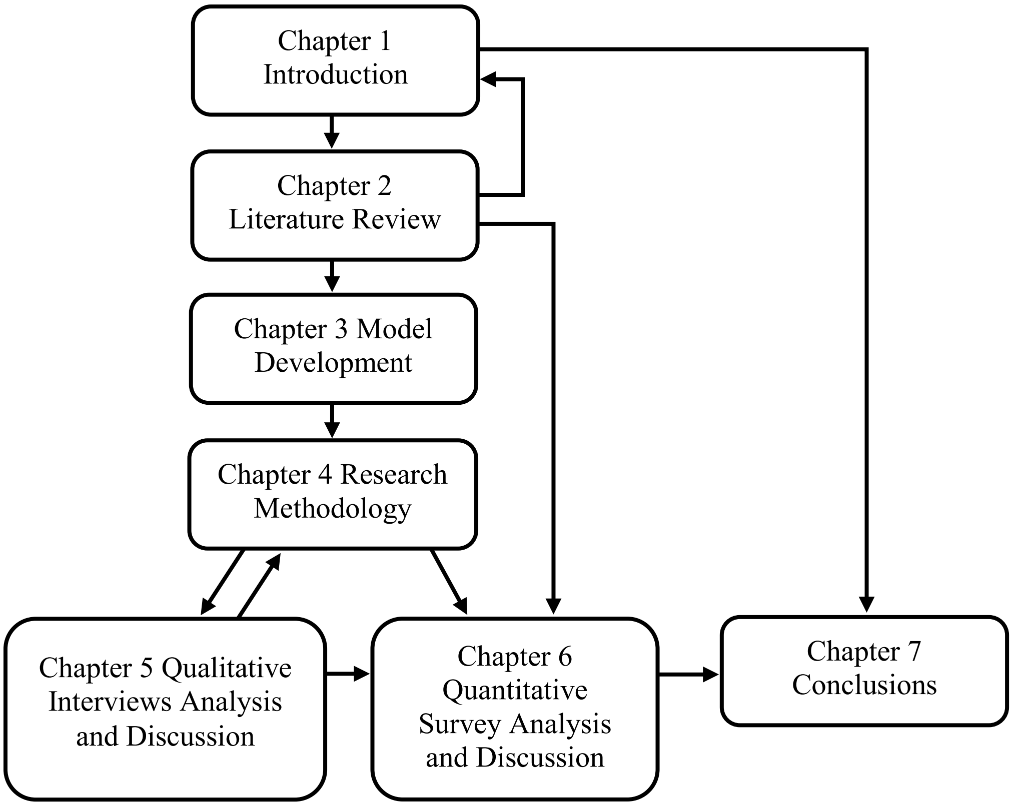
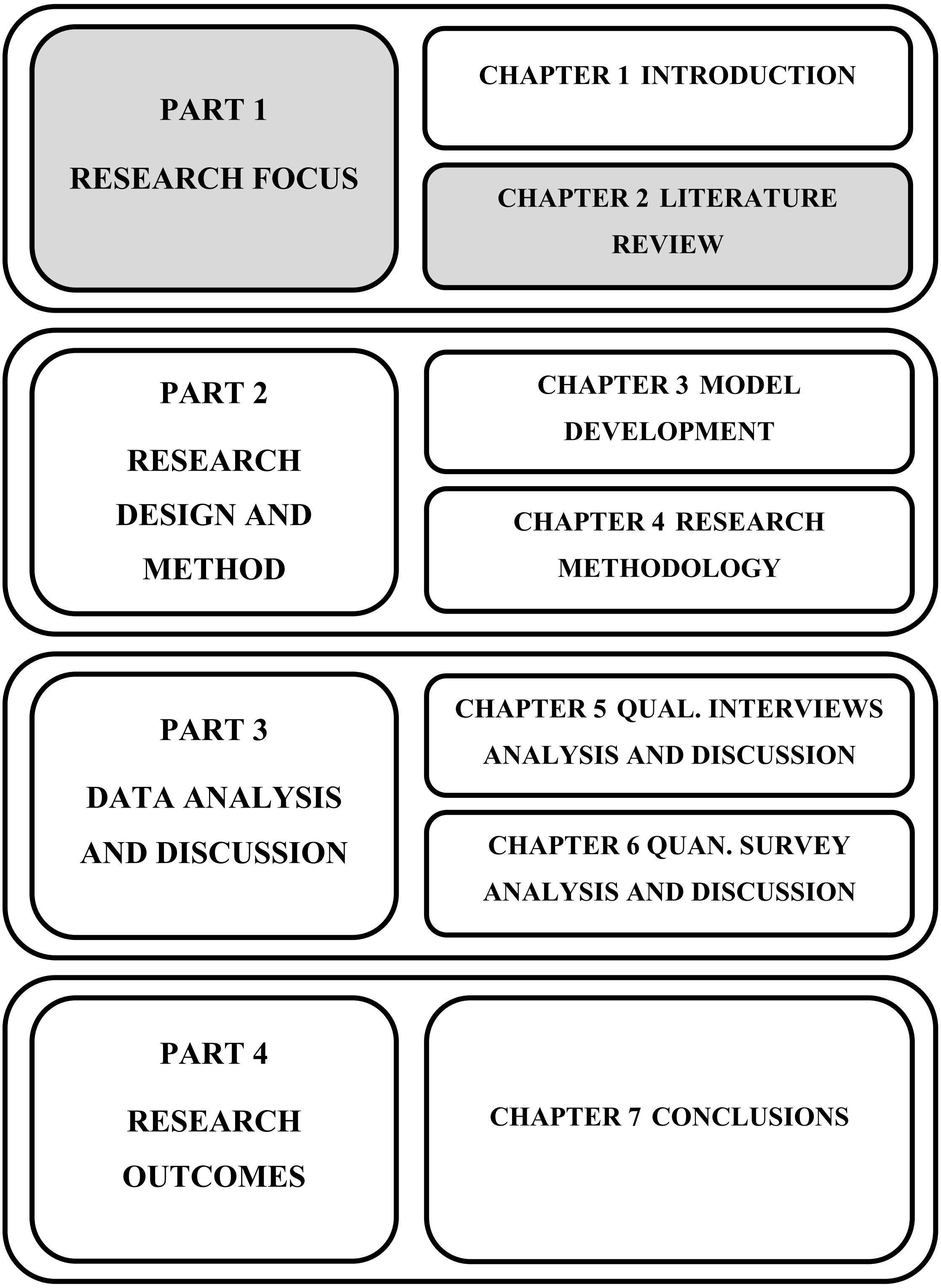


Figure 1.2: Thesis structure

PART 1: RESEARCH FOCUS



CHAPTER 2 LITERATURE REVIEW

2.1 Chapter Overview

This chapter provides a synthesis of literature on the determinants of radical product innovation and related subtopics. The New Zealand food and beverage industry (the research context) has been taken into account as much as possible. Figure 2.1 depicts the research domains relevant to the study as well as the focus of this study, which is the overlap area between following three domains: *Radical Product Innovation*, the *Food and Beverage Industry*, and the *New Zealand Context*. The three sections are important because they are used to justify the research background in Chapter 1 and support the model development process covered in Chapter 3. The three domains are reviewed in detail in sections 2.2, 2.3, and 2.4 respectively. The knowledge gaps and justification of the research questions are provided in section 2.5.

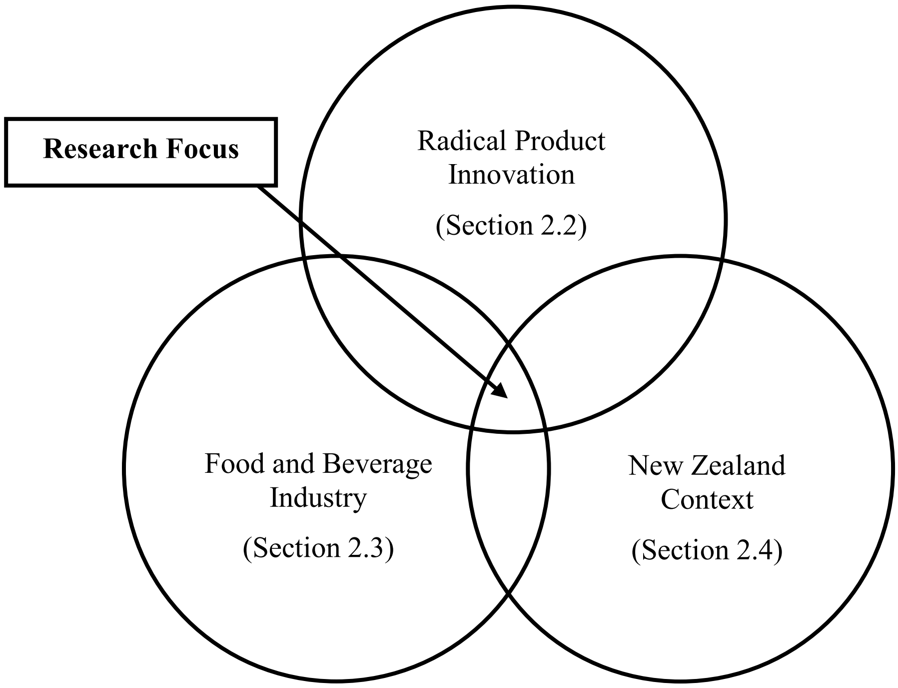


Figure 2.1: Broader domains and research focus

2.2 Radical Product Innovation

Radical product innovation is explained in this section. The purpose is to understand how radical product innovation can be defined differently and distinctively. Furthermore, its advantages, disadvantages, and determinants are explored with examples from literature in this section.

2.2.1 What is product innovation?

The *Oslo Manual* (OECD & Statistical Office of the European Communities, 2005) is the leading international source of guidelines for collecting and interpreting innovation data. The manual defines innovation as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation, or external relations" (p. 46). The definition distinguishes four types of innovation: product innovation, process innovation, marketing innovation, and organisational innovation.

For this study, the manual's definition of product innovation is used. The manual defines product innovation as "the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses" (p. 48). Product innovation can make use of both new and existing knowledge and technologies. Examples of product innovation include changes in a product's technical specifications, components and materials, incorporated software, user friendliness, or other functional characteristics. A minimum requirement for a product innovation is that the product must be new or significantly improved from products previously produced by the company.

2.2.2 How are product innovations classified?

The purpose of product innovation classification is to understand the impact or implication of different categories of product innovation on product development practice and new product success (Garcia & Calantone, 2002; Henderson & Clark, 1990; Holahan et al., 2014; D. A. Norman & Verganti, 2014). Since product innovation means the introduction of a new good or service, this definition implies that new products will have different degrees of newness relative to previous products. This difference in degree of newness leads to different classification of product innovation.

Below are examples of major product innovation classification based on the following categories: degree of product newness, degree of product innovativeness, transformation of a company's competency, disruption, business model and technical competency change, and innovation strategy. Their implication and application are also discussed.

2.2.2.1 Degree of product newness

The first attempt of a classification is to categorise product innovation based on its degree of product newness. Booz, Allen, and Hamilton (1982) conducted a survey of corporate executives and product managers of Fortune 1000 companies in the 1980s and collected information on over 13,000 new products introduced over a five-year period. They identify six categories of new products in terms of their newness to the company and to the marketplace, shown in Figure 2.2, as: *new-to-the-world products* are new products that create entirely new markets, *new product lines* are new products that allow a company to enter an established market for the first time, *additions to existing product lines* are new products that supplement a company's established product lines, *improvements in/ revisions to existing products* are new products that provide improved performance or greater perceived value and replace existing products, *repositionings* are existing products that target new markets or market segments, and *cost reductions* are new products that provide similar performance at lower cost. The percentage share for each category of the total new products introduced over the five-year period of the study is shown in Figure 2.2.

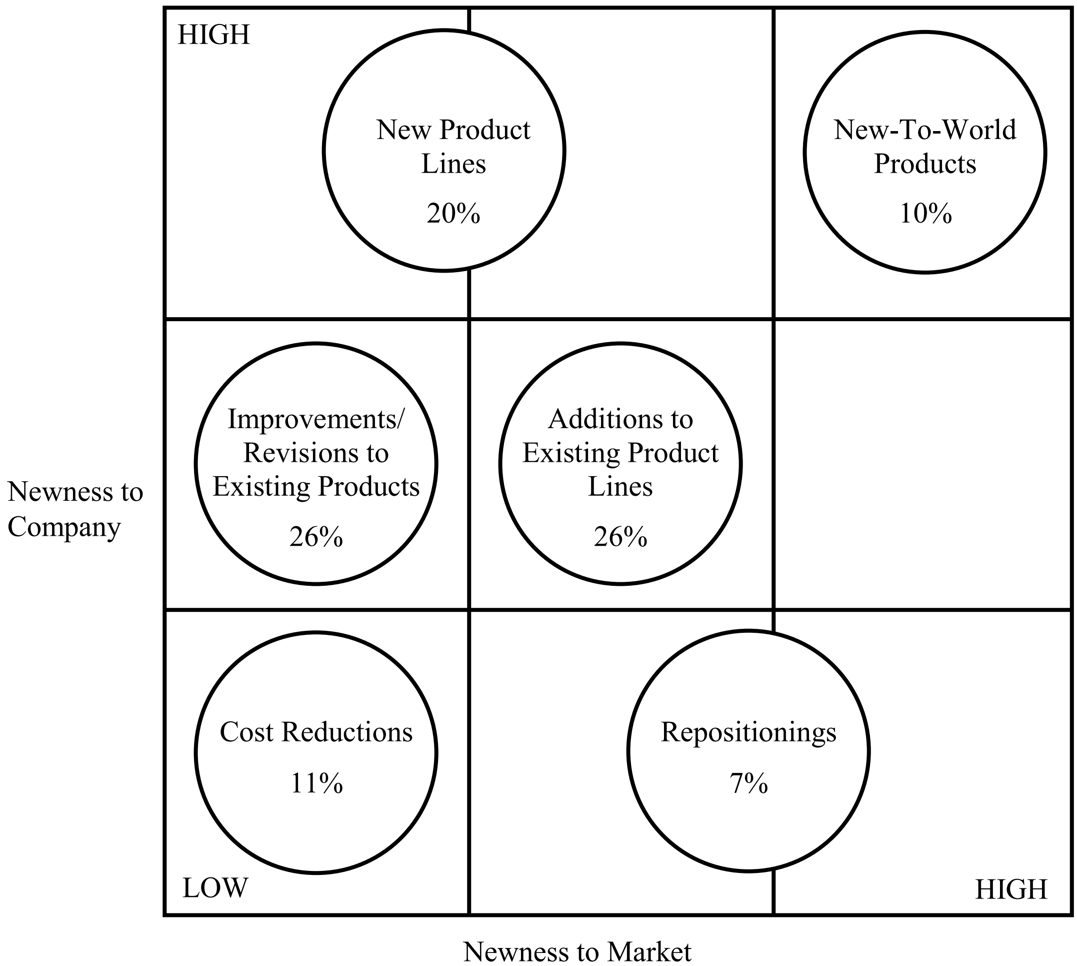


Figure 2.2: New product introductions (Booz et al., 1982, p. 9)

The classification is useful in understanding a company's mix of new product introduction and their consequences. From their survey, new-to-the-world products and new product lines were considered high value and accounted for 60% of the most successful new products; but at the same time, they were most risky due to higher variability of return (Booz et al., 1982).

2.2.2.2 Degree of product innovativeness

Another approach at a classification is to categorise product innovation based on its degree of product innovativeness. Product innovativeness is "a measure of the potential discontinuity a product (process or service) can generate in the marketing and/or technological process" (Garcia & Calantone, 2002, p. 113).

Incremental and radical product innovation are common categories of product innovativeness (Kyriakopoulos, Hughes, & Hughes, 2016; Leifer et al., 2000; Markham & Lee, 2013). They represent the opposite ends of a product innovativeness scale. An incremental product innovation has a low degree of product innovativeness and is associated with minor improvement or continuous evolution in existing technology and customer benefit. Radical product innovation has a high degree of product innovativeness and is associated with significant improvement or discontinuous change in technology and customer benefit. Categories such as "continuous innovation" and "discontinuous innovation" also have been used to represent incremental and radical innovation (Brentani & Reid, 2012; Veryzer, 1998).

In addition, some researchers have identified the need for a moderate category to represent a middle degree of product innovativeness (between incremental and radical); and proposed categories such as "moderate innovativeness" (Kleinschmidt & Cooper, 1991), "really new" (Garcia & Calantone, 2002), and "more innovative" (Holahan et al., 2014). Subsequently, incremental, moderate, and radical represent three categories of product innovativeness from low, middle, to a high degree.

The three categories of product innovativeness can have important implications for new product success and product development practice. It has been suggested that new products with a higher degree of product innovativeness will have superior product advantages leading to a higher chance of product success (Calantone, Chan, & Cui, 2006; Kock, Gemünden, Salomo, & Schultz, 2011). In addition, managers should adapt their product development practice according to their project's degree of product innovativeness (Cardinal, 2001; Holahan et al., 2014; Slater et al., 2014). For instance, companies can leverage their existing technologies and knowledge when developing incremental product innovations to increase their chance of success (Kleinschmidt & Cooper, 1991). However, with radical product innovation, companies face higher level of uncertainties (O'Connor & Rice, 2013) and challenges not faced by incremental product innovation such as organisational resistance to change (Chandy & Tellis, 2000), new market creation (Aarikka-Stenroos & Lehtimäki, 2014), and pioneer burnout (Olleros, 1986). Consequently, companies should implement a higher level of project control to increase their chances of success (Cardinal, 2001; Holahan et al., 2014), although this approach is not universally accepted (Booz et al., 1982; McDermott & O'Connor, 2002).

2.2.2.3 Transformation of a company's competency

Product innovation can also be classified based on its effect on the competency of the company. A company that chooses product development as its primary strategy can be considered to be competent, to the extent that the company is able to develop new products (Holahan et al., 2014; Prahalad & Hamel, 1990). A company can gain a competitive advantage by developing and utilising its competency so that it can offer products that have better functional performance as valued by its customers than its competitors can offer (Porter, 1985; Slater et al., 2014). Abernathy and Clark (1985) specify two domains of a company's competency: Technology/Production and Market/Customer Linkage. New products affect the two domains by either entrenching or disrupting them. They call an innovation's degree of effect as "transilience". Figure 2.3 shows Abernathy and Clark's transilience map of innovation.

According to Abernathy and Clark (1985), each quadrant represents different categories of product innovation and has different managerial implications. *Regular innovation* is an innovation that builds on established technology and marketing knowledge. It is like incremental product innovation because it conserves or builds on the company's existing technology and market knowledge. *Niche Creation innovation* is an innovation that uses existing technology to create new market opportunities. *Revolutionary innovation* is an innovation that disrupts or destroys established technical and production competencies while conserving the market linkage. Lastly, *architectural innovation* is an innovation that uses new concepts in technology and creates new market linkages. It is identical to radical product innovation because it utilises new technology and requires new marketing knowledge.

The transilience map of innovation allows managers to understand the impact their product innovation will have on their company's technology and market competency and to make preparations accordingly; whereas, innovativeness only deals with changes in the product's technology and customer benefits.

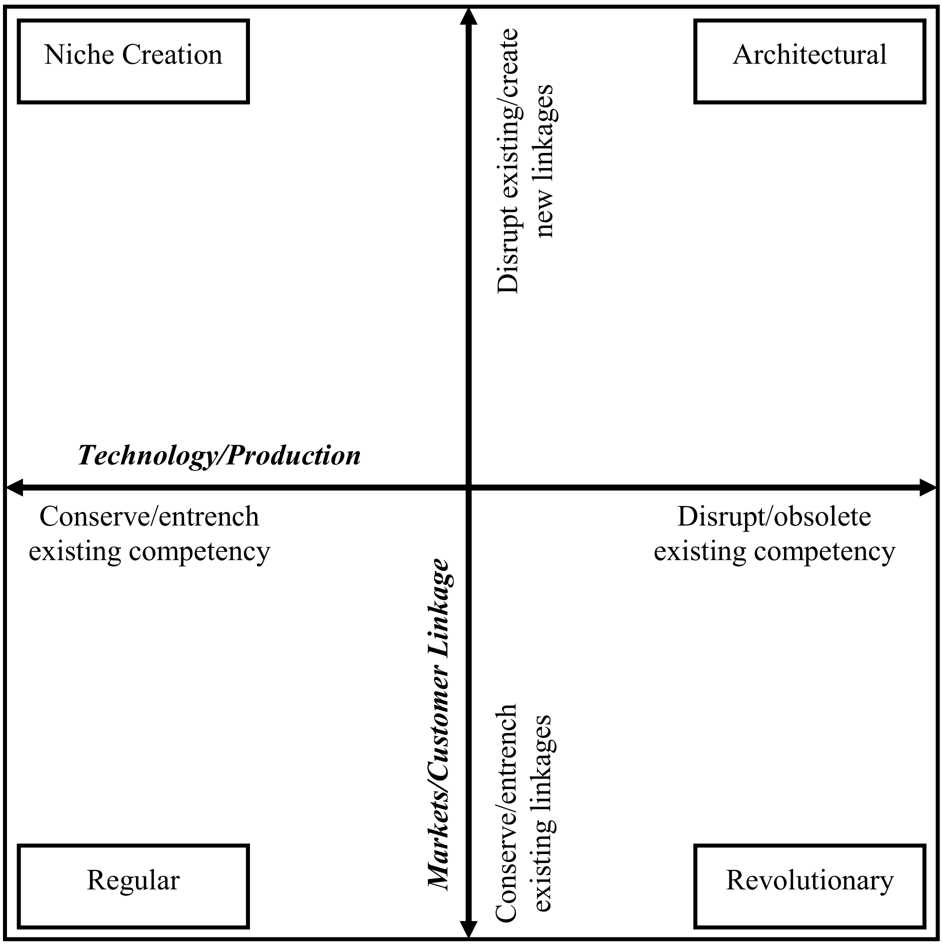


Figure 2.3: Transilience map of innovation (Abernathy & Clark, 1985, p. 8)

2.2.2.4 Disruption

Christensen (1997) proposes an alternative classification based on disruption. He investigated why leading companies failed to stay atop of their industry and found that leading companies often succumbed to industry entrants when they faced specific market and technology changes. These changes are not caused by radical product innovation or technological/marketing competency transformation. Instead, they are caused by disruptive technologies or *disruptive innovations*. He found this phenomenon repeated in many industries from disk drive, mechanical excavator, steel, computer, printer, and retailing. Consequently, he developed the disruptive innovation model to explain the phenomenon as shown in Figure 2.4.

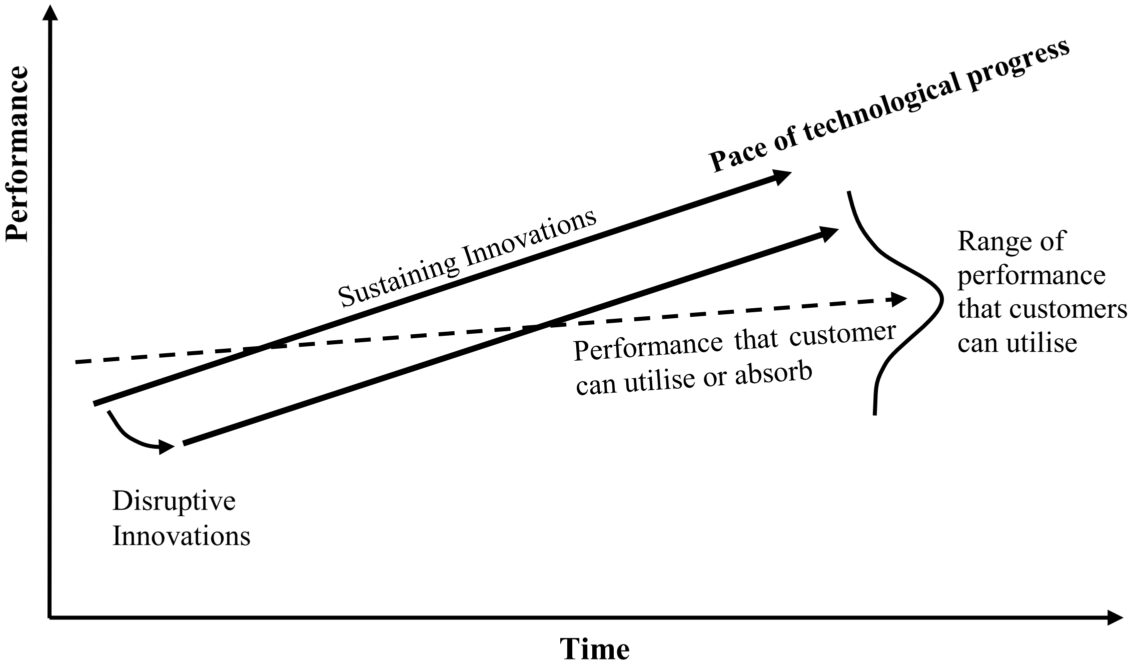


Figure 2.4: The disruptive innovation model (Christensen & Raynor, 2003, p. 33)

There are three critical elements of the disruption model (Christensen & Raynor, 2003). Firstly, it recognises that in every market there is a rate of improvement that customers can utilise or absorb; this is represented by the gently sloping upward dotted line in Figure 2.4. In addition, there is a distribution of customers around the dotted line, as indicated by the distribution curve at the right. The distribution represents different tiers of customer demand from low-end to high-end.

Secondly, it acknowledges that in every market there is a distinctly different trajectory of improvement that innovating companies provide as they introduce new and improved products in pursuit of profit. This pace of technological progress almost always outstrips the rate of improvement that customers can utilise or absorb. This is represented by the more steeply sloping upward solid lines in Figure 2.4.

Thirdly, it recognises two categories of innovation: sustaining innovation and disruptive innovation. *Sustaining innovation* is a product innovation that targets high-end customers with better performance. Sustaining innovation can be incremental or radical in character. What separates it from disruptive innovation is that it is based on a strategy of introducing new products to existing high-end customers. Here incumbent companies almost always win because they have powerful motivation and resources to win.

By comparison, *disruptive innovation* is a product innovation that targets emerging or low-end markets. It is often cheaper, simpler, or more convenient to use than the previous products. However, because it is new, it has a poorer performance as valued by the mainstream and high-end consumer. Only emerging or low-end markets are willing to buy the new product (Christensen & Raynor, 2003). Consequently, incumbent companies often reject disruptive innovation in favour of sustaining innovation, while industry entrants are attracted to it due to the other benefits it offers. As time passes, disruptive innovation improves in performance enough to meet the mainstream customer demand. At this point, the disruptive innovation will start replacing the sustaining innovation, leading to the demise of the incumbent companies.

Christensen's disruptive innovation model explains why leading/incumbent companies succumb to industry entrants with disruptive innovation. The model assists managers to recognise the danger and opportunity of disruptive innovation and to respond accordingly.

2.2.2.5 Business model and technical competency change

Another way to classify product innovation is to consider the business model and technical competency change involved in a new product. Pisano (2015) develops his classification by considering the degree of change a new product can have on the company's existing business model and technical competency.

Pisano (2015) identifies four categories of innovation as routine innovation, disruptive innovation, radical innovation, and architectural innovation, and proposed an innovation landscape map as shown in Figure 2.5.

Routine innovation is an innovation that involves a minimal business model and technological change so that it can leverage an existing business model and technical competencies. It can be likened to incremental, regular, or sustaining innovation.

Disruptive innovation is an innovation that requires a new business model while leveraging existing technical competencies. It can be likened to moderate innovativeness, niche creation, or disruptive innovation as defined by Christensen (1997).

Radical innovation is an innovation that requires new technical competencies but fits in with the company's existing business models. It can be likened to moderate innovativeness or revolutionary innovation.

Lastly, *architectural innovation* involves a significant business model and technological change and requires both a new business model and technical competencies. It can be linked to radical (high degree of innovativeness) or architectural innovation as defined by Abernathy and Clark (1985).

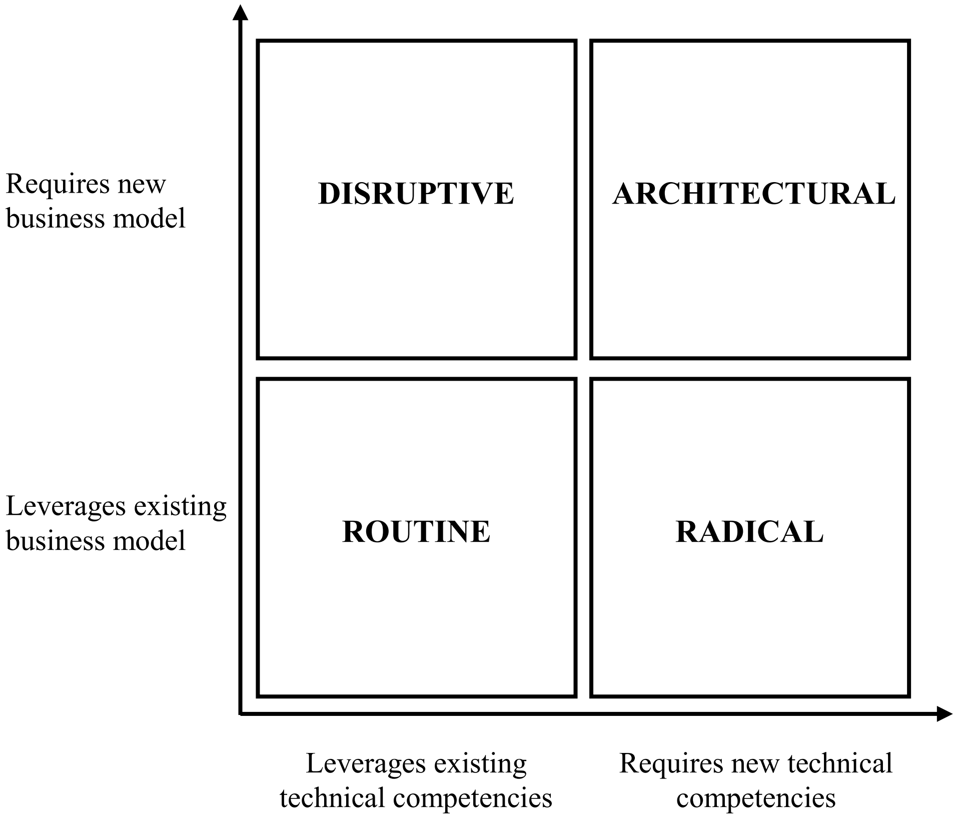


Figure 2.5: The innovation landscape map (Pisano, 2015, p. 51)

Pisano's innovation landscape map is a useful tool for managers to plan their innovation strategy and allocate resources according to the four categories of innovation. Different companies will face different competitive environments and have different existing business models and technical competencies. Thus, companies should focus on the type of innovation that will allow them to achieve their overall business strategy and adapt as their capabilities and competitive environment change (Pisano, 2015).

2.2.2.6 Innovation strategy

Finally, innovation strategy can also be used to classify product innovation. Innovation strategy can be defined as "a commitment to a set of coherent, mutually reinforcing policies or behaviours aimed at achieving" a specific innovation outcome (Pisano, 2015, p. 46). Verganti (2008) studied the innovation strategy of successful design-intensive Italian companies such as Alessi, Artemide, and Kartell. He identifies three innovation strategies: market pull, technology push, and design driven. They are shown in Figure 2.6.

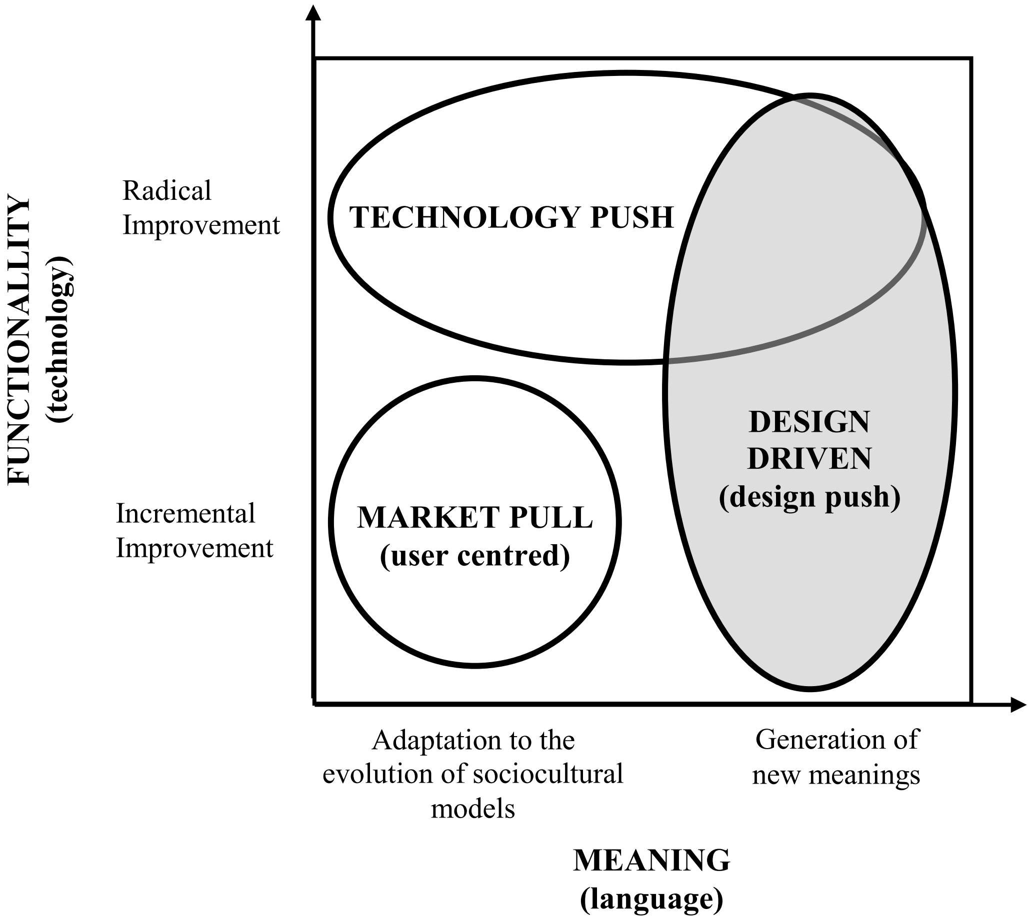


Figure 2.6: Innovation strategies (Verganti, 2008, p. 444)

Market pull, or *user centred innovation*, is a common innovation strategy where companies innovate in response to their user needs and demands. It is an innovation strategy that leads to incremental or routine innovation.

Technology push innovation is an innovation strategy where companies pursue breakthrough technologies to deliver a significant improvement in product performance. It is an innovation strategy that leads to new technology or revolutionary innovation.

Design driven innovation is an innovation strategy where companies propose new meanings or reasons for purchase. Design driven as an innovation strategy is often neglected in favour of technology push (Rubera & Droge, 2013; Talke, Salomo, Wieringa, & Lutz, 2009). However, it is a valid innovation strategy that leads to new customer benefits or disruptive innovation (Pisano, 2015; Verganti, 2009).

Lastly, the overlap between technology push and design driven innovation shows how breakthrough technologies can generate radical new meanings and vice versa (Verganti, 2008). This area is the innovation strategy that leads to high product innovativeness or architectural innovation.

2.2.3 What is radical product innovation?

Radical product innovation is a product innovation with a high degree of product innovativeness (Garcia & Calantone, 2002). As previously explained in section 2.2.2.2, product innovativeness is "a measure of the potential discontinuity a product (process or service) can generate in the marketing and/or technological process" (Garcia & Calantone, 2002, p. 113).

Product innovativeness is often broken down into technological and marketing newness (Danneels & Kleinschmidt, 2001; Garcia & Calantone, 2002; Kleinschmidt & Cooper, 1991). Technological newness is a measure of technological change (Chandy & Tellis, 1998; Kock et al., 2011). Technology can be defined as "the processes by which an organisation transforms labour, capital, materials, and information into products and services of greater value" (Christensen, 1997, p. xiii). Marketing newness is a measure of value proposition change (Kock et al., 2011; Markides & Geroski, 2005). Value proposition can be defined as "a short, clear, simple statement of how and on what dimensions a product concept will deliver value to prospective customers" (Kahn, Kay, Slotegraaf, & Uban, 2013, p. 475).

Both technological and marketing newness are used in this research to measure product innovativeness. Product innovativeness is measured by considering the core technology and core value proposition change in a new product relative to the previous products from the company and market perspective. A new product that utilises a new-to-market core technology and core value proposition has a high degree of product innovativeness. Whereas, a new product that builds on available core technology and core value proposition has a low degree of product innovativeness. Consequently, radical product innovation is defined as the introduction of a new product that involves a new-to-market core technology and core value proposition.

Section 3.2 describes the development of a product innovativeness model. It provides a comprehensive explanation of product innovativeness measure and radical product innovation definition.

2.2.4 Why is radical product innovation important?

Radical product innovation introduces to the marketplace a new technology and value proposition not previously available. This high degree of product innovativeness gives radical product innovation many advantages over less innovative product innovation. The advantages of radical product innovation are summarised below.

2.2.4.1 Superior product advantage

Firstly, product innovativeness is an important driver for product advantage. Product advantage or a product that delivers unique benefits and superior performance is the major factor for product success (Cooper & Kleinschmidt, 1987; McNally et al., 2010).

Kleinschmidt and Cooper (1991) studied the relationship between product innovativeness and product success of 195 new products from 125 industrial product companies. They found a U-shaped relationship between product innovativeness and product success where both incremental and radical product innovation had a statistically significant positive relationship with product success. Incremental and radical product innovation showed high product success while moderate product innovation showed the least product success. The reason for this U-shaped relationship is because incremental product innovation relies on the existing capabilities, leading to low uncertainties and more proficient product development activities, while radical product innovation offers new technologies and unique benefits, leading to superior product advantage. Moderate product innovation was the least successful because it was far enough from existing capabilities and not innovative enough to offer compelling values (Kleinschmidt & Cooper, 1991).

Other studies have come to a similar conclusion regarding the U-shaped relationship between product innovativeness and product success (Calantone et al., 2006; Kock et al., 2011). Still, it is important to recognise that some studies have found no relationship between them (Danneels & Kleinschmidt, 2001; Szymanski, Kroff, & Troy, 2007; Tatikonda & Rosenthal, 2000). For example, Szymanski, Kroff, and Troy (2007) conducted a meta-analysis of 95 correlations on product innovativeness and product success from 32 studies on the topic and found that product innovativeness did not have a direct impact on product success; only when a meaningfulness dimension (the degree of functional relevant to the customer) was included in the product innovativeness measure did the relationship become stronger. The reason for this is because product innovativeness can be perceived negatively by the customer due to issues such as low product familiarity (Calantone et al., 2006), high learning cost (Reinders, Frambach, & Schoormans, 2010), and innovation/change resistance (Heidenreich & Handrich, 2015). As a result, product innovativeness can also lead to product disadvantage and this explains why some studies find no relationship between product innovativeness and product success.

In conclusion, radical product innovation is important for creating product differentiation leading to superior product advantage. However, managers need to be careful not to create product disadvantage as a result of customer unfamiliarity or a lack of relevant product benefit or meaningfulness.

2.2.4.2 Industry transformation or new market creation

Secondly, radical product innovation can transform industry or create a new market (Golder et al., 2009; Utterback, 1994). The reason radical product innovation can transform or create a new market is because it brings to the marketplace a new technology and value proposition that lead to a significant change in consumer behaviour (Chandy & Tellis, 2000; Leifer et al., 2000).

Incremental product innovation plays an important role in advancing the existing technological process and maintaining company competitiveness (Foster, 1986; Pisano, 2015). However, radical product innovation is responsible for initiating a new technological process and introducing new customer benefits. This leads to a new product category and lays a foundation for future generations of incremental and moderate product innovation, which are important for long term growth (D. A. Norman & Verganti, 2014; Sood & Tellis, 2005; Utterback, 1994).

In certain cases, radical product innovation can be a matter of company survival (Chandy & Tellis, 2000). This is because radical product innovation can destroy existing technological and marketing competency and replace them with new ones (Abernathy & Clark, 1985; Abernathy & Utterback, 1978). Schumpeter (1942) referred to this as the process of “creative destruction” (p. 83). Companies that ignore radical product innovation risk having their competency obsoleted, while pioneers or early adaptors of radical product innovation can gain significant competitive advantages (Cooper, 2005; Verganti, 2009).

2.2.4.3 Driver for national growth

Lastly, radical product innovation is an important driver for national growth and prosperity (Golder et al., 2009; Tellis, Prabhu, & Chandy, 2009). Radical product innovation can affect a national economy by creating new industries or destroying them. For example, the invention of synthetic fibres destroyed 40% of New Zealand's wool export value during the 1970s (Easton, 2016b). The crash of wool export value, combined with higher competition from other countries, was considered unfavourable for the New Zealand economy at the time (Singleton, 2008).

Looking back from today's perspective, the change forced New Zealand companies to be more innovative and to diversify into new markets leading to a stronger economy overall. Other radical product innovations such as the refrigeration (Easton, 2016b), the tanker delivery of whole milk from farms to factory (Anderson, 2011), and the breeding of New Zealand specific plant and animal varieties (Riddet Institute, 2011) have opened up new export opportunities and added significant economic value for New Zealand. Hence, radical product innovation is considered here as an important driver for the growth of the New Zealand economy.

2.2.5 Why is radical product innovation difficult?

Despite its advantages, radical product innovation is a double-edged sword (Calantone et al., 2006; Kleinschmidt & Cooper, 1991). The 2012 Product Development and Management Association (PDMA)'s comparative performance assessment study, which studied product innovation performance from 453 companies in North America, Europe, and Asia, provides a project performance comparison between incremental, more innovative, and radical projects in Table 2.1 (Markham & Lee, 2013).

Table 2.1: Project Performance (Markham & Lee, 2013, p. 412)

	On Time (%)	On Budget (%)	Met Technical Objectives (%)	Met Market Objectives (%)
Radical	29.2	31.7	53.1	46.3
More Innovative	43.6	49.1	66.3	58.7
Incremental	57.9	62.3	72.9	68.0

Table 2.1 shows all project performance metrics worsen as the project becomes more innovative. This indicates that innovative projects present more challenges for companies. How companies overcome innovative project challenges can determine their success with radical product innovation. The disadvantages of radical product innovation are summarised below.

2.2.5.1 High degree of uncertainty

Firstly, radical product innovation has a higher degree of uncertainty when compared to incremental and moderate innovation. This is because radical product innovation requires new marketing and technological competency, which can be difficult to develop (Holahan et al., 2014; Slater et al., 2014). This also leads to higher level of risk, chance for failure, and variability of return (Booz et al., 1982; Leifer et al., 2000; Min, Kalwani, & Robinson, 2006).

2.2.5.2 Multi-dimensional uncertainties

Secondly, there are several dimensions of uncertainty associated with radical product innovation. O'Connor and Rice (2013) conducted a longitudinal case study of 12 radical projects in 10 large established companies in the United States. They identify four categories of uncertainty associated with radical projects as follows.

- **Technical uncertainty** – which is related to the development, application, and manufacturing of new technology.
- **Market uncertainty** – which is related to the understanding of customer wants and needs, and other marketing considerations such as a business model, market creation, sales and distribution, and competitors.
- **Organisational uncertainty** – which is related to the organisational transformation and learning needed to develop and commercialise the new product.

- **Resource uncertainty** – which is related to the resource acquisition (both financial and competency) needed for the project.

The four categories of uncertainty explain the key challenges associated with radical product innovation. The high technical and market uncertainty lead to long development time and project unpredictability, and organisational and resource uncertainty lead to organisational resistance and complicated product development processes. These high uncertainties explain why there is a strong tendency for companies to pursue incremental product innovation rather than radical product innovation (Bers, Dismukes, Miller, & Dubrovensky, 2009; Cooper, 2011).

Other dimensions of radical product innovation uncertainty include "latency" which refers to how predictable an uncertainty is and "criticality" which refers to how significant an uncertainty has on the project's success (O'Connor & Rice, 2013).

2.2.5.3 Context dependence

Lastly, the implication and significance of radical product challenges are dependent on the innovation context. Sandberg and Aarikka-Stenroos (2014) conducted a systematic review of 103 research articles on radical product innovation barriers. They identified and grouped the barriers into internal and external barriers. Internal barriers are challenges originating from within the company and are related to issues such as mindset, competencies, resources, and organisational structure. External barriers are challenges originating from outside the company and are related to issues such as external relations and business environment.

Table 2.2 presents the main internal and external radical product innovation barriers according to company size, target market, and stages of radical product innovation process. The table shows restrictive mindset as the prominent internal barrier, and customer resistance and undeveloped network and ecosystem as the major external barriers, across most innovation contexts.

Table 2.2: Main Radical Product Innovation Barriers (Sandberg & Aarikka-Stenroos, 2014)

Innovation Context		Main Radical Product Innovation Barriers	
		Internal barriers	External barriers
Company Size	SMEs	• Restrictive mindset • Lack of incubation competencies • Insufficient resources	• Undeveloped network and ecosystem • Paucity of external finance
	Large companies	• Restrictive mindset • Lack of discovery competencies • Unsupportive organisational structure	• Customer resistance • Undeveloped network and ecosystem • Technological turbulence
Target Market	Business-to-consumers	• Lack of discovery competencies • Restrictive mindset	• Customer resistance • Undeveloped network and ecosystem
	Business-to-business	• Restrictive mindset • Lack of incubation competencies	• Undeveloped network and ecosystem • Unsupportive government
Radical Product Innovation Process	Ideation stage	• Insufficient resources • Restrictive mindset	• Customer resistance
	R&D stage	• Restrictive mindset • Unsupportive organisational structure • Insufficient resources	• Customer resistance • Technological turbulence
	Commercialisation stage	• Lack of acceleration and commercialisation competencies	• Customer resistance • Undeveloped network and ecosystem

2.2.6 What determines radical product innovation?

In this section, radical product innovation determinants from other industries, beside the food and beverage industry, are identified and summarised. Determinants from other industries are identified first to provide a universal picture of radical product innovation determinants. The determinants of radical product innovation from the food and beverage industry are identified and discussed later in section 2.3.1.

Originally, the determinants of radical product innovation were conceptualised based on the organisational characteristics associated with radical product innovation. Today, they are mostly conceptualised based on the organisational capabilities required by a company to introduce radical product innovation. Subsequently, radical product innovation determinants are separated into two groups: organisational characteristics and organisational capabilities. They are explained below.

2.2.6.1 Organisational characteristics

Organisational characteristics are determinants of radical product innovation that include company age, company size, national culture, industry phase, willingness to cannibalise, and company orientation. They are explained in turn.

Company age

Company age is the number of years for the company since its inception. Young companies (e.g. industry entrants) are more likely than old companies (e.g. incumbents) to be innovative because they are less inhibited by bureaucratic process or past success (Balasubramanian & Lee, 2008; Christensen, 1997; Huergo & Jaumandreu, 2004).

Alternatively, older companies can accumulate more resources and experience, which can be beneficial when pursuing radical product innovation because it requires more development resources, technological capability, and product development capability (Chandy & Tellis, 2000; Holahan et al., 2014; Leifer et al., 2000).

Company size

Company size is the number of full-time employees in the company. Smaller companies are often associated with radical product innovation because of their entrepreneurial characteristics (Abernathy & Utterback, 1978; Schumpeter, 1934).

On the other hand, as innovation becomes more complex and resource intensive, larger companies with more resources and monopoly power can gain innovative performance advantage over smaller companies (Chandy & Tellis, 2000; Schumpeter, 1942).

National culture

National culture is defined as “the collective programming of the mind that distinguishes the members of one group or category of people from others” (Hofstede, 2011, p. 3). National culture can influence entrepreneurship characteristics of a nation and explain why certain nations are more innovative than others (Hayton et al., 2002). Furthermore, national culture can influence local markets’ acceptance of new and different products (i.e. consumer innovativeness) (Steenkamp, Hofstede, & Wedel, 1999).

Industry phase

Abernathy and Utterback (1978) studied the dynamics of innovation in multiple industries from incandescent light bulbs, papers, steel, and internal-combustion engines. They used a productive unit of analysis instead of a company or product type for their study to better capture the innovation dynamics across an industry. Their findings suggest that a company's capacity to innovate depends on the phase of the industry it is in. In other words, the phase of industry determines the company's capacity to introduce radical product innovation. A dynamics of innovation model shown in Figure 2.7 identifies three phases of industry: fluid phase, transitional phase, and specific phase.

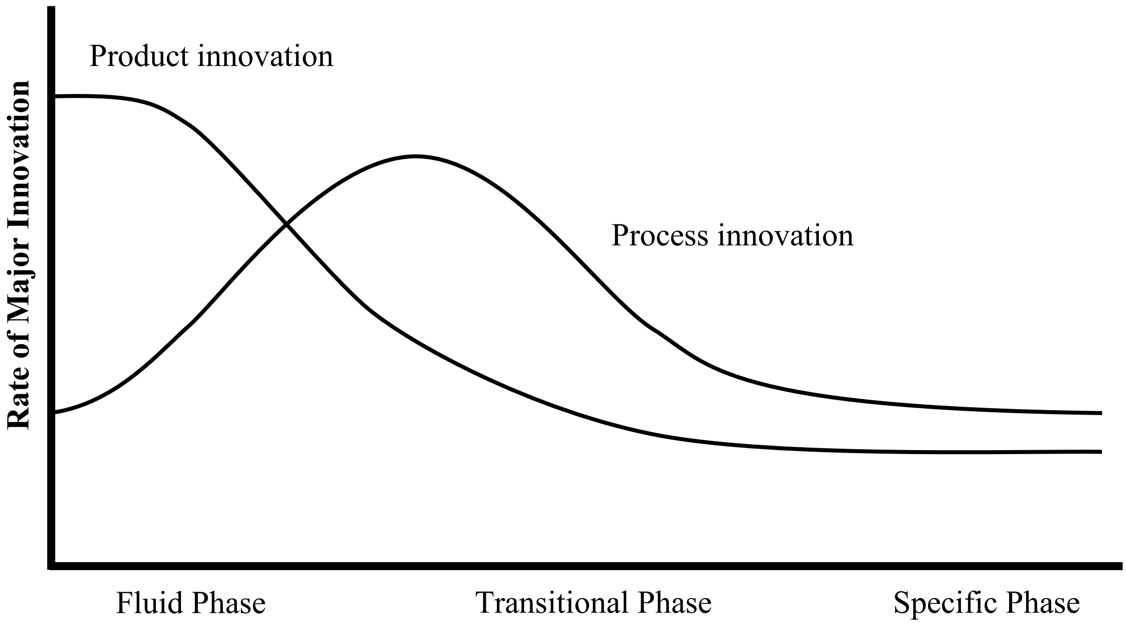


Figure 2.7: Dynamics of innovation model (Utterback, 1994, p. 91)

The *fluid phase* is the early years of an industry. It is initiated by the identification of a new need or new technology. During this period, there is a high rate of moderate or radical product innovation as industry pioneers experiment with different product designs. The competitive advantages are based on superior functional performance offered by the new technology rather than lower cost. Process innovation is not of primary importance due to constant change in product design.

The *transitional phase* is the middle years of an industry. It is initiated by the emergence of a dominant product design and market acceptance. During this period, companies begin changing their focus from product innovation to process innovation. The competitive advantages are based on meeting specific user needs and using more efficient and higher quality production processes.

The *specific phase* is the latter years of an industry that some industries enter. It is initiated by the introduction of a well specified product design and highly specialised production method. During this period, companies focus on incremental product and process innovation. The competitive advantages are based mainly on price. Moderate or radical product innovation is difficult and costly due to the highly-specialised production method. The only way for the industry to break out of this phase is through radical product or process innovation typically introduced from outside the industry.

Willingness to cannibalise

Chandy and Tellis (1998) investigated why some companies were more successful at radical product innovation than others. They argued against the Schumpeter's suggestion that company size was the predictor of radical product innovation. Instead, they proposed *willingness to cannibalise*, or the extent to which a company was prepared to reduce the actual or potential value of its investments, was the key driver of radical product innovation. This driver was critical because leading companies often were afraid to cannibalise their existing investments in specialised technology, needed to serve the current market, to pursue radical product innovation. Consequently, companies willing to abandon their existing investments were more likely to pursue radical product innovation.

They defined radical product innovation based on two commonly used underlining dimensions of radical product innovation definitions: "technology", which determined the extent the technology involved in a new product differed from prior technologies, and "markets", which determined the extent the new product fulfilled customer need per dollar better than existing products. Table 2.3 shows four types of innovation based on their classification using the two dimensions. According to the table, radical product innovation is an innovation that incorporates a substantially different technology and provides substantially greater customer need fulfilment per dollar relative to existing products.

Table 2.3: Types of Product Innovations (Chandy & Tellis, 1998, p. 476)

		Customer Need Fulfilment Per Dollar	
		Low	**High**
Newness of Technology	**Low**	Incremental innovation	Market breakthrough
	High	Technological breakthrough	Radical innovation

Chandy and Tellis (1998) then identified four organisational factors that influenced a company's willingness to cannibalise. These factors were more useful than company size and industry phase as they could be controlled by managers. The four factors were *specialised investments*, which was the level of company investments in specialised technology; *internal markets*, which was the level of internal organisational autonomy and competition; *product champion influence*, which was the extent employees who advocate new product ideas could affect the activities of the organisation; and *future-market focus*, which was the extent the company emphasises future customers and competitors relative to current customers and competitors.

Figure 2.8 shows the hypothesised model of radical product innovation developed by Chandy and Tellis (1998). Willingness to cannibalise acted as the mediator between the four organisational factors and radical product innovation. The company size (firm size) was hypothesised to have a direct relationship with radical product innovation.

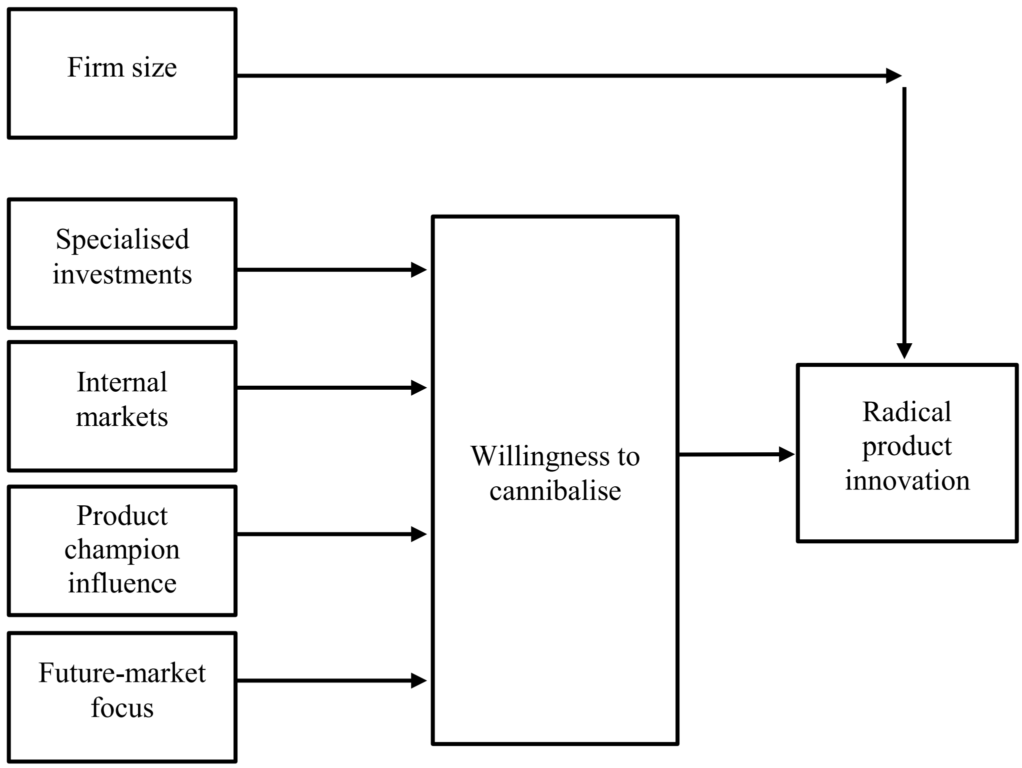


Figure 2.8: Hypothesised model of radical product innovation (Chandy & Tellis, 1998, p. 476)

Data were collected through a survey of key managers mostly at the director or vice president level. To control for the effects of competitive intensity and environmental turbulence, three highly competitive and turbulent high-tech industries were chosen for the study. The industries were computer hardware, photonics, and telecommunication. In total, 483 useable samples were collected, and the model was tested using a path analysis.

Chandy and Tellis (1998) found that willingness to cannibalise was a powerful predictor of an organisational propensity for radical product innovation. Alternatively, company size had no significant effect on radical product innovation. Out of the four organisational factors, only specialised investments, as expected, had a negative effect on the company willingness to abandon their investments. The other three factors were significant and positively contributed to the company willingness to cannibalise investments. Furthermore, they adequately countered the negative effect of specialised investments. Hence, internal markets, product champion influence, and future market focus are important organisational characteristics managers need to cultivate to increase their organisational willingness to cannibalise investments in the pursuit of radical product innovation.

Company orientation

Hult, Hurley, and Knight (2004) attempted to identify the antecedents of innovativeness. They defined *innovativeness* as the capacity of a company to introduce new processes, products, or ideas in the organisation.

Figure 2.9 shows their hypothesised model which identifies market orientation, learning orientation, and entrepreneurial orientation as the antecedents of innovativeness. *Market orientation* was related to the generation, dissemination, and responsiveness to market intelligence; *learning orientation* was related to the development of new knowledge in the organisation; and *entrepreneurial orientation* was related to the entry of new businesses. The three orientations represented the company's culture, or the norms, values, and beliefs that influenced the company's innovation behaviours, and were considered important for developing competitive advantages.

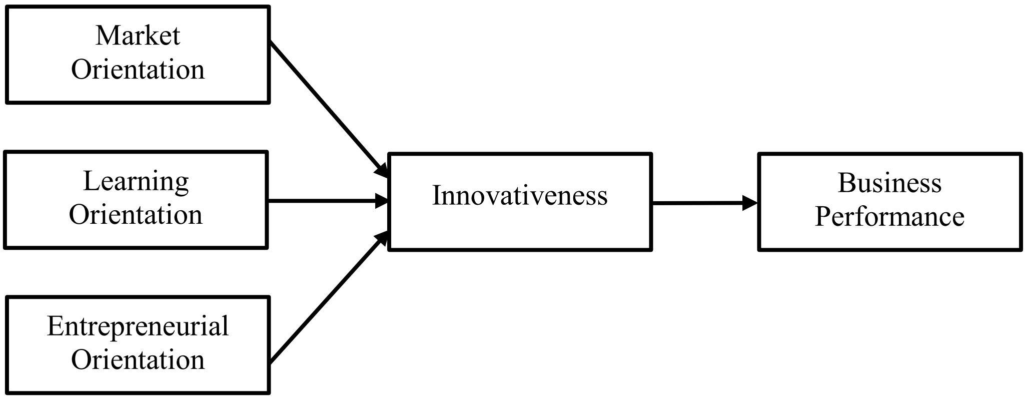


Figure 2.9: Hult et al.'s hypothesised model (Hult et al., 2004, p. 430)

Hult, Hurley, and Knight (2004) claimed they were the first to integrate the three orientations into a model with innovativeness and business performance. They also contended how market turbulence (the degree of customer demand and preference volatility) moderated the relationships between the three orientations and innovativeness and the innovativeness and business performance. They collected 181 survey responses from marketing managers in multinational industrial companies and tested their model using structural equations modelling.

They found all the relationships between the three orientations and innovativeness and the innovativeness and business performance significant and positive. Furthermore, innovativeness was an important mediator between the three orientations and business performance. The market turbulence had no effect on the innovativeness and business performance relationship, indicating that innovativeness was important regardless of the market volatility. Only market orientation was significant in high market turbulence, suggesting that market orientation was more important in a rapidly changing market environment and less so in a stable market environment.

2.2.6.2 Organisational capabilities

Later, researchers begin to use organisational capabilities, instead of organisational characteristics, to conceptualise the determinants of radical product innovation. This transition can be explained by the inclusion of resource-based views as their theoretical basis for model development. The resource-based view is a management theory that a company's competitive advantage comes from its resources, such as its organisational capabilities (Barney, 1991; Peteraf, 1993; Wernerfelt, 1984).

The resource-based view is employed by many researchers for studying radical product innovation determinants because it explains how a company can achieve radical product innovation by building productive organisational capabilities required for radical product innovation (Herrmann, Tomczak, & Befurt, 2006; Kyrgidou & Spyropoulou, 2013; Slater et al., 2014). Nevertheless, organisational characteristics are still used in some studies. For example, Herrmann et al. (2007) uses organisational characteristics as the antecedents to the organisational capabilities required for radical product innovation.

According to Porter (1985), companies can achieve competitive advantage by delivering a product at lower cost or offering unique benefits to the buyer. He identifies five forces which influence a company's ability to achieve competitive advantage in an industry: the entry of new competitors, the threat of substitutes, the bargaining power of buyers, the bargaining power of suppliers, and the rivalry among existing competitors. By evaluating the five forces of an industry, a company can determine the attractiveness or profitability of the industry and develop a competitive strategy that will allow the company to influence and position itself favourably against the five forces. A company is said to have sustainable competitive advantage when it can maintain its favourable position and consistently earn above the industry average (Porter, 1985).

The resource-based view is different from Porter's five forces theory because it considers a company's resources, instead of an industry's attractiveness, as the basis of competition. Resources can be defined as tangible and intangible assets connected to a given company such as its "brand names, in-house knowledge of technology, employment of skilled personnel, trade contacts, machinery, efficient procedures, capital, etc." (Wernerfelt, 1984, p. 172). For these resources to create competitive advantage, they must be valuable, rare, difficult to imitate, and hard to substitute (Barney, 1991). A company is said to have sustainable competitive advantage when its competitors are unable to recreate the company's resources or duplicate the competitive advantage the company enjoys from its idiosyncratic resources (Barney, 1991).

Prahalad and Hamel (1990) introduce a concept of "core competency" to expand the theory of resource-based view. Fundamentally, core competencies are "the collective learning in the organisation, especially how to co-ordinate diverse production skills and integrate multiple streams of technologies" (Prahalad & Hamel, 1990, p. 81). They can be viewed as the key technological resources companies can invest in and cultivate in order to gain a competitive advantage. A core competency must meet three criteria: it provides potential access to a wide variety of markets; it makes a significant contribution to the perceived customer benefits of the end product; and it is difficult for competitors to imitate (Prahalad & Hamel, 1990). Core competencies allow managers to exploit the key technological resources of their company through economy of scope, leading to new business units in multiple markets.

Following this, Grant (1996) introduces a “knowledge-based” concept as an extension of the resource-based view. Here, knowledge is posited as the primary source of value, making it the most important resource in an organisation. The company is conceptualised as an institution for integrating knowledge where its primary function is knowledge application rather than knowledge creation. Consequently, the focus of management should be on building knowledge management capability to support knowledge aggregation (i.e. absorptive capacity (Cohen & Levinthal, 1990)) and knowledge distribution, integration, and utilisation within the organisation. Because knowledge resides within individuals (employees), can be tacit or implicit, and is carried through an organisation by rules and directives, sequencing, routines, and group problem solving and decision making, it is considered socially complex and very difficult to duplicate, making a heterogeneous knowledge a major determinant of competitive advantage. The extent of competitive advantage will depend upon the ability of management to access and integrate the specialised knowledge of their employees. The knowledge-based concept expands the resource-based view theory by putting greater emphasis on knowledge (as a resource) and its relationship with competitive advantage.

In today’s business environment, there is a higher level of competition and market turbulence caused by globalisation and technological and market discontinuities. Consequently, core competencies can be seen as a liability or “core rigidities” in a high turbulence market because they discourage companies from abandoning their key technological resources or specialised investments (Chandy & Tellis, 1998; Leonard-Barton, 1992). To stay competitive, companies must be capable of abandoning their specialised investments and building new ones (Chandy & Tellis, 1998; Herrmann et al., 2007). This leads to another concept called “dynamic capabilities” introduced by Teece, Pisano, and Shuen (1997). They define dynamic capabilities as “the firm’s ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments” (Teece et al., 1997, p. 516). In other words, dynamic capabilities are a company’s ability to transform their resources in response to a changing business environment. To clarify the concept, Teece (2007) develops a framework to identify the foundations of dynamic capabilities, which includes sensing, seizing, and reconfiguring. By building organisational capabilities to sense technology and marketing changes, seize the resources required to exploit the changes, and reconfigure the existing resources, companies can constantly renew themselves and achieve sustainable competitive advantage in a high turbulence market (Teece, 2007).

For this research, the resource-based view theory, including its core competency, knowledge-based, and dynamic capabilities concepts, are used for developing the conceptual model in section 3.4. They are needed to understand the causes of sustainable competitive advantage in today's business environment and identify the organisational capabilities needed for radical product innovation at a company level of analysis. Porter's five forces theory is not considered because it is better suited for an industrial level of analysis which is outside the scope of this study. Subsequently, organisational capabilities needed for radical product innovation include: a radical innovation hub; willingness to abandon investments; the capability to transform competencies and markets; organisational capabilities in established firms; entrepreneurial, managerial, and technical capabilities; internally and externally oriented knowledge capabilities; and radical product innovation capability. They are explained in turn.

Radical innovation hub

Leifer et al. (2000) conducted a five-year longitudinal case study of 12 radical innovation projects in 10 large, mature companies. They defined a radical innovation project as a project with the potential to produce one or more of the following: an entirely new set of performance features, improvements in known performance features of five times or greater, and a significant (30 percent or greater) reduction in cost. A radical innovation was a product, process, or service with unprecedented performance features or familiar features with potential for significant improvements in performance or cost. Radical innovation had the potential to transform existing markets or industries or create new ones.

They found that radical innovation process had a long development time (often a decade or longer), was highly uncertain and unpredictable, nonlinear and stochastic (interrupted by several discontinuities such as project pauses, changed priorities, setbacks, or changes with key players), as well as being contextually dependent; in contrast, incremental innovation process was short, clearly defined, and continuous. As a result, radical innovation was much more difficult and riskier compared to incremental innovation. Nevertheless, radical innovation was becoming more important in large and mature companies for maintaining their competitiveness.

Consequently, they proposed establishing a radical innovation hub as a strategy for large and mature companies to deal with the many uncertainties and discontinuities associated with radical projects. They stated:

> A radical innovation hub—or even better, a distributed network of small, nimble hubs—can serve as the repository for the cumulative learning about managing radical innovation. In addition, a hub is a natural "home base" for all those who play pivotal organisational roles in making radical innovation happen—radical innovators, idea hunters and gatherers, internal venture capitalists, members of evaluation and oversight boards, and corporate entrepreneurs. Most important, hubs help manage the interfaces between radical innovation projects and the mainstream organisation, enhancing the flow of positive resources and diminishing the flow of negative elements. (p. 185)

Table 2.4 provides a summary of management mechanisms (competencies) in the radical innovation hub as identified by Leifer et al. (2000). The management mechanisms are as follows: involving senior management, capturing radical innovations, acquiring resources, engaging individual initiative, managing internal/external partners, and managing transitions. These competencies are explained according to their level of maturity between early and mature radical innovation capability. The level of maturity guides managers in developing these competencies or radical innovation capability within their organisations. Subsequently, the radical innovation hub is a powerful strategy for large and mature companies to develop radical innovation and achieve long term competitive advantage.

Table 2.4: Level of Radical Innovation Maturity and Associated Management Mechanisms (Leifer et al., 2000, p. 194)

	INVOLVING SENIOR MANAGEMENT	**CAPTURING RADICAL INNOVATIONS**	**ACQUIRING RESOURCES**	**ENGAGING INDIVIDUAL INITIATIVE**	**MANAGING INTERNAL/EXTERNAL PARTNERS**	**MANAGING TRANSITIONS**
Early Radical Innovation Capability	Executives act as provocateurs, patrons, and champions to compensate for lack of supportive culture.	Mavericks try to catch the attention of patrons. There is a lack of infrastructure and systematic approach.	Acquisition of resources is ad hoc. Project teams often expect a budget allocation to fund their work.	Completing radical innovation tasks, staffing the project team, and engaging champions rely on individual initiative.	Relationships with internal and external partners are developed on an ad hoc, project-by-project basis by each project team.	Communication is poor between the radical innovation project and the business unit. Project often transitions too early and radical innovation flounders. Project relies on intervention of senior management for transition.
Mature Radical Innovation Capability	The firm's leadership sets expectations, develops radical innovation culture, establishes facilitating organisational mechanisms, and develops goals and reward systems.	Radical innovation idea hunters seek opportunities. Radical innovation hubs help establish effective evaluation boards that use appropriate criteria. Non-traditional marketing and business development personnel work with radical innovation technical teams to develop the business model.	Individual managers with authority to provide seed funding and internal venture capital provide multiple sources of capital for radical innovation. The firm adopts a portfolio approach to funding radical innovation projects.	Radical innovation hubs work with HR to develop a strategy for identifying, selecting, rewarding, and retaining radical innovation champions, experts, and team members.	Relationships between radical innovation activity and internal and external partners are developed at a strategic level, relying on the collaboration of the project team, the radical innovation hub, and the oversight board.	Transition team is established to continue application and market development until uncertainty is reduced sufficiently to ensure a successful transition to the operating unit.

Willingness to abandon investments

Herrmann, Tomczak, and Befurt (2006) used a causal analytic model to identify the determinants of radical product innovation. They measured product innovativeness, or novelty, based on two dimensions: its degree of novelty intensity, between high and low; and the perspective of novelty, from the company and customer's point of view. Table 2.5 presents their four types of product innovation as a result of combining the two dimensions. Radical product innovation was defined as a new product based on a new technological basis with a high novel utility experience to the customer.

Table 2.5: Four Types of Product Innovations (Herrmann et al., 2006, p. 21)

Novelty of technology or novelty from the company's point of view	**Novelty of utility creation or novelty from the customer's point of view**	
	Minimal	**High**
Minimal	Incremental product innovation	Customer-related product innovation
High	Company-related product innovation	Radical product innovation

Herrmann, Tomczak, and Befurt (2006) expanded the willingness to cannibalise—the model previously developed by Chandy and Tellis (1998)—to include other organisational and strategy factors based on the resource-based view proposed by Wernerfelt (1984) and the value-added chain created by Porter (1985). The resource-based view was a management theory that a company's idiosyncratic resources determined its ability to create competitive advantage (Peteraf, 1993; Wernerfelt, 1984). The value-added chain identified core business functions that were involved with product innovation process such as human resource management, technology development, operations, logistics, and marketing and sales (Porter, 1985). Their resulting hypothesised model is shown in Figure 2.10.

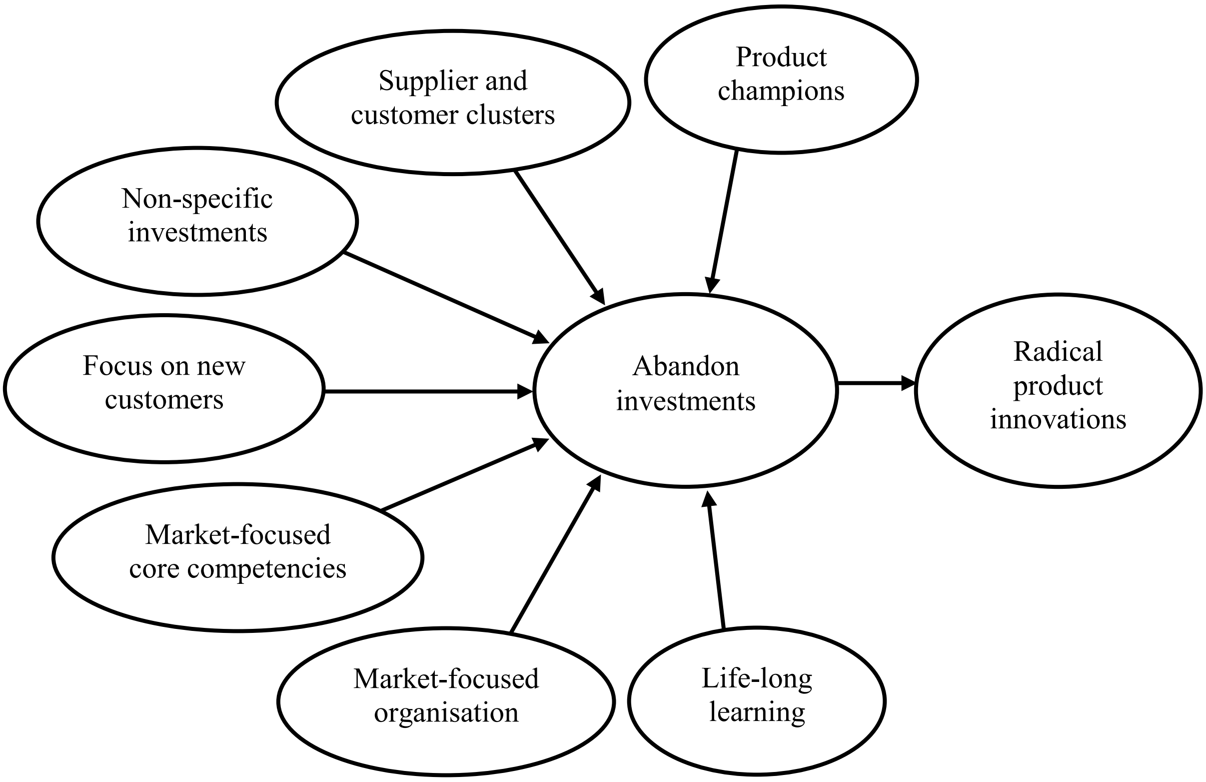


Figure 2.10: Herrmann et al.'s hypothesised model (Herrmann et al., 2006, p. 31)

Herrmann, Tomczak, and Befurt (2006) collected 109 questionnaire responses from senior managers in 53 companies across software, hardware, telecommunications, biotechnology, microelectronics, and image processing industries that originated in Germany, UK, and France. They tested their hypothesised model through a partial least squares analysis and found that the willingness to abandon investments strongly determined radical product innovation. All the factors in Figure 2.10 were found to drive the company's willingness to abandon investments, but not at the same level. A focus on new customers had the strongest impact followed by the product champions and life-long learning. They were identified as the key factors that influenced a company's willingness to abandon investment and pursue radical product innovation.

Capability to transform competencies and markets

Herrmann, Gassmann, and Eisert (2007) went further than the previous models and considered both the antecedents and determinants of radical product innovation in order to develop a more unifying framework of radical product innovation determinants. They defined their dependent variable *radical product innovations* similarly to the definition proposed by Chandy and Tellis (1998) as the propensity of a company to introduce new products that incorporated substantially different technology from existing products and could fulfil customer needs either significantly better than existing products, or addressed different types of needs not previously fulfilled with existing products.

First, Herrmann, Gassmann, and Eisert (2007) borrowed the theory of a resourced-based view (Wernerfelt, 1984) and the core competency (Prahalad & Hamel, 1990) to explain the impact radical product innovation had in diminishing the value of existing resources and core competencies. Then, they argued that dynamic capabilities, as proposed by Teece et al. (1997), were necessary to cope with the diminishing value caused by radical product innovation and build new resources and core competencies. This leads to their hypothesised model shown in Figure 2.11.

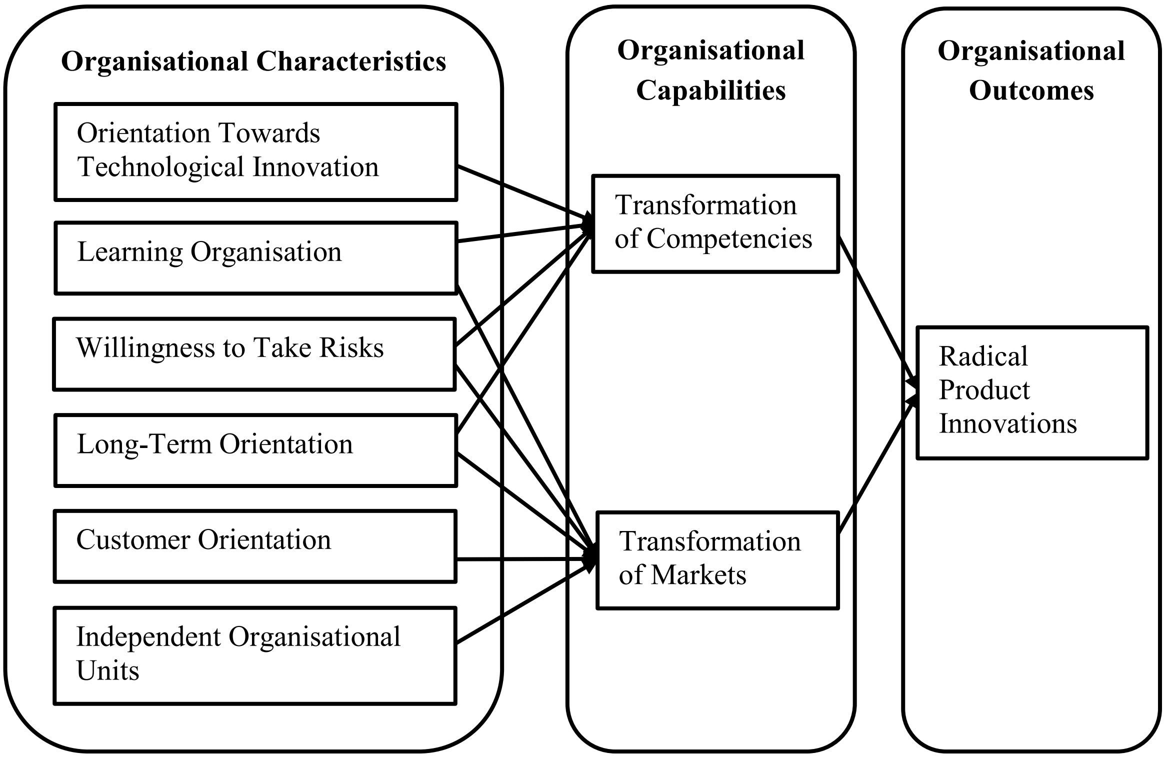


Figure 2.11: Herrmann et al.'s hypothesised model (Herrmann et al., 2007, p. 96)

The model consisted of organisational characteristics, organisational capabilities, and organisational outcomes. Organisational characteristics were the innovation culture and orientations that acted as the antecedents to organisational capabilities. Organisational capabilities were the dynamic capabilities that acted as the determinants of radical product innovation. They specified two dynamic capabilities as transformation of competencies and transformation of markets. The *transformation of competencies* was defined as the company's willingness to abandon and develop new competencies (such as new technologies), and the *transformation of markets* was defined as the company's willingness to pursue new markets at the potential expense of existing markets. Organisational outcomes were the propensity of a company to introduce radical product innovation and acted as the study dependent variable.

Herrmann, Gassmann, and Eisert (2007) collected 72 questionnaires from general managers or managers in the R&D areas from companies in industries with high competition and dynamic technological changes. The hypothesised model was tested using partial least square modelling. They found that both the transformation of competencies and the transformation of markets were strongly related to radical product innovation. This suggested that organisational capabilities to transform competencies and markets were important determinants of radical product innovation. All the organisational characteristics were also found to influence the organisational capabilities. However, learning organisation and long-term orientation did not have a significant relationship to the transformation of markets.

Organisational capabilities in established firms

Chang, Chang, Chi, Chen, and Deng (2012) investigated how established companies could improve their radical innovation performance from an organisational capabilities view. They argued that established companies often lagged behind young/start-ups companies in introducing radical innovation because of their structural inertia (inappropriate structures and systems), which acted as inhibitors to radical innovation.

Based on the organisational capability theory and innovation capability view, they regarded *radical innovation capability* as "a firm's ability to explore, adapt, tolerate and experiment with new products, processes, and services for non-mainstream businesses" (Chang et al., 2012, p. 443). They then divided the radical innovation capability into four types:

1. **Openness capability** – "a firm's ability to search sources of radical innovation with external, distant and wider orientation rather than internal, local and narrow sources" (Chang et al., 2012, p. 444).
2. **Integration capability** – "a subset of the ability to integrate and align the organisational connectedness and ambidexterity of radical innovation with the mainstream business" (Chang et al., 2012, p. 444).

3. **Autonomy capability** – “a firm’s ability to encourage and tolerate risky, ambiguous, unsuccessful radical ideas” (Chang et al., 2012, p. 445).
4. **Experimentation capability** – “a subset of a firm’s ability to probe, experiment with, test, and commercialise radical ideas and concepts, across R&D, manufacturing and marketing disciplines” (Chang et al., 2012, p. 445).

Their hypothesised model is presented in Figure 2.12. The model shows how the four organisational capabilities are positively correlated to radical innovation performance and act as mediators to overcome the structural inertia that exists in established companies. The structural inertia consists of five inhibitors: limited organisational searching; insufficient organisational capabilities to plan and evaluate radical innovation; rigid organisational routines and culture; incorrect staffing, compensation, and reward systems; and reluctance to experiment in unknown territory. Radical innovation performance is measured as the percentage share of radical innovation sales to total sales within five years, and the profit ratio of radical innovation to total innovation.

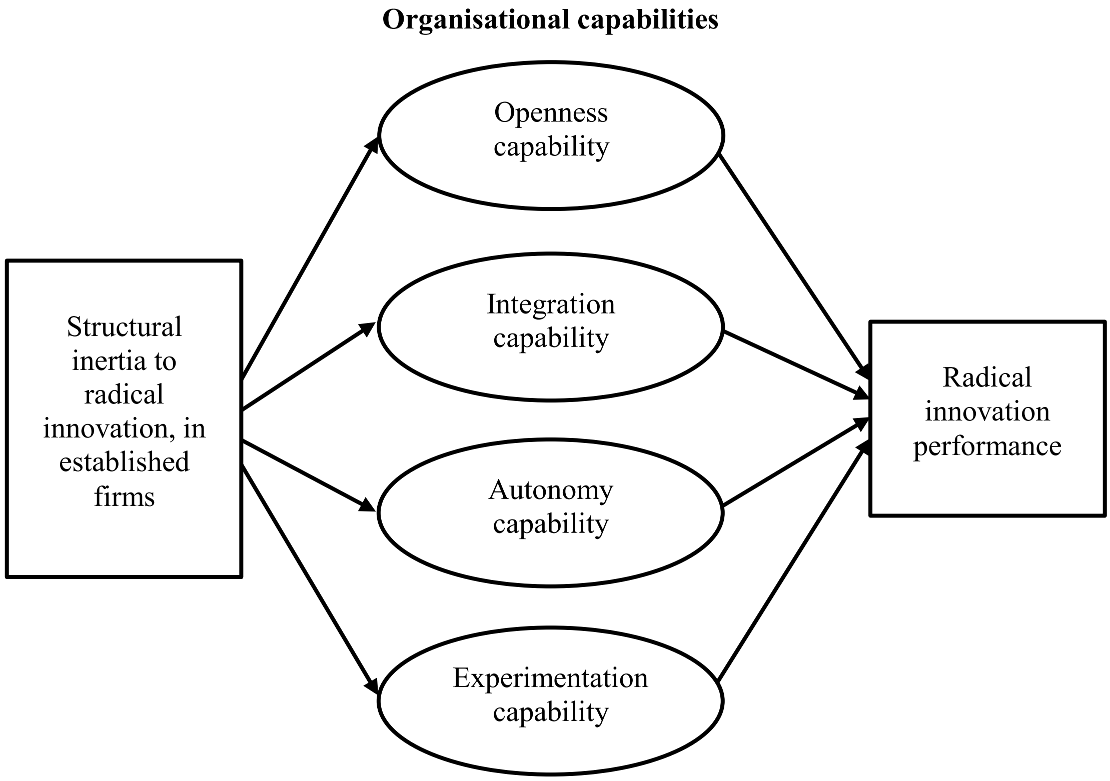


Figure 2.12: Chang et al.’s hypothesised model (Chang et al., 2012, p. 445)

Chang et al. (2012) conducted a postal questionnaire survey targeting the senior managers in charge of corporate R&D such as Chief Technology Officers, Vice Presidents of R&D,

or Senior R&D managers, from top 500 Taiwanese manufacturing companies. The survey resulted in 112 effective responses with a 22.4% response rate and the data were analysed through multiple regressions. They found all the organisational capabilities were significant and positively correlated to radical innovation performance, which indicated their importance in improving radical innovation performance in established companies. Experimentation capability was found to have the highest positive coefficient followed by autonomy capability, integration capability, and openness capability. They also tested organisational characteristic factors such as company size, R&D size, ICT-firm, and original brand manufacturer's business model and found most of them insignificant in explaining radical innovation performance. They recommended future study could investigate the structure and interrelationships of these organisational capabilities where a structural equation model method may be used for analysis.

Entrepreneurial, managerial, and technical capabilities

Borrowing from the resource-based view and insights from the literature on organisational capabilities, Kyrgidou and Spyropoulou (2013) proposed three organisational capabilities needed for radical product innovation. Their study provided new insights into the role of innovativeness to business performance from the resource-based view perspective. It aimed to examine the relationship between organisational capabilities, innovativeness, and business performance. Capabilities were referred to as "the organisational processes through which resources are obtained, combined and deployed, enabling the firm to achieve a strong marketplace position relative to competitors" (DeSarbo, Di Benedetto and Song, 2007, as cited in, Kyrgidou & Spyropoulou, 2012, p. 3).

Figure 2.13 shows their hypothesised model which includes three organisational capabilities: *entrepreneurial capabilities* refers to the company's ability to identify and exploit new innovative ideas, *managerial capabilities* refers to the company's ability to manage and utilise resources, and *technical capabilities* refers to the company's ability to develop and advance new technology.

Innovativeness was defined as a measure of an organisation's willingness to adapt new technologies, processes, and ideas in order to offer new products. Business performance was related to the company's sales, customer, and financial performances. The firm's age and number of employees were used as control variables.

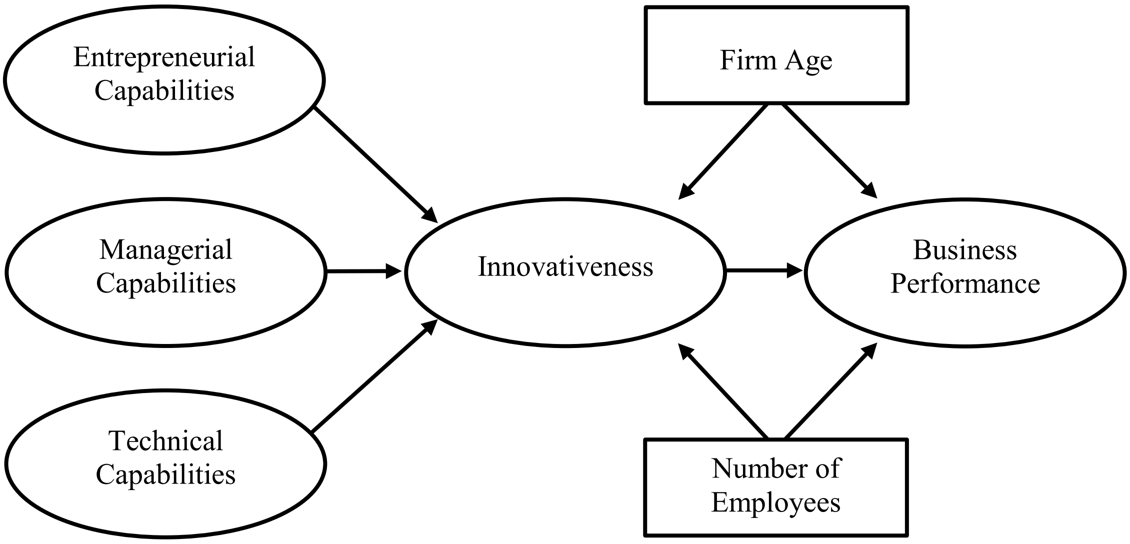


Figure 2.13: Kyrgidou and Spyropoulou's hypothesised model (Kyrgidou & Spyropoulou, 2013, p. 291)

Kyrgidou and Spyropoulou (2013) conducted a mail survey of top-level managers such as CEOs and managing directors from 218 Greek companies in pharmaceuticals, information communication and technology, and food and beverage manufacturers. They used the elliptically reweighted least squares estimation procedure in EQS for model analysis. The results supported that entrepreneurial, managerial, and technical capabilities drove innovativeness and that innovativeness enhanced business performance. They also found that the control variables, number of employees and the firm's age, had no significant effect on innovativeness and business performance.

Internally and externally oriented knowledge capabilities

Maes and Sels (2014) examined the role and contribution of internally and externally oriented knowledge-related capabilities to radical product innovation in small and medium-sized enterprises (SMEs). Their hypothesised model, shown in Figure 2.14, was developed based on the knowledge-based (Grant, 1996) and dynamic capabilities concepts (Teece et al., 1997).

Internally oriented knowledge-related capabilities were *knowledge diversity capability,* which represented the company's ability to broaden their employees' knowledge base; and *knowledge sharing capability,* which represented the company's ability to facilitate knowledge sharing among their employees. Externally oriented knowledge-related capabilities were *exploratory learning*, *transformative learning*, and *exploitative learning*, which represented the learning processes that constituted a company's ability to acquire and utilise external knowledge (i.e. absorptive capacity (Cohen & Levinthal, 1990)). They hypothesised that a company's internally oriented knowledge-related capabilities were positively related to its externally oriented knowledge-related capabilities because a company's absorptive capacity was dependent upon the company's internal knowledge base and its ability to combine and exchange knowledge internally. They defined *radical product innovation* as the development of a new product not familiar to customers or with a new quality and measured based on its percentage to total sales in the year of the survey.

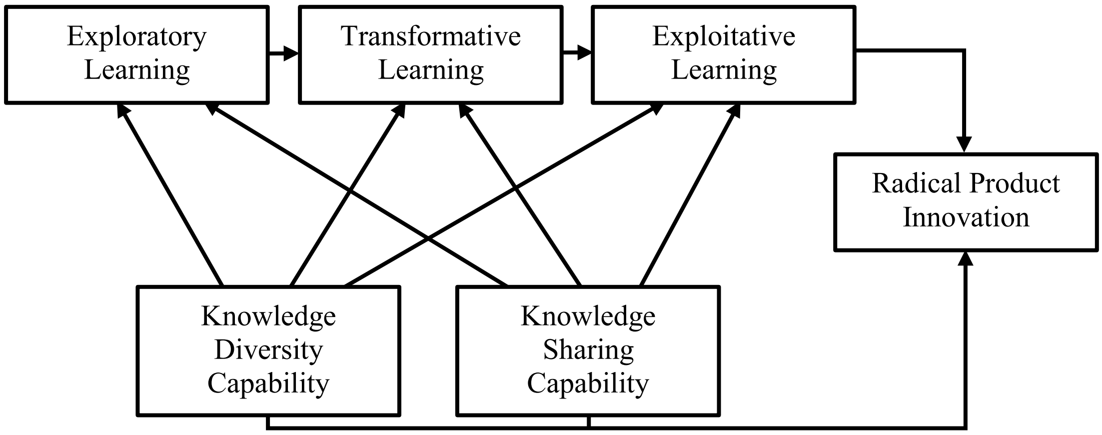


Figure 2.14: Maes and Sels' hypothesised model (Maes & Sels, 2014, p. 146)

Maes and Sels (2014) collected a sample of 194 SMEs (companies with maximum 250 employees) in dynamic environments (high demands for innovation) from the Panel Survey of Organisations in the Flanders survey database and tested their hypothesised model using path analysis. They found the knowledge sharing capability strongly related with all the learning processes, whereas knowledge diversity capability only strongly related with the exploratory learning and weakly with the other two. In addition, all the learning processes were strongly connected with each other leading to radical product innovation. However, only knowledge sharing capability was strongly related to radical product innovation, but knowledge diversity capability was not.

Radical product innovation capability

Slater et al. (2014) conducted an extensive literature review in order to develop a model of radical product innovation capability (RPIC). They defined RPIC as the capability to develop and commercialise products or services that offered unprecedented performance benefits, substantial cost reductions, or the ability to create new businesses. They argued that RPIC was more difficult to develop than incremental product innovation capability because radical product innovation required dynamic capabilities, where managers needed to adapt, integrate, and deploy both internal and external skills, resources, and functional competencies in order to maintain competitive advantage.

They first conducted a review of the empirical literature in order to identify the organisational characteristics supportive of the RPIC. Subsequently, Slater et al. (2014) specified five components of RPIC: *senior leadership* which was the characteristics of chief-level executives of the organisation; *organisational culture* which was the values, beliefs, and assumptions of the organisation; *radical product innovation process* which was the radical product development process and practices of the organisation; *organisational characteristics* which was the structure, reliance on partners, cross-functional integration, and performance measurement of the organisation; and *product launch strategy* which was "the mechanism through which the organisation communicates its value proposition to the chosen target customers" (Slater et al., 2014, p. 554). The five components and their detailed factors are shown in Figure 2.15.

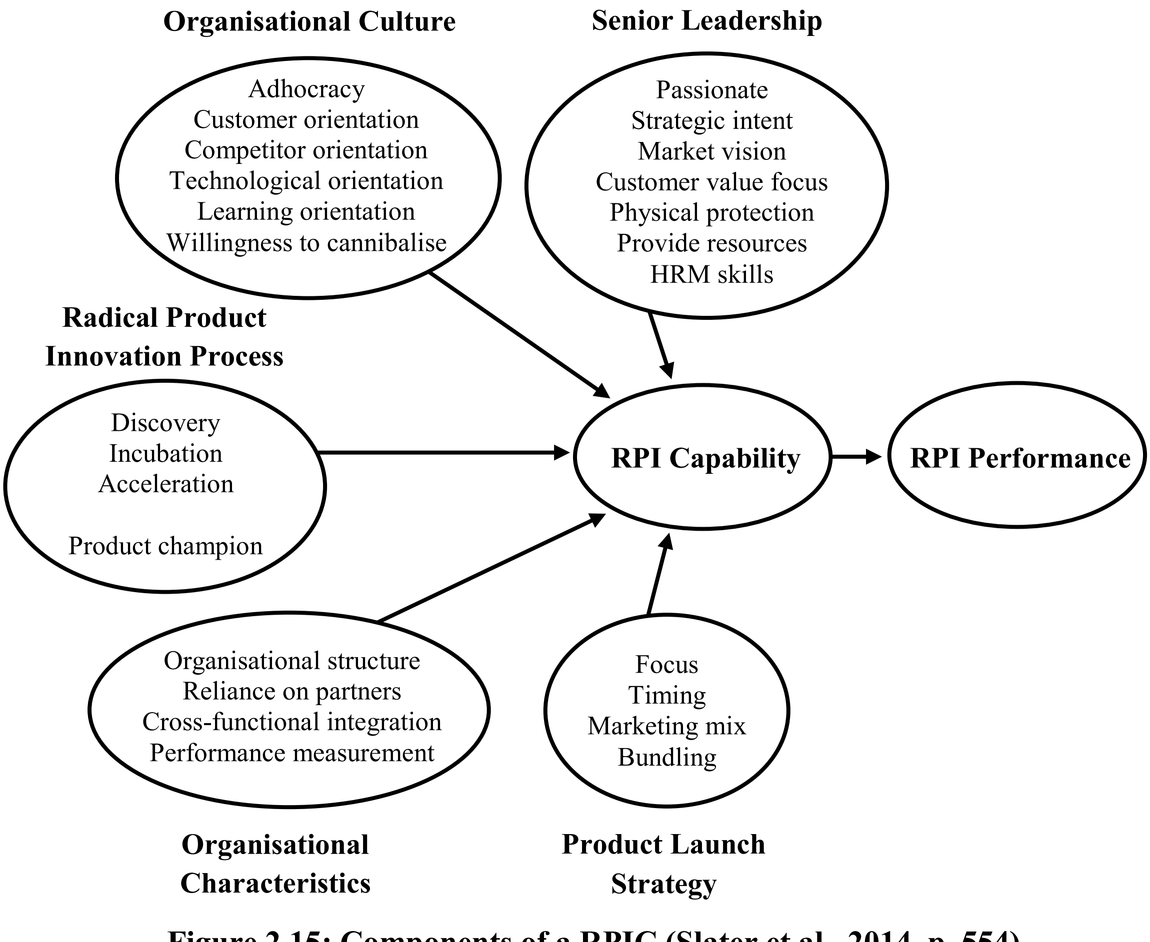


Figure 2.15: Components of a RPIC (Slater et al., 2014, p. 554)

Slater et al. (2014) then realised the existence of interrelationships between each of the components. Through additional literature review, they proposed an interrelationships model between the components of RPIC as shown in Figure 2.16.

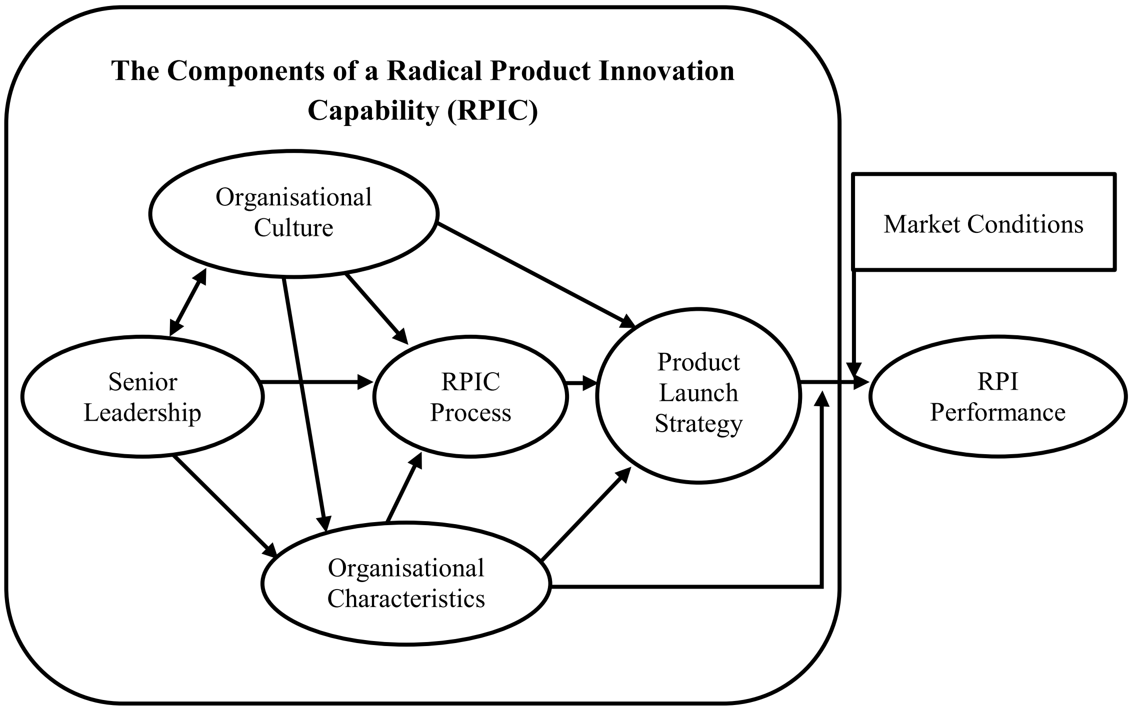


Figure 2.16: Interrelationships between components of radical product innovation capability (RPIC) (Slater et al., 2014, p. 555)

Slater et al. (2014) posited that senior leadership shaped the organisational culture, RPIC process, and organisational characteristics given their responsibility. They also contended that organisational culture could influence senior leadership (the bidirectional arrow in Figure 2.16), organisational characteristics, RPIC process, and product launch strategy because it guided the values, beliefs, and assumptions of the whole organisation. Next, they argued that organisational characteristics affected RPIC process and product launch strategy because it determined resources available for radical product innovation. In addition, RPIC process affected product launch strategy because it influenced the final product concept. Lastly, radical product innovation (RPI) performance, which was the final dependent variable (the phenomenon that Slater et al.'s (2014) attempted to explain via their model), was defined as the success of the radical product innovation in the marketplace. This success was typically measured in revenue, profit, customer satisfaction, and number of ideas in the pipeline (Chan, Musso, & Shankar, 2008, cited in Slater et al., 2014) and moderated by market conditions because they influenced how likely the target customers would buy the radical product and by organisational characteristics because they determined resources available for the company to commercialise it successfully.

Slater et al. (2014) concluded their paper by recommending scholars to explore and test the interrelationships between the various components of RPIC as well as their level of importance in order to assist managers in their pursuit of a RPIC. Furthermore, how the components could operate differently for radical versus incremental product innovation was another potential area of investigation.

2.3 The Food and Beverage Industry

The nature of radical product innovation in the global and New Zealand food and beverage industry are explored in this section.

2.3.1 What influences radical product innovation in the global food and beverage industry?

The food and beverage industry refers to a group of companies involved in the manufacturing, processing, producing, and wholesaling of food and beverage products. Compared to other industries, the food and beverage industry has a relatively low rate of radical product innovation. Booz, Allen, and Hamilton (1982) provided a percentage of new-to-the-world products at 10% for all industries average and 6% for consumer nondurables (which was the lowest among all industries). According to ECR Europe (1999), out of 24,543 new consumer goods (beverages, food, and non-food) introduced to retailers in Europe, around 2.2% could be considered radical or true new products, while the majority (77%) were "me-too" or incremental products. Furthermore, out of all the radical products launched, 43% were "dead" or "almost dead" within one year (ECR Europe, 1999). A more recent review of food product innovation has given the industry average of 1-2% for radical product innovation and 75% for incremental product innovation; while around 75% of new food products failed (Winger & Wall, 2006). This indicates that the food and beverage industry has a smaller number of radical product innovations compared to other industries and those introduced are not very well appreciated by consumers (Lagnevik et al., 2003).

One major reason there is less radical product innovation in the food and beverage industry is because of the conservative/risk avoidance nature of food consumers (Galizzi

& Venturini, 2008; Lagnevik et al., 2003; Rama & Tunzelmann, 2008). Food products are strongly associated with cultural and societal values, more so than other industries (Earle, 1997b). As a result, food consumers can be strongly resistant to new and different food products as discovered in insect-based food products (de-Magistris, Pascucci, & Mitsopoulos, 2015), coffee in capsules (Barrena-Figueroa & Garcia-Lopez-de-Meneses, 2013), and vacuum meat packaging (Chen, Anders, & An, 2013). In addition, national context can influence the local consumer acceptance of new food products (Barcellos, Aguiar, Ferreira, & Vieira, 2009; Squires, Juric, & Cornwell, 2001), including the retailers because they determine what products are placed before the consumer (Winger & Wall, 2006). Without strong consumer demands for innovative products, food and beverage companies are less likely to pursue radical product innovation.

However, fewer radical product innovations does not mean the industry lacks innovation or ability to innovate. Instead, Galizzi and Venturini (2008) argue that the industry is reasonably innovative with increasing streams of product innovation. Furthermore, the industry has a lot of innovation through the entire food system including production, harvesting, processing, manufacturing, and distribution that often are not measured when evaluating the industry's innovativeness or technology intensity (Earle, 1997b; Ministry of Economic Development, The Treasury, & Statistics New Zealand, 2011).

Nevertheless, relatively slow growing global food markets, increasing competition, and food consumer needs for pleasure and health, in connection with simplicity, are creating demands for innovative food products (Figiel & Kufel, 2016). Today's food consumers are demanding more *functional foods* (food products with health benefits, technological process, and nutritional function) due to increasing healthcare costs, life expectancy, and older peoples' desire for an improved quality of life in their later years (Bigliardi & Galati, 2013a). This requires a break from the traditional food product development that favours incremental food product innovation towards a new approach of food product development that can support radical food product innovation (Khan, Grigor, Winger, & Win, 2013).

There have been many studies that look into the determinants of radical product innovation in the global food and beverage industry. Table 2.6 provides a summary of studies related to radical product innovation determinants in the global food and beverage industry. They all report similar findings regarding food and beverage companies favouring incremental over radical product innovation. Smaller food companies are also likely to pursue incremental rather than radical product innovation. The common determinants of radical product innovation in the industry are investment in internal technical and marketing capabilities; collaboration with suppliers, retailers, and consumers; and ability to absorb external information and knowledge.

Table 2.6: Studies of Radical Product Innovation Determinants in the Food and Beverage Industry

Authors (Year)	**Methodology**	**Findings**
Martinez & Briz (2000)	Quantitative postal innovation questionnaires sent to 500 Spanish food and drink companies.	They found the nature of innovation activities in the Spanish food and drink industry to be evolutionary rather than revolutionary. This was due to the industry's adoption of defensive or imitative innovation strategy. The level of in-house technological capability was identified as an important determinant of radical product innovation because it influenced the company's ability to utilise externally generated technological knowledge.
Siriwongwilaichat & Winger (2004)	Interviews with 62 food-processing companies, 43 technical information providers, and three focus groups with technical food product developers in Thailand.	Thai-owned food companies tended to be less innovative than multinationals. Thai food companies' internal technical staff were the major source of new food product ideas and internal technical knowledge for food product development. New radical products required greater input from external technical knowledge sources compared to incremental products. Food ingredient suppliers were the main external knowledge provider to the internal technical staff for incremental innovation and food-processing equipment suppliers for radical innovation. Improving the internal technical staff's capabilities to absorb external technical knowledge could improve radical product innovation.
Avermaete et al. (2004)	In-depth survey of 177 small food manufacturing companies (3 to 50 employees) located in six rural areas in the EU.	Skills of the workforce, the company's investment in know-how, and the use of external sources of information had a positive impact on small companies' innovativeness. Interestingly, they found no evidence of a significant relationship between the top manager's characteristics (background

Authors (Year)	Methodology	Findings
		and experience) and innovation performance.
Ziggers (2005)	A survey with 650 companies in the food and pharmaceutical industry in the Netherlands.	The results indicated that differences in organisational factors, more than environmental factors, determine the adoption of radical product innovation (such as health enhancing food products) in the industry. The organisational factors that encouraged the adoption of radical product innovation in the industry were organisational characteristics (size, organisational knowledge, formalisation, centralisation, and interconnectedness), and propensity to co-operate (flexibility, openness and information exchange, and loyalty).
Capitanio, Coppola, & Pascucci (2010)	The national survey data for innovation analysis carried out by Capitalia—isolated data for 234 companies in the Italian food industry.	The quality of human capital (i.e. accumulated know-how and education within the organisation) and capacity to build relationships (i.e. with the modern distribution) were the main determinants of product innovation in Italian food companies.
Beckeman, Bourlakis, & Olsson (2013)	Open-ended interviews with 21 participants from 12 Swedish food manufacturing companies.	Few innovations in the Swedish food industry were considered radical. Food manufacturers developed products in house for consumers without working with them or other companies. This was due to lack of trust in the supply chain and limited exchange of information. An "open innovation" mindset to organise and work differently could encourage more radical innovation.
Tomas, Rosales, Batalha, & Alcantara (2014)	A survey questionnaire with 84 participants from large and non-large Brazilian food companies.	External integration with suppliers and customers was positively related to both incremental and radical innovation. However, customer integration was mainly found in large food companies. Furthermore, radical innovation was directly related to large companies whereas incremental innovation was directly related to non-large food companies.

In conclusion, the food and beverage industry has a relatively lower rate of radical product innovation compared to other industries because the majority of food consumers are conservative and risk adverse. Despite this, there is an increasing demand for functional foods leading to opportunities for innovative food product innovation. Surprisingly, the food and beverage industry has similar radical product innovation determinants, although not as comprehensive, to other industries such as building technical and marketing capabilities, collaboration with external partners (e.g. suppliers, retailers, and consumers), and learning/absorbing new knowledge. However, given the food and beverage industry context, certain determinants may be more important such as a willingness to abandon investments (to overcome organisational resistance/inertia) and capability to transform markets (to reduce consumer resistance).

2.3.2 What influences radical product innovation in the New Zealand food and beverage industry?

The New Zealand food and beverage industry has an important role for the New Zealand economy. The industry contributed to around 46% of New Zealand's total export values in 2015 (The Treasury, 2016). Meat and dairy products are the most important food exports and they accounted for around 37% of total export values in 2015 (The Treasury, 2016). Other major food and beverage products include apples, kiwifruit, salmon, mussels, oysters, and wine. The industry also has a wide range of emerging growth products such as honey, avocados, ice cream, chocolate, beer, and soft drinks (Wilkinson et al., 2015).

The industry has many cases of successful radical product innovation. Examples include the Anlene™ range of bone nutrition products launched in 1991 by Fonterra, which is the first high-calcium dairy product marketed in Asia and is earning more than $350 million per annum with an average 70% market share (Riddet Institute, 2011); Zespri Gold, which is a game-changing golden kiwifruit variety launched in 2000 that has added nearly $4 billion to the New Zealand economy (Zespri, 2015); Rockit™ apple, which is the world's first specially bred miniature apple that has been licensed to growers across the world (Rockit Trading Company, n.d.); and Greenshell™ Mussel hatchery, which is a pioneering method for breeding Greenshell™ mussels in captivity that could soon be worth $200 million to the New Zealand economy (SPATNZ, 2017). These products are radical because they utilise a new technology platform and offer to the market a major new customer benefit or product differentiation.

The industry successful radical product innovation can be attributed to its commitment to product innovation, investment in scientific research and development, and education and training of its people (Earle, Earle, & Anderson, 2001; Riddet Institute, 2011; Wilkinson et al., 2015). The previous examples of radical product innovation happened because of the commitment by the innovating companies/innovators to pursue their ideas despite the technical and marketing challenges. For example, it took four years of paper work for the Rockit™ apple to officially become the world's smallest apple (Rawson, 2014). Government owned research organisations (i.e. Crown Research Institutes) such as Plant & Food Research, AgResearch, and Landcare Research serve the industry by conducting scientific research and development in response to industry needs. For example, Zespri Gold was developed as a joint effort between Plant & Food Research and Zespri (Plant & Food Research, 2017). Lastly, New Zealand has four higher education institutions with major food and beverage research to provide the education and training: Massey University, Lincoln University, The University of Auckland, and University of Otago (Wilkinson et al., 2015). Furthermore, New Zealand food and beverage companies have access to food innovation hubs such as the New Zealand Food Innovation Network, FoodHQ, and Lincoln Hub that are located across New Zealand. These hubs provide technical and business consultation, networking, and investments to New Zealand food and beverage companies that may require them.

Nevertheless, the industry has a few weaknesses regarding radical product innovation; a small domestic market, long distance to market, small company size, and the lack of a deep and rich food cultural heritage (compared to France or Italy) can be considered the industry's weaknesses (Coriolis & MBIE, 2014). This again reflects the unique New Zealand contextual factors of small population and relative geographical isolation, which inhibit New Zealand companies from obtaining the resources or knowledge that could be critical for radical product innovation.

Currently, there are no studies of radical product innovation determinants in the New Zealand food and beverage industry. By comparison, there have been a few studies of product innovation determinants in the New Zealand food and beverage industry. Three relevant studies are summarised here.

The first study was by West (1980), who conducted research into product development practice and success factors in the New Zealand food industry. The study was conducted through a detailed questionnaire sent to 24 food companies in New Zealand followed by a personal interview with the company executive responsible for the product development function for each company selected. She identified five factors considered by New

Zealand managers to be important for product development success: an innovative and technological company orientation, a supportive company structure, consideration for the consumer, security for development, and a well-rounded company marketing emphasis. These factors were then evaluated against the actual practices. Technical skills were found to be heavily emphasised while design creativity, supportive company structure, and marketing emphasis (particularly a consideration for consumer needs) were inadequate. Overall, the study indicates New Zealand food companies' strength lies in the technical skills but less in design creativity, consumer knowledge, and supportive company structure.

The second study was by Marsh (2004) who developed a framework for analysing the determinants of innovation, using the New Zealand biotechnology sector as the study context. The framework was developed with particular reference to the neo-classical, endogenous growth, evolutionary, and systems of innovation approaches, including alternative methods of measuring innovation output and innovation rate. Data were collected from a re-analysis of the first comprehensive survey of biotechnology in New Zealand, an original survey conducted by Marsh, interviews with senior management of biotechnology companies, and a detailed review of secondary sources. The framework covered several determinants of innovation (company size, company type, conduct of R&D, involvement in modern biotechnology, specialisation, and alliances) on innovation output and innovation rate, and the final results supported most of these determinants. His study also provided a detailed description of the biotechnology sector and empirical insights into the innovation behaviour of biotechnology companies in New Zealand.

Finally, the third study was by Khan (2014) who investigated the characterisation of functional food product development in New Zealand and Singapore. Functional foods were becoming a major focus of new food product development because they were associated with higher return and competitive advantage. However, their development was more complex than traditional food products because they called for an open and interactive product development approach. Data were collected from New Zealand and Singaporean companies using a mixed-method approach (quantitative and qualitative techniques). Significant differences between traditional food product development suited for incremental food products, versus functional food product development suited for radical food products, were found. The differences included orientation towards innovation, knowledge generation (analytical), development of the resource base of a company (open innovation), collaborative networks and arrangements, and commercialisation strategies. Barriers to functional food product development were from a closed new product development perspective driven by the management cost of innovation, regulatory complications, and lack of technical skills. Khan (2014) concluded New Zealand food companies needed to move away from traditional food product development and adopt a new product development approach that supports more innovative food products such as functional foods in order to differentiate their offerings and sustain their competitive advantage.

On the whole, the New Zealand food and beverage industry's radical product innovation performance is facilitated by its commitment to product innovation, scientific research and development, and education and training; and hindered by its distance from market and small local population. Multiple organisations in New Zealand, ranging from the government funded research institutions, education institutions, and innovation hubs, help the industry overcome the hindering factors by providing the resources and knowledge required. The previous studies of product innovation determinants suggest that the industry is reasonably good at incremental product innovation. However, further studies are required to understand radical product innovation determinants in the New Zealand food and beverage industry and explain how some New Zealand food and beverage companies achieve radical product innovation.

2.4 New Zealand Context

This section explains what influences product innovation in New Zealand by reviewing its economic background, innovation performance, strengths, and weaknesses for all New Zealand industries as a whole.

2.4.1 What influences product innovation in New Zealand?

From the 1850s until the Second World War, the New Zealand economy was based mainly on the export of wool and sheep meat to the United Kingdom (Easton, 2016a). Due to the high demand for New Zealand primary products, New Zealand enjoyed premium payment and high economic growth. For the domestic market, New Zealand companies were protected from overseas competition by Government regulations and protection policies. During this period, New Zealand maintained a high standard of living with little competitive pressures from overseas companies.

In late 1966, the export price of wool collapsed by 40% due to the competition from synthetic fibres (Easton, 2016b). This was followed by the United Kingdom's entry into the European Economic Community in 1973. The lower payment and reduced demand from the United Kingdom forced New Zealand companies to innovate and seek new markets. Globalisation also pressured the New Zealand government to radically change its economic policy. From 1984, the New Zealand government significantly reduced its level of regulations and protection policies. This gave New Zealand companies greater freedom and flexibility to compete internationally. However, some local manufacturing industries, such as car assembly, could not compete and closed as a result.

Today, the New Zealand economy is made up of a sizable manufacturing and a large services sector complementing a highly efficient export-oriented agricultural sector (The Treasury, 2016). The primary industries (agricultural, horticultural, forestry, mining, and fishing industries) still play an important role in New Zealand's economy and account for just over 50% of New Zealand's total export earnings (The Treasury, 2016). China, Australia, and the United States are New Zealand's top three export markets, and they account for 46% of New Zealand's merchandise exports in 2015 (The Treasury, 2016).

Small to medium sized enterprises (SMEs), defined as companies with 0 to 99 full-time employees, have an important role in the New Zealand economy (Cameron & Massey, 1999). SMEs represent 99.6% of all companies in New Zealand and provide 52.8% of all employment, and in 2011, contributed around 48% to the GDP (Ministry of Business, Innovation and Employment, 2014).

2.4.2 What is New Zealand's innovation performance?

On a measure of innovation output, New Zealand has relatively higher rates of marketing and product innovation but lower rates of process and organisational innovation compared to other countries in the OECD (Ministry of Economic Development et al., 2011). Around 46% of all companies reported innovation activities in 2011 and the innovation output increases with the company size as larger companies have more resources and capacity to innovate (Statistics New Zealand, 2011). Companies with 6 to 19 employees also reported a higher rate of marketing method innovation than other types of innovation (Ministry of Business, Innovation and Employment, 2014).

On a measure of product innovativeness, of all the New Zealand companies who had introduced new products in 2009, 43% had new-to-New Zealand product innovation and

19% had new-to-the-world product innovation (Statistics New Zealand, 2010). By comparison, in Australia during the 2014-15 period, 7.4% of innovating business had new-to-Australia product innovation and 8.4% had new-to-the-world product innovation (Australian Bureau of Statistics, 2016). New Zealand's high percentage of new-to-market product innovation can be explained given the New Zealand's relatively small local market, making it easier to introduce new products from overseas (Statistics New Zealand, 2010). However, it is unclear why New Zealand had a higher percentage of new-to-the-world product innovation. This could be due to differences in measurement method, timing of data collection, or national context.

Figure 2.17 compares the rate of New Zealand's product innovativeness with respect to business size. It shows the rate of new-to-New Zealand product innovation increases with business size. This suggests that larger companies are better at introducing new-to-New Zealand product innovation than smaller companies. However, there was no clear relationship between new-to-the-world product innovation and business size (Statistics New Zealand, 2010).

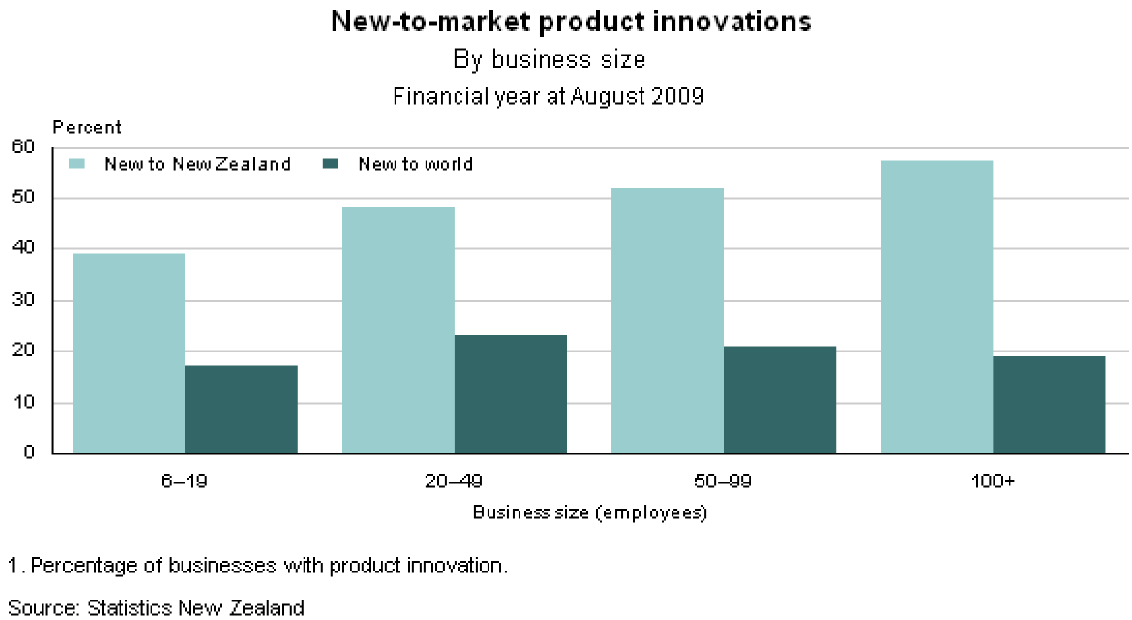


Figure 2.17: Rate of product innovativeness relative to company size (Statistics New Zealand, 2010, p. 33)

2.4.3 What are New Zealand's innovation strengths?

New Zealand innovation system's strengths lie mainly in its scientific research base (Ministry of Business, Innovation and Employment, 2012). Compared to the other 30

OECD countries, New Zealand publications in science and engineering articles per million inhabitants is ranked 11th in the OECD and a proportion of total R&D personnel per thousand total employment is ranked 6th in the OECD (Ministry of Economic Development et al., 2011).

Furthermore, New Zealand has good conditions and supportive environments for entrepreneurship and innovation (OECD, 2007). New Zealanders are often recognised for their ability to innovate despite the challenges; for example, the terms "kiwi ingenuity" or "No. 8 wire" often comes to mind (Bridges & Downs, 2000). It is suggested that New Zealand's can-do attitude, entrepreneurship, and ingenuity may be the result of its pioneer and agricultural background (Anderson, 2011; Riddet Institute, 2011). In addition, the New Zealand government has been promoting product innovation, starting from the Think Big projects in the 1980s (Gustafson, n.d.), the Knowledge Wave Conference in 2001 (University of Auckland Business Review, 2001) to the recent Business Growth Agenda (Ministry of Business, Innovation and Employment, 2015).

2.4.4 What are New Zealand's innovation weaknesses?

On the other hand, New Zealand's innovation system's weaknesses are in its relatively low business R&D spending, venture capital investment, and patent activities (Ministry of Business, Innovation and Employment, 2012). Compared to the other 30 OECD countries, New Zealand's business expenditure on R&D as a percentage of GDP is much lower (24th in the OECD), the size of the venture capital market as a percentage of GDP is smaller and relatively underdeveloped (21st out of 26 available OECD countries), and the number of triadic patent families[1] per million population is low and decreasing (21st in the OECD) (Ministry of Economic Development et al., 2011).

In addition, New Zealand companies face unique contextual factors of small firm size, small local market, and geographical isolation, which can be considered disadvantages to New Zealand innovation performance (Hong et al., 2016). These unique contextual factors contribute to innovation difficulties faced by New Zealand companies, which include higher R&D cost, difficulty in accessing distant overseas markets, and a lack of management, marketing, and distribution skills (OECD, 2007); it is estimated that the

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1 "Triadic patent families" means a set of patents taken at the European Patent Office (EPO), the Japan Patent Office (JPO), and granted by the US Patent and Trademark Office (USPTO), to protect the same invention.

geographical isolation alone accounts for 10% of New Zealand productivity loss (OECD, 2008, as cited in McCann, 2009). This is supported by Statistics New Zealand's (2011) finding where the high cost to develop or introduce innovation, lack of management resources, and lack of appropriate personnel are the biggest barriers to innovation as reported by New Zealand companies.

A higher percentage of SMEs also experienced challenges such as the high cost and lack of management resources compared to large companies (Ministry of Business, Innovation and Employment, 2014). Whereas, the majority of businesses reported factors not hampering their ability to innovate are access to intellectual property, lack of co-operation with other businesses, government regulation, and lack of information, which reflect New Zealand's good and supportive business environment (Statistics New Zealand, 2011).

Equally important, is a finding suggesting that New Zealand's lifestyle, pioneer values and cultural beliefs may contribute only to user and small-scale innovation, not popular and commercially successful innovation (Rinne, 2011). Rinne and Fairweather (2011) conducted a research to understand the difference in innovation identity across countries. They collected data from multiple countries through computer-assisted self-interviewing and internet survey with adult volunteers from local schools. They found little evidence that the government effort to promote innovation as a part of New Zealand national identity is entering the public's consciousness. Less than 10% of innovating companies surveyed by Statistics New Zealand (2011) rated universities, polytechnics, Crown Research Institutes (CRIs), other research institutes, or research associations as important sources of ideas and information for innovation. It is possible that New Zealand companies are not fully utilising the New Zealand innovation system's strength in its scientific research base or that these institutions are not relevant to most New Zealand companies.

Overall, New Zealand has a reasonably good product innovation performance relative to other OECD countries. This is due to its strong scientific research base, ingenuity, and government support for business, entrepreneurship, and innovation. However, given New Zealand's relatively small population, small local market, and geographical isolation, many small to medium sized New Zealand companies lack the resources needed to pursue product innovation effectively (Hong et al., 2016; OECD, 2007). As a result, most New Zealand companies focus their innovation efforts on domestic markets (Ministry of Economic Development et al., 2011). New Zealand's export share of medium to high technology export is also the lowest in the OECD due to a high concentration of primary exports and the share of high growth businesses is low and dropping (Ministry of Economic Development et al., 2011). Given the New Zealand context, it is important to test the validity of the determinants of radical product innovation identified by the researcher through systematic review of extant literature, which seldom cover food and beverage, as well as the New Zealand context. Thus, this research examines the validity of the determinants of radical product innovation from a theoretical standpoint (theoretical validity or construct validity) and practical validity (acceptance via qualitative field research).

2.5 Knowledge Gaps and Justification of the Research Questions

2.5.1 The need for a theoretical framework that better explains how radical product innovation is caused through organisational behaviour

The preceding sections of this chapter reviewed several models that either predict or explain radical product innovation phenomenon using organisational characteristics (section 2.2.6.1) and organisational capabilities (section 2.2.6.2). The organisational characteristics identify the organisational traits that are associated with radical product innovation phenomenon and the organisational capabilities identify the organisational behaviours that are associated with radical product innovation phenomenon.

The model posited by Chandy and Tellis (1998), posits “willingness to cannibalise” as the sole company trait that causes radical product innovation. Willingness to cannibalise is an organisational characteristic because it explains a company’s attitude towards investments, rather than an organisational behaviour that explains (along with other variables) how radical product innovation is caused.

Similarly, the model posited by Hult et al. (2004) posits innovativeness as being caused through three company orientations. The three company orientations are organisational characteristics because they explain a company’s attitude towards innovation, rather than the behaviours that can lead to radical product innovation. A potential shortcoming of Hult et al.’s (2004) model is that the model assumes that the three company orientations are causally mutually exclusive.

In light of the resource-based view of competitive advantage, as mentioned earlier in section 2.2.6.2, quite a number of researchers posited organisational capabilities as the determinants of radical product innovation (e.g. the radical innovation hub proposed by (Leifer et al., 2000), the model proposed by Herrmann et al. (2006), and the model proposed by Herrmann et al. (2007)), but organisational capabilities is just an inimitable resource bundle that is being used by the proponents of the resource-based view to explain competitive advantage, with or without radical product innovation. As a result, they fail to explain radical product innovation as an organisational behavioural phenomenon.

In addition, the model posited by Herrmann et al. (2006) can be considered to be a refinement of the work of Chandy and Tellis (1998). The sole mediator used by Herrmann et al. (2006) to explain radical product innovation phenomenon, namely "Abandon Investments", is identical to the sole mediator used by Chandy and Tellis ("Willingness to Cannibalise") in every respect but the name. While Herrmann et al. (2006) used more organisational characteristics to explain willingness to cannibalise than Chandy and Tellis (1998), their model, too, fails to explain radical product innovation as an organisational behavioural phenomenon.

Other newer models (e.g. the model proposed by Chang et al. (2012), the model proposed by Kyrgidou and Spyropoulou (2013), and the model proposed by Maes and Sels (2014)) offer greater insights into organisational behaviours that lead to radical product innovation. Nevertheless, they are limited within their study contexts (e.g. established firms or SMEs) and Kyrgidou and Spyropoulou (2013) assume the behavioural determinants are causally mutually exclusive.

The model proposed by Slater et al. (2014) is a step in the right direction because the researchers have included several behavioural determinants to explain the radical product innovation phenomenon by enhancing organisational capability (more precisely, RPIC). The model offers a more cohesive and comprehensive model of radical product innovation determinants than prior models.

In summary, Slater et al.'s (2014) model provides a reasonable basis (a starting point) to study the behavioural determinants of radical product innovation, taking the food and beverage industry as a context and New Zealand as a delimiter (boundary) for the study. This justifies the overarching research question (*what are the determinants of radical product innovation in the New Zealand food and beverage industry, and how do they explain product innovativeness?*), which in turn leads to the first two research questions.

2.5.2 Company characteristics on radical product innovation

The literature review of organisational characteristics (section 2.2.6.1) revealed that company characteristics (e.g. age, size, national culture, industry phase, willingness to cannibalise, and company orientation) do potentially affect radical product innovation. What is not known is the extent to which these company characteristics explain radical product innovation in the New Zealand food and beverage industry. This justifies the third research question: "what company characteristics affect product innovativeness in the New Zealand food and beverage industry?".

The fourth and final research question is a natural extension of the preceding research questions.

2.6 Chapter Summary

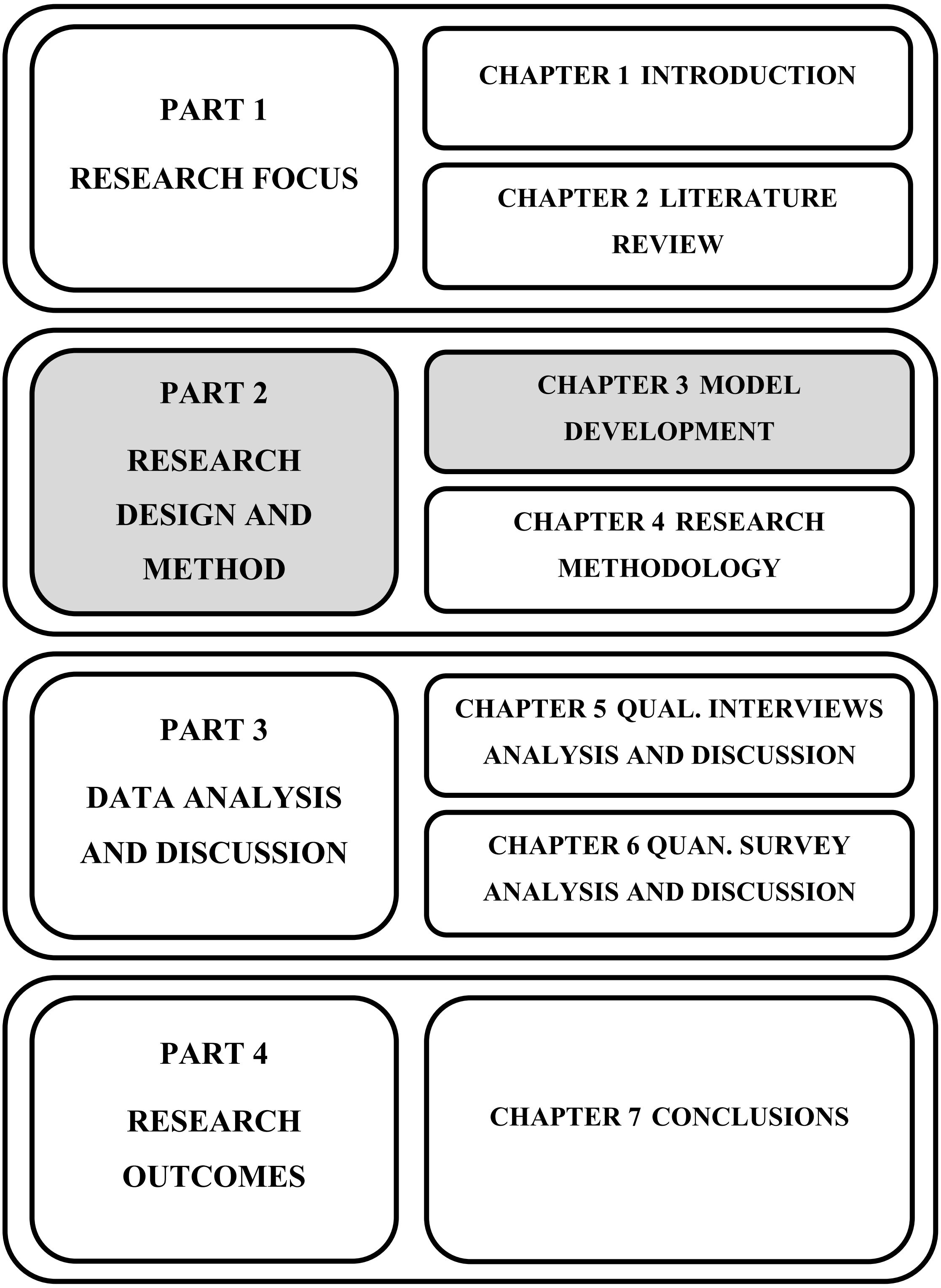
The chapter presented the literature review related to the determinants of radical product innovation in the New Zealand food and beverage industry (research focus). The findings in this chapter are used to justify the research background in Chapter 1, prepare the model development in Chapter 3, and support the discussion in Chapter 6. Three research areas relevant to the research focus are summarised as follows.

Firstly, radical product innovation was reviewed to identify its definition, advantages, disadvantages, and determinants. Radical product innovation is defined as the introduction of a new product that involves a new-to-market core technology and core value proposition. It has a high potential to cause technological and marketing discontinuity, making it important for creating superior product advantage, new markets, and national growth. However, it is challenging to develop because of the high level of uncertainties and barriers (O'Connor & Rice, 2013; Sandberg & Aarikka-Stenroos, 2014). There have been many studies on radical product innovation determinants from organisational characteristics to today's organisational capabilities. At this time, an empirically tested interrelationships model of radical product innovation determinants is needed (Chang et al., 2012; Slater et al., 2014).

Secondly, factors that influence radical product innovation in the global and New Zealand food and beverage industry are explored. It is found that radical product innovation is rare within the global food and beverage industry due to the conservative nature of food consumers. Nevertheless, functional foods are creating demands for innovative food products. Radical product innovation in the New Zealand food and beverage industry is influenced by the industry's commitment to product innovation, scientific research and development, and education and training. There have been three studies that investigate product innovation determinants in the New Zealand food and beverage industry. However, further study into the determinants of radical product innovation is needed.

Thirdly, the New Zealand context is explained. Overall, New Zealand product innovation performance is strongly influenced by its economic background and context. Its strong scientific research base, supportive business environment, and government initiatives help strengthen its innovation performance. However, it is hampered by the unique New Zealand context factors of small population and geographical isolation that increase cost and limit skilled employees available for innovation. Given this context, this research examines the validity of the determinants of radical product innovation from a theoretical standpoint (theoretical validity or construct validity) and practical validity (acceptance via qualitative field research).

PART 2: RESEARCH DESIGN AND METHOD



CHAPTER 3 MODEL DEVELOPMENT

3.1 Chapter Overview

This chapter covers the development of models and research hypotheses needed to answer the research questions.

RQ1 What are the determinants of radical product innovation in the New Zealand food and beverage industry?

Two measurement models are needed to answer the RQ1. A product innovativeness model is needed to operationally define "product innovativeness". The criterion variable product innovativeness acts as the response variable (also the effect variable) of the causal determinants of product innovativeness. This model is developed using technological and marketing newness literature provided in section 3.2. Companies that score highly in product innovativeness are deemed to be practicing radical product innovation. A product innovation process model (the second model) is needed to identify different stages in the product innovation process, which collectively explains (or determines or predicts) product innovativeness. The product innovation process model is developed by combining existing product innovation processes literature provided in section 3.3, in order to answer the first research question.

RQ2 How do the identified determinants of radical product innovation relate to one another in predicting and explaining product innovativeness?

A conceptual model is needed to conceptualise the interrelationships between the identified determinants of radical product innovation and product innovativeness. In other words, the conceptual model serves as the basis for the product innovativeness model and the product innovation process model. The conceptual model is developed from the theory of a resource-based view and organisational capabilities for radical product innovation, with regard to the New Zealand food and beverage industry context, in section 3.4, in order to answer the second research question.

RQ3 What company characteristics affect product innovativeness in the New Zealand food and beverage industry?

Company characteristics that have the potential to affect product innovativeness in the New Zealand food and beverage industry are identified in section 3.5. This is in order to answer the third research question.

RQ4 What are the salient features of a highly innovative New Zealand food and beverage company?

Both the conceptual model and company characteristics are used to answer the RQ4.

Finally, a hypothesised model and research hypotheses are presented in section 3.6.

3.2 Product Innovativeness Model

In this section, the product innovativeness model is developed to measure product innovativeness and identify radical product innovation. Product innovativeness is defined as "a measure of the potential discontinuity a product (process or service) can generate in the marketing and/or technological process" (Garcia & Calantone, 2002, p. 113).

Product innovativeness can be broken down into technological newness and marketing newness (Danneels & Kleinschmidt, 2001; Garcia & Calantone, 2002; Kleinschmidt & Cooper, 1991). As a result, both the technological newness and marketing newness are used to measure product innovativeness in this study. As mentioned earlier, the higher a company scores on newness (i.e. product innovativeness score), the higher the degree of product innovativeness of that company.

In the following three sections, technological newness and marketing newness are explained in section 3.2.1 and 3.2.2 respectively, leading to the final model of product innovativeness covered in section 3.2.3.

3.2.1 Technological newness

Technological newness is a measure of technological change (Chandy & Tellis, 1998; Kock et al., 2011). Technology can be defined as "the processes by which an organisation transforms labour, capital, materials, and information into products and services of greater value" (Christensen, 1997, p. xiii).

Tushman and Anderson (1986) studied the patterns of technological change in the minicomputer, cement, and airline industries from their beginnings through 1980. They found that technology evolved through a long period of technological evolution interrupted by technological breakthrough. Technological evolution means an incremental improvement in product performance through technological refinement. Technological breakthrough means a significant improvement in product performance due to technological discontinuity.

Foster (1986) introduced the *S-curve concept* (Figure 3.1) to help managers visualise and predict technological change. Essentially, the S-curve, in the above context, is a graph of the relationship between technology performance and effort (or funds) put into improving it. In the beginning, the performance improvement is slow due to limited knowledge and competencies. As key knowledge and technological competencies are obtained, the performance begins to improve rapidly (learning curve effect) as shown in the middle of the curve. Eventually, the rate of performance improvement slows down, and further improvement becomes more difficult and expensive when the limit of technology performance is reached. This is shown as a flat line at the top end of the S-curve.

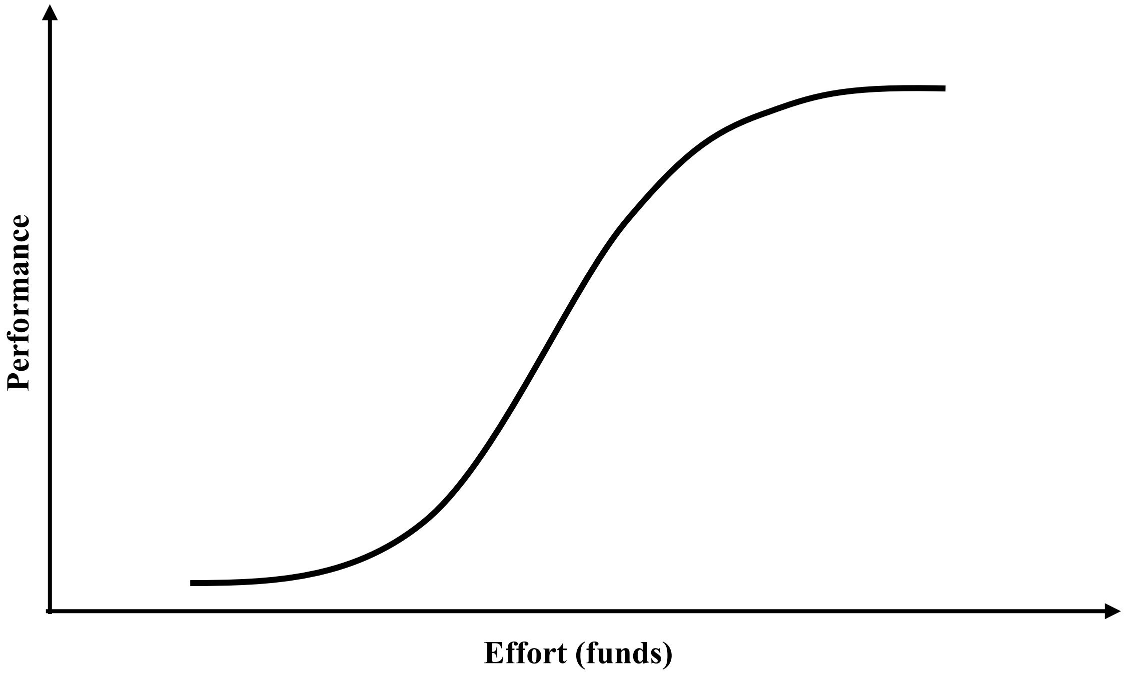


Figure 3.1: The S-curve on technology performance vs effort (Foster, 1986, p. 31)

When the limit of technology performance is reached, an alternative technology with a higher limit often emerges to replace the current technology. Foster (1986) calls this technological transition period, a "technological discontinuity". This period is shown as a gap between a pair of S-curves in Figure 3.2. According to Foster (1986), leading companies often lose their market leadership position during the technological transition period because they fail to understand the limit of their technology performance.

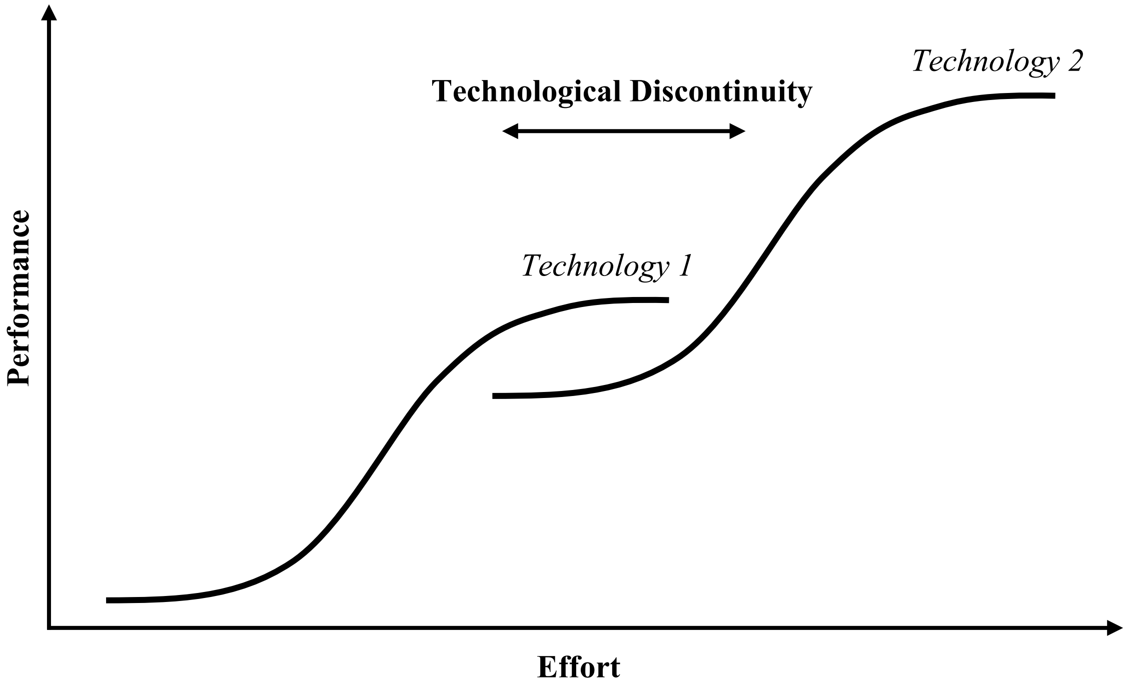


Figure 3.2: Technological discontinuity (Foster, 1986, p. 102)

Sood and Tellis (2005) further investigated the pattern of technological change empirically. They argued that the commonly believed S-curve model of technological change is incorrect and lacked empirical support. They studied the evolution of 14 technologies in the following four product categories: data transfer, computer memory, desktop printers, and display monitors. Data were sourced from historical archives using the *historical method*[2] to minimise survival and self-report bias and to gain new insights from historical readings and longitudinal analysis (Sood & Tellis, 2005). They found that technology change follows an irregular step function instead of a single S-shaped curve. Technologies can have a long period of no improvement in performance then interrupted by a significant improvement. New technologies could enter above or below the performance of existing technologies and have zero or multiple crossing in performance as they compete with each other. The idea of smooth performance improvement and

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2 The historical method is defined by Golder (2000) as "the process of collecting, verifying, interpreting, and presenting evidence from the past" (p. 157). He has broken it down into five stages: 1. Select a topic and collect evidence. 2. Critically evaluate the sources of the evidence. 3. Critically evaluate the evidence. 4. Analyse and interpret the evidence. And 5. Present the evidence and conclusions.

single crossing as predicted by the S-curve are not supported by their analysis. This leads to their conclusion that the S-curve may not be suitable to predict technological change.

It is also important to consider the technological components and architecture of a new product when evaluating radical and incremental technological change (Henderson & Clark, 1990; Sood & Tellis, 2005). A product can be considered a system consisting of sub systems, where each sub system represents an individual component of the product; and how the sub systems are assembled together into a system represents an architecture of the product (Henderson & Clark, 1990). For example, print head, ink cartridge, paper feeder, and power supply are components of an inkjet printer, and how these components are assembled together into a functional product is the architecture of the inkjet printer.

Sood and Tellis (2005) take this distinction further and define technological change based on the technology's attributes instead of its effects in order to avoid the risk of asserting premises that are true by definitions. They define three types of technological change: "platform innovation" as a new technology based on distinctly different scientific principles from those of existing technologies, "component innovation" as a new use of parts or materials within the same technological platform, and "design innovation" as a reconfiguration of the linkages and layout of components within the same technological platform. Other researchers use the term "core technology" (Chandy & Tellis, 2000; Golder et al., 2009; Tushman & Anderson, 1986) and "ancillary components" (Golder et al., 2009) to make the distinction between radical and incremental technological change respectively. Core technology is the central technology used in the product and ancillary components are the supporting technologies and mechanisms used in the product (Golder et al., 2009).

This study chooses to use a change in the new product's core technology relative to previous products to measure its technological newness. This measure is considered most reliable given the pattern of technological change as discovered by Sood and Tellis (2005). Consequently, a new product that uses a new core technology has a high degree of technological newness and a new product that uses available core technology has a low degree of technological newness.

3.2.2 Marketing newness

Marketing newness is a measure of value proposition change (Kock et al., 2011; Markides & Geroski, 2005). Value proposition can be defined as "a short, clear, simple statement of how and on what dimensions a product concept will deliver value to prospective customers" (Kahn et al., 2013, p. 475).

Marketing newness or value proposition change is an important measure of product innovativeness (Garcia & Calantone, 2002; Markides & Geroski, 2005). People do not buy products solely for practical purposes; they can also buy them for emotional, ideological, or societal purpose (Drucker, 1994; Kotler & Armstrong, 2014; Verganti, 2008). New products such as fashionable goods, books, and online web services are examples of new value propositions that use available technologies.

It has been proposed that value proposition follows a similar change pattern to that of technology's (Garcia & Calantone, 2002; Verganti, 2008). When a new product is introduced, marketers need to find a compelling value proposition to get sales. They improve their product's value proposition performance by building customer knowledge and marketing competencies. This incremental improvement in value proposition performance can be called the value proposition refinement. Similarly, when a value proposition is replaced by a superior value proposition, this process of change can be called the value proposition discontinuity. Examples of value proposition discontinuity are new uses of existing technologies or changes in customer demand brought by a new or disruptive technology (Christensen & Raynor, 2003; Golder et al., 2009).

Furthermore, it is proposed here that value proposition can be broken down into two levels of benefits—core benefit and auxiliary benefits—much the same way as technology can be broken down into its core and ancillary components; this is to make the distinction between radical and incremental value proposition change. According to Kotler and Armstrong (2014), a product can be broken down into three levels, as shown in Figure 3.3: core customer value, actual product, and augmented product. *Core customer value* is the fundamental reason the customer buys the product; *actual product* is the way core customer value is delivered to the customer; and *augmented product* is the additional customer services and benefits associated with the product.

In this case, the three levels of product can be used to break value proposition down to core benefit and auxiliary benefits. As a result, the core value proposition is the core customer value (i.e. the fundamental reason the customer buys the product) while the auxiliary benefits are the actual product and augmented product (i.e. the way core value proposition is delivered to the customer including addition customer services and benefits).

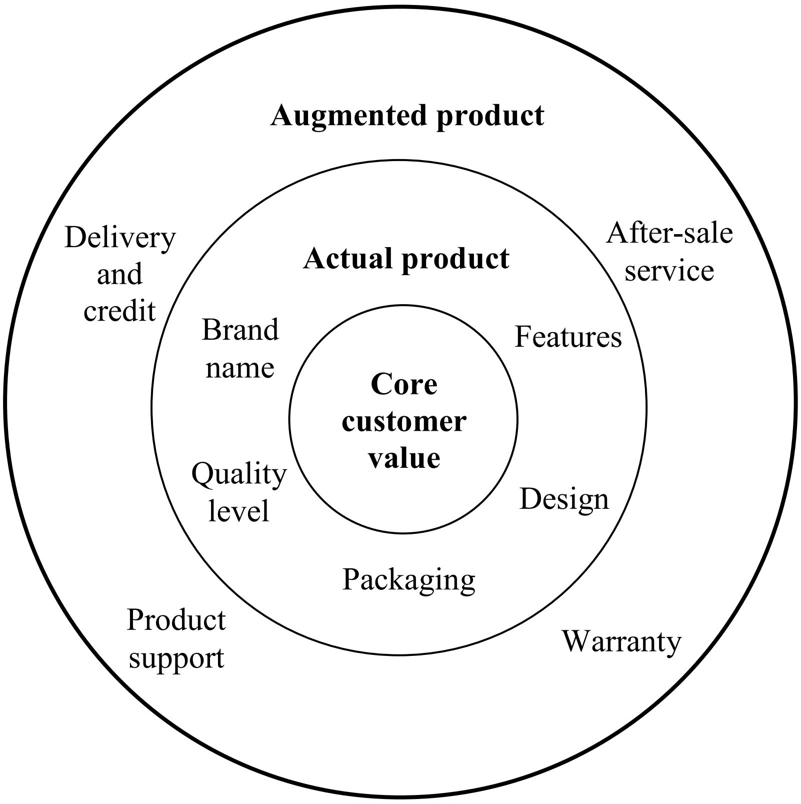


Figure 3.3: Three levels of product (Kotler & Armstrong, 2014, p. 250)

This study chooses to use a change in the new product's core value proposition relative to previous products to measure marketing newness. It is assumed that the pattern of value proposition change is similar to the pattern of technological change, as discovered by Sood and Tellis (2005) and that value proposition can be broken down into core benefit and auxiliary benefits. Consequently, a new product that uses a new core value proposition has a high degree of marketing newness; by the same token, a new product that uses available core value proposition has a low degree of marketing newness.

3.2.3 Final measurement model on product innovativeness

By combining both the technological newness and marketing newness of a new product, the final product innovativeness model is developed and shown in Figure 3.4. The vertical axis is the technological newness, which measures core technology change of the new product relative to previous products. And the horizontal axis is the marketing newness, which measures core value proposition change of the new product relative to previous products.

The model presents four categories of product innovativeness: incremental, new technology, new value proposition, and radical. Since the degree of change is continuous, dash outlines are used to separate each category.

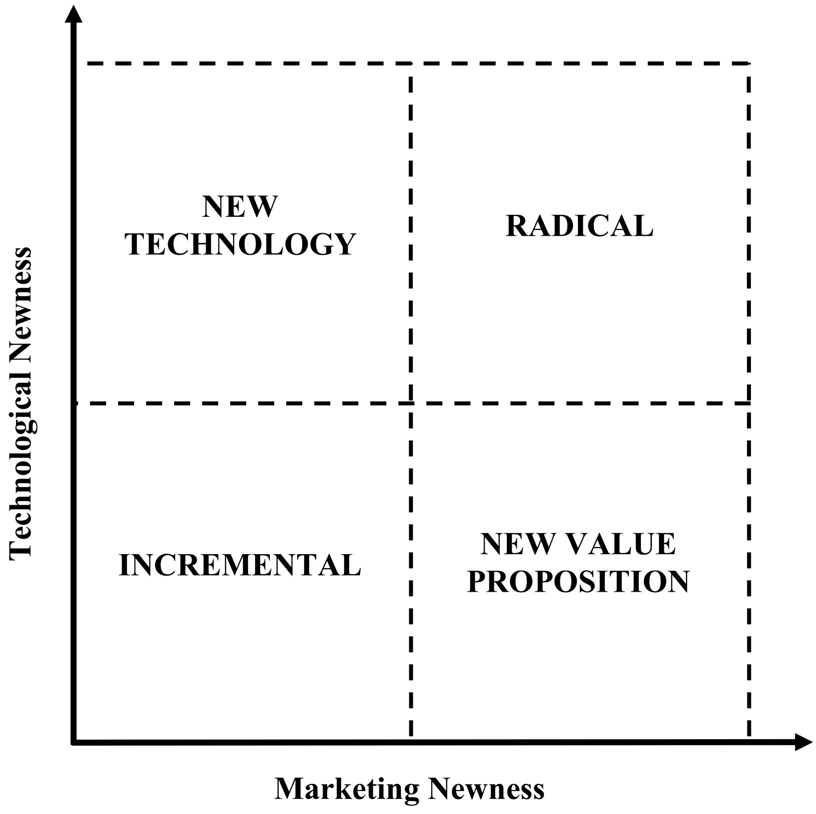


Figure 3.4: Product innovativeness model

In order to define each category of product innovativeness, it is important to consider from whose perspective a new product's technological and marketing newness is judged (Danneels & Kleinschmidt, 2001; Garcia & Calantone, 2002; Johannessen, Olsen, & Lumpkin, 2001). For example, a product can be seen as new by a company from a company perspective, but old when judged from a broader, industry perspective. Hence, it is important to consider at what level (and who's perspective) a product's degree of innovativeness is being judged.

Garcia and Calantone (2002) conducted an extensive review of product innovativeness measures from marketing, engineering, and product development disciplines. They recommend two levels of perspective that should be used when judging a product degree of innovativeness: the macro level and the micro level. The macro level includes the world, industry, and market perspective, while the micro level includes the company perspective. Figure 3.5 provides a visual representation of the macro and micro level perspectives as suggested by Garcia and Calantone (2002).

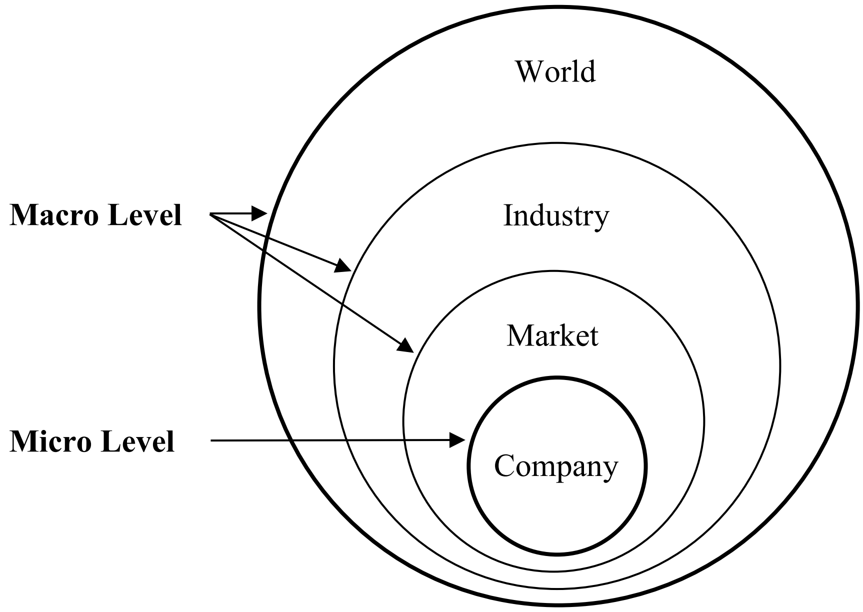


Figure 3.5: Visualisation of the macro and micro level perspectives (adopted from Garcia & Calantone, 2002)

Since the world, industry, and market perspective are all interconnected, Garcia and Calantone (2002) contend that the industry perspective is sufficient to measure macro level change (and of course, the company perspective, for micro level change). However, due to New Zealand's relatively small market size, it is argued that for the New Zealand context, the market perspective is a more appropriate measure of macro level change than the industry perspective. Therefore, the technological and marketing newness are judged from the market perspective (macro) and company perspective (micro) in this study.

Given the final model of product innovativeness and the macro and micro level perspectives, the four categories of product innovativeness are defined as follows.

1. **Incremental product innovation** – is the introduction of a new product that involves a new-to-company core technology and/or core value proposition. An example is a new product with new ancillary components and/or auxiliary benefits that is based on an available core technology and core value proposition. It has a low degree of product innovativeness.
2. **New technology innovation** – is the introduction of a new product that involves a new-to-market core technology. An example is a new product with new ancillary components and/or auxiliary benefits that is based on a new-to-market core technology but an available core value proposition. It has a moderate degree of product innovativeness.
3. **New value proposition innovation** – is the introduction of a new product that involves a new-to-market core value proposition. An example is a new product with new ancillary components and/or auxiliary benefits that is based on a new-to-market core value proposition but an available core technology. It has a moderate degree of product innovativeness.
4. **Radical product innovation** – is the introduction of a new product that involves a new-to-market core technology and core value proposition. An example is a new product with new ancillary components and auxiliary benefits that is based on a new-to-market core technology and core value proposition. It has a high degree of product innovativeness.

This study uses the product innovativeness model to measure product innovativeness and identify cases (companies) that achieve radical product innovation. The model is consistent with Garcia and Calantone's (2002) recommendation to consider both the marketing and technological perspective and the macro and micro level perspective when judging a product's degree of innovativeness. It also judges product innovativeness based on its attributes instead of its effects to avoid asserting premises that are true by definition as suggested by Sood and Tellis (2005).

3.3 Product Innovation Process Model

Product innovation can be viewed as a process of technological development combined with market introduction of an invention to end-users through adoption and diffusion (Garcia & Calantone, 2002). This means product innovation is a process that can be broken down into multiple stages or steps (Cooper, 2008; Earle, 1997a). To be specific, a product innovation process (or product development process) is defined as "a disciplined and defined set of tasks, steps, and phases that describe the normal means by which a company repetitively converts embryonic ideas into saleable products or services" (Kahn et al., 2013, p. 463).

There are five popular product innovation processes: Stage-Gate, integrated product development (IPD), lean product development, agile product development, and design thinking (Anderson, 2017). Stage-Gate is a product innovation process based on a set of product development activities separated by gates (Cooper, 2008). IPD is a product innovation process based on a managerial approach for product development through parallel execution and exchange of information (Gerwin & Barrowman, 2002). Lean product development is a product innovation process based on lean principles originally developed from Toyota's Production System (Liker & Morgan, 2006). Agile product development is a product innovation process based on twelve principles of agile software development commonly used in the software industry (Beck et al., 2001). Lastly, design thinking is a product innovation process based on a designer's thinking process (design-driven innovation (Verganti, 2009) is an example of design thinking).

For this section, product innovation processes with similar characteristics to Stage-Gate are selected to develop a model of the product innovation process. These product innovation processes are chosen because they identify predominant activities involved in the entire product innovation process (regardless of their degree of product innovativeness), whereas the other four product innovation processes identify a set of guiding principles (i.e. lean and agile) and overlapped/specific activities involved in the product innovation process (i.e. IPD and design thinking).

An overview of different product innovation processes related to both incremental and radical product innovation are provided first in section 3.3.1. These product innovation processes are combined into the final model of product innovation process in section 3.3.2. The model is used to structure the interview questions in section 4.4.2.

3.3.1 Product Innovation Processes

Below is an overview of different product innovation processes for both incremental and radical product innovation. They are selected based on their relevance to the research.

3.3.1.1 Booz, Allen, and Hamilton's new product development process

Booz, Allen, and Hamilton (1982) conducted many in-depth interviews and comprehensive surveys with top management and product managers from leading companies in the United States and Europe to map the key stages involved in new product development. Through their research and consultancy experience, they have developed several important new product management concepts. One such contribution is the 7-step new product development process shown in Figure 3.6. The new product development process identifies 7 steps which in turn specify the activities and management requirements needed to introduce new products from new product strategy development through to commercialisation.

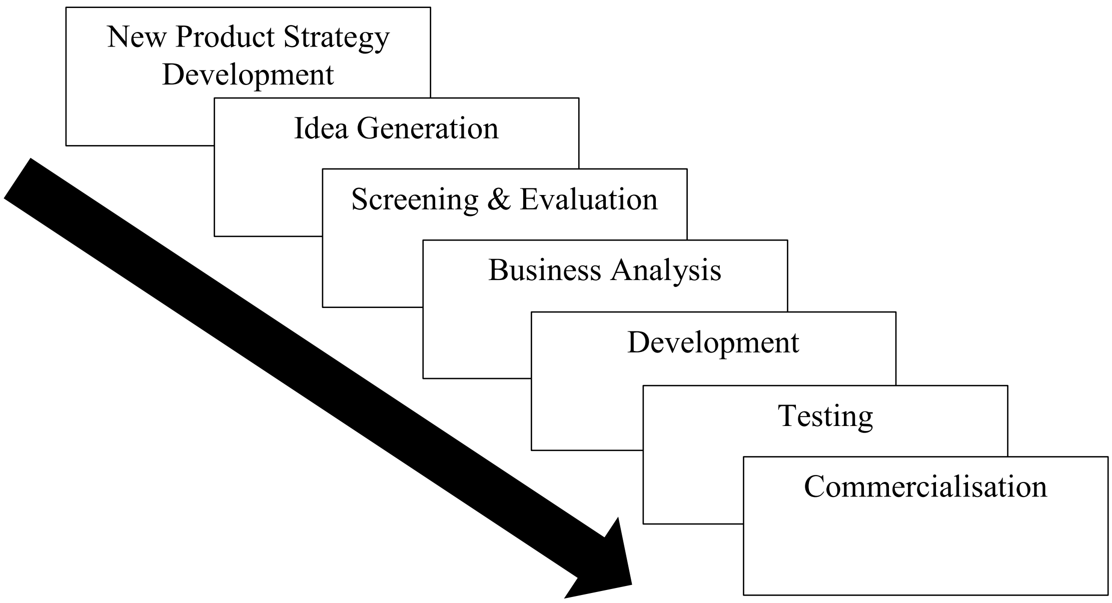


Figure 3.6: New product development process (Booz et al., 1982, p. 11)

3.3.1.2 Marquis's process of innovation framework

Marquis (1982) analysed more than 500 successful incremental product and process innovations to find common characteristics in incremental innovation (Marquis viewed radical product innovation as rare and unpredictable and hence did not include radical product innovation in his analysis). However, Marquis's process of innovation framework is useful for understanding the radical product innovation process because it explains how a company can search and utilise technological knowledge and recognise market demand.

Marquis's process of innovation framework is shown in Figure 3.7. A temporal scale is shown at the bottom of the diagram to show the stages a company goes through to develop a successful innovation: recognition, idea formulation, problem solving, solution, development, and utilisation and diffusion. Innovation can be conducted from beginning to end within a single company. However, it is more common for companies to utilise information from other sources at different times and places. The two major sources of information are the current state of technical knowledge and the existing or potential demand. Both sources are represented as bold arrows at the top and bottom of the process respectively.

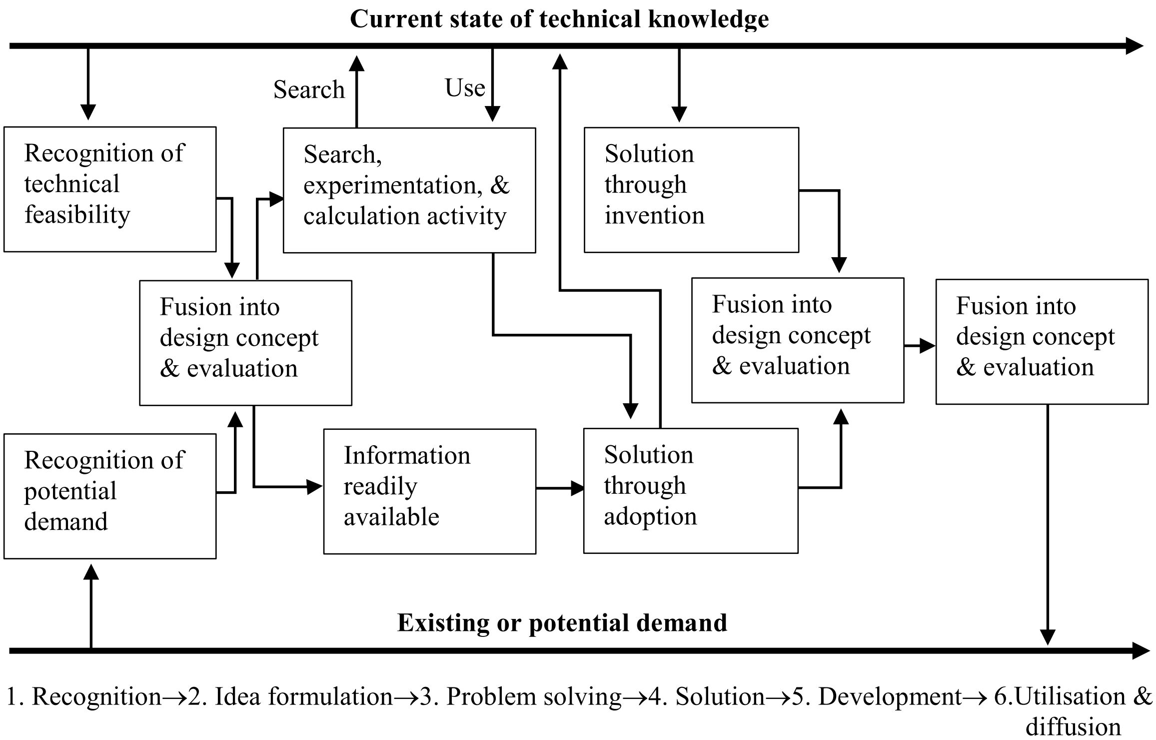


Figure 3.7: Process of innovation (Marquis, 1982, p. 44)

3.3.1.3 Earle's framework for a food product development process

Earle (1997a) studied the changes in the food product development processes from the 1960s through to the 1990s. She elucidates that the food product development processes have evolved over time as a result of new food production methods, increased emphasis on recipe development, greater consideration of consumer needs, and integration of market research and new technologies. She considers both the knowledge of industrial customers (or consumers and the knowledge of modern sciences) and technological development as being equally important in a food product development process.

By reviewing the evolution of food product development processes from 1967 through to 1995, Earle (1997a) identifies seven stages in a food product development process:

1. Business strategy
2. Product and process development
3. Product testing
4. Market testing
5. Product launch preparation
6. Product launch
7. Post-launch evaluation

Earle (1997a) shows that a new process is developed based on new changes in the food industry, which includes the consideration of the total food system, greater consumer demands and quality concerns, long term business needs, and the multinational nature of the food system. The proposed process consists of four stages:

1. Product strategy and planning
2. Creation, design, and development of product
3. Production process, marketing strategy, quality assurance, and commercial product
4. Launch and post-launch

The four stages can be broken down into activities, outcomes, and management actions and decisions, and are separated by top management's go or no-go decision. They are developed in response to the new changes in the food industry and can guide managers in their food product development effort. Earle's (1997a) four stage food product development process framework is used for this analysis.

3.3.1.4 Song and Montoya-Weiss's conceptualisation of new product development activities

Song and Montoya-Weiss (1998) compared a "really new" versus incremental product innovation process. From their previous case-studies and focus group interviews, they identify six new product development activities critical for a new product's success, regardless of its degree of innovativeness:

1. **Strategic planning** – the preliminary assessment and integration of a project's resource requirement, market opportunities, and strategic directives.
2. **Idea development and screening** – the generation, elaboration, and evaluation of potential solutions to the identified strategy opportunities.
3. **Business and market opportunity analysis** – the execution of the marketing tasks into well-defined sets of attributes that fulfil consumers' needs and desires.
4. **Technical development** – the designing, engineering, testing, and building of the desired product.
5. **Product testing** – the testing of the product itself as well as its marketing and advertising programs.
6. **Product commercialisation** – the co-ordination, implementation, and monitoring of the new product launch.

After studying 163 really new and 169 incrementally developed new products, Song and Montoya-Weiss (1998) found strategic planning, business and market opportunity analysis, technical development, and product commercialisation equally important for both really new and incremental product innovation in determining their success. However, *strategic planning* and *business and market opportunity analysis* had opposite effects on the innovation profitability. Improving the proficiency in business and market opportunity analysis was found to increase the profitability of incremental products, but was found to be counterproductive for really new products. In contrast, improving the proficiency in strategic planning positively improved the profitability of really new products, but had a negative effect on incremental products. Hence, the authors argued that companies should adjust their attention and resource allocation for each new product development activity, according to the product's degree of innovativeness (Song & Montoya-Weiss, 1998).

3.3.1.5 Veryzer's conceptualisation of discontinuous product innovation process

Veryzer (1998) investigated the difference between the new product development processes for discontinuous (radical) products and continuous (incremental) products. Discontinuous products are products that involve significant new technologies and offer significantly enhanced customer benefits. Continuous products are products that utilise existing technology and provide the same benefits as existing products.

Based on in-depth case studies involving eight discontinuous product development projects in large Fortune 500 companies with proven track records for discontinuous innovation, Veryzer (1998) identified some significant differences between discontinuous innovation process and continuous innovation process. Firstly, unlike continuous innovation, discontinuous innovation was found to be managed in a more flexible way due to high level of technological and market uncertainty. Secondly, internal technological capability, technological breakthroughs, and a product champion were found to be important drivers in starting a discontinuous innovation project. Lastly, customer involvement and conventional business analysis were found to be counterproductive in the early phases of discontinuous innovation because of the lack of understanding or appreciation of the new technologies.

From these differences, Veryzer (1998) develops a model of discontinuous product innovation process, which is shown in Figure 3.8.

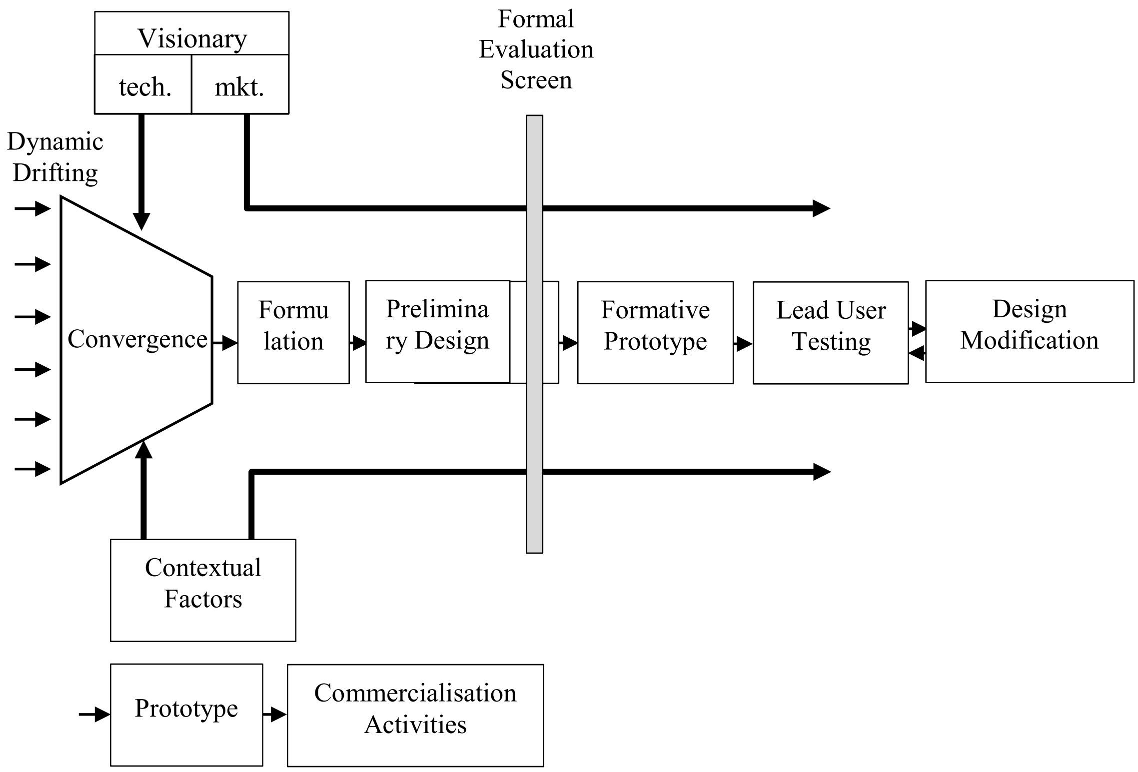


Figure 3.8: Discontinuous product innovation process (Veryzer, 1998, p. 317)

The discontinuous product innovation process is initiated by the convergence of dynamic drifting (new technologies), contextual factors, and the vision of a product champion. From this convergence, new technologies are explored through formulation and preliminary design to identify a potential product application. Then, the formal evaluation screen is carried out in order to significantly increase funding for development. Following this, formative prototype, lead user testing, and design modification are conducted to develop the product into a prototype to test its feasibility and identify a target market. The conventional market assessment and financial analysis are seen negatively during these early stages because of the limited understanding of the new technologies. Afterwards, a more conventional product development process can be conducted, once the product is transferred from the R&D group to the operating unit. At this point, the development process becomes similar to continuous or incremental product innovation, from prototyping through to commercialisation activities. Market assessment and financial analysis can be conducted to increase the product's chance of success.

In summary, discontinuous innovation, like radical product innovation, has a high level of technological and market uncertainty. As a result, companies need a different innovation process, such as the discontinuous product innovation process articulated by

Veryzer (1998), to deal with high uncertainties. Nevertheless, further work is needed to determine whether or not a more formalised and systematic process could improve the radical or discontinuous project performance (Veryzer, 1998).

3.3.1.6 Cooper's Stage-Gate approach

Cooper (2008) introduces the idea of *Stage-Gate* as a robust idea-to-launch system for new product development. Stage-Gate is a conceptual and operational map for managing new product development projects from idea to launch and beyond. The standard Stage-Gate process consists of a series of stages where a team carries out development activities, separated by gates, where go or kill decisions are made to continue investing in the project. Each stage is designed to gather relevant information to reduce key project uncertainties and risks, and the project gets costlier to cancel after each stage.

The Stage-Gate approach assists the project team in planning and improving the quality of product development activities and can be adapted according to the level of uncertainty or risk, which in turn increases the chance of new product success (Cooper, 2008). The stages in the Stage-Gate process described by Cooper (2008) are as follows:

1. Discovery
2. Scoping
3. Build business case
4. Development
5. Testing and validation
6. Launch
7. Post-launch review

3.3.2 Finalising the model based on extant literature

The product innovation processes identified in section 3.3.1 are compared and combined in Table 3.1.

Table 3.1: Combining Product Innovation Processes

Booz, Allen, & Hamilton (1982)	Marquis (1982)	Earle (1997)	Song & Montoya-Weiss (1998)	Veryzer (1998)	Cooper (2008)	Combined Process
New Product Strategy Development	Recognition	Product Strategy and Planning	Strategic Planning	Convergence	Discovery	Opportunity Recognition
↓	↓	↓	↓	↓	↓	↓
Idea Generation	Idea Formulation	Creation, Design, and Development of Product	Idea Development & Screening	Formulation	Scoping	Idea Development
Screening & Evaluation	↓	↓	↓	↓	↓	↓
Business Analysis	↓	↓	Business & Marketing Opportunity Analysis	↓	Build Business Case	Business Analysis
↓	↓	↓	↓	↓	↓	↓
Development	Problem Solving	↓	Technical Development	Preliminary Design	Development	Development
↓	Solution	↓	↓	Formative Prototype Lead User Testing Design Modification	↓	↓
Testing	Development	Production Process, Marketing Strategy, Quality Assurance, & Commercial Product	Product Testing	Prototype	Testing & Validation	Testing & Validation
↓	↓	↓	↓	↓	↓	↓
Commercialisation	Utilisation & Diffusion	Launch and Post-Launch	Product Commercialisation	Commercialisation Activities	Launch	Commercialisation
					Post-Launch Review	

The final model of product innovation process based on the above combined process is shown in Figure 3.9. The arrow signifies the process direction from idea recognition to commercialisation.

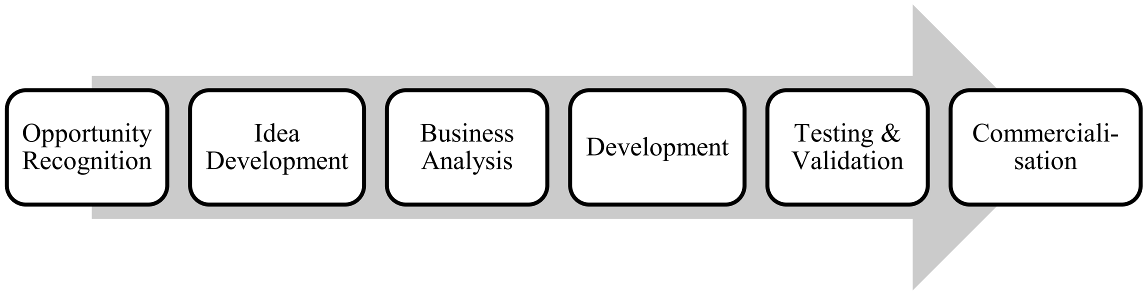


Figure 3.9: Product innovation process model

The product innovation process model specifies predominant activities an innovating company most likely goes through to introduce a new product to the marketplace. The model is applicable for all product innovations, regardless of the degree of innovativeness. The model is only used as a guide for the interview structure in section 4.4.2. It does not list all the activities involved in new product development. Each stage represented by the product innovation process model is defined below.

1. **Opportunity recognition** – a new product idea is recognised possibly through random discovery, new technologies, or strategic planning.
2. **Idea development** – the new product idea is developed into a new product concept or prototype.
3. **Business analysis** – the new product concept is evaluated according to the innovating company's criteria.
4. **Development** – the new product concept undergoes technological and marketing development into a functional new product.
5. **Testing & validation** – the functional new product is prepared for production and commercialisation.
6. **Commercialisation** – the final new product is launched into the marketplace followed by post-launch evaluation.

3.4 Conceptual Model

This section covers the development of the conceptual model of radical product innovation determinants, using the New Zealand food and beverage industry as a context. The conceptual model provides the basis for addressing the research questions. Radical product innovation determinants are defined as the factors that affect the propensity of a company to pursue radical product innovation (Herrmann et al., 2007).

From the literature review of radical product innovation determinants in section 2.2.6, it is concluded that radical product innovation determinants are commonly conceptualised based on organisational capabilities. These organisational capabilities are from the theory of a resource-based view of competitive advantage. The resource-based view is a management theory that considers a company's idiosyncratic and valuable resources (such as its capabilities, competency, and knowledge, and more importantly the complex way in which they are bundled that makes them difficult for another organisation to imitate) as the cause of its competitive advantage (Barney, 1991; Peteraf, 1993; Wernerfelt, 1984). Hence, organisational capabilities conducive to radical product innovation are considered as the determinants of radical product innovation.

Seven organisational capabilities conducive to radical product innovation have been identified and discussed in section 2.2.6.2. Following this, a conclusion is that a more comprehensive and structural model of radical product innovation determinants is needed (Chang et al., 2012; Slater et al., 2014). Since the food and beverage industry has similar determinants of radical product innovation to other industries' (as concluded in section 2.3.1), the seven organisational capabilities are combined into five determinants of radical product innovation as shown in Table 3.2. The organisational characteristics in Herrmann et al.'s (2007) study are not included since they are not organisational capabilities.

The five determinants that are identified are top management innovation capability, internal innovation capability, external networking capability, innovative organisational culture capability, and innovative product development capability. The five determinants are defined as organisational behaviour and explained in sections 3.4.1 to 3.4.5 respectively. Afterwards, the conceptual model and the interrelationships between the identified determinants and product innovativeness are proposed in section 3.4.6. It is argued that managers can encourage more radical product innovation in their organisation by knowing these determinants and their effects on radical product innovation.

Table 3.2: Combining Organisational Capabilities (Determinants) of Radical Product Innovation

Radical innovation hub (Leifer et al., 2000)	Willingness to abandon investments (Herrmann et al., 2006)	Capability to transform competencies and markets (Herrmann et al., 2007)	Organisational capabilities in established firms (Chang et al., 2012)	Entrepreneurial, managerial, and technical capabilities (Kyrgidou & Spyropoulou, 2013)	Internally and externally oriented knowledge capabilities (Maes & Sels, 2014)	Radical product innovation capability (Slater et al., 2014)	Combined determinant
Involving senior management	N/A	N/A	N/A	Managerial capabilities	N/A	Senior leadership	Top management innovation capability
Acquiring resources	Non-specific investments Market-focused core competencies	N/A	Integration capability	Technical capabilities	Knowledge diversity capability Knowledge sharing capability	Organisational characteristics	Internal innovation capability
Managing internal/external partners	Supplier and customer clusters	N/A	Openness capability	N/A	Exploratory learning Transformative learning Exploitative learning		External networking capability
Engaging individual initiative Managing transitions	Abandon investments Focus on new customers Life-long learning	Transformation of competencies Transformation of markets	Autonomy capability	Entrepreneurial capabilities	N/A	Organisational culture	Innovative organisational culture capability
Capturing radical innovations	Product champions Market-focused organisation	N/A	Experimentation capability	N/A	N/A	Radical product innovation process Product launch strategy	Innovative product development capability

3.4.1 Top management innovation capability

Top management innovation capability is the ability of top management to manage radical product innovation in their organisation. Earle et al. (2001) provide a summary of top management responsibilities in food product development (PD) as follows.

> Product development at both the programme and the project levels needs to be based on the business strategy. It is the responsibility of top management and they need to set the strategies for the product development programme for the present and future years, and also the aims for the individual projects. Top management needs to ensure that there are systematic PD Processes for the different levels of innovation and types of products. Having set the strategy and the PD process, they need to ensure that there is the necessary product, processing, distribution and marketing knowledge in the company, and also the ability to create new knowledge in design, development, and commercialisation. (p. x)

This indicates that top management have the responsibilities of setting the business and product development strategy, product development process, resource allocation, and product development capability of their organisation. Without top management involvement, radical projects can easily be replaced with less innovative projects, or abandoned due to lack of resources or other short-term concerns (Cooper, 2011; Kyrgidou & Spyropoulou, 2013; Leifer et al., 2000). Top management act as radical project sponsors, protecting them from inhibiting forces in the company and supplying them with the resources and encouragement required (Booz et al., 1982; McDermott & O'Connor, 2002). In large established companies, they can establish supportive organisational structure and mechanisms, such as the radical innovation hub, to facilitate radical projects and personnel involved (Leifer et al., 2000; Slater et al., 2014).

According to O'Connor and Rice (2013), companies face four types of uncertainties associated with radical product innovation:

- **Technical uncertainty** – which is related to the development, application, and manufacturing of new technology.
- **Market uncertainty** – which is related to the understanding of customer wants and needs, and other marketing considerations such as a business model, market creation, sales and distribution, and competitors.

- **Organisational uncertainty** – which is related to the organisational transformation and learning needed to develop and commercialise the new product.
- **Resource uncertainty** – which is related to the resource acquisition (both financial and competency) needed for the project.

These uncertainties explain the majority of radical product innovation barriers (Sandberg & Aarikka-Stenroos, 2014) and prevent most companies from achieving radical project success (O'Connor & Rice, 2013). It is argued that top management have the power to alleviate these uncertainties (or barriers) through their actions, given their responsibilities in the organisation.

Firstly, top management can overcome the technical and marketing uncertainty by providing a product development strategy and process to their organisation. Product development strategy directs the company's product development programme in alignment with the business strategy (Earle et al., 2001). Product development strategy can be greatly influenced by top management's strategic vision (Booz et al., 1982; Slater et al., 2014). Tellis and Golder (1996) refer to top management's vision influencing the product development strategy as "envisioning the mass market", where top management envision a future product or target market that guides and inspires their company's product development programme. Other types of visions include "technology vision" (Reid, Roberts, & Moore, 2015) and "market visioning" (O'Connor & Veryzer, 2001) that bring clarity and solutions to the technical and marketing uncertainty. Some tools top management can use to communicate their vision include portfolio management, technology roadmapping, and product roadmapping (Anderson, 2017; Phaal, Farrukh, & Probert, 2004). In addition, top management have the ability to influence the choice of product development process (Booz et al., 1982; Slater et al., 2014). By choosing appropriate product development processes according to a different degree of product innovativeness, top management can provide structure and instruction to the product development team, reducing uncertainties and risks, and improving project performance (Cooper, 2008; Holahan et al., 2014).

Secondly, top management can reduce the organisational uncertainties by demonstrating their commitment to innovation to the whole organisation. They can demonstrate commitment by allocating resources to radical projects (Slater et al., 2014), abandoning old investments in pursuit of new opportunities (Herrmann et al., 2006), transforming their organisational competencies and pursuing new markets (Herrmann et al., 2007), and showing managerial persistence in spite of technical and marketing challenges (Tellis & Golder, 1996). They can also provide an executive oversight to assist with the organisational transformation process and encourage learning and risk taking within their organisation through appropriate incentives, performance indicators, and initiatives (Herrmann et al., 2006; Leifer et al., 2000; Slater et al., 2014).

Lastly, top management can reduce resource uncertainty by acquiring and allocating the necessary resources for radical product innovation. They can acquire the necessary resources from both internal sources (within the company) and external sources (external partners). Top management can acquire resources from internal sources by allocating available company resources such as finances and personnel for radical projects. They can also build internal resources within their organisation by investing in internal competencies (Danneels, 2002). These internal competencies are the company's internal innovation capability that allows it to create new knowledge in design, development, and commercialisation (Earle et al., 2001). Top management can also acquire external resources (such as capitals, capabilities, competency, and knowledge) by building relationship and collaboration with external partners. According to Verganti (2008), top management of the organisation recognises the importance of maintaining a network of interpreters in a design discourse. These interpreters work to provide vital knowledge and influence on evolving consumer needs and design trends; both of these are necessary for radical product innovation. They can also invest in the development of absorptive capacity for acquiring and utilising external knowledge (Grant, 1996; Maes & Sels, 2014).

For the aforesaid reasons, top management innovation capability is posited to be a major determinant of radical product innovation. This determinant goes beyond the traditional view of top management support for innovation; top management innovation capability considers the ability to envision product development strategy, acquire and allocate necessary resources, support and protect radical projects, and implement appropriate product development practices. These become possible because of the responsibilities and influence top management have in their organisation. The better the top management are at managing innovation, the more likely their organisation would pursue radical product innovation.

3.4.2 Internal innovation capability

Internal innovation capability is the ability of an organisation to develop and utilise its in-house technological and market competency for radical product innovation. As highlighted by Rubera, Ordanini, and Calantone (2012), two key tasks are involved in product innovation: "to physically develop a product (which requires technological competency) and to sell the product (which requires market competency)" (p. 768). Examples of technological competency include manufacturing plant and equipment, manufacturing know-how, engineering know-how, and quality assurance tools; examples of market competency include knowledge of customer needs and processes, distribution and sales channels, communication channels, and company/brand reputation (Danneels, 2002). This determinant is similar to the core competency concept (section 2.2.6.2), making it important for gaining competitive advantage (Prahalad & Hamel, 1990).

Internal innovation capability is closely related to overcoming technical, market, and resource uncertainty. A company with strong technological and market competency can exploit them for product innovation (Danneels, 2002; Rubera et al., 2012). Cooper and Kleinschmidt (1987) recommend companies to pursue new products with high technological and marketing synergy (a good fit with the company's available technological and market competency) because such products are positively linked to new product success. Similarly, Tellis and Golder (1996) advise companies to leverage their assets such as brand-name recognition, including their distribution, production, or managerial expertise, when entering into a new product category. Likewise, Prahalad and Hamel (1990) advocate for companies to invest in and cultivate their core competency to achieve economy of scale and scope. In other words, companies with strong internal innovation capability are better prepared to cope with technical and marketing uncertainties leading to a higher chance of new product success.

Based on the previous argument, it is further argued that internal innovation capability is important for product innovation, *regardless of its degree of innovativeness*. This view is at odds with some radical product innovation literature that view internal competencies as having the potential to inhibit companies from pursuing radical product innovation. It is argued in the literature that radical product innovation can sometimes destroy internal competencies, which in turn leads to organisational resistance (Abernathy & Clark, 1985; Chandy & Tellis, 1998; Leonard-Barton, 1992; Tushman & Anderson, 1986). In this study, it is argued that failure to pursue radical innovation is due to inability or unwillingness on the part of the company to develop their internal competencies by replacing, transforming, or integrating the current internal competencies with new competencies (Chang et al., 2012; Herrmann et al., 2007, 2006; O'Reilly & Tushman, 2011). As discovered by Chandy and Tellis (1998), supportive organisational characteristics (internal markets, product champion influence, and future-market focus) do adequately counter the negative effects of having specialised investments (large investment in specialised technology). This finding is consistent with the findings of Chang et al. (2012) and Kyrgidou and Spyropoulou (2013) who identified "integration capability" and "managerial capabilities" respectively as powerful determinants to overcome the organisational resistance for radical innovation. Companies could also invest in "non-specific investments" and "market-focused core competencies" to avoid having specialised investments (Herrmann et al., 2006).

The process of internal competency development can be interpreted as a process of organisational learning or *exploration*, where a company develops new knowledge through activities such as search, experimentation, risk taking, and innovation (March, 1991). According to Danneels (2002), exploration is a necessary process for companies to acquire new competencies they do not have for radical product innovation. McDermott and O'Connor (2002), based on their case studies of radical product innovation in 10 large established companies, found that companies sometimes engaged in *competency stretching*, where their internal competencies were neither enhanced nor destroyed; instead, they found that new competencies are being created, allowing the companies to enter into new competency domains. McDermott and O'Connor (2002) argue that competency stretching could be an important activity for long-term growth and renewal of large established companies. Alternatively, companies can become *ambidextrous organisations* so that they can exploit existing competencies, while exploring for new competencies at the same time (O'Reilly & Tushman, 2011).

It is suggested that one of the reasons companies can utilise their existing competencies for radical product innovation is because radical product innovation actually borrows in a certain degree from previous radical product innovation (Golder et al., 2009). Golder et al. (2009) examined 29 radical innovations (e.g. telegraph, refrigerator, tape recorder, microwave, colour television, and digital camera) from their initial concept through to mass-market commercialisation. They found that many radical innovations are actually borrowed from previous radical innovations in four ways: shared core technology, shared ancillary components, shared functionality, and shared look-and-feel. Similarly, Kleinschmidt and Cooper (1991) found radical product innovation to be linked to high technological and marketing synergy. They went on to say:

> Non-innovative products are logically ‘close-to-home,’ hence synergies will exist, an expected result. But highly innovative products also had synergy. One might speculate that because highly innovative products are more uncertain and risky that they tend to be undertaken only when management is convinced that there is a good match between the resource base of the firm and the needs of the project. (p. 248)

Tellis and Golder (1996) made a similar discovery in that they found that many market leading companies use their dominant positions or expertise and strengths in one product category to enter and dominate another related product category. Golder et al. (2009) best summarise this when they say:

> Companies can take both an engineering orientation toward borrowing from previous innovations by adopting core technologies and components or a marketing orientation by adopting common functionality and a similar look-and-feel. Because most of the radical innovations in our sample borrowed from previous radical innovations, such strategies are likely to be very important in developing future radical innovations. (p. 177)

Thus, a strong internal innovation capability is argued to be beneficial for radical product innovation because it allows the company to achieve an economy of scope and reduce technical and marketing uncertainty when developing new technologies and value propositions; this is based on the assumption that the company is able to develop its internal innovation capability according to their radical product innovation needs.

Lastly, it is proposed that internal innovation capability is important for alleviating resource uncertainty. Pioneers of radical product innovation often fail because they are unable or unwilling to commit the resources necessary for market leadership (Golder & Tellis, 1993). It may also be that sometimes, pioneers of radical product innovation could not handle the technological discontinuities that may happen after the introduction of new technology (Olleros, 1986). They could also be ill-equipped with regard to market competency needed to access end consumers, create demands, or capture the value of their radical products (Min et al., 2006; Teece, 1986). Furthermore, incumbents face additional challenges of integrating new competencies into their existing competencies (Chang et al., 2012). As a result, the lack of strong internal innovation capability could explain the high pioneer failure rate for radical product innovation.

Thus, in this study, having a strong internal innovation capability is posited to be an important determinant of radical product innovation. Internal innovation capability allows the company to leverage its internal competencies for new technologies and value propositions. How well a company is able to invest in and utilise their technological and market competency will determine the strength of its internal innovation capability.

3.4.3 External networking capability

External networking capability is the ability of an organisation to collaborate with external partners for radical product innovation. It complements the company's internal innovation capability (internal resources) by providing it with an access to external resources (e.g. assets, capitals, capabilities, competencies, and knowledge) that the company does not have for radical product innovation. It is noted that companies can outsource resources from other companies. This is interpreted as being congruent with the resource-based view in relation to a firm's boundary, where certain resources are kept in-house as core competencies while others are outsourced for strategic reasons such as to reduce cost, increase flexibility, improve focus, and exploit external resources (Espino-Rodríguez & Padrón-Robaina, 2006).

Joseph (2008) studied the role of customers and other external influencers (OEIs) had on the development and success of six radical ICT products for industrial markets by small to medium sized New Zealand technology companies. Since Joseph's study context is similar to the context of this study, his list of potential external influencers on new product development is used for the field work in the present study. The potential external influencers identified by Joseph (2008) are customers (including distributors, purchasers, and end users), suppliers, investors, complementors, consultants and advisors, universities, competitors, and governments and other authorities.

The external influencers mentioned above are referred to as *external partners* in this study. External partners can help companies reduce the technical, market, and resource uncertainty associated with radical product innovation in many ways. Olleros (1986) suggests that pioneers of radically new technologies use strategies such as subcontracting manufacturing work, forming joint ventures with established mass-marketers, licensing its technology, or establishing co-operative R&D agreement with current or potential competitors to reduce risks associated with being a pioneer (e.g. pioneer burnout).

McDermott (1999), based on a longitudinal case study of seven radical product development projects in five Fortune 500 companies, found that product development team members (in all seven projects) rely on the existence of large, informal networks of individuals—both inside and outside the company—to help with the development process, the objective being the achieving of savings, both in money and time. Furthermore, McDermott found that alliances (long-term relationship between two companies) ranging from market-driven, manufacturing-driven, and R&D-driven alliances are used by successful developers to fill in any competency gaps. In addition, government funding for research was also found to be important (McDermott, 1999).

External networking capability is related to the “open innovation” model where a company commercialise both its own and external ideas by utilising both its internal and external resources and pathways (Chesbrough, 2003). Since new knowledge and radical product ideas are often located outside the companies, the development of absorptive capacity or openness capability can contribute to radical product innovation (Chang et al., 2012; Cohen & Levinthal, 1990; Maes & Sels, 2014). This view is shared by several researchers who have identified the ability to utilise externally generated ideas and knowledge, build relationships with distributors, and integrate with suppliers and customers to be an important determinant of radical product innovation in the food and beverage industry (Capitanio et al., 2010; Martinez & Briz, 2000; Siriwongwilaichat & Winger, 2004; Tomas et al., 2014).

However, the idea of open innovation is still not widely adopted in the food and beverage industry (Bigliardi & Galati, 2013b; Sarkar & Costa, 2008). Some of the reasons include a lack of trust and communication in the supply chain (Beckeman et al., 2013), the industry’s orientation toward incremental innovation strategy (Martinez & Briz, 2000), and a low level of competitive pressure (Martinez, Lazzarotti, Manzini, & García, 2014; Ziggers, 2005). According to Martinez et al. (2014), food and beverage companies need to have a dedicated architecture for collaboration (supporting organisational structures, supporting management actions, collaboration mindset, and IP protection mechanisms) to successfully access and leverage external knowledge. Similarly, Saguy and Sirotinskaya (2014) identify a lack of open innovation mindset and an IP model prevents SMEs in the food and beverage industry from fully embracing open innovation. These issues suggest that external networking capability may be relatively weak in the food and beverage industry compared to other industries.

Another important facet of external networking capability is the *cluster effect*. As Porter (1998) defines, “clusters are geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition” (p. 78). A cluster enables companies and institutions within it to share information and resources that can improve the whole cluster’s productivity, competitiveness, and ability to innovate (Porter, 1998).

There are many strategies companies can employ to exploit or leverage the clusters they are in. Coviello and Joseph (2012) propose a company’s ability to immediately identify and involve customers (from its customer network) in new product development being crucial for a successful major innovation. Verganti (2008) demonstrates how leading Italian design companies are able to build and exploit their network position within the design discourse to generate new product ideas, influence consumer demands, and attract talented designers to work for them.

However, it needs to be noted that gaining access to valuable resources in a cluster is not an easy task. As Porter (1998) points out, “tapping into the competitively valuable assets within a cluster requires personal relationships, face-to-face contact, a sense of common interest, and ‘insider’ status. The mere colocation of companies, suppliers, and institutions creates the *potential* for economic value; it does not necessarily ensure its realisation” (p. 88). Companies also need the competency to involve the right customers, at the right time, and in the right form, to benefit significantly from customer collaboration (Lettl, 2007).

For the food and beverage industry, food clusters have been identified to promote innovation in several food export countries (Beckeman & Skjöldebrand, 2007; Lagnevik et al., 2003). Retailers are a major external partner in a food cluster because they ultimately determine what products get placed before the consumer and can also influence consumer tastes and buying habits by changing the placement of products on shelves (Winger & Wall, 2006). Retailers can work together with food manufacturers to share important consumer knowledge and improve the success rate of new products (ECR Europe, 1999; Stewart-Knox & Mitchell, 2003). At the same time, a trend of retailers’ branded food products has, in some cases, turned retailers into competitors who drive the innovation activities of food and beverage companies (Galizzi & Venturini, 2008; Winger

& Wall, 2006). Since consumers are the final deciders of new food product acceptance, they too should be involved in all stages of the food product development project (Earle et al., 2001). Next, food ingredient suppliers and food processing equipment suppliers can provide important technical knowledge for innovation (Siriwongwilaichat & Winger, 2004). Spill over of knowledge from other manufacturing sectors (especially from the chemical and drug industry) could also be useful for food and beverage companies (Rama & Tunzelmann, 2008).

For the New Zealand food and beverage industry context, food clusters or networks such as the New Zealand Food Innovation Network, Food HQ, and Lincoln Hub provide a pathway for companies to share knowledge and resources more effectively and efficiently. New Zealand government funded research institutions, universities, and government grants also play a pivotal role for the industry by conducting scientific research and development (i.e. knowledge creation), education and training, and encouraging innovation respectively.

Consequently, in this study, it is posited that external networking capability enables companies to acquire and utilise external resources to fill gaps in their internal innovation capability to achieve radical product innovation. As shown above, there are many external partners a company can tap into to build strategic relationships for development of innovative new products. Furthermore, given how difficult it is to build long-term relationships with external partners, external networking capability is hard to imitate and substitute, and can be important for competitive advantage.

3.4.4 Innovative organisational culture capability

Innovative organisational culture capability is the ability of an organisation to cope with high uncertainty created by radical product innovation. Organisational culture is defined as the values, beliefs, and assumptions of the organisation (Slater et al., 2014). Radical product innovation is seen as high risk, due to a high degree of uncertainty (O'Connor & Rice, 2013). As a result, many companies are reluctant to pursue radical product innovation (Sandberg & Aarikka-Stenroos, 2014). This is especially true for large established companies given their specialised investments, established competencies, and structural and cultural inertias (Chandy & Tellis, 1998; Tushman & Anderson, 1986; Tushman & O'Reilly, 1996). However, an organisation that can tolerate a high degree of uncertainty (or risks), are more likely to welcome and support radical product innovation (Chang et al., 2012; Kyrgidou & Spyropoulou, 2013; Slater et al., 2014).

Innovative organisational culture capability is very important for dealing with the technical, market, and organisational uncertainty. Cooper (2011) sums this up very nicely:

> Having the right climate and culture for innovation, an appetite to invest in innovative and more risky projects, and the right leadership from the top is *the number one factor that distinguishes top innovation companies*… Those businesses that create a positive climate for innovation, support innovation at every opportunity, reward and recognise innovators and successful development teams, and welcome ideas from all employees do much better at product innovation. (p. 6)

Tellis and Golder (1996) use the phrase "relentless innovation" to refer to companies that are committed to continuous innovation to keep improving their products (this covers both incremental and radical product innovation), even at the cost of cannibalising their current product sales. Markham and Lee (2013), who presented the results of Product Development and Management Association's 2012 comparative performance assessment study, identified eight elements of an innovation culture; best companies were found to exhibit all eight cultural elements over 55% of the time, while the remaining companies exhibited all but one of those elements less than 50% of the time. The eight elements of an innovative culture identified by Markham and Lee (2013) are 1. Failure is understood as a part of innovation. 2. Managers establish innovation objectives. 3. Innovation objectives are included in a performance review. 4. Recruitment parameters are included in innovation potential. 5. There is effective communication with external partners. 6. Innovation and risk-taking are valued. 7. Managers are open to constructive conflict. And 8. There is effective communication within the company.

One way to study a company's organisational culture is to investigate its orientation. Hult et al. (2004) identify three orientations (i.e. the culture or norms, values, and beliefs) that significantly and positively influence a company's innovativeness: "market orientation", "learning orientation", and "entrepreneurial orientation". Market orientation refers to the generation, dissemination, and responsiveness to market intelligence; learning orientation refers to the development of new knowledge; and entrepreneurial orientation refers to the entry of new businesses. Based on the literature, other orientations that could affect a company's propensity for radical product innovation include "technological orientation" (the ability and willingness of a company to acquire a substantial technological background and use it in the development of new products); "competitor orientation" (the ability and willingness of a company to identify, analyse, and respond to competitors' actions); and "customer orientation" (the ability and willingness of a company to identify, analyse, understand, and answer user needs) (Gatignon & Xuereb, 1997). In addition, some organisational capabilities conducive to organisational culture for radical product innovation, based on the literature are "autonomy capability", which is a company's ability to encourage and tolerate risky, ambiguous, and unsuccessful radical ideas (Chang et al., 2012); and "entrepreneurial capabilities", which is a company's ability to identify and exploit new innovative ideas (Kyrgidou & Spyropoulou, 2013).

Equally importantly, it is argued that companies must engage their employees to support radical product innovation (Cooper, 2011; Leifer et al., 2000). There must be a human resource strategy to identify, select, reward, and retain radical innovation champions, experts, and team members (Leifer et al., 2000). In addition, top management must clearly define a product innovation strategy and a set of objectives that are well communicated across the organisation (Cooper, 2011). Without the appropriate human resource strategy and clearly defined product innovation strategy and objectives, top management is likely to face strong organisational resistance to radical product innovation (Cooper, 2011; Leifer et al., 2000). According to Tushman and O'Reilly (1996), strong organisational resistance is caused by both "structural inertia" and "cultural inertia". Structural inertia is a resistance to change rooted in the size, complexity, and interdependence of an organisation's structures, systems, procedures, and processes; cultural inertia is a resistance to change rooted in the informal norms, values, social networks, and stories that come from age and success (Tushman & O'Reilly, 1996). In addition, employees can perceive radical projects as career risks, leading to individual resistance (O'Connor & McDermott, 2004). Thus, top management can reduce organisational resistance to radical product innovation by setting an appropriate human resource strategy and clearly communicating their product innovation strategy and objectives across the organisation.

Thus, innovative organisational culture capability is a pivotal organisational capability to cope with high uncertainty created by radical product innovation. Culture represents the values, beliefs, and assumptions of the organisation and can be embedded in their structures, procedures, processes, and networks that can be explicit or implicit.

Companies with strong innovative organisational culture capability are more likely to accept radical product ideas and transform themselves accordingly, while companies without this capability are likely to reject radical product ideas or have strong resistance against them. Innovative organisational culture capability can be developed by implementing strategic orientations that favour radical product innovation, such as relentless innovation, entrepreneurial orientation, setting an appropriate human resource strategy to support radical innovators, and communicating a clearly-defined product innovation strategy (and objectives) across the organisation.

3.4.5 Innovative product development capability

Innovative product development capability is the ability of an organisation to conduct product development of a *radical product*. Product development is defined as "the overall process of strategy, organisation, concept generation, product and marketing plan creation and evaluation, and commercialisation of a new product" (Kahn et al., 2013, p. 462).

Radical product development is different from moderate and incremental product development because of the varying degrees of product innovativeness, in the case of the latter two types of product development. The phase "varying degrees" can be interpreted to mean different degrees of uncertainty or risk (O'Connor & Rice, 2013). Many researchers have recommended that product development managers change their product development practices according to their project's level of product innovativeness (Booz et al., 1982; Holahan et al., 2014; McDermott & O'Connor, 2002; Slater et al., 2014). However, what practices are appropriate for radical product development, vis-à-vis others (moderate and incremental), is still being highly debated in the literature (Holahan et al., 2014; Lee & Markham, 2016; Story, Daniels, Zolkiewski, & Dainty, 2014).

Based on a survey and personal interviews involving 125 industrial product companies, Cooper and Kleinschmidt (1987) identified three critical success factors for new products, through their seminal study:

- **Product advantage** – The product is superior to competing products in the eyes of the customer; the product offers unique features, higher quality, lower costs, innovativeness (first of its kind in the market), or better solutions.
- **Proficiency of predevelopment activities** – The "up-front" activities, namely initial screening, preliminary market assessment, preliminary technical

assessment, detailed market study or marketing research, and business or financial analysis, are undertaken proficiently.

- **Protocol** – There is a clear definition of the target market prior to the product development stage; customers' needs, wants, and preferences; the product concept; and product specifications and requirements.

Cooper and Kleinschmidt (1987) also identified five less critical, but important, success factors:

- **Proficiency of technological activities** – The technological-oriented activities, namely preliminary technical assessment, product development, in-house testing of a product, trial/pilot production, and production start-up, are undertaken proficiently.

- **Proficiency of market-related activities** – The market-oriented activities, namely preliminary market assessment, detailed market study/marketing research, customer testing of a prototype or sample, trial selling/test market, and market launch, are undertaken proficiently.

- **Technological synergy** – A good fit between the project needs and the company's technological competency.

- **Market potential** – Market attractiveness from size, growth, customer demand, and product importance to the customer.

- **Marketing synergy** – A good fit between the project needs and the company's marketing competency.

In a subsequent study, Kleinschmidt and Cooper (1991) analysed the relationship between the eight success factors and the degrees of product innovativeness (low, moderate, and high) using the same data in their previous study (Cooper & Kleinschmidt, 1987). They found five out of the eight success factors to be significantly related to product innovativeness; the five significant success factors are characterised as follows.

- **Product advantage** – More innovative products offer greater opportunities for differentiation leading to superior product advantage.
- **Synergies (marketing and technological)** – Highly innovative products can have high synergies like low innovative products, while moderately innovative products have the lowest synergies.

- **Pre-development activities** – The "up-front" works are particularly well executed for highly innovative products due to their higher uncertainties and risks.
- **Marketing activities** – Marketing activities are well-executed for both highly innovative and low innovative products. Highly innovative products demand more time and attention to deal with market uncertainties and risks, while low innovative products are closer to home, meaning marketing activities are executed more routinely and proficiently. However, moderately innovative products suffer most from poorer execution.

In relation to the three non-significant success factors (protocol, market potential, and technological activities), Kleinschmidt and Cooper (1991) argue that innovative products do not have more-or-less attractive markets (market potential); similarly, they argue that the protocol and technological activities are equally well defined and executed for all levels of product innovativeness. According to them, moderately innovative products are the least successful overall, because they lack the product advantage and synergies and have poorly executed predevelopment and marketing activities.

Holahan et al. (2014) recently reviewed product development practices for radical product innovations. They used a sample of 380 business units drawn from the 2004 Product Development and Management Association (PDMA) Foundation's Comparative Performance Assessment Survey to investigate how formal product development practices differ for incremental, more innovative, and radical product innovations. They reviewed product development practices according to five major new product development (NPD) capabilities; they found several significant differences in the practices depending on the degree of product innovativeness:

- **NPD process** – As the degree of product innovativeness increases, so does the adherence to formal product development processes. This is contrary to the general recommendation (e.g. Booz et al., 1982; Leifer et al., 2000) that radical product development be managed more flexibly. Instead, companies are more likely to skip, combine, or overlap stages/gates during incremental projects than radical projects. The possible reasons for this are to mitigate risks and reduce cost and time associated with radical product development, by bringing in more structure and control. This finding is inconsistent with the literature (e.g. McDermott & O'Connor, 2002; Song & Montoya-Weiss, 1998).

- **Organisation for NPD (people, project team etc.)** – A full-time project leader, a project champion, and cross-functional team effectiveness are associated with radical projects, while only a part-time project leader is associated with incremental projects. Product champion and cross-functional team effectiveness are less important for incremental projects due to the lower level of support required. This finding is consistent with the literature (e.g. Booz et al., 1982; Leifer et al., 2000; McDermott & O'Connor, 2002).
- **PD strategy (portfolio management etc.)** – Radical projects are actually managed with the same level of rigour and accountability as incremental (and more innovative) projects to meet strategic and financial objectives. This is contrary to the expectation that a radical product should be managed with more open-ended and entrepreneurial managerial approach. However, it is noted that this finding may not be applicable for the fuzzy front end (the early stages of product development process) where radical ideas are identified and developed. This finding is inconsistent with the literature (e.g. Booz et al., 1982; Song & Montoya-Weiss, 1998; Tushman & O'Reilly, 1996).
- **Organisational culture** – Radical product ideas surprisingly come from both formal idea generation practices such as trend analysis, customer observation, brainstorming sessions, and competitor analysis, and informal idea generation practices such as skunkworks, bootstrapping projects, and free time. The authors assert that radical ideas are reportedly coming from formal practices more than informal practices. This finding is inconsistent with the literature (e.g. Leifer et al., 2000; Veryzer, 1998).
- **Senior management commitment to NPD (top management support, resources allocation etc.)** – Top management and corporate level of support, involvement, and commitment to new products are correlated with the level of product innovativeness. This finding is consistent with the literature (e.g. Booz et al., 1982; Cooper, 2011).

An important conclusion in the Cooper and Kleinschmidt (1987; 1991) and Holahan et al. (2014) studies is that radical product development can and should be managed through a formal product development process, mainly to reduce risk and improve project success. Another important conclusion in the aforesaid studies is that many success factors or best practices on incremental and moderate product development are applicable to radical product development. Authors argue that these shared success factors or best practices are superior product advantage; clearly defined project protocol; well executed predevelopment, technological, and marketing activities; high technological and marketing synergies; and attractive market potentials are important for reducing technical, market, organisational, and resource uncertainty associated with all degrees of product innovativeness.

In addition, the aforementioned studies identify several key differences in success factors or best practices that product development managers should be aware of when developing new products (radical versus incremental or moderate). The differences are listed below.

Firstly, radical product development requires a full-time project leader (Booz et al., 1982; Holahan et al., 2014). This is because radical projects have a high level of uncertainty and risk. Thus, a full-time project leader is needed to take accountability for the project and provide full-time attention. On the other hand, a part-time project leader who has other responsibilities could manage incremental and moderate products because these projects require less attention and managerial resources.

Secondly, radical product development requires the existence of a project champion (Cooper, 2011; Holahan et al., 2014; McDermott & O'Connor, 2002). A project champion is a passionate supporter of the project and can come from any part of the company. They contribute to radical project success by providing support and protection against organisational barriers or inertias the radical product development team may face. They are not really needed for incremental and moderate projects since these projects are generally well accepted by the company (these project teams experience fewer organisational barriers or inertias).

Thirdly, radical product development requires a multi-disciplinary team (Booz et al., 1982; Cooper, 2011; Holahan et al., 2014; McDermott & O'Connor, 2002). This is because radical product development requires both existing knowledge and new knowledge and that these knowledge bases are likely to reside in personnel from different departments across the company. A multi-disciplinary team allows for these knowledge bases to be accessed, utilised, and combined into new knowledge. For incremental and moderate products, specialised or experienced team members are more likely to have the required knowledge without requiring significant involvement of personnel from other departments.

Lastly, radical product development requires a well-structured product development process (Cooper, 2011; Holahan et al., 2014). A well-structured product development process brings in structure and control, which reduces uncertainties and risks and improves a project's chance of success. Top management should also set clear and appropriate performance metrics or project criteria to track radical project performance and make go/kill decisions. On the other hand, a more free and flexible product development process can be used for incremental or moderate project to save time and cost—for example, see Stage-Gate Xpress and Stage-Gate Lite processes (Cooper, 2008).

A possible explanation for the above mentioned practice differences is that the radical versus incremental activities of product development represents the exploration of new ideas versus exploitation of known capabilities in organisational learning (March, 1991). In keeping with the knowledge-based view, exploration implies the search for new knowledge, while exploitation implies the utilisation of existing knowledge (Grant, 1996). This indicates that radical product development is an exploration activity for new knowledge, while incremental product innovation is an exploitation activity of existing knowledge (moderate product development is a middle-of-the road activity that involves both new knowledge and existing knowledge) (Danneels, 2002). Therefore, good practices on incremental product development are likely to be good exploitation activities, whereas good practices on radical product development are likely to be good exploration activities. This explains the need for different product development practices to suit different degrees/levels of product innovativeness.

Furthermore, since radical product development is likely to be an exploration activity, it can shed some light on the current debate in the literature on best practices for radical product development. One side of the argument is that radical product development teams need more freedom and flexibility to successfully explore for new knowledge (Booz et al., 1982; McDermott & O'Connor, 2002). According to Booz et al. (1982), an appropriate environment is required for radical product development. As Booz et al. (1982) highlight "in general, riskier ventures or those with a longer payback period, such as the development and launching of new product lines or new-to-the-world products, require a relatively unstructured, entrepreneurial management approach" (p. 22). Similarly, McDermott and O'Connor (2002) found radical product development teams experienced greater difficulties due to the existing product development practices that were impractical and illogical for radical product development. The basic premise in this school of thought is that it is difficult to make plans and set objectives for radical product development because of its exploration nature. As a result, a more flexible and less controlling product development process gives more leeway to the product development team and is likely to be more successful than the traditional structure and control driven product development process associated with incremental product development.

The other side of the argument is that radical product development teams need more structure and managerial control to successfully explore for new knowledge (Cooper, 2011; Holahan et al., 2014). As Cooper (2011) asserts, "just because these projects are imaginative and bold is no reason to throw discipline out the window. In fact, quite the reverse is true" (p. 2). Holahan et al. (2014) made a similar argument for researchers to reconsider the role of control in radical product development. Without structure and control, the project team runs the risk of going out of control in their exploration activities (March, 1991). According to Cooper (2008), the difficulties experienced by radical product development teams are likely caused by poorly designed product development process and metrics. Cooper observes that some companies misinterpret the Stage-Gate (an idea-to-launch process) as a rigid and linear process, leading to bureaucracy that stifles innovation. Cooper highlights that Stage-Gate is a flexible and adaptable process that can be scaled according to project needs and risk levels; radical products should be managed through a full Stage-Gate process because they have high risks, while incremental and moderate products could be managed through shortened processes (e.g. Stage-Gate Xpress and Stage-Gate Lite) to save resources and improve speed because they have lower risks. The basic premise in this school of thought on radical product innovation is that structure and control bring order to exploration activities and help mitigate risks, saving both time and organisational resources. This is different from the previous argument that recommends a more free and flexible product development process to cope with high uncertainties.

It is argued that both arguments suffer from a few limitations. Firstly, the Booz et al. (1982) and McDermott and O'Connor (2002) studies are limited to large companies and a few detailed case studies. Thus, their findings may not be generalisable across small to medium sized companies whose resources are limited to the extent that they cannot afford to give their employees the freedom and flexibility to develop radical products in their own ways. The Cooper (2011) and Holahan et al. (2014) studies are based on a company level of analysis and quantitative measures. As a result, the researchers might have missed the challenges faced by radical product development team members. In addition, McDermott and O'Connor (2002) and Holahan et al. (2014) did not specifically state whether or not the radical projects/products they studied were commercialised (reached the marketplace) or were considered commercially successful. Therefore, it is quite possible that the differences in the findings are attributable to different research methodologies.

Secondly, Holahan et al. (2014) suggest that the difference between incremental product development practices and radical product development practices could lie in the early stages of the product development process or the fuzzy front end of the product development process. Both Holahan et al. (2014) and Veryzer (1998) posit that, relative to incremental product development, a different idea selection process may be needed in radical product development to capture and formulate radical product ideas because radical product ideas are highly unpredictable. This idea notwithstanding, Eling, Griffin, and Langerak (2016) found that a formal idea selection process is associated with *both* commercially successful incremental and radical new products. However, Eling et al. (2016) do not explain the challenges radical product development teams face during the middle and latter stages of the product development process (McDermott, 1999; Veryzer, 1998). Therefore, it is reasonable to argue that differences between incremental and radical practices could exist in any stage of the product development process, not just the early stages.

Thirdly, the idea of radical product development as an exploration activity may be too simplistic. Several studies on radical product innovation have demonstrated that companies utilise both their existing resources (exploitation) as well as newly searched resources (exploration) (Kleinschmidt & Cooper, 1991; McDermott, 1999; Tellis & Golder, 1996). This suggests that radical product development is a mixture of both exploitation and exploration activities. Thus, it might be possible to utilise good practices for both exploitation and exploration activities in a radical product development environment. Therefore, this offers another explanation for the finding differences between incremental and radical product development practices.

The three limitations discussed above provide some insights into the two conflicting arguments. Nevertheless, the discussion does not resolve the conflict nor answer what best practices to use for radical product development. For the purpose of this study, one possible solution is for a company to be capable of doing exploitation and exploration activity simultaneously or become an "ambidextrous organisation" as introduced by Tushman and O'Reilly (1996). This view is shared by Cooper (2008) and Veryzer (1998) who recommend for companies to adapt their product development process according to different degrees of product innovativeness (or uncertainty/risk). Unfortunately, due to the conflicting findings previously discussed, there are no ready-made answers to the question "what product development process should a company adopt for radical product innovation?". In an attempt to extend knowledge, this study takes a position that a well-structured product development process is superior to a flexible product development process for radical product innovation because the studies supporting this argument are more recent (e.g. Cooper, 2011; Holahan et al., 2014).

In the balance, this research posits that innovative product development capability is required to develop radical products. It is different from incremental and moderate product development capability (an ability to develop incremental and moderate products) simply on the argument that radical product development has a higher degree of uncertainty leading to different best practices. The best practices for radical product development (based on the current literature) are a full-time project leader, a project champion, a multi-disciplinary team, a compelling business case (superior product advantage, clearly defined project protocol, high technological and marketing synergies, and attractive market potentials), well executed product development activities (predevelopment, technological, and marketing activities), and a well-structured product development process. These practices are important for reducing technical, market, organisational, and resource uncertainty associated with radical product innovation. Companies with innovative product development capability are more likely to successfully develop radical products.

3.4.6 Final model development process

Having identified the five determinants of radical product innovation, how these determinants relate to product innovativeness is argued in this section. To this end, a conceptual model is developed by reviewing the impact radical product innovation has on the organisation; the dynamic capabilities concept is introduced to provide a theoretical basis for the five determinants as well as to explain how impacts on radical product innovation are managed. Subsequently, each determinant (depicted in the conceptual model) of radical product innovation is reviewed as a causal antecedent to develop the final theoretical model that predicts and explains radical product innovativeness (the final outcome variable).

3.4.6.1 Dynamic capability as a basis for radical product innovation

To recap, radical product innovation is a form of product innovation that involves a new-to-market and new-to-company core technology and core value proposition (previously covered in section 3.2.3). Consequently, radical product innovation has a potential to cause discontinuities for both the company responsible for the innovation and the marketplace the innovation is introduced to (Garcia & Calantone, 2002). The company and market discontinuities mean companies need capabilities to transform themselves accordingly. Otherwise, they risk losing competitive advantage to their competitors (Abernathy & Clark, 1985; Abernathy & Utterback, 1978; Tushman & Anderson, 1986). Organisational capabilities that allow companies to transform themselves in response to radical product innovation are construed as *dynamic capabilities*.

“Dynamic capabilities” is a management concept introduced by Teece et al. (1997). It is defined as “the firm’s ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments” (Teece et al., 1997, p. 516). The concept was developed based on the theory of a resource-based view to respond to a higher degree of market turbulence brought by globalisation and increasing market and technological discontinuities. Teece (2007) argues that dynamic capabilities are needed for sustainable competitive advantage (i.e. superior long-term financial performance). Companies with dynamic capabilities are likely to gain competitive advantage because they can respond to technology and/or market discontinuities more quickly and effectively than their competitors who do not possess dynamic capabilities.

According to Teece (2007), dynamic capabilities are made up of three core components: *sensing*, *seizing*, and *reconfiguring*. Sensing refers to identifying and shaping opportunities and threats; seizing refers to acquiring and developing of the right resources to address the opportunities and threats; and reconfiguring refers to transforming and reorganising of a company’s resources in response to changes.

In a radical product innovation context, *sensing* could be viewed as identifying and shaping radical product innovation opportunities and threats. Many companies fail to recognise a radical product innovation opportunity or threat because their existing organisational structure and culture, which are important for their current business success, blind them from recognising the radical product innovation opportunity or threat (Tushman & O'Reilly, 1996). Other factors such as specialised investments and core rigidities can also prevent or inhibit companies from pursuing radical product innovation for fear of cannibalising or obsoleting them (Chandy & Tellis, 1998; Leonard-Barton, 1992). Too much focus on the current customer, technology, or business model can also prevent companies from realising the emergence of a new customer, technology, or business model that then become the mainstream (Christensen & Raynor, 2003; Foster, 1986; Herrmann et al., 2007). Lastly, a lack of absorptive capacity (the ability to recognise the value of new external information and assimilate and apply it for product innovation) can prevent companies from appreciating a new technology or customer, and in the long-term could prevent the companies entirely from pursuing the product innovation (Cohen & Levinthal, 1990). Companies that fail to sense market or technological changes are likely to be superseded by their competitors who capitalise on these macro-environmental changes (Christensen, 1997; Foster, 1986; Utterback, 1994).

The above said, sensing alone is insufficient because companies need *seizing* to acquire necessary resources for radical product innovation. Without the necessary resources, a company (particularly a pioneer) is unlikely to be successful in its radical product innovation endeavour (Golder & Tellis, 1993; Leifer et al., 2000; Olleros, 1986). Few companies have all the necessary resources readily available, and therefore most companies need strategies to acquire them from internal and external sources (McDermott & O'Connor, 2002). Companies can acquire the necessary resources from internal sources by developing and utilising their own in-house technological and market competencies (Danneels, 2002); for example, leveraging their production and brand assets (Tellis & Golder, 1996), and resource allocation (Cooper, 2011). In addition, companies can acquire the necessary resources from external sources in many ways; for example, forming alliances with other companies (McDermott, 1999), outsourcing to provide certain capabilities (Olleros, 1986), integration or licensing (Teece, 1986)[3], hiring knowledgeable personnel (McDermott & O'Connor, 2002), and tapping into their networks or clusters (Porter, 1998; Verganti, 2008).

[3] According to Teece (1986), integration involves owning and aligning complementary assets within the company and licensing involves signing contracts with independent suppliers, manufacturers, or distributors.

Finally, companies must be able to reorganise themselves to pursue radical product innovation. *Reconfiguring* could be viewed as transformation of the organisation itself. As the business environment changes, a company needs to be capable of adjusting its resources such as its strategy, structure, skills, and culture to stay competitive (Tushman & O'Reilly, 1996). Most companies are successful doing this for incremental product innovations because the transformation required is minimal. However, they often fail when they try to transform themselves for radical product innovation (Abernathy & Utterback, 1978; Tushman & Anderson, 1986). There are many reasons companies fail to transform themselves for radical product innovations. The first major reason is due to the high and multi-dimensional uncertainties of radical product innovation (O'Connor & Rice, 2013). The second, equally major reason is the structural and cultural inertia that inhibits companies (often an incumbent) from successfully transforming themselves (Tushman & O'Reilly, 1996). Sometimes, the changes are subtle and hard to detect making it difficult for companies to transform effectively in a timely manner (Christensen & Raynor, 2003; Henderson & Clark, 1990). Lastly, there are many contextual barriers such as insufficient resources and customer resistance that can inhibit a company from pursuing radical product innovation (Sandberg & Aarikka-Stenroos, 2014). Consequently, it is argued that companies that are capable of overcoming the difficulties of organisational transformation are likely to be successful in their pursuit of radical product innovation.

Based on the previous arguments, it is posited that the five identified determinants of radical product innovation constitute dynamic capabilities. This author shares a similar view with many authors that have linked radical product innovation determinants to dynamic capabilities (Chang et al., 2012; Herrmann et al., 2007; Kyrgidou & Spyropoulou, 2013; Maes & Sels, 2014; Slater et al., 2014). Consider Chang et al. (2012) who assert the following: "as radical innovation deals with the transfer of resources and the acceleration of innovation capabilities, it is argued that the dynamic capability view can help to explain how such transfer of resources and change in capabilities can be achieved" (p. 449). Herrmann et al. (2007) make a similar argument: "we argue that dynamic organisational capabilities are required to manage the discontinuities associated with radical innovations" (p. 94). Slater et al. (2014) assert the same thing: "the ability to successfully develop and commercialise radical product innovations constitutes a 'dynamic capability'" (p. 553).

3.4.6.2 A structural model linking the determinants of radical product innovation via dynamic capability

Top management innovation capability

From the foregoing discussion, it is argued that top management innovation capability is a part of sensing capabilities. Top management play a vital role in identifying and shaping radical product innovation opportunities and threats. However, this does not mean that all the processes and mechanisms for information collection and organisational learning should be replaced by top management. The said processes and mechanisms are important for collecting and processing information. Rather, the argument brought forth here is that top management have an important role in evaluating this information and converting it into strategic decisions or actions. As stated by Teece (2007):

> Information must be filtered, and must flow to those capable of making sense of it… Hypothesis development, hypothesis 'testing,' and synthesis about the meaning of information obtained via search are critical functions, and must be performed by the top management team… If enterprises fail to engage in such activities, they won't be able to assess market and technological developments and spot opportunities. As a consequence, they will likely miss opportunities visible to others. (p. 1323)

Thus, top management innovation capability allows a company to identify and shape radical product innovation opportunities and threats and is linked to sensing capabilities.

Internal innovation capability and external networking capability

Internal innovation capability and external networking capability are a part of seizing capabilities. Both determinants are vital in providing access to internal and external resources needed for radical product innovation. They also enable the creation and development of these resources, making the resources more valuable in the long run. Internal innovation capability allows internal resources to be acquired by developing and utilising the company's in-house technological and market competencies. By comparison, external networking capability allows external resources to be acquired by developing collaborative relationships with key external partners that control access to these valuable resources. Teece (2007) sums up seizing capabilities very nicely: "Addressing opportunities involves maintaining and improving technological competencies and complementary assets and then, when the opportunity is ripe, investing heavily in the particular technologies and designs most likely to achieve marketplace acceptance" (p. 1326). Thus, it is argued that internal innovation capability and external networking capability are important for providing and utilising the resources needed for radical product innovation and are linked to seizing capabilities.

Innovative organisational culture and innovative product development capabilities

Innovative organisational culture capability and innovative product development capability are a part of reconfiguring capabilities. Teece (2007) refers to the process of reorganising both internal and external resources for radical product innovation as "asset orchestration"; Teece considers this (asset orchestration) as part of a company's reconfiguring capabilities. As companies introduce new products and learn from them, their resources can be developed and strengthened (Danneels, 2002; Leonard-Barton, 1992; March, 1991). However, they can also trap them on a certain trajectory; this phenomenon is commonly referred to as "core rigidities" (Leonard-Barton, 1992), "path dependencies" (Teece, 2007), or "structural and cultural inertia" (Tushman & O'Reilly, 1996). Justification for reconfiguration is aptly summarised by Teece (2007):

> A key to sustained profitable growth is the ability to recombine and to reconfigure assets and organisational structures as the enterprise grows, and as markets and technologies change, as they surely will. Reconfiguration is needed to maintain evolutionary fitness and, if necessary, to try and escape from unfavourable path dependencies. (p. 1335)

Both innovative organisational culture capability and innovative product development capability allow the companies to reorganise their resources such that they can pursue new product categories (i.e. radical product innovations). Innovative organisational culture capability enables companies to cope with high uncertainties associated with radical product innovation while innovative product development capability enables companies to develop radical products. Consequently, innovative organisational culture capability and innovative product development capability are essential for organisational transformation and are linked to reconfiguring capabilities.

In addition, Teece (2007) demonstrates that there exists a structural relationship between the three core components of dynamic capabilities and sustainable competitive advantage: sensing $\rightarrow$ seizing $\rightarrow$ reconfiguring $\rightarrow$ sustainable competitive advantage; this structural relationship has been supported by an empirical study (Chiu, Chi, Chang, &

Chen, 2016). This structural relationship, depicted as Figure 3.10, shows the theoretical basis of the researcher's conceptual framework.

As shown in Figure 3.10, the five identified determinants of radical product innovation (italicised in the figure) are sequentially arranged as causal antecedents to explain sustainable competitive advantage via the three elements of dynamic capability. Radical product innovation is linked to the sustainable competitive advantage because when a company chooses radical product innovation as the key strategy, the competitive advantage is accomplished through the capability bundle presented in Figure 3.10 (Calantone et al., 2006; Kleinschmidt & Cooper, 1991; Kock et al., 2011).

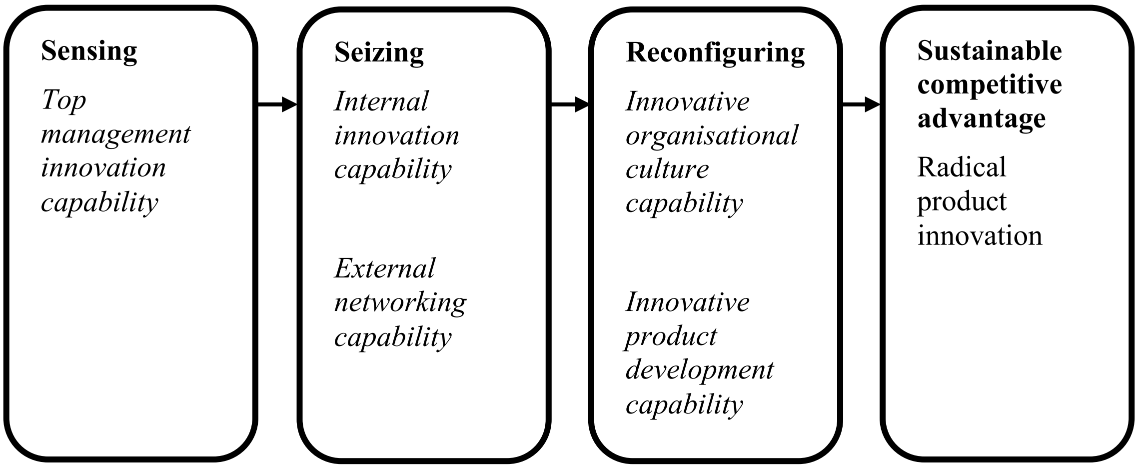


Figure 3.10: The structural model linking the determinants of radical product innovation via dynamic capability

3.4.6.3 The conceptual model on radical product innovation phenomenon

The conceptual model shown in Figure 3.11 is developed by augmenting the structural relationship discussed in the previous section. The conceptual model depicts the relationships between the five identified determinants and product innovativeness (depicted as "Radical Product Innovation" in the conceptual model). Furthermore, the conceptual model reveals additional interrelationships between the five identified determinants not shown previously. The relationships for each of the five determinants and product innovativeness are explained using each determinant as a causal antecedent of another determinant or radical product innovation.

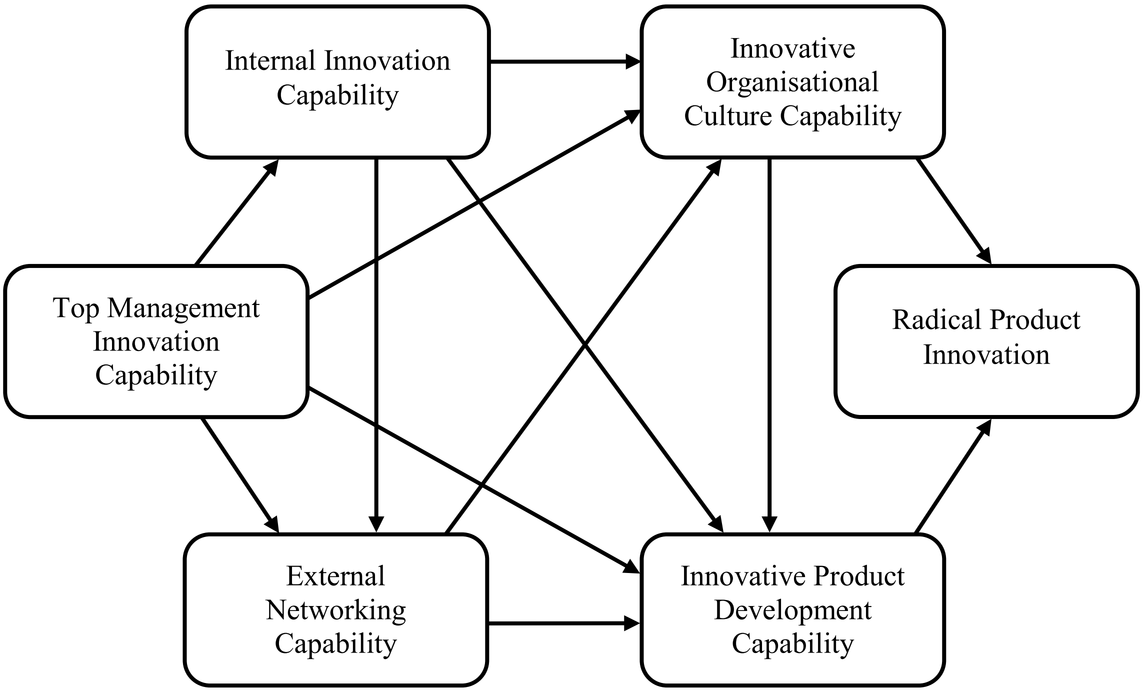


Figure 3.11: The conceptual model linking radical product innovation to its determinants

Top management innovation capability as a causal antecedent

Top management innovation capability is considered the most important determinant of radical product innovation. Top management have responsibilities that can affect the whole organisation (Cooper, 2011; Earle et al., 2001; Leifer et al., 2000). These responsibilities include setting the company's overall business and product development strategy, product development process, resource allocation, and product development capability (Earle et al., 2001). Subsequently, top management are expected to set them in such a way that enable radical product innovation (Cooper, 2011). In addition, they need to establish expectations, organisational culture, facilitating organisational mechanisms, and goals and reward systems that are supportive of radical product innovation (Leifer et al., 2000). As a result, it is proposed that top management innovation capability can influence internal innovation capability, external networking capability, innovative organisational culture capability, and innovative product development capability. The proposed relationships are explained below.

Firstly, top management can influence the internal innovation capability through product development/innovation strategy (Cooper, 2011; Earle et al., 2001). As Cooper (2011) asserts "product innovation strategy guides the business's product development direction and helps to steer resource allocation and project selection" (p. 7). In other words, product innovation strategy determines what resources are available for the development of the company's in-house technological and market competencies needed for product innovation and what types of project or product innovation are pursued (in this case, radical product innovation). In addition, by selecting innovative projects, managers can discover deficiencies or dysfunctionalities in their existing competencies and capabilities, leading to the development of new competencies and capabilities (Danneels, 2002; Leonard-Barton, 1992). This relationship between top management innovation capability and internal innovation capability is similar to the relationship between "senior leadership" and "organisational characteristics" posited by Slater et al. (2014) in their model. Therefore, it is proposed that top management innovation capability has a positive relationship with internal innovation capability.

Secondly, top management can influence external networking capability by building relationships with external partners. According to Verganti (2009), top management have a vital role in developing the design-driven innovation capabilities or establishing their company's position in the design discourse (a network of external partners involved in the development of new product meanings and design languages). Similarly, top management can pursue alliances, contracts, or partnership with other companies to share resources and reduce risks (McDermott, 1999; Olleros, 1986; Teece, 1986). This relationship is similar to Slater et al.'s (2014) model that shows "senior leadership" having a direct relationship with "organisational characteristics" (i.e. reliance on partners). As a result, it is proposed that top management innovation capability has a positive relationship with external networking capability.

Thirdly, top management can influence their organisational culture through their goals and reward systems (Leifer et al., 2000). Culture is usually driven from the top (Cooper, 2011; Slater et al., 2014). By rewarding and recognising innovators, top management are creating incentives for employees to take risks and pursue radical product innovation for the company (Cooper, 2011; Leifer et al., 2000). At the same time, by setting radical product innovation goals, top management are demonstrating to the whole organisation their commitment and expectations that can affect individual employee's attitude towards radical product innovation (Cooper, 2011; Leifer et al., 2000). This relationship is similar to the "senior leadership" and "organisational culture" relationship captured in Slater et al.'s (2014) model. It is noted that the relationship, as shown in Slater et al.'s (2014) model, is a bidirectional relationship because they argue organisational culture can also influence new top leaders. For this study, the proposed relationship is taken as a unidirectional relationship to make the conceptual model a recursive model, so that it can be tested empirically with cross sectional data (the correlational research technique used by the researcher does not allow testing bidirectional/nonrecursive causal relationships). Thus, it is proposed that top management innovation capability has a positive relationship with innovative organisational culture capability.

Fourthly, top management can influence the product development practices by establishing the formal product development process in their organisation, such as the Stage-Gage system (Cooper, 2008). Furthermore, top management can also engage in Go/No Go decisions of radical projects, while leaving day-to-day activities/decisions to the project team (Cooper, 2011). This is similar to the direct relationship between "senior leadership" and "radical product innovation process" shown in the Slater et al.'s (2014) model. Therefore, it is posited that top management innovation capability has a positive relationship with innovative product development capability.

Lastly, it is argued that top management do not have a direct relationship with radical product innovation. To say that they have a direct relationship with radical product innovation is to say that top management are responsible for personally conducting radical product development, which is not true in the majority of companies. Instead, top management act as the primary cause of radical product innovation in that they drive the other four determinants that lead to radical product innovation.

Internal innovation capability as a causal antecedent

Internal innovation capability is the internal technological and market competencies that a company can develop and utilise for radical product innovation. They are a result of collective learning and co-ordination of resources in the organisation (Prahalad & Hamel, 1990). In addition, internal technological and market competencies can determine (to a certain degree) what the company can do in the future because of path dependency (Danneels, 2002; Teece, 2007). As a result, internal innovation capability can influence external networking capability, innovative organisational culture capability, and innovative product development capability.

Firstly, internal competencies can determine how well the organisation identify, access, and utilise external resources for product innovation, according to the *absorptive capacity* of the company. Absorptive capacity, as mentioned before, is the company's ability to evaluate the true value of external resources (such as knowledge about a new technology) and utilising them for commercial ends (Cohen & Levinthal, 1990). According to Cohen and Levinthal (1990), absorptive capacity is a function of the company's level of prior related knowledge; the more diverse and accumulated knowledge held by individuals in the company, the better the company is overall at recognising new valuable external resources and utilising them for product innovation. This relationship is supported by Maes and Sels (2014) who have empirically demonstrated direct positive relationships from "knowledge diversity capability" and "knowledge sharing capability" to "exploratory learning", "transformative learning", and "exploitative learning". Nevertheless, Cohen and Levinthal (1990) also point out that too much emphasis on internal competencies can lead to the pathology of the not-invented-here (NIH) syndrome, which is defined as "the tendency of a project group of stable composition to believe it possesses a monopoly of knowledge of its field, which leads it to reject new ideas from outsiders to the likely detriment of its performance" (Katz & Allen, 1982, p. 7). Given that some prior studies in the food and beverage industry have emphasised the importance of strong internal competencies for absorbing and utilising external knowledge (Martinez & Briz, 2000; Siriwongwilaichat & Winger, 2004), it is argued that internal innovation capability has a positive relationship with external networking capability.

Secondly, internal competencies can determine how well the organisation copes with uncertainty. For example, many companies leverage their existing competencies to cope with technical and market uncertainty when developing radical products (Kleinschmidt & Cooper, 1991; McDermott & O'Connor, 2002). This is supported by Herrmann et al. (2006) who found "non-specific investments" and "market-focused core-competencies" had positive relationships with "abandon investments". However, Slater et al. (2014) suggest that the said relationship is in the opposite direction. Their argument is that culture has a significant effect on the company's cross-functional integration and reliance on partners (both of which they consider components of organisational characteristics). For this study, cross-functional integration is covered in innovative product development capability and reliance on partners is covered in external networking capability; thus, their relationships are already considered by other determinants. Consequently, it is proposed that internal innovation capability is positively related to innovative organisational culture capability.

Thirdly, internal competencies can influence how well the company conducts radical product development. This is because internal competencies are used by companies to develop new technologies and value propositions. In other words, they are core competencies or core capabilities for solving technical and marketing problems in product development (Danneels, 2002; Leonard-Barton, 1992). Thus, companies with strong internal innovation capability can conduct predevelopment, technological, and marketing activities more proficiently, improving radical product success (Kleinschmidt & Cooper, 1991). Furthermore, companies with strong internal innovation capability can determine what product development practices are possible. For example, a multi-disciplinary team can be utilised by having a diverse set of skilled employees. The said relationship (internal innovation capability → innovative product development capability) is supported by Slater et al.'s (2014) model that shows "organisational characteristics" having direct relationships with "radical product innovation process" and "product launch strategy". Therefore, it is proposed that internal innovation capability has a positive relationship with innovative product development capability.

Lastly, it is argued that internal innovation capability does not have a direct relationship with radical product innovation. The internal innovation capability simply represents the internal resources owned by the company. These resources by themselves do not bring about radical product innovation. Companies need innovative organisational culture capability and innovative product development capability to utilise their internal innovation capability for radical product innovation.

External networking capability as a causal antecedent

External networking capability is the company's ability to collaborate with external partners (i.e. outside individuals or companies) to pursue radical product innovation. Rarely does a company possess all the resources for radical product innovation (McDermott & O'Connor, 2002). Companies can use their external networking capability to access the valuable resources controlled by external partners to fill their resource gaps. As a result, external networking capability can influence innovative organisational culture capability and innovative product development capability. These relationships are explained below.

Firstly, external networking capability provides companies with an access to valuable external resources, such as production facility or consumer knowledge, that can be used to reduce uncertainties associated with radical product innovation. More often than not, all it takes to reduce uncertainty is simply knowing who to call (Cohen & Levinthal, 1990; McDermott, 1999). By developing and maintaining a network with valuable external partners, companies can fall back on their external networks (when needed) to help reduce uncertainty. This relationship is supported by Herrmann et al. (2006) who found a positive relationship between "supplier and customer clusters" and "abandon investments". However, the direction of this relationship is opposite to the direction suggested by Slater et al. (2014) who argue that organisational culture can affect a company's reliance on partners. It is suggested that Slater et al.'s argument is based on a different construct definition, where they define "organisational culture" as the values, beliefs, and assumptions of the company; this study defines "innovative organisational culture capability" as the ability to cope with uncertainty, which has a somewhat similar meaning to Slater et al.'s conceptualisation but is not identical. Thus, the researcher contends that external networking capability is positively related to innovative organisational culture capability.

Secondly, external networking capability can influence how well a company conducts radical product development. Similar to internal innovation capability, this capability determines what external resources a company can access and utilise for radical product development. A company that possesses a rich external networking capability will know who they can call for help to solve their product development problems; this can be very important when the company does not have the necessary resources in-house. For example, if the company cannot acquire a certain production facility or reach their target customers for a certain radical project, they are unlikely to be successful with their new product development project (Olleros, 1986; Teece, 1986). Sometimes, knowing whom and when to invite to participate in radical product development is also very important because their inputs may be valuable at certain times, but inhibiting at others (Coviello & Joseph, 2012; McDermott & O'Connor, 2002). This relationship is supported by Slater et al.'s (2014) model which depicts "organisational characteristics" as having direct relationships with "radical product innovation process" and "product launch strategy". Thus, it is argued that external networking capability has a positive relationship with innovative product development capability.

Lastly, it is argued that external networking capability does not have a direct relationship with radical product innovation. Like internal innovation capability, external networking capability is simply providing access to resources belonging to external partners. Companies need innovative organisational culture capability and innovative product development capability to utilise them for radical product innovation.

Innovative organisational culture capability as a causal antecedent

Innovative organisational culture capability is the company's ability to cope with high uncertainties created by radical product innovation. It is the first determinant in the conceptual model to have a direct relationship with radical product innovation. Radical product innovation is difficult because of high and multifaceted uncertainties associated with its development (O'Connor & Rice, 2013). Hence, it is posited that a company with high tolerance to uncertainties is more likely to pursue radical product innovation as well as to improve its proficiency at radical product development. Notwithstanding strong top management support and incentives, employees in a company that does not possess an innovative organisational culture can still be reluctant to pursue radical product innovation because that goes against their ingrained skills and culture (Tushman & O'Reilly, 1996). Consequently, it is argued that innovative organisational culture capability directly influences innovative product development capability as well as radical product innovation. The relationships are explained below.

Firstly, innovative organisational culture capability can influence the innovative product development capability because organisational culture captures the company's overall values, beliefs, and assumptions—companies with cultures favourable to radical product innovation are more likely to conduct radical product development (Chandy & Tellis, 1998). Furthermore, such cultures can promote the adoption of radical product development practices across the organisation (Cooper, 2011; Tushman & O'Reilly, 1996). Therefore, innovative organisational culture capability does have a positive relationship with innovative product development capability. This relationship is consistent with Slater et al.'s (2014) model that shows "organisational culture" having a direct hypothesised relationship with "radical product innovation process" and "product launch strategy" (both are combined as radical product development practices). However, this relationship goes against Herrmann et al.'s (2006) model that posits a reverse direction from "product champions" and "market-focused organisation" to "abandon investments". Since this study has identified top management innovation capability as the driver of innovative organisational culture capability (similar to Slater et al.'s (2014) view), whereas Herrmann et al. (2006) has not considered so, the earlier proposition is chosen. Thus, it is proposed that innovative organisational culture capability has a positive relationship with innovative product development capability.

Lastly, innovative organisational culture capability is directly related to radical product innovation. Culture can influence a company's behaviour and attitude towards the adoption of radical product innovation (Chandy & Tellis, 1998; Tushman & O'Reilly, 1996). As a result, it is suggested that companies that lack this capability will prefer to pursue incremental product innovation instead of radical product innovation. The innovative organisational culture capability can be characterised through other capabilities identified in the literature such as "abandon investments" (Herrmann et al., 2006), "transformation of competencies and markets" (Herrmann et al., 2007), "autonomy capability" (Chang et al., 2012), and "entrepreneurial capabilities" (Kyrgidou & Spyropoulou, 2013). These capabilities all share a common sentiment of coping with uncertainties and are linked directly and positively to radical product innovation in their respective models. Thus, it is proposed that innovative organisational culture capability has a positive relationship with radical product innovation.

Innovative product development capability as a causal antecedent

Innovative product development capability allows a company to conduct product development of a radical product. It is the second determinant in the conceptual model to have a direct relationship with radical product innovation. Radical product innovation requires different product development practices because of its high degree of innovativeness (Cooper, 2008; Garcia & Calantone, 2002; Holahan et al., 2014). As a result, companies need the innovative product development capability to develop radical products. Consequently, the innovative product development capability is likely to have a positive relationship with radical product innovation. This relationship is further explained below.

As covered in the previous discussion in section 3.4.5, the current best radical product development practices are a full-time project leader, a project champion, a multi-disciplinary team, a compelling business case, well executed product development activities, and a well-structured product development process. These practices have been identified as important success factors of radical product development by many researchers (e.g. Booz et al., 1982; Cooper, 2011; Cooper & Kleinschmidt, 1987; Holahan et al., 2014; McDermott & O'Connor, 2002). These practices are captured in the "radical product innovation process" and "product launch strategy" posited by Slater et al. (2014)

and "experimentation capability" posited by Chang et al. (2012), who have linked them directly and positively to radical product innovation in their models. Therefore, it is proposed that innovative product development capability has a positive relationship with radical product innovation.

3.5 Company Characteristics

Company characteristics are the attributes of a company that could affect its degree of product innovativeness. These characteristics are generally inherent within the company itself and difficult to change quickly. As previously discussed in section 2.2.6.1, six company characteristics that could determine radical product innovation include company age, company size, national culture, industry phase, willingness to cannibalise, and company orientation.

Both company age and company size are included in the analysis because they are common organisational characteristics utilised by researchers to study product innovativeness in the global food and beverage industry. National culture, conceptualised as the company foreign ownership in this study, is included in the analysis in order to understand if foreign ownership (i.e. by companies or individuals from overseas) of New Zealand food and beverage companies could affect their product innovativeness performance. The foreign ownership is a relevant issue for the New Zealand food and beverage industry, given the increasing foreign investments and purchases of New Zealand food and beverage companies (Wilkinson et al., 2015). Increasing foreign ownership could change the culture and product innovativeness performance of the acquired companies.

The latter three company characteristics (industry phase, willingness to cannibalise, and company orientation) are not included in the analysis. Industry phase is not included because it requires an industrial level of analysis which is beyond the scope of this study (which is a company level of analysis). Willingness to cannibalise and company orientation have been captured in the *innovative organisational culture capability* which is included in the conceptual model. Hence, they are not included in this analysis.

In summary, the company characteristics that could affect product innovativeness in this study are company age, company size, and company foreign ownership. They are discussed in the following sections.

3.5.1 Company age

Company age is the number of years since the company was founded. It is closely related to the concept of industry entrant (i.e. young) and industry incumbent (i.e. old) (Chandy & Tellis, 2000).

The company age reflects the accumulation of its valuable resources (such as competencies, capabilities, and knowledge) that happens as a natural process of organisational learning (Balasubramanian & Lee, 2008). This process of resource accumulation is necessary for improving efficiency and competitiveness as the companies and their markets mature (Abernathy & Utterback, 1978; Tushman & Anderson, 1986). However, it can also inhibit the companies from pursuing radical product innovation due to core rigidities, path dependencies, or organisational inertias (Leonard-Barton, 1992; Teece, 2007; Tushman & O'Reilly, 1996). These factors make a revolutionary change or major transformation (necessary for radical product innovation) very costly and difficult (Abernathy & Utterback, 1978; Foster, 1986; Tushman & Anderson, 1986). As a result, older companies (or incumbents) simply have no incentive to pursue radical product innovation, given the significant revenues they earn from existing products based on their current valuable resources (Chandy & Tellis, 2000). Instead, younger companies (or industry entrants) are more driven to innovate for market share and growth since they don't earn such revenues (Abernathy & Utterback, 1978; Chandy & Tellis, 2000; Christensen & Raynor, 2003; Tushman & Anderson, 1986).

Like other industries, company age can influence product innovativeness in the food and beverage industry. However, Rama and Tunzelmann (2008), from their assessment of major findings in the global food and beverage industry, see that accumulated resources and good R&D experience could foster product innovativeness in the industry. Both Martinez and Briz (2000), Ziggers (2005), and Capitanio et al. (2010) have identified accumulated resources as an important determinant of radical food product innovation. Nevertheless, it is possible these accumulated resources are a function of company size instead of the company age. For example, Capitanio et al. (2010) found a weak negative relationship between company age and new product adoption in the Italian food industry and Martinez and Briz (2000) did not investigate company age. Furthermore, the accumulated resources and good R&D experience could still be insufficient for food product innovation success (Rama & Tunzelmann, 2008). Consequently, the effect of company age on product innovativeness in the global food and beverage industry appears inconclusive.

In the New Zealand food and beverage industry, it is suggested that younger companies are more likely to pursue radical product innovation because they already have access to accumulated resources provided by the government funded research organisations, higher education institutions, and innovation hubs; whereas older companies are likely to suffer path dependencies or organisational inertias given the conservative nature of food consumers. As a result, it is proposed that younger New Zealand food and beverage companies are more accepting of radical product innovation than older New Zealand food and beverage companies.

3.5.2 Company size

Company size is the number of full-time employees a company currently employs. It reflects the number of personnel a company has for product innovation. In a simplistic view, larger companies should be capable of introducing more radical product innovations than smaller companies because they have more personnel to assign to the projects. However, this relationship is not always straightforward. This is because companies need more organisational mechanisms as they hire more employees to manage them. These organisational mechanisms can lead to bureaucracies and inhibit radical product innovation.

Originally, smaller companies were considered in the literature to be more innovative than larger companies because of their nimble and entrepreneurial characteristics (i.e. they had less bureaucracies) (Schumpeter, 1934). However, Chandy and Tellis (2000) found after World War II that the source of radical product innovation has changed from small and medium companies to large companies. They suggest two possible causes: *dynamic organisational climates* that allow large companies to become more decentralised, increasing competition among business units; and strong *technological capability* that allows large companies to develop and commercialise increasingly complex technologies. Indeed, major radical product innovation barriers specifically for SMEs are lack of incubation competencies, insufficient resources, and paucity of external finance (Sandberg & Aarikka-Stenroos, 2014). As a result, larger companies no longer suffer as much from bureaucracies as they had in the past. Furthermore, this has allowed them to leverage their size advantages for radical product innovation by using their monopoly power to defend against industry entrants (Schumpeter, 1942) or expertise in distribution, production, and management to enter new markets (Tellis & Golder, 1996). As a result, larger companies are now more capable than smaller companies at radical product innovation.

Given that the global food and beverage industry is going through similar changes with increasing competition, changing consumer demands, and more complex food product development (e.g. for functional foods), more resources are probably needed for radical food product innovation as well. Rama and Tunzelmann (2008) conclude that larger food and beverage companies generally have more innovations and innovative intensity (innovation relative to sales, assets, or employees) than smaller companies. They cite Galizzi and Venturini's (1996) study of product innovation in the U.S. food industry who suggest that the poor performance is not because of the lack of R&D resources (SMEs can conduct R&D like large companies) but a lack of marketing and advertising resources, which indicates a minimum company size is required to successfully launch new products (although they did not specify what size). They conclude that once the minimum company size is surpassed, there are no differences in innovative intensity among these companies. Other empirical studies from Brazil (Tomas et al., 2014), Italy (Capitanio et al., 2010), Netherlands (Ziggers, 2005), Spain (Martinez & Briz, 2000), and UK (Baregheh, Rowley, Sambrook, & Davies, 2012) tentatively support this view.

In the New Zealand food and beverage industry context, small company size can be more detrimental due to the small local population and distance to major markets. Indeed, many New Zealand companies reported lack of resources and skilled employees as major barriers to innovation (Statistics New Zealand, 2011). New Zealand serial product innovators, such as Fonterra, Zespri, and Silver Fern Farms, are large companies with monopoly power and strong production and marketing expertise. Furthermore, as food product development becomes more sophisticated, more skilled personnel are likely to be needed. Consequently, larger New Zealand food and beverage companies are more likely to introduce radical product innovation than smaller New Zealand food and beverage companies.

3.5.3 Company foreign ownership

Company foreign ownership is the degree of overseas ownership of a New Zealand food and beverage company. National culture can affect a company product innovativeness performance by influencing the company entrepreneurial characteristics (Hayton et al., 2002). Entrepreneurial orientated companies have been found to be more innovative (Hult et al., 2004).

Few studies have investigated the effect of foreign ownership on product innovativeness in the food and beverage industry. Siriwongwilaichat and Winger (2004) found "Thai-owned companies (both private and public) tended to favour introducing imitation or "me-too" food products while foreign owner-dominated companies were more likely to focus on product improvements" (p. 242). However, they found no significant relationship between the company foreign ownership and product innovativeness. Sadowski and Sadowski-Rasters (2006) examined the effect of foreign ownership on product innovativeness of 4,780 manufacturing companies (including food companies) that took part in the Community Innovation Survey for 1996 in the Netherlands. They found that foreign subsidiaries were more innovative than domestic companies, partly because they utilised external knowledge transferred from associated companies. Another similar study investigated the effect of foreign ownership on innovation performance in the 2,800 Spanish manufacturers (including food and beverage manufacturers) (Guadalupe, Kuzmina, & Thomas, 2012). They found overseas companies often acquired the best (high performance) domestic companies and investing in or transferring to them superior technologies and organisational practices, which improved the innovation performance of the acquired companies (this is consistent for all manufacturing sectors). However, they only measured product and process innovation and not their degree of innovativeness. On the whole, the effect of company foreign ownership on product innovativeness in the global food and beverage industry seems inconclusive.

In New Zealand, there is a national culture of "No. 8 wire" and "kiwi ingenuity" that come from our agricultural background and is linked to our business success (Anderson, 2011; Bridges & Downs, 2000; Riddet Institute, 2011). Subsequently, some New Zealand food and beverage companies have been purchased by overseas investors or companies over the past few years because of their success. For example, Shanghai Maling Aquarius (from China) acquired 50% of Silver Fern Farms in 2015; BayWa (from Germany) acquired 73% of T&G (Turners and Growers) in 2012; and Affinity Equity Partners (from

Singapore) acquired 100% of Tegel in 2011 (Wilkinson et al., 2015). Of the top 100 New Zealand food and beverage companies by revenue, 64% are New Zealand owned and 37% (sic) are overseas owned by companies that are 42% from Asia, 23% from Americas, 22% from Europe, and 13% from Australia (Wilkinson et al., 2015).

Given that the New Zealand government promotes the industry to overseas investors (Wilkinson et al., 2015), it is considered the government sees foreign investments as positive for the industry. This is possibly to grow the competitiveness of New Zealand companies as well as giving them access to more external finance. Nevertheless, from the view of a radical product innovation determinant, a question arises if having an overseas ownership can influence the culture (i.e. entrepreneurial characteristics) of the acquired companies and make them less innovative in the long run. None of the three studies previously listed considers the impact of foreign ownership on the company's culture. Considering New Zealand's innovation strengths and weaknesses, it is proposed that New Zealand owned companies are more innovative than overseas owned companies given New Zealand's innovative culture and strong scientific research base and training.

3.6 Research Hypotheses

Two sets of research hypotheses are presented in this section. The first set of research hypotheses were meant to predict and explain the radical product innovation phenomenon. Here, the author represents the relationships between the five identified determinants (causally related predictors or cause variables) and radical product innovation (response or the effect), based on the conceptual model developed in section 3.4.6.3. The second set of research hypotheses are meant to elucidate the relationships between company characteristics that could affect product innovativeness in the New Zealand food and beverage industry, based on the three company characteristics identified in section 3.5. The two sets of hypotheses are discussed in section 3.6.1 and 3.6.2 respectively.

3.6.1 Hypothesised model on radical product innovation phenomenon

A hypothesised model, which identifies the research hypotheses related to radical product innovation determinants and their relationships with each other and product innovativeness, is presented in Figure 3.12. The model is simply the conceptual model (previously presented as propositions without a numbering system) with hypotheses shown for all the relationships.

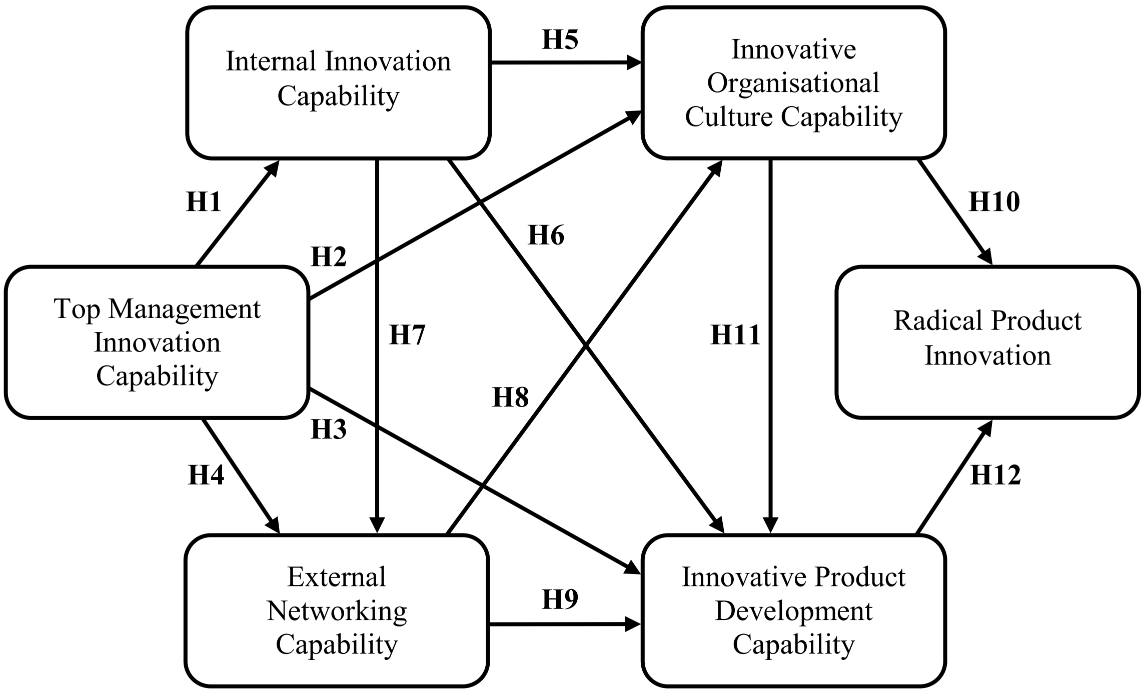


Figure 3.12: Hypothesised model on radical product innovation

Top management innovation capability is considered the most important determinant because it drives the other four determinants (two of which are directly connected to radical product innovation). Top management have the responsibility to establish the product innovation strategy (resource allocation and project selection), build external networks, set appropriate culture, and implement innovative product development practices, based on the discussion provided earlier (section 3.4.6.3). However, as argued earlier, the researcher maintains that top management innovation capability has no direct effect on radical product innovation, because top management do not conduct product development activities. Consequently, the research hypotheses related to top management innovation capability as a predictor/causal antecedent are as follows:

H1: Top management innovation capability has a positive effect on internal innovation capability.

H2: Top management innovation capability has a positive effect on innovative organisational culture capability.

H3: Top management innovation capability has a positive effect on innovative product development capability.

H4: Top management innovation capability has a positive effect on external networking capability.

Internal innovation capability is hypothesised to be causally related to three other determinants. Internal innovation capability determines what internal competencies are available for radical product innovation and affect the company's ability to collaborate with external partners, cope with uncertainty, and conduct product development, as previously discussed (section 3.4.6.3). However, internal innovation capability represents only in-house assets that need to be utilised; as such, this capability is not hypothesised to be directly related to radical product innovation. Consequently, research hypotheses related to internal innovation capability are as follows:

H5: Internal innovation capability has a positive effect on innovative organisational culture capability.

H6: Internal innovation capability has a positive effect on innovative product development capability.

H7: Internal innovation capability has a positive effect on external networking capability.

External networking capability is hypothesised to be causally related to the other two determinants. External networking capability provides access to external resources needed for radical product innovation; this can enhance a company's overall ability to deal with uncertainty in conducting product development, based on the previous discussion (section 3.4.6.3). Much in the same way as internal innovation capability represents internal assets, external networking capability represents only external assets that need to be utilised. Therefore, external networking capability is not hypothesised to be directly related to radical product innovation. Consequently, research hypotheses related to external networking capability are as follows:

H8: External networking capability has a positive effect on innovative organisational culture capability.

H9: External networking capability has a positive effect on innovative product development capability.

Innovative organisational culture capability is hypothesised to be causally related to innovative product development capability and radical product innovation. Innovative organisational culture capability determines the company's ability to cope with high uncertainty and can improve the company's ability to conduct product development and propensity for radical product innovation, as discussed previously (section 3.4.6.3). Consequently, research hypotheses related to innovative organisational culture capability are as follows:

> **H10**: Innovative organisational culture capability has a positive effect on radical product innovation.
>
> **H11**: Innovative organisational culture capability has a positive effect on innovative product development capability.

Finally, innovative product development capability is hypothesised to be causally related to radical product innovation. Innovative product development capability determines the company's ability to conduct radical product development. Therefore, this capability has a direct relationship with radical product innovation, based on the previous discussion (section 3.4.6.3). Consequently, the research hypothesis related to innovative product development capability is as follows:

> **H12**: Innovative product development capability has a positive effect on radical product innovation.

3.6.2 Hypotheses on the effects of company characteristics on radical product innovation

Given the five determinants of radical product innovation, company characteristics that could potentially affect product innovativeness in the New Zealand food and beverage industry are identified in section 3.5. These are company size, company age, and company foreign ownership. The hypotheses involving these characteristics are formulated as follows.

Firstly, it is proposed that younger New Zealand food and beverage companies are more accepting of radical product ideas relative to their older counterparts because younger companies are not inhibited by accumulated experience and resources, based on the previous discussion provided in section 3.5.1. As a result, younger companies are also more driven to innovate in order to grow and gain market share. Hence:

> **H13:** There is a greater level of acceptance for product innovativeness in younger New Zealand food and beverage companies than in older companies.

Secondly, it is proposed that larger New Zealand food and beverage companies have less barriers to radical product innovation because of their resources and monopoly power, based on the previous discussion provided in section 3.5.2. This is particularly so given the New Zealand context of small population and local market. Hence:

> **H14:** Larger New Zealand food and beverage companies are more likely to have a higher level of product innovativeness than smaller counterparts.

Thirdly, it is proposed that New Zealand majority owned companies are more innovative than overseas majority owned companies because of New Zealand's innovative national culture and strong scientific research and training on food process technology, based on the previous discussion provided in section 3.5.3. Foreign ownership can introduce new culture to an acquired company; this can change the entrepreneurial characteristics, reducing the company's product innovativeness in the long run. Hence:

> **H15:** New Zealand owned food and beverage companies are more innovative than overseas owned companies.

3.7 Chapter Summary

This chapter covered the development of models needed to answer the four research questions. Firstly, a product innovativeness model was developed to measure product innovativeness and identify radical product innovation. Product innovativeness is defined as "a measure of the potential discontinuity a product (process or service) can generate in the marketing and/or technological process" (Garcia & Calantone, 2002, p. 113). In keeping with definition, product innovativeness is measured by considering the technological newness of the new product as well as the marketing newness, from both market and company perspective. A radical product is identified as a new product with both new-to-market and new-to-company core technology and core value proposition.

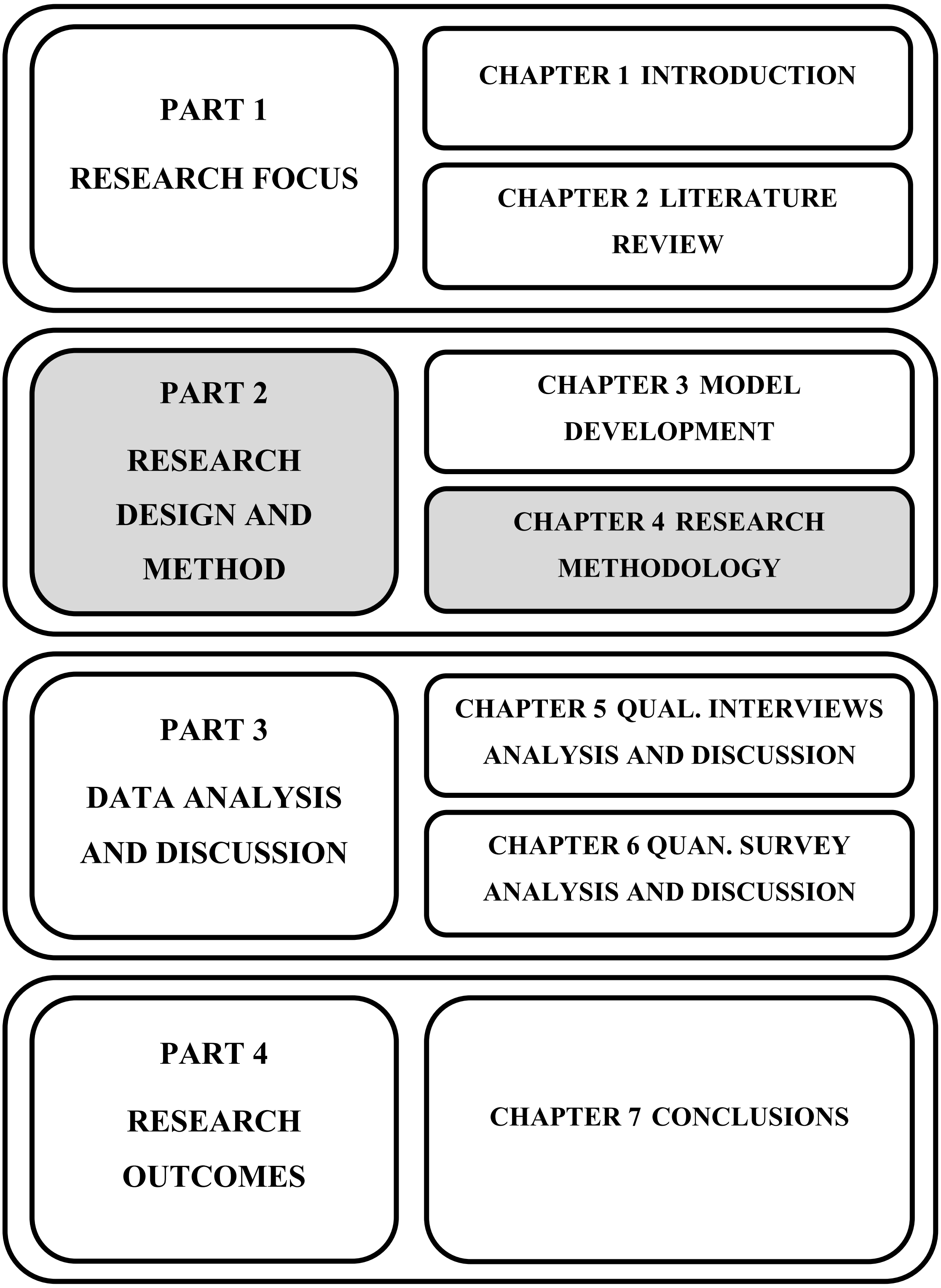
Secondly, a product innovation process model was developed to identify the predominant stages in a product innovation process. The product innovation process model is used to assist the design of qualitative interview structure (details in section 4.4.2). The final product innovation process model presented (Figure 3.9), consists of six stages: opportunity recognition, idea development, business analysis, development, testing & validation, and commercialisation.

Thirdly, a conceptual model was created to analyse the interrelationships between radical product innovation determinants and product innovativeness. The model identifies five determinants: top management innovation capability, internal innovation capability, external networking capability, innovative organisational culture capability, and innovative product development capability. They are developed based on the resource-based view on competitive advantage (including the concepts of that theory) and extant literature on organisational capabilities pertaining to radical product innovation, within the New Zealand food and beverage industry context.

Fourthly, company characteristics that could affect product innovativeness in the New Zealand food and beverage industry—company age, company size, and company foreign ownership—were elicited and discussed. It is proposed that younger companies are more likely to accept innovative products because of their entrepreneurial characteristics; larger companies have more resources and monopoly power to introduce innovative products; and, New Zealand owned companies are more innovative than overseas owned companies given our national culture and strong scientific research and training.

Finally, the research hypotheses were presented in section 3.6. In Chapter 4, the methodology of the study is presented. This includes the design of a qualitative interview and quantitative surveys (data collection instruments and data collection approaches) to test the research hypotheses.

PART 2: RESEARCH DESIGN AND METHOD



CHAPTER 4 RESEARCH METHODOLOGY

4.1 Chapter Overview

The purpose of this research is to explain the radical product innovation phenomenon in the New Zealand food and beverage industry. The study has been conducted to encourage more radical product innovation in the New Zealand food and beverage industry by being able to demonstrably explain what causes *radical product innovation*. The research methodology used to answer the research questions is presented in this chapter. The research questions are (section 1.5):

RQ1 What are the determinants of radical product innovation in the New Zealand food and beverage industry?

RQ2 How do the identified determinants of radical product innovation relate to one another in predicting and explaining product innovativeness?

RQ3 What company characteristics affect product innovativeness in the New Zealand food and beverage industry?

RQ4 What are the salient features of a highly innovative New Zealand food and beverage company?

Section 4.2 presents how a particular research paradigm was chosen from the research paradigms used in social research. Then the chosen paradigm "pragmatism/mixed methods research" is described in section 4.3. Following this, the qualitative interview design and quantitative survey design to collect and analyse data are provided in section 4.4 and 4.5 respectively. The generalisation considerations of the research are then provided in section 4.6. Lastly, the research's ethical considerations associated with data collection process are discussed in section 4.7.

4.2 Research Paradigms

A researcher's philosophical assumptions (research paradigm) will influence his or her view of reality (worldview/paradigm) and choice of research method (Collis & Hussey, 2014; Creswell, 2014; Holden & Lynch, 2004).

4.2.1 Constituents of a research paradigm

A research paradigm consists of a set of specific interrelated philosophical assumptions. There are five common philosophical assumptions that underline most research paradigms: ontological, epistemological, axiological, rhetorical, and methodological assumptions (Bryman & Bell, 2015; Collis & Hussey, 2014). They are explained in turn.

Ontological assumption is concerned with the nature of social reality. There are two widely subscribed, yet polar opposite views of social reality: objectivism and constructionism (Bryman & Bell, 2015). Objectivism sees social reality as an objective reality where reality is external to the participants and can be observed without prejudice (hence reality is singular) (Holden & Lynch, 2004). Constructionism on the other hand sees social reality as subjective realities constructed by the participants themselves making the research subjective and context-dependant (hence multiple realities) (Guba & Lincoln, 1994).

Epistemological assumption is concerned with what is considered acceptable knowledge. An objectivist view considers only objective evidences (phenomena that are observable and measurable) as acceptable knowledge, while a constructionist view considers social meanings given by participants in a given context as acceptable knowledge (Bryman & Bell, 2015; Collis & Hussey, 2014).

Axiological assumption is concerned with the role of values. Researchers could consider themselves either un-biased/value-free, which is the case with objectivism's view; or biased/value-laden, which is the case with constructionism's view (Collis & Hussey, 2014; Guba & Lincoln, 1994).

Rhetorical assumption is concerned with the language of the research. A value free axiology follows a third person passive voice writing style, while a value laden axiology follows a first person active voice writing style (Collis & Hussey, 2014).

Methodological assumption is concerned with the process of data collection and analysis, which depends on the researcher's ontological and epistemological assumptions (Collis & Hussey, 2014; Guba & Lincoln, 1994).

4.2.2 Types of research paradigms

The contrasting sets of philosophical assumptions (section 4.2.1) lead to two contrasting research paradigms: *positivism* (or *postpositivism*, which is a less objective form of positivism) and *constructivism*.

Positivism (postpositivism included) would view reality as objective and singular (ontology), would rely on objective evidence to gain knowledge (epistemology), would be value free (axiology), and would follow a value free rhetoric (Guba & Lincoln, 1994). Invariably, positivism supports the use of scientific methods to study social reality. Hence, positivism (postpositivism included) attempts to understand the world through deductive reasoning and conducts scientific experiments (or alternative methods such as survey research that enable statistical hypothesis testing) to test proposed hypotheses in order to advance new theories or knowledge. Positivism/postpositivism is generally based on the following principles (Bryman & Bell, 2015):

1. **The principle of phenomenalism** – only observable and measurable phenomena can be considered knowledge.
2. **The principle of deductivism** – phenomena can be reduced to testable hypotheses in order to explain it.
3. **The principle of inductivism** – knowledge is obtained through gathering of facts and evidences.
4. **Objectiveness** – that science can be conducted in a way that is value free.
5. **Scientific statements** – there is a clear distinction between scientific and normative statements and scientists use scientific statements.

Constructivism (or interpretivism) is the antithesis of positivism. Proponents of constructivism believe that reality is subjective and multiple (ontology) in the sense that people interpret and understand the world they live and work in by giving subjective meanings towards objects and things. Their context, culture, background, and interaction with others also influence their interpretation of reality. This leads to many interpretations of reality. Consequently, constructivist researchers who aim to understand social reality often use open-ended research questions to encourage their participants to share their view and meaning within a given context. A researcher's experience and background also influence how they interpret their findings, making the research value-laden. Through gathering of different interpretations, new knowledge or meaning can be obtained (Creswell, 2014; Guba & Lincoln, 1994; Holden & Lynch, 2004).

In addition to positivism and constructivism, Creswell (2014) identifies two other relevant paradigms on social research: transformative and pragmatism. *Transformative* is a research paradigm that promotes the application of change in order to better help the marginalised minority in society. The proponents of transformative feel that the constructivism does not sufficiently capture the worldview of a marginalised victim in society or the issues related to power and social justice, discrimination, and oppression. They challenge some assumptions of constructivism and aim to cause change through their research (Creswell, 2014).

Pragmatism, as the name implies, focuses on problem solving without being too paradigm locked. Consequently, pragmatic researchers are open to use all possible research approaches/methods to understand and solve their research problems. Their philosophical belief borrows the elements of other paradigms (Morgan, 2007). Consequently, pragmatism allows for the possibility of multiple streams of data collection and analysis (e.g. quantitative data followed by qualitative data or vice versa). Creswell (2014), a leading advocate of pragmatism and the use of mixed methods, asserts that because pragmatism does not have a set of strong underlying philosophical assumptions, researchers need to carefully outline their approach and philosophical assumptions.

The major elements of the four research paradigms are summarised in Table 4.1.

Table 4.1: Four Research Paradigms (Creswell, 2014, p. 6)

Postpositivism/positivism	**Constructivism**
• Determination • Reductionism • Empirical observation and measurement • Theory verification	• Understanding • Multiple participant meanings • Social and historical construction • Theory generation
Transformative	**Pragmatism**
• Political • Power and justice oriented • Collaborative • Change-oriented	• Consequences of actions • Problem-centred • Pluralistic • Real-world practice oriented

For positivism, the research is often based on collecting large quantitative data through methods such as surveys and experiments due to the principle of "phenomenalism" (Bryman & Bell, 2015, p. 28). Alternatively, for constructivism the research is often based on collecting qualitative data from a small sample through methods such as interviews and case studies due to the belief that reality is a social construct (Guba & Lincoln, 1994). Transformative and pragmatism are research paradigms that utilise both qualitative and quantitative approaches due to their flexibility (Creswell, 2014; Mertens, 2007).

Philosophical assumptions related to two major research paradigms (positivism and interpretivism) are provided in Table 4.2. It compares how the five philosophical assumptions differ between the two research paradigms. According to Collis and Hussey (2014), both research paradigms represent two extreme end of world views and that other research paradigms exist between the two. For example, transformative and pragmatism could be said to exist between the two paradigms because they borrow the elements of both. In section 4.2.3, the researcher's research paradigm is chosen, and his philosophical assumptions are stated.

Table 4.2: Positivism and Interpretivism Philosophical Assumptions (Collis & Hussey, 2014, p. 46)

Philosophical assumption	**Positivism**	**Interpretivism**
Ontological assumption (the nature of reality)	Social reality is objective and external to the researcher.	Social reality is subjective and socially constructed.
	There is only one reality.	There are multiple realities.
Epistemological assumption (what constitutes valid knowledge)	Knowledge comes from objective evidence about observable and measurable phenomena.	Knowledge comes from subjective evidence from participants.
	The researcher is distant from phenomena under study.	The researcher interacts with phenomena under study.
Axiological assumption (the role of values)	The researcher is independent from phenomena under study.	The researcher acknowledges that the research is subjective.
	The results are unbiased and value-free.	The findings are biased and value-laden.
Rhetorical assumption (the language of research)	The researcher uses the passive voice, accepted quantitative words and set definitions.	The researcher uses the personal voice, accepted qualitative terms and limited a priori definitions.
	The researcher takes a deductive approach.	The researcher takes an inductive approach.

Philosophical assumption	Positivism	Interpretivism
Methodological assumption (the process of research)	The researcher studies cause and effect, and uses a static design where categories are identified in advance.	The researcher studies the topic within its context and uses an emerging design where categories are identified during the process.
	Generalisations lead to prediction, explanation and understanding.	Patterns and/or theories are developed for understanding.
	Results are accurate and reliable through validity and reliability.	Findings are accurate and reliable through verification.

4.2.3 The researcher's paradigm

In the previous chapter, the researcher formulated two sets of research hypotheses (section 3.6). The researcher could go on to test these two sets of research hypotheses using survey (quantitative) data. Thus, one could view this type of research as positivist research.

However, the researcher found that there is not sufficient knowledge available to conduct the research in rigid positivistic (or even postpositivistic) form. For example, development of the measurement scales of theoretical variables (constructs) required industry engagement, as there wasn't sufficient published literature to develop measurement scales (the survey instrument), solely from extant knowledge. As such, this research was conducted within the pragmatic research paradigm.

Pragmatism is a research paradigm that adopts from other research paradigms depending on the needs of the research itself rather than a particular philosophical belief (Creswell, 2014; Morgan, 2007). A pragmatic research paradigm was most relatable to the researcher compared to the other three research paradigms because it allowed him to borrow elements from both positivism (e.g. empirical observation and measurement, theory verification) and constructivism (e.g. understanding the full meaning of concepts for the purpose of measurement through interviews of multiple participants).

To be more specific, the researcher believed that the world was governed by cause and effect relationships and that the relationships could be explained through deductive reasoning. Nevertheless, how close to the absolute truth he might never know. He also recognised that humans gave meaning to things and objects around them and that these meanings were influenced by their context, culture, background, and interaction with people. For deductive reasoning to be effective, he needed to understand the meanings his participants gave to their world (or context) in his attempt to understand their worldview.

Consequently, his research called for both qualitative and quantitative data collection and analysis method. A qualitative research method was needed first to understand the interpretation his research participants gave in an attempt to understand their worldview or context. Later, a quantitative research method was needed to test his proposed two sets of research hypotheses deduced through the qualitative research. By using valid and reliable data collection and analysis methods, methodological bias could be reduced.

However, the researcher's personal bias (experience and background) could influence his interpretation of the findings and needed to be accounted for. This led him to favour a postpositivism research paradigm over positivism research paradigm. Postpositivism is a less objective form of positivism because it challenges the positivism's traditional notion of the absolute truth of knowledge and recognises that we cannot be positive about our claims of knowledge when studying human behaviours and actions (Creswell, 2014).

Given the previous explanation of the researcher's worldview, he had a strong belief in the postpositivism research paradigm with some elements of constructivism research paradigm. The research also called for a mixed methods research. Consequently, pragmatism was the most appropriate research paradigm for this research. The chosen pragmatic research paradigm was defined as a research paradigm primary based on postpositivism with some elements of constructivism.

Subsequently, it was important to clearly state the researcher's philosophical assumptions due to the pragmatism's weakness regarding its potential for unclear philosophical assumptions. Table 4.3 provides a summary of the researcher's philosophical assumptions based on the five philosophical assumptions identified by Collis and Hussey (2014). The research aim and questions were constructed according to the assumptions listed below.

Table 4.3: The Researcher's Philosophical Assumptions (Adopted from Collis & Hussey, 2014, p. 46)

Philosophical assumption	**Researcher's research paradigm (pragmatism)**
Ontological assumption (the nature of reality)	Social reality is objective and external to the researcher.
	There is only one reality.
Epistemological assumption (what constitutes valid knowledge)	Knowledge comes from both objective evidence about observable and measurable phenomena and subjective evidence from participants.
	The researcher is distant from phenomena under study.
Axiological assumption (the role of values)	The researcher is independent from phenomena under study.
	The results are unbiased and value-free. However, the researcher's experience and background can influence the interpretation of the results.
Rhetorical assumption (the language of research)	The researcher uses the passive voice, accepted quantitative words and set definitions.
Methodological assumption (the process of research)	The researcher takes both an inductive and deductive approach.
	The researcher used a mixed methods research to study the topic within its context and later to study cause and effect relationship.
	Generalisations lead to prediction, explanation and understanding.
	Results are accurate and reliable through validity and reliability.

4.3 Mixed Methods Research

Mixed methods methodology was chosen for this research because it was best suited for a pragmatic research paradigm. Mixed methods research is a research method that combines both quantitative and qualitative methods. There are many types of mixed methods. They are typically classified based on the priority (which methods are the principle data collection tool) and sequence (which order the methods are conducted) between quantitative and qualitative methods (Bryman & Bell, 2015). According to Creswell (2014), there are three widely used mixed methods used in social sciences[4]:

- **Convergent parallel mixed methods** – a form of mixed methods design where both quantitative and qualitative methods are conducted simultaneously, with

[4] Creswell (2014) explains three others less widely used complex mixed method designs. Coverage of these designs is beyond the scope of this study as these methods do not become potential candidates for this research.

equal priority. The researcher then compares and/or merges quantitative and qualitative data in order to provide a comprehensive analysis of the research problems or to integrate the research findings.

- **Explanatory sequential mixed methods** – a form of mixed methods design where quantitative research (quantitative data collection and analysis) is conducted before qualitative research (qualitative data collection and analysis). Qualitative research is conducted to explain or elaborate the findings of the quantitative research.
- **Exploratory sequential mixed methods** – a form of mixed methods design where qualitative research is conducted before quantitative research. The purpose of conducting qualitative research before quantitative research is to make quantitative research (typically survey research) possible by exploring areas that are not very well known to the researcher. Qualitative data collection and analysis may be required to test the completeness of the variables to be included in the quantitative study, develop scales for variables (i.e. to develop the survey instrument) and/or expand the researcher's horizon to enable the researcher to formulate hypotheses (Creswell, 2014). Quantitative research is then conducted to test the hypotheses or deploy the research instrument to obtain numerical information to explain a social phenomenon.

Looking at the research questions, the first research question (RQ1) requires eliciting a finite number of variables that determine the phenomenon of interest, namely radical product innovation. The second research question (RQ2) concerns cause and effect relationships between theoretical variables (this covers both formulation and testing the cause and effect hypotheses). RQ2 can only be answered through empirical observation and measurement. Exploratory sequential mixed methods was chosen as the appropriate mixed methods design platform for this research because the study prioritised quantitative research for data collection and analysis, for which views of participants were obtained prior to the development of the research instrument. Figure 4.1 shows a summary of the mixed methods research process that was followed.

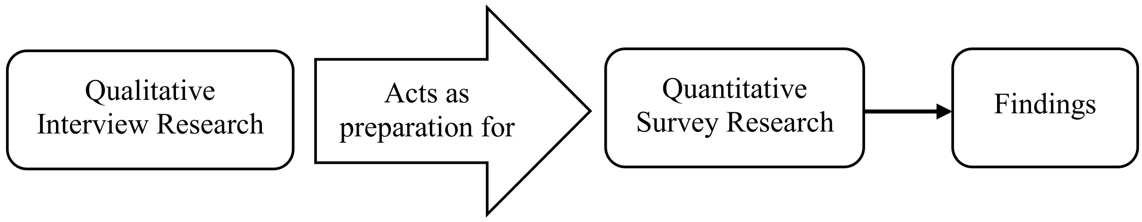


Figure 4.1: Mixed methods research process (Adopted from Creswell & Clark, 2011, cited in Bryman & Bell, 2015, p. 647)

Thus, in keeping with the exploratory sequential design platform, in the first phase, a qualitative interview was conducted. The purpose of this phase was to validate the research hypotheses (proposed in section 3.6) with selected New Zealand food and beverage companies and assist in operationalising survey items. Qualitative research was needed due to the limited information on the determinants of radical product innovation in the New Zealand food and beverage industry. Furthermore, the researcher's limited understanding and experience in the industry also contributed to the need for qualitative research. The findings served as a preparation for quantitative survey research that was conducted in the second phase. The qualitative interview design is described in detail in section 4.4.

In the second phase, quantitative survey research was conducted. The aim of this phase was to test the research hypotheses (proposed in section 3.6). A quantitative survey design was appropriate because it allowed the development of the measurement scales for the determinants of radical product innovation (independent variables) and product innovativeness (dependent variable) in the New Zealand food and beverage industry (context). Quantitative survey design also included company characteristics as categorical variables. The quantitative data collected enabled the researcher to fit these data to statistical models to assess the goodness-of-fit (Ornstein, 2013). Quantitative research also has a higher degree of external validity making it possible to generalise the research findings (Bryman & Bell, 2015). The quantitative findings (supported hypothesis and unsupported hypothesis) were used to finalise the researcher's theory (theoretical model). The model was then used to discuss and recommend practices for radical product innovation within New Zealand food and beverage companies. The quantitative survey design is explained in detail in section 4.5.

4.4 Qualitative Interview Design

In this section, the qualitative interview design is explained. The purpose of the interview was to validate the research hypotheses (listed in section 3.6) and assist in the operationalisation of survey items in section 4.5.2. Qualitative data were obtained from five selected companies in the New Zealand food and beverage industry. These companies have a demonstrable track record of radical product innovation, having launched and sustained successful and innovative food and beverage products. The second criterion for company selection was the locality. Only companies in the Manawatu-Wanganui region of New Zealand were considered for interviews due to logistical and budgetary constraints. The final and more obvious criterion for selecting companies/interview participants was availability and willingness/consent of the potential participants contacted. In the following sections, the participant selection, interview structure, and interview analysis are explained. The analysis of interview data is presented in Chapter 5.

4.4.1 Participant selection

The New Zealand Food & Beverage Directory was used to search and obtain the contact information of the selected companies. The directory was a part of the New Zealand Food & Beverage Information Project that aimed to provide a comprehensive directory of over 1,000 companies in the New Zealand food and beverage industry (Ministry of Business Innovation and Employment, n.d.).

There were many food and beverage companies located in the Manawatu-Wanganui region that had successfully developed and commercialised radical product innovation. This was due to the region's long history of food scientific research and education. Snowball sampling and personal suggestion were also used to select additional companies. The selected food and beverage companies were manufacturers, processors, producers, and wholesalers of diverse food and beverage products for which New Zealand remains very competitive. To be specific, the first company interviewed was a processor of blackcurrants, the second company interviewed was a manufacturer of honeys, the third company interviewed was a wholesaler of sweet products, the fourth company interviewed was a manufacturer of confectionaries, and the fifth company interviewed was a manufacturer of dairy products.

Selected companies were first contacted with an invitation email sent, addressed to the company director. See Appendix A for the interview invitation letter. The company director or personnel directly involved in product innovation or new product development project were invited to participate in the interview. A follow up call was made a week after sending the invitation email to personally invite the company director or get recommendation to a relevant person in their company for an interview. Only one participant from each participating company was interviewed. Two arguments are given for selecting only one participant from each company. Firstly, the unit of analysis of this study is the organisation (not its people). Secondly, because all constructs (theoretical variables) covered in this study are strategic in nature, it was assumed that the top manager on product innovation would provide far more reliable and trustworthy information than middle-level managers, low-level managers, or floor-level workers.

4.4.2 Interview structure

A semi-structured interview was used to question the participating companies. A semi-structured interview enables a researcher to cover a sizable list of questions on specific topics (Bryman & Bell, 2015). The other benefit of the semi-structured interview, which was particularly relevant to the researcher who uses English as the second language, was the benefit of knowing what exactly needs to be asked from each respondent, because in a semi-structured interview, interview questions are prepared ahead of time (Rabionet, 2011).

Thirty interview questions were developed and presented in Appendix B. These interview questions were reviewed by food technologists and academic staff at Massey University who had food industrial experience. The interview questions were structured into six sections as presented below.

- **About the company** – this section covered questions 1 to 5 on the company characteristics and its background. Responses to questions in this section provided the information needed to analyse the company characteristics that could affect product innovativeness.
- **About the interviewee** – this section covered question 6 on the interviewee’s responsibility. Responses to questions in this section ensured the interviewee’s suitability for the interview.

- **About the company's product development process** – this section covered questions 7 to 9 on the company's product development activity, process, and motivation. Responses to questions in this section provided information about how and why the company develops new products.
- **About the company's radical product innovation strategy** – this section covered questions 10 to 26 on the company's radical product innovation background, definition, motivation, and determinants across each stage of the product innovation process model from opportunity recognition, idea development, business analysis, development, testing & validation, and commercialisation. Responses to questions in this section provided information on the definition and determinants of radical product innovation in the New Zealand food and beverage industry, as perceived by the interviewee.
- **Testing for other drivers** – this section covered questions 27 to 29 on other determinants of radical product innovation that may had not been identified by the interviewee through answers to earlier questions. Responses to questions in this section ensured that other potential determinants would be given due consideration in the quantitative survey design, depending on the tenacity and veracity of the answer.
- **Ending questions** – this section covered question 30 on the interviewee's feedback on how the research could benefit their business. Responses to questions in this section helped the researcher to align the research outcomes with business interests.

The interview was designed to take approximately one hour. It was conducted face-to-face at a time and place that was convenient for the participant. Prior to the interview, the respondent was briefed on the objectives of the study and how the interview would help the researcher to achieve his research objectives. The data were collected through hand-written notes and an audio recording (prior permission was sought from the respondent to record the interview). The audio recording was transcribed and analysed together with the hand-written notes after the interview. The interview was conducted in accordance with the human ethics guidelines of Massey University (details in section 4.7).

4.4.3 Interview analysis

After the interview data were collected, they were processed manually using different colours (highlighter pen) to highlight common themes for each question. This analysis enabled the researcher to identify generalisable facets (e.g. common themes) based on textual information. This enabled the researcher to understand common meanings of theoretical concepts (as used in the industry), challenges in operationalising theoretical constructs (i.e. develop measurement scales), and determinants that were perceived to be significant for radical product innovation. The latter were then cross-referenced with the research hypotheses and discussed in section 5.3.

4.5 Quantitative Survey Design

In this section, the quantitative survey design is explained. The purpose of the survey was to collect data on the operational definitions of the constructs underlying the research hypotheses proposed in section 3.6. Registered New Zealand food and beverage companies were targeted in the survey. In the following sections, the participant selection, development of the survey questionnaire, pilot testing of questionnaire, and survey data analysis method are explained.

4.5.1 Participant selection

Registered New Zealand companies in the food and beverage industry were the target population in the survey. This included manufacturers, processors, producers, and wholesalers of food and beverage products. A sampling frame included New Zealand food and beverage companies that were listed in the New Zealand Food & Beverage Directory. The directory was a part of the New Zealand Food & Beverage Information Project that provided a comprehensive list of over 1,000 New Zealand companies in the food and beverage industry (Ministry of Business Innovation and Employment, n.d.). In total, 1,144 New Zealand food and beverage companies from the directory were contacted. Figure 4.2 indicates how the sampling frame stacks up against the target population and the wider industry sector in New Zealand.

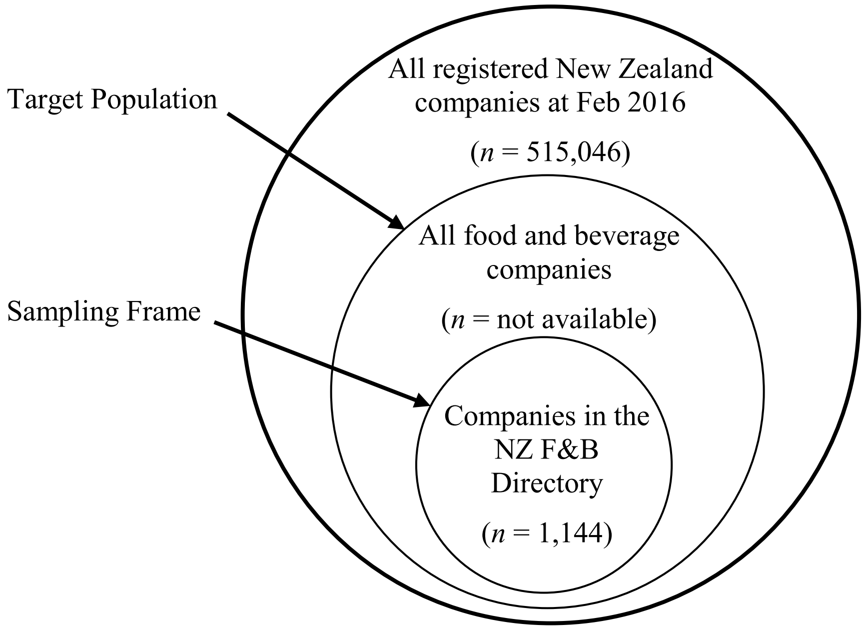


Figure 4.2: Target participating companies (not to scale)

Having developed the sampling frame, the next was to identify who should be invited in each company to participate in the survey. The Managing Director or relevant personnel responsible for the company's new product development projects was chosen to be invited to participate in the survey. A tabulated directory of personnel contact information for all the companies in the directory was provided by Kompass, the company responsible for maintaining the directory at the time of the survey.

4.5.2 Survey questionnaire development and administration

The survey questionnaire was developed to consist of two parts. In the first part, six survey items were included to gather information about the respondent and their company. In the second part, thirty-one seven-point Likert scale (1: strongly disagree; .....; 7: strongly agree) survey items were included to operationalise the six constructs underlying the research hypotheses. Thus, in keeping with the Likert format, each survey items in part two was represented as a statement covering a certain facet of the construct, for which the agreement of the respondent was sought in a scale of 1 to 7. Table 4.4 depicts the sources that were used to derive the operational definitions of the constructs. Some of the facets under each construct (Table 4.4) also emerged from interview data that preceded the quantitative survey.

Table 4.4: Literature Review Summary Chart for Operationalising the Theoretical Constructs

Construct	Facet of the Construct Covered	Label Given for the Corresponding Measure	Source	Type of Article
Product Innovativeness (PI)	Micro technological discontinuity	PI_1	(Garcia & Calantone, 2002)	Review article
	Macro technological discontinuity	PI_2	(Garcia & Calantone, 2002)	Review article
	Micro marketing discontinuity	PI_3	(Garcia & Calantone, 2002)	Review article
	Macro marketing discontinuity	PI_4	(Garcia & Calantone, 2002)	Review article
Top Management Innovation Capability (TMIC)	Highly involved with the project	TMIC_1	Company A, B, C, and D	Section 5.3.1
	Providing project direction	TMIC_2	Company A, B, C, D, and E	Section 5.3.1
	Willing to pursue radical products	TMIC_3	Company A, B, C, and E	Section 5.3.1
	Allocating sufficient financial resource	TMIC_4	Company A, B, C, D, and E	Section 5.3.1
	Building relationships with external partners	TMIC_5	Company A, B, C, and D	Section 5.3.1
Internal Innovation Capability (IIC)	Strong in-house technological competency	IIC_1	Company A, C, D, and E	Section 5.3.2
	Strong in-house market competency	IIC_2	Company B, C, and E	Section 5.3.2
	Utilising in-house technological competency	IIC_3	Company A, C, D, and E	Section 5.3.2
	Utilising in-house market competency	IIC_4	Company B, C, and E	Section 5.3.2

Construct	Facet of the Construct Covered	Label Given for the Corresponding Measure	Source	Type of Article
External Networking Capability (ENC)	Informal networks	ENC_1	(McDermott, 1999)	Research article
	Outsourcing	ENC_2	(Olleros, 1986)	Research article
	Alliances	ENC_3	(McDermott, 1999)	Research article
	Customer collaboration	ENC_4	(Coviello & Joseph, 2012)	Research article
Innovative Organisational Culture Capability (IOCC)	Relentless innovation	IOCC_1	(Tellis & Golder, 1996)	Research article
	Entrepreneurial orientation	IOCC_2	(Hult et al., 2004)	Research article
	Customer orientation	IOCC_3	(Gatignon & Xuereb, 1997)	Research article
	Technological orientation	IOCC_4	(Gatignon & Xuereb, 1997)	Research article
	Competitor orientation	IOCC_5	(Gatignon & Xuereb, 1997)	Research article
	Learning orientation	IOCC_6	(Hult et al., 2004)	Research article
	Well communicated product innovation strategy	IOCC_7	(Cooper, 2011)	Review article
	Appropriate employee performance metrics	IOCC_8	(Leifer et al., 2000)	Research book
Innovative Product Development Capability (IPDC)	A full-time project leader	IPDC_1	(Holahan et al., 2014)	Research article
	A project champion	IPDC_2	(Holahan et al., 2014)	Research article
	A multi-disciplinary team	IPDC_3	(Holahan et al., 2014)	Research article
	A compelling business case	IPDC_4	(Cooper & Kleinschmidt, 1987)	Research article
	A well-structured product	IPDC_5	(Holahan et al., 2014)	Research article

Construct	Facet of the Construct Covered	Label Given for the Corresponding Measure	Source	Type of Article
	development process			
	Well executed product development activities (more structured process for higher level of uncertainty)	IPDC_6	(Holahan et al., 2014)	Research article

The validity of the contents of part two of the survey questionnaire (content validity) was established by giving the draft questionnaire to five Massey academics experienced in new product development for review. Content validity establishes the fact that the survey content covered under each construct is a reasonable representation of the domain the construct is supposed to cover (Haynes, Richard, & Kubany, 1995; Nunnally & Bernstein, 1994; Straub, Boudreau, & Gefen, 2004). Content validity is a matter of judgement based on expert opinion; as such content validity is not a statistical matter as such, although statistical theory can be used to judge whether or not a particular survey question was judged to be relevant by members of an expert panel by chance (Lawshe, 1975).

The questionnaire (including the pilot testing stage) was administered through the "Google Forms" platform electronically by inviting each respondent to participate in the study by providing them the link (URL) containing the questionnaire. Although Google Forms is a freeware, it is a widely used electronic platform to launch quantitative survey research (Mallette & Barone, 2013). Two weeks were given for participants to respond to the survey. A day before the expiry of the two-week period, a reminder was sent to all participants extending the deadline by two weeks. The survey invitation that was sent to invite companies is provided in Appendix C and the survey questionnaire that was used to collect data is provided in Appendix D.

4.5.3 Pilot survey

In a pilot survey, a researcher administers the survey instrument within a small sample, prior to launch of the survey instrument to the full sample. This is to identify any shortfalls of the questionnaire as a risk avoidance strategy (Rea & Parker, 2014). Eight companies in the Manawatu-Wanganui region from the sampling frame were selected for pilot testing. At the pilot testing stage, respondents were asked to complete the survey and comment on any particular survey items that were either unclear or irrelevant for their company. Surprisingly, all comments received from the respondents were complementary, which meant that no changes were required to the draft survey instrument in any shape or form.

4.5.4 Survey data analysis

One of the most important checks that need to be conducted in self-administered surveys, in particular, is checking that the responses are not tainted by "common method bias". Common method bias is the bias that comes from systematic error caused due to the measurement instrument (including the method used in administering that instrument) rather than random measurement error associated with measures underlying the constructs (Conway & Lance, 2010; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Harman's single factor test (Harman, 1976) was used to show that the measures in part two of the questionnaire resolve into multiple (nine) factors (Eigenvalues of these factors being: 7.26, 2.65, 2.13, 1.82, 1.68, 1.48, 1.27, 1.19, and 1.02 in the un-rotated solution) via Principal Components Analysis (PCA) of survey data. This suggested that common method variance (bias) is substantially absent in survey data (Conway & Lance, 2010; Harman, 1976). The PCA was performed using Minitab 18 software.

A partial least squares path modelling (PLSPM) approach was used to test the hypothesised theoretical relationships between constructs. It was chosen over covariance-based path modelling (CBPM) because this research is an exploratory research to develop theories rather than to confirm (or reject) theories, making PLSPM more appropriate (Hair, Hult, Ringle, & Sarstedt, 2017). Grigg and Jayamaha (2014) note that a PLSPM approach is more prevalent in PhD research in evolving social research disciplines (as opposed to more established path modelling techniques used in psychology) due to the flexibility afforded by that technique, such as having a small sample size and non-normally distributed data (Hair et al., 2017). Subsequently, the researcher ensured that all the latest guidelines on PLSPM (e.g. Hair et al., 2017) were followed in the data analysis. PLSPM was performed using SmartPLS 3 software (Ringle, Wende, & Becker, 2015).

By definition/default, the constructs are modelled as directly unobservable variables (i.e. latent variables) that are indirectly captured using the operationalisations (measurement items) used for each construct (Chin, 1998; Hair et al., 2017). PLSPM is a regression modelling approach involving latent variables (factors), where a series of locally optimised least squares regression models are fitted to data on the measures (Grigg & Jayamaha, 2014). These regression models cover both measurement models and structural models. A measurement model is a model that represents the statistical relationships between the latent variable (typically the predictor) and its underlying measurement items (typically the responses) while a structural model is a regression model that predicts one latent variable through one or more predictor latent variables (Chin, 1998; Grigg & Jayamaha, 2014).

It is important to note that in PLSPM, validity of the constructs—construct validity in the form of convergent validity and discriminant validity—is established parallel to testing the hypothesised theoretical relationships between the constructs (Hair et al., 2017), which is different from conventional path modelling where validity of the constructs is established (using a construct confirmation procedure known as confirmatory factor analysis) before testing the hypothesised theoretical relationships (Hair et al., 2017).

Multifactor analysis of variance—in Minitab 18 software, this is presented under module General Linear Model—was used to test whether or not the hypothesised company characteristics affect product innovativeness in the New Zealand food and beverage industry. The three hypothesised company characteristics (and therefore the three factors) were age, size, and foreign ownership (identified in section 3.5). Hypothesised company characteristics were separated into sub-groups/factor levels: company age (the year company was founded) was separated into "before 1900", "1900 – 1950", "1951 – 2000", and "2001 to present" (four levels); company size (the number of full-time employees) was separated according to Cameron and Massey (1999) into "0 – 5", "6 – 49", "50 – 99", and "99 +" (again four levels); lastly, company foreign ownership (the majority ownership base) was separated into "fully New Zealand owned", "partially overseas owned", and "overseas majority owned" (three levels). In analysis of variance (ANOVA), means of each factor level are compared. The null hypothesis (H_0) is that all means are the same while the alternative hypothesis (H_1) is that all means are not the same. For example, for the factor company size, H_0 is "product innovativeness (mean value) is the same across all four company sizes" while H_1 is "product innovativeness (mean value) is not the same across all four company sizes". A statistically significant *F* value (95%

confidence level was used in this study), rejects the H_0 in favour of H_1 (Kutner, Nachtsheim, Neter, & Li, 2005). ANOVA was performed using Minitab 18 software.

Table 4.5 depicts the statistical operations conducted by the researcher (using survey data) to answer his research questions (RQ1, RQ2, and RQ3). The test results of the hypothesised relationships between the determinants of radical product innovation and product innovativeness (i.e. PLSPM results), ANOVA results, and qualitative data analysis were triangulated to identify the salient features of a highly innovative New Zealand food and beverage company (RQ4). Triangulation is the use of two or more data sources, methods, investigators, theoretical perspectives, and approaches to study a phenomenon (Brink, 1993). Additional qualitative data were also collected from publicly available administrative records (e.g. websites) of the participating companies. Collected data include information such as the company's background and reputation, top management's role and background, product differentiation, target market, mission statement, values, partners, and product development process. The additional qualitative data are used to improve the internal validity of the answer to RQ4.

Table 4.5: Statistical Analyses Corresponding to Each Research Question

Reference	Statistical Requirement	Specific Statistical Technique(s) Used	Software Used
RQ1	Showing that constructs are valid	Convergent validity and discriminant validity assessment as part of PLSPM	SmartPLS 3
RQ2	Examining the hypothesised statistical relationships via regression	PLSPM	SmartPLS 3
RQ3	Examining the hypothesised company characteristics via variance	ANOVA	Minitab 18
RQ4	N/A	N/A	N/A
Note that PCA was performed via Minitab 18 software prior to all statistical analyses to show that common method bias is not present in survey data.			

4.6 Generalisation Considerations

Generalisability or external validity is an important consideration because it determines how the findings can be applied to contexts beyond the context of the study (Bryman & Bell, 2015; Kukull & Ganguli, 2012). Since this study adopts a mixed methods approach, generalisation considerations apply for both the qualitative and quantitative phases of the study. This is to clarify the limitations when applying the research findings beyond its study context, which is the New Zealand food and beverage industry.

Applicability is the strategy being used in qualitative research to improve the generalisability. Applicability works by asking the researcher to provide rich detail and documentation of the study context so that the qualitative findings can be applied or transferred to other similar contexts (Leung, 2015; Noble & Smith, 2015). Hence, detailed overviews are provided for each of the companies interviewed to aid transferability of findings.

In addition, given that only companies in the Manawatu-Wanganui region with a known history of radical product innovation were targeted for the interviews, there is a potential of selection bias associated with this study. It is argued that due to the high concentration of leading food and beverage companies and food research institutions being based in the Manawatu-Wanganui region, the companies that were selected for interviews represent the innovative food and beverage companies in New Zealand. Companies without radical product innovation were not targeted because they were considered to have low understanding of the determinants of radical product innovation. Logistical and budgetary constraints were another reason for selecting only one region to interview innovative food and beverage companies.

For the quantitative part, *random sampling* is the strategy being used to improve the generalisability, in which case the researcher needs to define the population (sampling frame) before drawing samples from the population. Random sampling works by improving the chance that the samples are a true representative of the target population (Kukull & Ganguli, 2012; Winter, 2000). Hence, the sample distribution was compared with known population distribution (in section 6.3) to ensure the samples were an accurate representative of the food and beverage companies in New Zealand. In a strict statistical sense, the quantitative findings of this study are generalisable across the New Zealand food and beverage sector only, because the sampling frame was drawn from New Zealand food and beverage companies. A pertinent question is "are the quantitative findings generalisable across the food and beverage industry in other countries?" An extension of this question is "are the quantitative findings generalisable across other industries within and outside New Zealand?" The short answer to both questions, especially the latter, is that generalisation of any study beyond the boundary of a study needs to be made with extreme caution (Bryman & Bell, 2015).

Above said, as discussed elsewhere (section 2.3.1), food and beverage industry has a similar set of determinants of radical product innovation to other industries. This suggests that the findings of this study have relevance to other industries. Nevertheless, food and beverage companies in New Zealand face unique contextual factors of small firm size, small local market, and large distance from major markets. Unfortunately, these unique contextual factors limit the generalisation to other countries. The best way to confirm generalisability of a study to other contexts is to repeat this study in such contexts (Kukull & Ganguli, 2012).

4.7 Ethical Considerations

Since this research involved human participants, the human ethics guidelines of Massey University, which are published as *Code of Ethical Conduct for Research, Teaching and Evaluations Involving Human Participants* was followed (Massey University, 2015). Human participants were involved during two stages: the interview including a small sample (stage 1) and the online survey including a large sample (stage 2). After following the online application and notification procedures for human ethics (Massey University, 2017), it was determined that a Low Risk Notification would suffice for both stages of the study. The acceptance letter of Low Risk Notification for stage 1—this in effect serves as the human ethics approval for the study—issued by the chair of the human ethics committee of Massey University is shown in Appendix E. The Low Risk Notification for stage 2 was accepted with Ethics Notification Number: 4000015815.

The main ethical considerations for the research are summarised below:

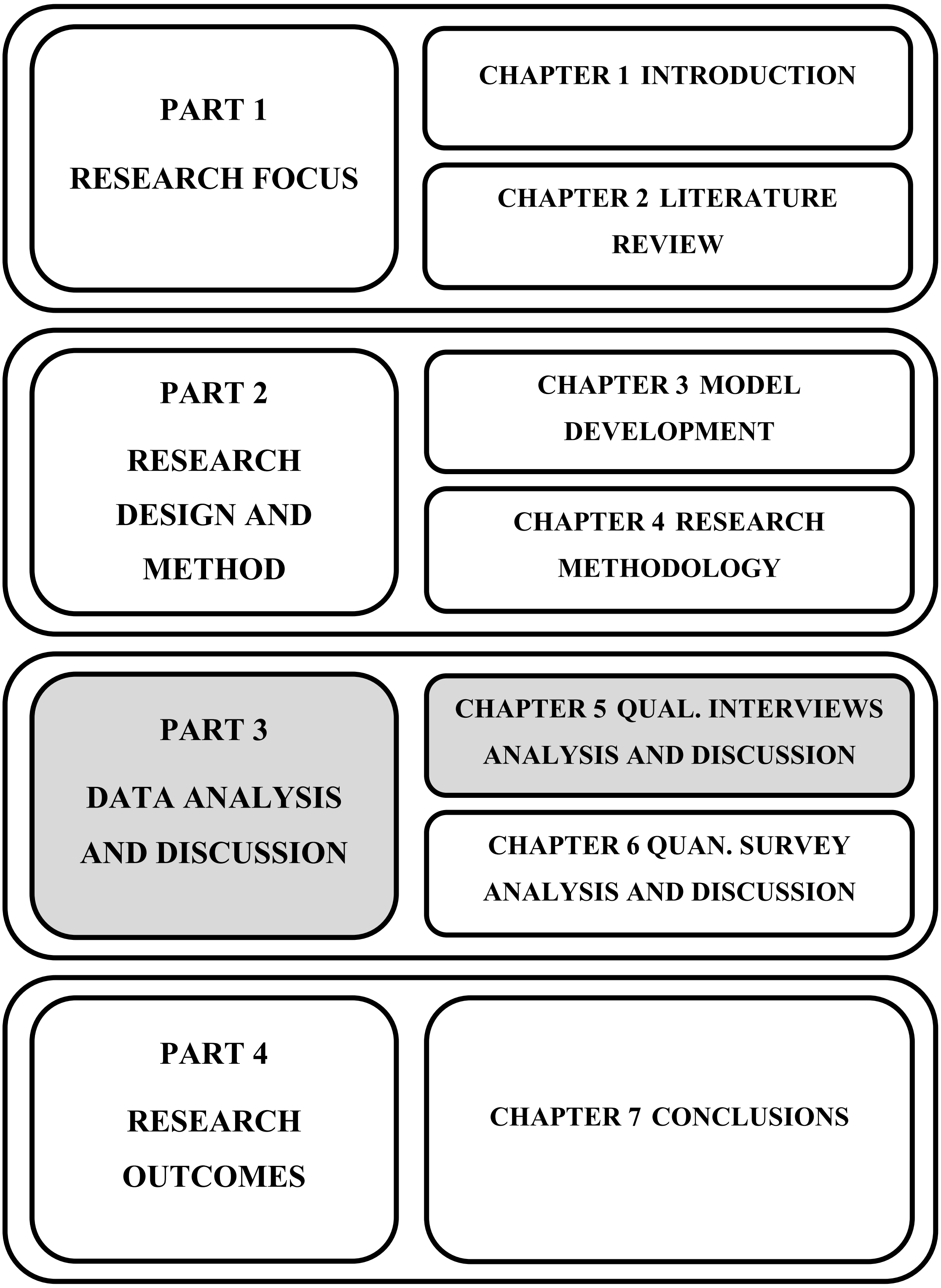
1. The participants were informed of the research purpose and their right to decline or withdraw from participation at any time without penalty or justification. Voluntary consent for participation and collection of information was obtained before conducting the research.

2. It was determined that the research might collect personally identifiable and commercially sensitive information. As a result, the information collected was treated as confidential and stored in the researcher's computer that was password protected. Only the researcher and supervisors had access to the information. No personally identifiable and commercially sensitive information was published.
3. The participants were treated with respect. Companies were selected according to their product innovation's degree of product innovativeness using the product innovativeness model (section 3.2) and participating personnel were selected based on their knowledge and role relevant to product innovation in the company.
4. The research was conducted in a professional manner. Potential for conflict of interest or harm to the researcher and supervisors, participants, participants' companies, and Massey University's reputation were considered and avoided.
5. The participants interested in the outcome of the research were informed and given the research outcome when it was available.

4.8 Chapter Summary

Having reviewed social research paradigms, choice of the pragmatism paradigm, which involves mixed method research, was justified by the researcher. Thereafter, how qualitative data were collected from five food and beverage companies was explained. These data did not lead the researcher to answer any of the four research questions directly, but they helped the researcher to validate the research hypotheses and prepare the quantitative survey design. Explanation of quantitative data collection included design of the survey instrument, sample selection, and the techniques used in quantitative data analysis to answer the four research questions (also see Table 4.5). Generalisation and ethical considerations were provided. The researcher provides qualitative data analysis and discussion in Chapter 5 and quantitative data analysis and discussion in Chapter 6.

PART 3: DATA ANALYSIS AND DISCUSSION



CHAPTER 5 QUALITATIVE INTERVIEWS ANALYSIS AND DISCUSSION

5.1 Chapter Overview

The purpose of the qualitative interviews was to analytically validate the proposed research hypotheses (i.e. provide a practical basis for the hypotheses) and prepare the researcher for the quantitative survey, in terms of drafting the right statements that have a practical basis and have some practical grounding for the hypotheses. Five innovative food and beverage companies located in the Manawatu-Wanganui region of New Zealand participated in the interview. The company overviews are presented first in section 5.2. The interview results, analysis, and discussion are then provided in section 5.3. They are arranged according to the research hypotheses previously proposed in section 3.6. At the very outset, it is acknowledged that qualitative data were not collected to test hypotheses; hypothesis testing is a statistical matter that falls under Neymen-Pearson's logic of rejecting (or failing to reject) a null hypothesis (Neyman & Pearson, 1928). Hypothesis test results are covered in the next chapter with quantitative data. Qualitative data, the focus of this chapter, were nonetheless useful in verifying that none of the case studies provided evidence that contradict the hypotheses.

5.2 Company Overviews

As mentioned in the previous chapter, the five companies were selected based on their seemingly innovative product innovations (they had at least one radical product innovation in their history), locality (within the Manawatu-Wanganui region), and willingness to participate. Table 5.1 shows a summary of the characteristics of the participating companies including the position of the participant interviewed and their radical product innovation(s). Afterwards, a detailed overview of each company (from Company A to E) is provided.

Table 5.1: A Summary on Participant Companies

Company	Year Founded	Number of Employees	Ownership Base	Position of Participant Interviewed	Radical Product Innovation(s)
A	2001-present	0-5	Fully New Zealand owned	Technical and Operations Manager	Novel NZ blackcurrant extraction process
B	1951-2000	0-5	Fully New Zealand owned	Director	Pioneer of NZ mono-floral honeys
C	2001-present	6-49	Fully New Zealand owned	Manager	First to introduce gelato to their marketplace
D	1951-2000	6-49	Fully New Zealand owned	Director	Unique range of confectionaries
E	2001-present	99+	Fully New Zealand owned	Technical Manager	Pioneer of low-fat cheese and novel cheese production process

5.2.1 Overview of Company A

Company A is a young, micro sized, and fully New Zealand owned processor of New Zealand blackcurrants. The company is a joint venture between two New Zealand companies. The first company is a producer of New Zealand blackcurrants, while the second company is a pharmaceutical company specialising in biochemical extraction and purification. Their products (blackcurrant extracts) are sold to pharmaceutical and nutraceutical manufacturers around the world. These manufacturers transform the products into final end products (such as health capsules and functional foods and beverages) to sell to the end consumers.

The participant, the Technical and Operations Manager of the company, has been performing his role since the beginning of the company and is responsible for product development and resolving technical issues. He has worked in the second company, in a similar position.

The company's products are blackcurrant extracts obtained from New Zealand blackcurrants using the company's innovative extraction process. According to a nutritional analysis carried out by the Plant & Food Research (A Crown Research Institute), New Zealand blackcurrants have a higher content of anthocyanins and other phytochemicals than blackcurrants grown elsewhere. This gives New Zealand blackcurrants (including its extract) higher antioxidant properties as well as several unique health benefits.

The company's competitive advantage comes from its unique New Zealand blackcurrants and the extraction process. The growing, harvesting, and extraction process of blackcurrants are difficult to accomplish without lowering the anthocyanins content in the fruit. The company therefore harvests blackcurrants from their specially developed blackcurrant cultivars grown in the company farm located in the South Island of New Zealand. In addition, the company developed its own innovative manufacturing system to press and extract the blackcurrants. This allows the company to extract a higher content of anthocyanins, which it treats as a trade secret. The resultant products (blackcurrant extracts) are clinically tested to prove their health benefits.

At the time of the interview, the company was focused on improving their extraction process (i.e. to increase the yield and lower cost) and finding new health benefits and applications of the blackcurrant extracts. The company considers itself a leader in the research and development of blackcurrant extracts. The company maintains a high quality and safety standard through its in-house quality assurance laboratory. The company manufactures its products in a state-of-the-art production facility in the Manawatu-Wanganui region.

5.2.2 Overview of Company B

Company B is a young-middle aged, micro sized, and fully New Zealand owned manufacturer of New Zealand honeys. The company has a contract with a local New Zealand honey producer who harvests, packs, and exports honeys for the company. The company sells the final products to retailers all over the world.

The participant is the Director of the company who has extensive experience as an apiarist. She started the company to sell New Zealand honeys when the honey industry was going through a transformation process: transforming from low-value bulk honey export to high-value packaged honey export. This director is responsible for the majority of business activities, including product development. However, she leaves most of the production and distribution activities to other companies, which she has business contracts with.

The company's innovative products are the mono-floral honeys that the company pioneered, such as Clover honey, Manuka honey, and Rewarewa honey. Mono-floral honey is produced by placing bee hives in areas with high concentration of the desired floral source. Each mono-floral honey (i.e. honey attributable to a particular plant species) typically has unique features and health benefits. Some honeys, such as the Manuka honey, can only be produced from the Manuka tree unique to New Zealand.

The company's competitive advantage comes from its unique branding and reputation in the industry. When the company first started, most of New Zealand's honey exports were in bulk or barrel form. To differentiate, the company packed the bulk honey into packaged mono-floral honeys and started selling them directly to retailers as consumer food products. The company is one of the first companies in New Zealand to identify the health benefits of mono-floral honeys. The company emphasises the importance of product traceability back to its origin, for food safety. The company played an active role in organising successful seminars run by a New Zealand scientist to present research findings on New Zealand Manuka honey to Japanese audiences; this boosts the export of New Zealand honey to the Japanese market.

At the time of the interview, the company was experimenting with a new product line based on another bee by-product. The experiments are conducted by the Director herself. The Director conducts product development on a case by case basis by identifying new opportunities in the marketplace, and then experimenting with different formulations and packaging. Over the years, she has introduced several successful honey products and established a notable reputation of high-quality New Zealand made honey for the company.

5.2.3 Overview of Company C

Company C is a young, small sized, and fully New Zealand owned wholesaler of gelatos (Italian-style ice cream), sweets, and drinks. The company operates a shop in the Manawatu-Wanganui region that sells its products directly to domestic retailers and consumers. The shop is a result of the company's attempts to expand their restaurant business. They moved to the current location after it became available.

The participant is the manager of the company who also happens to be the director of the company. He has extensive experience in operating restaurant and café businesses; he is responsible for managing the employees who operate the shop. The participant (manager) conducts product development during his free time and builds new business relationships with suppliers and customers.

The company's innovative products are its range of gelato flavours that they develop. The company was also the first to introduce gelato to their marketplace (within the Manawatu-Wanganui region). Gelato is different from the traditional ice cream sold in the marketplace. Gelato is made by combining milk, cream, and sugar plus other ingredients such as fruits, sweets, or beverages—all being churned at a slow speed. This gives gelato a denser (it contains less air), less fat, and richer flavour than traditional ice cream. However, because gelato contains less air, it needs to be kept in a lower temperature ice cream display.

The company's competitive advantage comes from its location and continuous product development. The company's shop is located in a high traffic area opposite to a well subscribed restaurant. The shop is decorated with fancy items and furniture to attract customers to sit in and enjoy the atmosphere. Furthermore, the company imports genuine Italian ingredients from Italian ice cream makers and produces fresh gelato at their shop in small batches to ensure freshness and variety of flavours. In addition, the company experiments with adding New Zealand ingredients to invent their own unique gelato flavours. The company uses social media and social events to promote their new flavours and products.

At the time of the interview, the company was experimenting with new gelato flavours and introducing new sweet and drink products (from both local and overseas suppliers) to be sold in the shop. The company attempts to pursue new and innovative products in order to differentiate themselves from the generic and brand competitors. However, the company is constrained by the availability and cost of ingredients (some ingredients are seasonal), and local consumer taste and buying habits (the locals tend to be conservative and cost conscious, being a low-income region in New Zealand). The company regularly conducts market research to improve their products and services. By offering appealing products, maintaining good services, and controlling cost, the company has achieved success within their target market.

5.2.4 Overview of Company D

Company D is a young-middle aged, small sized, and fully New Zealand owned manufacturer of confectionaries. The company offers a large variety of classical and modern confectionaries in categories such as eclairs, nougats, fudges, caramels, and liquorices. They manufacture their products in their own modern production facility in the Manawatu-Wanganui region. They sell their products to distributors and wholesalers all over New Zealand, who in turn sell the products to retailers, to be sold to the end consumer.

The company has gone through several changes of ownership. The company originally started as a backyard confectionery operation around the 1950s. In the 1970s, the company grew into a full-scale factory operation supplying products countrywide, before being sold to the second entrepreneur. Subsequently, the company was sold again to a third entrepreneur in the 1980s. The third entrepreneur grew the company even further before transferring the ownership to his son who now acts as the director of the company. It was this person who acted as the participant for Company D.

The director (participant) carries out product development by coming up with new product variations or flavours, conducting test runs, and evaluating them—all being done within the company production facility. The director also travels to visit customers (distributors and wholesalers) in order to get feedback and sell the new products.

The company's innovative products are its range of unique confectionaries. Most of these confectionaries are developed by the company itself over the years; the company's product formulations are protected as trade secrets. However, the company has developed some brands and formulations by acquiring other companies. By investing in expanding their production capability and buying newer machines, the company has grown to offer a very wide product range in large volume.

The company's competitive advantage comes from their existing production facility and distribution network. The production facility is monitored by their own Hazard Analysis and Critical Control Points (HACCP) food safety programme, to ensure the product quality and food safety. Furthermore, the company has established a long-term relationship with its core customers, who promote the company's products to end consumers.

At the time of the interview, the company was experimenting with new flavours and variations of their existing products. They also have started to expand their customer base beyond New Zealand (currently only to Australia). The constant introduction of new products, sales techniques, and sales outlets enables the company to achieve steady growth. The company attributes their success to the passion they have for the confectionery industry and strict quality control.

5.2.5 Overview of Company E

Company E is a young, large sized, and fully New Zealand owned manufacturer of dairy products. The company manufactures various categories of dairy products ranging from dairy milk, cheese, milk powder, infant formula, supplements, and ice cream. These dairy products are marketed with the company's own brands; their products are exported to many overseas countries. The company operates dairy production and research facilities in key markets around the world. Through these facilities, the company has pioneered many commercially successful dairy products.

The participant is one of the Technical Managers of the company. This manager has had long work experience in the dairy industry as a dairy production manager and a researcher. He is responsible for leading a small team of technologists and technicians conducting product development within one category of the company's dairy products.

Since the participant was responsible for only one category of the company's dairy products, the innovative products were limited to that category. The company's innovative products include a low-fat cheese product and an entirely new production process that significantly shortens production time. These products were developed over several years within the company's research facilities. The company is highly successful and have earned innovation awards regularly, both as a company as well as a team/individual (participant included).

The company's competitive advantage comes from its dairy production facilities, dairy research facilities, and brand recognition. The company has several dairy production and research facilities located in its targeted markets. Its primary dairy research facility began its functions before the company itself. As a result, researchers in the facility have the luxury of extensive knowledge and experience in dairy research and development. The researchers in the facility also collaborate with universities and Crown Research Institutes to develop new dairy technologies. This leads to the introduction of many new dairy products and process improvements. The company has also developed and acquired many well-known dairy brands to differentiate their products and build reputation in their marketplace, both locally and internationally.

At the time of the interview, the participant was actively involved in the development of new dairy products. However, he could not provide much detail due to confidentiality reasons. On the whole, the company is very strategic in their product innovation effort, given they have limited resources and high competition. The company also has a formal product development process that the Technical Managers and their teams follow. The company's product innovation strategy and formal product development process result in many new product successes for the company.

5.3 Interview Results, Analysis, and Discussion

This section provides the interview results, qualitative data analysis, and discussion, with regard to the practical perspectives (e.g. the relevance of the hypotheses to the food and beverage context) of research hypotheses (section 3.6). The first five sections (section 5.3.1 to 5.3.5) cover the five determinants of radical product innovation and their interrelationships. Section 5.3.6 discusses the company characteristics that could affect product innovativeness in the industry. Lastly, section 5.3.7 presents other potential moderators (called "other drivers" in the interview structure, section 4.4.2) not considered by the research hypotheses. Cross-comparisons are made to find similarities and differences between the participating companies and whether or not the interview results are consistent with the research hypotheses.

5.3.1 The role of top management in radical product innovation and top management innovation capability as a causal variable

Top management (e.g. directors, executives, or managers) were found to be playing a role in radical product innovation in all five participating companies. However, their degree of involvement depended on the company size and the stages of radical product innovation. For micro to small companies (Companies A, B, C, and D), top management seem to be taking a frontstage role in conducting radical product development in most stages. Whereas, in the large company (Company E), top management seem to be taking a backstage role, leaving radical product development in the hands of Technical Managers and their teams. In this large company, top management were actively involved in formulating the product innovation strategy as well as monitoring the effectiveness of strategy implementation, and employee performance metrics; they were also involved in formal product development process when required.

In Company A, top management were found to be directly participating in radical product innovation during the opportunity recognition, business analysis, and testing and validation stages. According to the participant (Technical and Operations Manager), the idea of selling New Zealand blackcurrant extracts came from a blackcurrant farmer, who was the director of a blackcurrant farm (Company A1). He first approached a pharmaceutical company (Company A2) and asked for investment and production expertise. This was the perfect timing for Company A2 since they were interested in expanding their business. Together, they formed a joint venture (Company A) to pursue the business opportunity. According to the participant:

> *We were interested in a new product using New Zealand raw material. One of the ideas was berries. Blackcurrants and how its anthocyanin extract might help our health. So, I started a pilot project to see if we could extract substantial anthocyanin out of blackcurrants. And sure, we came up with a method. At the same time, [Company A1], operated by another group of people were also interested in blackcurrant extracts. They too came up with a method of blackcurrant extraction. But they didn't have enough investment to make their idea successful. A Development Manager [Company A2] eventually made contact with these people. Because, you know, his job was to get new work (laughing). He found out that they wanted an investment and we moved ahead together like that.*

Top management of the company were found to be involved during the business analysis stage. When asked whether or not Company A conducts any market research to test their radical product ideas, the participant said:

> *Yes. Originally, we had [name concealed], one of our executives solely for market research. He did all the market research. He was the marketing guy for the team.*

In addition, top management were found to be responsible for allocating the resources needed to set up a new production line, and open sale offices in key markets during the testing and validation stage. Quoting the participant:

At the start, we actually opened offices in key parts around the world. We made sure that these offices focused on our products. That is what you have to do to establish the market demand.

When asked specifically if top management took part in the radical product development, in any shape or form, the respondent replied:

Certainly, when we were focusing on creating the market for blackcurrants, the team managing director [name concealed], played a huge role in that. The management team were interested. They wanted it to succeed. They created a plan and they organised resources and opened offices.

For Company B, the director was directly responsible for conducting radical product development across most stages of product innovation. She had a different vision from most of the New Zealand honey companies at the time. She explained her vision as follows.

Just to give you the background. When I first started, honey was being sold in bulk drums. 300 kg drums. It was always identified as being very good quality honey. It was used for blending with lower quality honey and as a consequence, lost its New Zealand identity. Honey to me was always precious. I was a beekeeper at that time. I always think that even just a little bit of honey coming from a flower was beautiful. So, I wanted to promote the idea of origin—the flower—and from New Zealand and take it to the customer. So, I went into mono-floral honey rather than just general honey. Making stories about each of the sources… At the time, there weren't really too many people doing that sort of thing.

The director mentioned that she did not have all the knowledge and assets to harvest, pack, and export the end products herself and therefore, she subcontracted a local honey producer to manufacture her products for export. She explained:

[Company B1] is the producer. They make Manuka honey. But when I first started, there was very little export of packed honey in New Zealand. It was always bulk. They were very supportive of me.

[Company B1] have their own brand. [Company B1's brand]. I always allow them to use [Company B's brand] in some markets, for example, the Middle East. They have been selling [Company B] brand because our labels and things were

developed for the export markets. They have access to them. They also sold in Hong Kong and some other markets. And I concentrated on the Japanese market.

According to the director, exporting to the Japanese market was difficult in the beginning, due to limited market knowledge and access to retailers. As a result, she visited Japan herself and was able to establish the first customer (retailer) for the company. She said:

I was lucky with my first trip to Japan. I found a company that was selling exotic gifts for tourists and it was a suitable gift shop to sample what I produced. That really was the start that I needed to build the customer base.

For Company C, the manager (who also was the director) was found to be directly involved in most stages of product innovation. According to the manager, Company C started as a way to expand the company's restaurant business. It also was a result of the company's previous attempts at opening a chocolate café. He went on to say:

We opened a chocolate café. It was all about chocolate in hot drinks, similar to Starbucks, but we did not take on Starbucks. Starbucks' speciality is the coffee, but we are specialising in chocolate. Different flavours of chocolate: vanilla chocolate, caramel chocolate, mint chocolate, and so on. After we moved to the right place, we wanted to expand the business and improve the chocolate café, and we considered trialling with ice cream.

According to the manager, they were the first to introduce gelato to the marketplace. At the beginning, they also imported authentic gelato ingredients from Italian suppliers. He explained:

We imported our ingredients direct from Italy at the beginning. One such supplier is [Supplier]. They are the oldest chocolate company in Italy. Their speciality is chocolate.

The manager also told that he self-learned how to make gelato. According to him, this helped his company to develop unique gelato flavours from New Zealand ingredients. He stressed:

Actually, each company has their own recipes and their secret recipes. I myself learned how to make gelato in Thailand from an American guy. They had a class to teach how to make gelato. This helped me in my dealings with the gelato chef, because I've had a little bit of background on how to make gelato.

The manager still remained in contract with the original suppliers, and at the same time, searched for new suppliers. He said:

> *They still supply us ingredients. Many companies in Italy supply ingredients to gelato shops around the world. But some companies are good at chocolate. Some companies are good at fruit flavour. Some companies are good at vanilla flavour. So, you have to choose which company you want to work with. That is why you need to go to the gelato fair to try their products. You need to think which one is going to sell in New Zealand. Because everybody has their own recipes, you have to choose which supplier is the best.*

Lastly, the manager explained the taste and buying habits of New Zealand consumers. He gained these insights from his restaurant experience. He explained how these insights influenced his product design decisions and sale techniques—and why coming up with a new product is difficult.

> *This is from experience. We have been studying customer behaviour for many years. Keeping things simple is a safe option in the food industry. People expect something simple here in New Zealand. Fish and chips and salads are always popular. If you produce something really fancy, people will be hesitant to try that out. Because they have to pay for something that looks very different, often it is hard to get the customer buy-in for radically different offerings. They are not there to try. They are for real. That is why radical innovations are hard to come by.*

For Company D, the director of the company was responsible for product development across most stages of product innovation. However, he did not consider the confectionaries developed by his company very radical or innovative. He explained:

> *New products for us are not necessarily new products to the market. Sometimes, we are developing products that may already be on the market.*

According to the director, the company did not pursue radical product innovation because most of their available equipment and machines are very specialised. He explained the process his company adopts in identifying and selecting new products as follows.

> *For us specifically, producing or manufacturing confectionery is very machine-orientated. We need to have the right machinery to produce certain products. I cannot think about a radically new product idea and decide how to make them. We would first decide which new product might be a good fit for our machinery*

and equipment. We would then decide what the sales potential is. Then, we would generally have a chat with some of my customers just to see if they have a need or demand for that product. Getting customer buy-in is usually challenging.

The director said that the company primarily pursued incremental product innovation, where the new product is either a new variation or flavour of an existing product. Only in rare cases would the company acquire new equipment or machines to pursue radical products. The director stressed:

Unless somebody comes to me with a very large business proposition, I won't look to produce the product. I won't pursue radically new ideas unless I have got the right machinery. If there is a very attractive or a very large business proposition, then I might consider investing in the equipment. Otherwise, I just use existing equipment with slight modifications.

He then gave an example of successful incremental product innovation:

We do a lot of variations of our existing products. Something that has gone pretty well for us lately is Nougat. I don't know if you are familiar with Nougat. It is an aerated confection. The different variations have different centres or different inclusions. And that is going pretty well for us. We have developed quite a big range of different flavours.

Since the company primarily developed new products for their existing customers (i.e. established wholesalers and distributors), it was easy for the company to introduce new products. He explained:

We have been manufacturing confectionaries for a very long time. So, our customers are generally very long-standing customers. They have been around for a long time. It is not very often that we start up a new distributor. I don't really go and look for new customers. I am generally producing more products for my existing customers.

The director emphasised the importance of getting product quality and the processes right. He elaborated on his view:

I find that I am much more critical than others. Product quality is very important, and everybody knows it but nothing much happens. Whereas, I would tend to say *"no, it is still not good enough". I do listen to what other people have to say, but if I feel they are not being critical enough, I will just do what I think is right.*

For Company E, top management had a hands-off approach to radical product innovation. In Company E, the technical managers and their teams were responsible for conducting radical product development across most stages of product innovation. Nevertheless, top management established the product innovation strategy, oversaw formal product development processes, and formulated employee performance metrics as part of performance monitoring. According to the participant (Technical Manager), the company product development activities followed a strategic approach. The participant explained:

It is about strategy. We can't do everything. We are a big company, but the world is big as well. We will only compete in products that fit our competencies where opportunities can be exploited. Probiotic, for example, is an area we want to use our brands to our advantage… Strategy is very important.

In Company E, top management were very committed to provide financial resources for product innovation as well as process innovation. Their product innovation strategy was in alignment with the company's overall business strategy. The participant said:

We are committed. We have put a lot of capital into new plants. We have just spent 32 million dollars upgrading the process cheese plant in [New Zealand] to make more cheese slices, doubling the capacity. It is the same with mozzarella around new technologies. We invested 64 million and doubled that a year ago. We are looking at plans to increase the volume to create more cheese. We double the capacity at [Plant]. Those are the sort of things we are doing. Also creams as well. UHT cream is pretty big and growing rapidly in China.

The participant gave an overview about the company's formal product development process and how top management were very involved during gate reviews. He explained:

We have a very structured gating system, stage gate system. And we stick rigidly to that. To do any work, we have to ensure our projects will go through that gate and get approval by senior managers before we start on anything.

Lastly, he pointed out the role top management play in setting the employee performance metrics. These employee performance metrics influence the product development activities in the company. He went on to say:

We have a very strict criterion. You know [name concealed]? He was working for [another research institute] for a while. He was in charge of Ingredients [a major business area of the company] for a while. Under his stewardship, he had some very strict KPIs. We were trying to have a dollar value on how many dollars we would make on new products developed and commercialised over three years.

Overall, the analysis of interview results presented and discussed above reveal the important roles top management play in radical product innovation; this is consistent with the literature (Cooper, 2011; Earle et al., 2001; Leifer et al., 2000). Top management were found to be highly involved with radical projects. They provided radical project direction, encouraged and motivated radical project teams, allocated resources, and built relationships with external partners. Following this, the research hypotheses that involve top management innovation capability as a causal variable are listed and discussed below.

H1: Top management innovation capability has a positive effect on internal innovation capability.

In the majority of the companies, top management seemed to have a positive effect on the internal innovation capability, through resource allocation and project selection. For example, in Company A, top management were willing to set up a new production line and open sale offices in key markets; in Company B, top management were determined to pursue a new product category against the industry trend and visited potential retailers in overseas markets; in Company C, top management were willing to open a new shop and visit gelato fairs; and in Company E, top management formulated product innovation strategy, product development criteria, and employee performance metrics; and were committed financially to investing in new plants. By comparison, top management of Company D were not as committed financially to pursue radical product innovation. As a result, the majority of their product innovations were incremental. This provides practical credibility to **H1**.

H2: Top management innovation capability has a positive effect on innovative organisational culture capability.

Given only three of the participants (Companies B, C, and D) were top managers, it was difficult to verify whether or not top management innovation capability had any impact on the organisational culture in these companies. In regard to Company A, some evidence was found on top management innovation capability. Their Technical and Operations

Manager told of how hard their top management pursue radical products. In regard to Company E, the Technical Manager stated that the company is *"committed"* to investing in new technology and plants as well, and that they follow top management's strict criteria and metrics on new product performance, although the top management kept an arm's length approach as far as their involvement is concerned. Thus, there is no qualitative evidence to refute **H2**.

> **H3**: Top management innovation capability has a positive effect on innovative product development capability.

In Companies A, B, C, and D, top management were found to be highly involved with radical product development activities. In these cases, top management acted as both the leader and innovator by conducting product development themselves. In other words, they carried within them the company's innovative product development capability, and their commitment to innovation drove their product development effort. Although, this situation appeared to happen mainly in smaller companies where product development personnel are limited. In the case of Company E, top management were not highly involved, but they established the formal product development processes which the product development team followed.

> **H4**: Top management innovation capability has a positive effect on external networking capability.

Only the top management in Companies A, B, C, and D were building relationships with external partners, while in Company E, relationships were established by the Technical Managers and their teams. This piece of evidence does not imply that top management innovation capability has no positive effect on external networking capability. What this evidence seems to imply is that external networking capability could sometimes be developed without top management innovation capability, thanks to the capability of the middle management.

5.3.2 Internal innovation capability as a causal variable

All of the participating companies had in-house technological and market competency for radical product innovation. These internal competencies resided within the company's top management, employees, and assets (e.g. machinery, information system, brand, and facility). The internal innovation capability enabled these companies to conduct radical product innovation and gain competitive advantage.

For Company A, internal innovation capability came from their expertise in blackcurrant cultivation and extraction. At the start of the interview, the participant pointed out the advantage of having New Zealand farmers with experience in blackcurrant cultivation:

> *Right at the start, the big differentiation was the fact that our fruit was growing in New Zealand. The fact that New Zealand berries and New Zealand farming are of very high standard means that our products have a very high quality. If you go to the wrong area, you will find a high level of pesticides, for example. We know that our farmers control that sort of stuff very well. Also, we have a good variety of blackcurrants with a high anthocyanin level.*
>
> *We harvest berries from a number of farmers. One of the guys who started [Company A] was a blackcurrant farmer and he still is a blackcurrant farmer. Having a blackcurrant farmer is obviously an advantage.*

The company had its own in-house research laboratory, which according to the participant, was responsible for developing new products and improving their existing processes (i.e. increase yield and lower cost). The participant pointed out how investing in their own research laboratory and clinical testing helped the company establish a competitive advantage:

> *If I said that my blackcurrant extract is good for eyesight, someone out there who also makes a blackcurrant extract cannot say the same, because they have no proof. Plenty of proof for my product. Others do not know what my procedure is, and their procedures are different. If no one knows what our processes are, they can't make that same product and therefore make the same type of claim.*

For Company B, internal innovation capability came from their knowledge about New Zealand honey and Japanese consumers. The director explained how her understanding of Japanese consumers evolved over time.

> *It is interesting. When they had a honey shop, it would always be the old people in their 70s and 80s patronising. I used to think that Japan would move towards quick breakfasts. Their old-style breakfast was a full meal with miso soup, pickles, egg, rices, and salad. And I thought, "oh yeah, they're probably wanting just a bit of toast." And I was completely wrong. Actually, they do have some now. Many people do have a quick toast. BUT, not with sweets. Because their PALATE is accustomed to a savoury taste. Very often toast with ham or something like that.*

For Company C, internal innovation capability came from their restaurant and café management experience. The manager mentioned that one of the company's previous shops was not very successful due to poor location. The learning from that shop contributed to the success of the new gelato shop. The manager explained:

> *In the past, we had one ice cream shop in [location], but it was not there very long. The location is quite important for success. The shop was doing very well during the summer time, but during the winter time, it was hard to get customers because the shop was cold. But the new shop is different because it is in the building, which is quite warm; people do not feel the cold. Attracting customers all year round did not become a problem anymore. And we are not just selling the ice cream; we sell hot chocolate as well to counter seasonal effects and even out sales. More food and hot drinks in the winter and more ice cream in the summer.*

The manager also pointed out how the company's knowledge in gelato making allowed them to develop unique gelato flavours using New Zealand ingredients, some very successfully and some not so successfully:

> *We used to have red wine and beer ice cream, but it was hard to sell that stuff. One reason is that we could not sell these ice creams to minors. So, our experiments with red wine and beer ice cream did not last long. V gelato and sorbet that contain the energy V drink we make now, on the other hand, is very popular because people already know what V tastes like.*

For Company D, internal innovation capability came from their knowledge in confectionery making and the available production facility. The director explained how he himself gained knowledge by working in the company:

> *This is the only place I have ever worked. My first job here, pretty much after leaving school was out on the production floor doing manufacturing, engineering, and packing. Then I went out on the road to do some selling, which enabled me to relate the customer to product development and production much better. I have pretty much done all aspects of operations in this company.*

He also clarified why he focused on exploiting available production facility instead of exploring for something radical. He said:

> *If you shoot for anything too radical, you have got to have the right machinery to produce it. What we do is that we play with different variations of the same*

> *Nougat, where we use the same based formulation and just put in different inclusions.*

For Company E, internal innovation capability came from their dairy research and production facilities. For example, one of the company's radical product innovations, a low-fat cheese product, was originally developed by the company's research facility in Australia. The company's primary research facility in New Zealand then conducted the technical development. The final product was produced and commercialised in Australia by the Australian office. The Technical Manager explained how they came up with the idea:

> *Our Australia office sensed opportunities with reduced fat and lighter products for the Australian market. And they said "the area in cheese is fairly limited. There are some products… but people are not buying them." "Why don't they buy them?" "Because they taste terrible." They asked, "if we make reduced fat cheese, to whom would that appeal?" They did some demographic work and some consumer survey work… The key is trying and making something that appeals better and appeals more.*

The company then utilised their New Zealand dairy research facility to develop the product, saving both time and money. The Technical Manager explained how they developed the product from idea to commercialisation:

> *Because the trend in reduced fat has been around for a while, we actually have done some work in the new technology development to try and see what we can do, in terms of our starter culture and our cheese technology. We actually developed prototypes some years before but stopped that work a while later. So, it was a case of picking up the pieces, fine-tuning it in the pilot plant, and commercialising it. All being done while getting feedback from Australia.*

When asked how they made sure the taste was right, the Technical Manager answered:

> *Largely, it was about our experience and knowing what the competition was like. We tasted and evaluated competing products. We knew that our product was better than what was on the market. Then, it was a case of doing some sensory work in Australia with our commercial trial product and fine-tuning it accordingly. We just basically launched from there. We also put in a lot of marketing and advertising behind the launch.*

Although, the company was not the first to introduce low-fat cheese to Australia, their existing dairy research and production facilities gave them significant product differentiation and advantage. The Technical Manager said:

> *We could do some unique flavours. When you make cheese, you have to use starter bacteria. These are special bacteria. Think of them as good bugs. We produce all our starter bacteria here on site in [New Zealand]. Our big cheese plants will make about three hundred thousand tonnes of cheese in New Zealand. Also, we have got two plants in Australia… We have other starters that we can add to give new flavours. Our knowledge and management of these starters means that we can develop and produce new flavours quickly.*

Overall, the analysis of interview results is in line with the hypothesis that internal innovation capability is an enabler of radical product innovation. All the participating companies had strong in-house technological competency (Companies A, C, D, and E) and market competency (Companies B, C, and E). These internal innovation capabilities were utilised for radical product innovation by leveraging and/or exploiting them; this is consistent with the literature (Danneels, 2002; Prahalad & Hamel, 1990; Tellis & Golder, 1996). In many cases, the radical product innovation ideas appeared to borrow from the previous radical product innovations: biochemical extract to blackcurrant extract (Company A), bulk honey to packaged honey (Company B), traditional ice cream to gelato (Company C), and cheese to low-fat cheese (Company E); this is consistent with the finding by Golder et al. (2009). These radical product innovations also had high synergies with the existing resources and skills of the innovating companies, supporting the conclusion by Kleinschmidt and Cooper (1991). Following this, the research hypotheses related to internal innovation capability as a causal variable are listed and discussed below.

> **H5**: Internal innovation capability has a positive effect on innovative organisational culture capability.

In all cases, strong internal innovation capability allowed the companies to cope with high uncertainties associated with radical product innovation. Strong internal innovation capabilities were called upon in the form of knowledge (or expertise) and physical facilities to help solve problems. For example, in Company A, their blackcurrant cultivation and extraction expertise were utilised to achieve high anthocyanins yield; in Company B, their industry insight and consumer knowledge were leveraged to develop and commercialise mono-floral honeys; in Company C, their restaurant and café management knowledge was used to successfully open the gelato shop; in Company D, their confectionary making knowledge and available production facility were exploited to develop new products; and in Company E, their dairy research and production facilities were called upon to develop and commercialise new products quickly and successfully. The above findings provide legitimacy to **H5**.

> **H6**: Internal innovation capability has a positive effect on innovative product development capability.

On the whole, based on the information provided by the participants, the internal innovation capabilities of their companies enabled the companies to conduct radical product development more effectively. This included developing compelling business cases and proficiency in executing product development activities. However, it seems that internal innovation capabilities do not necessarily encourage the companies to utilise all the best practices of radical product development.

> **H7**: Internal innovation capability has a positive effect on external networking capability.

In all cases, the internal innovation capability assisted the companies in establishing alliances with external partners. In Company A, their expertise in blackcurrant harvesting and extraction allowed them to work effectively with "Plant & Food Research" for clinical testing and health research. In Company B, their reputation gave them the credentials to form a long-term alliance with the local New Zealand honey producer. In Company C, their gelato making knowledge allowed them to select and work with best gelatos suppliers. In Company D, their superior production facility meant that their customers often come to them for new orders. Lastly, in Company E, their reputation allowed them to attract external partners who were willing to share expertise and resources in developing new technologies.

5.3.3 Role of external partners and external networking capability as a causal variable

External partners seemed to be powerful allies in radical product innovation for all participating companies. The external partners provided resources that the innovating companies lacked or were incapable of acquiring themselves. According to McDermott (1999), there are three reasons for companies to pursue long-term relationships (alliances): market-driven reasons, manufacturing-driven reasons, and R&D-driven reasons. All of the participating companies match with one or more of these reasons.

For Company A, the reasons for alliances are R&D-driven and market-driven. According to the participant, they work together with Universities and Crown Research Institutes (e.g. Plant & Food Research) to conduct clinical tests and health research. He explained the company's reasons for forming R&D-driven alliances:

> *It is incredibly expensive to develop in-house R&D and a lot of money is being funded by the New Zealand government for the benefit of the whole blackcurrant industry. I think the government also funds other berries under the same funding scheme, such as boysenberries and blueberries. There is no single berry that is more important that the other.*

The company also leverages their relationships with distributors to promote new products. At the beginning, the company opened their own sale offices to educate the market about New Zealand blackcurrants. Afterwards, they relied on their distributors to drive sales. The participant went on to say:

> *We now rely on the distributors. For most areas, we use the distributors of [Company A2] because they are people that we know. People who have confidence and trust in our ideas.*

For Company B, their reasons for alliances are manufacturing-driven and market-driven. The director considered building relationships vital for her business success. She established a manufacturing-driven alliance with a local New Zealand honey producer (Company B1). This long-term relationship allows the company to harvest, pack, and export their products. Company B1 continues to work with the company even though they have their own competing products. The director said:

> *Back in the day, if you want to have security in that supply, all you have to do is keep producing. Now, the demand for Manuka honey totally EXCEEDS supply. So, anybody that has the supply can sell it to customers without difficulty. So [Company B1] who works with me sell all their honey several times over. Of course, they still support me for the goodwill. But they don't need me now. They have their own customers to pull their demand.*

Furthermore, she attributed the company's early success in the Japanese market to find the right retailer who was willing to buy their products. The director pointed out that the biggest growth potential came after a New Zealand scientist discovered the antiseptic properties of Manuka honey. Subsequently, she established a contact with the scientist, took him to Japan, and organised a seminar on New Zealand Manuka honey to teach the Japanese people about its health benefits. She explained:

> *The biggest growth potential came after the research by [Scientist] on Manuka honey. That was the defining moment. In this country, we are lucky to have scientists who do such wonderful research. [Scientist] was doing research and nutritional research on Manuka honey and found high antibacterial levels… I took him to Japan with me. We had a two-day seminar in Japan. I organised that. The seminar was effective.*

Moreover, she mentioned that she had some help from Crown Research Institutes, a private laboratory, and the New Zealand Trade & Enterprise for product testing and research grants. But these relationships were short term in nature.

For Company C, their reason for alliances is manufacturing-driven. According to the manager, he was fortunate to have an Italian brother-in-law who helped him overcome the language and cultural barriers. He told a story how this led to the first contract with an Italian supplier for the company:

> *We went to the gelato fair held in Rimini. Rimini is a seaside city. Usually, Italian people are not very good at English and they are not interested to sell to overseas companies because their local market is really big. Fortunately, I had got my brother-in-law. He is an Italian. So, he became the interpreter. He translated as I spoke to the supplier. They were really happy to do business because during that time, the financial crisis was starting to hit Europe. So, they wanted to expand their business to other countries. That helped us to bring some Italian ingredients to New Zealand.*

Furthermore, this relationship was a mutually beneficial one. He explained:

> *Actually, we depend on each other. We have to give them feedback about how Kiwis like the ice cream, so they could improve the quality by changing ingredients and their proportions to suit the Kiwi taste.*

For Company D, their reason for alliances is market-driven. The company has established a long-term relationship with several of their customers (i.e. distributors and wholesalers).

These customers often bring new businesses and product ideas to the company. The director described how the company discover new product ideas:

> *New ideas? To be honest, most of the new ideas come from the market. My customers often bring new ideas… They would quite often ask whether we can make such and such a product. We would do a quick assessment and if we see a market, we decide whether or not we have the ability or the equipment to make the product. And if we do, we would give it a go.*

When asked how the company normally launched a new product into a market, he answered:

> *Most of the time, the launch of a new product is taken care of by my customers… I will produce a product and then give it to the customers to let them launch it rather than us. We don't have any marketing or sales expertise really within our business. I guess my personal strength is probably more on the manufacturing side.*

The company outsourced product packaging design to a design consultant in Auckland. The director also consulted with his family and friends for product feedback. Sometimes, he paid for technical assistance from food scientists and food technology consultants.

For Company E, their reason for alliances is R&D-driven. It is likely that the company has market-driven and manufacturing-driven alliances as well. However, the participant did not give any specific examples because he was solely involved with R&D. The participant gave an example of the Primary Growth Partnership (PGP), which was a joint venture between the New Zealand government and primary industry to invest in long-term innovation. This partnership allows the company to explore new technologies or areas that could lead to new products and processes. The participant gave reasons for the PGP:

> *That is a Primary Growth Partnership. We develop contacts in that space for radical technology or areas we don't know quite as much. It is quite good to get PGP postgrads doing some of that work.*

Overall, external partners seem to play an important role in radical product innovation for all companies. All the participants are able to easily communicate with external partners, which indicates the presence of large *informal networks* (McDermott, 1999). Some companies prefer to outsource when developing new products and collaborate with existing customers, which is consistent with the literature (Coviello & Joseph, 2012; Olleros, 1986). For Company A and E, *cluster effect* (Porter, 1998) comes into play because these companies rely on many external partners. Often, the companies seem to form long-term relationships (alliances) with key external partners such as suppliers, Crown Research Institutes, and distributors. Following this, the research hypotheses related to external networking capability as a causal variable are listed and discussed below.

> **H8**: External networking capability has a positive effect on innovative organisational culture capability.

All participating companies relied on external partners to overcome radical product innovation challenges. Their reasons for long-term relationships are either market-driven (Companies A, B, and D) or manufacturing-driven (Companies B and C) or R&D-driven (Companies A and E) or a combination of these. They also have short-term relationships for assistance when needed. Thus, field data provide credibility to **H8**.

> **H9**: External networking capability has a positive effect on innovative product development capability.

The external partners seem to assist the companies in predevelopment (Company D), technological activities (Companies A, B, C, and E), and marketing activities (Companies A, B, and D) of radical product development. Somewhat surprisingly, they did not help the companies with other best practices.

5.3.4 The importance of innovative organisational culture and innovative organisational culture capability as a causal variable

All of the participating companies seem to experience challenges with radical product innovation. According to O'Connor and Rice (2013), these radical product innovation challenges are caused by four categories of uncertainty: technical, market, organisational, and resource. The major uncertainties experienced by each company and how they cope with them are discussed below.

For Company A, the major uncertainties are technical, market, and resource. According to the Technical and Operations Manager, many products failed due to technical and market uncertainty. He explained:

Because we are a pharmaceutical company, many of our failed products are due to technical issues. For example, we created a product which an overseas pharmaceutical company wanted for their pharmaceutical development. We sold the product to them for five years. Unfortunately, they reached a stage where their pharmaceutical development was not going anywhere. They had to stop buying the product… We could not find a market for the product elsewhere. At the end of the day, if there is no market for a product, no matter how good your engineering is, you aren't going to succeed. I can give you plenty of examples. Part of the reason why pharmaceuticals are so expensive is because everything we test, are expensive and many of our tests end up being failures.

He explained how the company coped with the technical and market uncertainty by having the right equipment and perseverance:

For process development, there are normal difficulties you can get around, as long as you have the right equipment. For market development, the biggest challenge is creating demand. Our first market was Japan. The biggest challenge there I think was the fact that no one in Japan really knew what a blackcurrant was… So, you really have to work hard in educating the consumer.

According to him, the company was approached by another bigger company for a partnership. This greatly reduced resource uncertainty for the company. The participant said:

We were helped in Japan in the early days. We worked with a company that was very big and very interested in the project. They had a lot of resources. However, they weren't as successful as we would have liked. Even though, they spent a lot of money educating the consumer, they were probably not the main player in Japan.

In addition, he referred to their R&D alliance with Plant & Food Research and how they helped the company reduce technical, market, and resource uncertainty. He elaborated:

We partner with Plant & Food to cope with uncertainty. For example, there is some good work being done on the benefits of blackcurrants on sport performance. This is something that blackcurrants have never been used for before. Being able to make that information available to our customer gives our customer an opportunity to market their products using the new information.

There is plenty of information now to show that blackcurrant extracts help you to concentrate and think.

There was some organisational uncertainty faced by the company. For example, they needed to set up a new production line and open overseas sale offices. However, the participant could not provide much input since he was not involved in these activities.

For Company B, the major uncertainties are market and resource. The director gave an overview of the biggest challenges she faced during product development:

There is always the cost. Until you've got a product, you are not sure if it's going to be successful or not. There is a risk. A risk in you putting time and money into a product that is to be developed. Will it work? Now it is becoming increasingly difficult to develop and sell a new product. The range of choices is so immense.

She gave an example of a market barrier she faced when commercialising a new product line in Japan. She mentioned that more effort is needed in commercialisation to overcome barriers. She explained:

One of the things I am most interested in is propolis. Propolis is a product from beehives. It is collected by the bees from resin. Resin from a tree… Although Japanese people were very accustomed to propolis, they were buying it from Brazil, paying a very high price. Honey companies in Japan operate in a very controlled market; the companies were contracting for the propolis from Brazil. Brazilian suppliers had the Japanese market REALLY secure, even though I could prove that our propolis was superior. And I had research to back my claims. It was impossible to break through the barrier. In the minds of the Japanese, if it is propolis, it is from Brazil.

For Company C, the major uncertainties are technical, market, and resource. The manager gave an overview of the difficulties associated with selling sweet products to New Zealand consumers:

Sometimes, it is hard because sweetness is always the second priority. The food is always the number one priority.

He recalled the first time the company introduced gelato. As mentioned earlier, the company hired an Italian chef to educate the local consumer about gelato as well as to train the company staff about gelato making. He said:

At the beginning, we hired an Italian chef from Italy. We wanted him to create an impression on people who come to eat ice cream, that they had a chance to talk with an Italian who knows a thing or two about gelato… It was the best way to educate the customer. We also wanted our staff to understand more about gelatos and how to make them.

In addition, he went on to explain the technical uncertainty with developing new gelato flavours:

The biggest challenge with making gelato is to make it stable. Sometimes, when it comes out it might be a flop—it is not stable. You need to find the right ingredient proportions and process parameters.

Lastly, the company copes with market and resource uncertainty by constantly monitoring their competitors and suppliers to keep their menu fresh and cost competitive. He explained the process as follows.

Usually, we try to think about the raw material first by using something simple and seasonal. If you import an ingredient such as a type of cheese, it is going to be hard to get your supply when you want them, and the cost of the menu is going to be very high. So, when you set up the price it is going to be really hard for the customer… We try to check and monitor the menus of our competitors all the time to keep our menu right, quality and price wise. We also often try our competitors' food to improve the quality of our food. The freshness of the raw material is quite important.

For Company D, the major uncertainties are technical and resource. The director explained the technical uncertainty faced by the company:

With confectionery, it is probably getting a stable product or the right formulation. For us, a lot of the time, we use trial and error to get the formulations right. Once the formulation is right, it is about ensuring that the formulation can be processed easily through the machinery that we have. If we see potential in the product, we might make some adaptations to the machinery. The physical production is another big challenge that we face.

He also explained how the company was constrained by available resources (time, effort, and machines):

We are constrained by machines, time, and how busy we are. Generally, we are pretty busy doing what we are doing. It is a much more efficient to produce variations of what we already produce rather than trying to recreate something entirely new. Having said that, producing a variation of what we already produce is not entirely easy either. I have got a product that I am working on at the moment, which is a slight variation of what we already produce. So far, we have had 47 trials and we think the formulation is still not quite right.

For Company E, the main uncertainties are technical, market, organisational, and resource. The company reduces resource uncertainty through their product innovation strategy and formal product development processes. The Technical Manager explained how the company reduces resource uncertainty:

Our new product development process is integrated across the company. We have to prioritise what we do before we start any project because we often have more projects in the pipeline than we have people to do the R&D. We use multiple criteria to prioritise projects. One important criterion is "How big is the project?" Another is "How big is the volume of potential products that we make?" Each project also has to be in a strategic area that we want to develop… We don't sit around and sort of say "this is a new technology, let's go and do this." If we are doing anything radical, it must be linked to our strategy.

In addition, the company faces several technical and market uncertainties. These include meeting technical performance, creating market demands, and complying with regulations. Many of the company's new products failed because of low market demand. Consequently, they attempted to involve people who had to sell, buy, and consume the new product during product development. They also used their formal product development processes to identify and kill failing projects early, through review at each gate. The participant explained the importance of gates:

What usually happens is that we kill projects early. After going through a gate, if we find that we might have a very sound technical product, but we aren't going to sell very much because there is no value proposition for the consumer, we'd say, "Nah. We will stop it now."

He clarified the difficulties with regulations as follows.

Regulations pose problems everywhere. In individual markets, we have individual regulations. We have got to be compliant across all these regulations. If we are going for something new, maybe like putting in an ingredient that is new, we have got to make sure that it is approved and sometimes that is quite difficult. That is one of the challenges. The other is in the intellectual property space. You have to make sure that you are not going across somebody else's patent. That is sometimes quite tricky.

Lastly, he explained the organisational uncertainty he had experienced in R&D. These included getting buy-in from other departments, collaborating and communicating within the company, and setting up appropriate employee performance metrics. He clarified:

The key is that you have got to get the right people in the market and sales to commit to something new. How do you do that? Well, they have to put it in their budget and say (clapped his hands) "we are going to sell 100 tonnes of this new product next year." We hold them accountable to their actions, but we delegate them the necessary authority and support them to achieve the goals. If you just wait for things to happen, you are not going to get anywhere. Even within a big company like ours.

You have got to make sure that you have got a matrix structure where you can get the projects moving fast. During NPD, it is all about teams. Everybody has a different discipline. It is not just about the researchers.

Yeah. We do [have employee performance metrics]. I have been in this game for a long time and I have seen various KPIs around R&D. That is very difficult... Our KPIs are around how many projects we have, and delivery timelines and they are very strict. Yes, KPIs are very important.

Overall, the analysis of the interview results indicates the importance of innovative organisational culture capability in coping with high uncertainties created by radical product innovation. All the companies experienced to a greater or lesser extent: technical uncertainty (Companies A, C, D, E), market uncertainty (Companies A, B, C, E), organisational uncertainty (Company E), and resource uncertainty (Companies A, B, C, D, E). Their ways of coping with these uncertainties included persevering, forming partnerships, improving/expanding existing products, monitoring competitors, trial and error, having product innovation strategy, following formal product development processes, establishing collaborative organisational structure, and setting appropriate employee performance metrics, which are consistent with the literature (Cooper, 2011; Gatignon & Xuereb, 1997; Hult et al., 2004; Leifer et al., 2000; Tellis & Golder, 1996). Interestingly, all radical product innovations were either competency enhancing (Companies D, E) or stretching (Companies A, B, and C), and not destroying. As a result, no *willingness to abandon investments* was required in these cases. Following this, the research hypotheses related to innovative organisational culture capability as a causal variable are listed and discussed below.

> **H10**: Innovative organisational culture capability has a positive effect on radical product innovation.

In all the companies, their ability to cope with the high level of uncertainties resulted in successful radical product innovation, evidencing the legitimacy of **H10**.

> **H11**: Innovative organisational culture capability has a positive effect on innovative product development capability.

The innovative organisational culture capability helped the companies to tolerate high levels of uncertainty when preparing a compelling business case and conducing predevelopment, technological, and marketing activities. Nevertheless, they did not cause the companies to adopt all best practices. In addition, it was revealed that innovative product development capability could have a positive effect on innovative organisational culture capability as evidenced in Company E, where they used their formal product development process to reduce technical, market, and resource uncertainty. This suggested that the relationship between the two determinants might be a bidirectional one, something Slater et al. (2014) did not consider in their model, but suggested by Herrmann et al. (2006).

5.3.5 The application of innovative product development practices and innovative product development capability as a causal variable

All the participating companies had in some shape or form an innovative product development capability. From the previous discussion in section 3.4.5, current best radical product development practices are a full-time project leader, a project champion, a multi-disciplinary team, a compelling business case, well executed product development activities, and a well-structured product development process. How many of these practices are utilised and in what form are discussed below.

Company A had a full-time project leader committed to product/process development (e.g. Technical and Operations Manager). They also had a project champion in the form of the Marketing Executive. The project was carried out by a multi-disciplinary team consisting of the top management and technical staff. The company had a compelling business case based on the upfront work they did to understand the technological and market potential. And lastly, the product development activities were well executed given their upfront work, harvesting and extraction expertise, research facility, market-driven and R&D-driven alliances, production facility, and sale office. However, the company did not have a well-structured product development process. The participant gave an overview of what he considered important for new product success.

> *There are always two sides to getting a successful product in the market: developing the process and developing the market. Process development is just something you learn fairly quickly whether it is going to succeed or not. Market development I think is more difficult. But you can succeed as long as you apply yourself and make a good choice upfront. A lot of this is about treating upfront. Do you want to do this? If you want a product that feels good, you might succeed (laughing). You might not. But you can see that there is an opportunity out there in the market. And you have got your data to support that opportunity. You have got to believe in that opportunity and then you can go out and create a market.*

Company B did not have a full-time project leader, a project champion, and a multi-disciplinary team since product development was carried out by the Director. The company did have a compelling business case given the Director's industry insight. The product development activities were conducted effectively by exploiting the Director's work experience and leveraging external partners. Nevertheless, the company did not have a well-structured product development process. When asked what factors she believes make her business successful, she replied:

> *Good relationships. I build up trust. I always reply really promptly and carefully. And quality of the product is absolutely critical. If there is a problem, sort it out. Sometimes at your cost but sort it out.*

Company C did not have a full-time project leader, a project champion, and a multi-disciplinary team because product development was conducted by the Manager. The company did have a compelling business case given the Manager's learning and market research. The product development activities were carried out well by utilising the

Manager's knowledge in restaurant management and gelato making, a collaborative relationship with suppliers, and advertisements. However, the company did not have a well-structured product development process. The participant gave a summary of important success factors as follows.

> *Location is number one key to success. Second is the service. If your food is OK but your service is terrible, people will not be coming back. If the food is just average, but you have a good service, people would still come back because in the service industry customer perception is very important. In our business, freshness of the ingredients and the right pricing are also important.*

Company D did not have a full-time project leader, a project champion, and a multi-disciplinary team because the director conducted product development himself. The company did have a compelling business case due to the director's discerning taste, business analysis, and confirming demand with his customers. The product development activities were well executed because of the director's confectionary manufacturing and development expertise, reliance on customers to promote new products, and available production facility. Still, the company did not have a well-structured product development process. When asked what factors he believes make his new products successful, he replied:

> *The product has to be good for a starter (laughing). You can't put a product into the market which is not fit for purpose or doesn't last or doesn't have good flavour or good texture. Number one, the product has to be right. And number two, there has to be a demand for it. Here, I pretty much rely on my customers to generate that demand.*

Company E had a full-time project leader and a multi-disciplinary team to conduct product development. They did not appear to have a project champion since the project leader or team member acted as the champion, and each project was supported by top management. The company had a compelling business case through their product innovation strategy and strict project selection criteria. Their product development activities were carried out proficiently through sufficient resource allocation, knowledgeable personnel, research and production facilities, project and employee performance metrics, and advertisements. Lastly, only Company E had a formal (well structured) product development process. The participant said the formal product development process contributed to their product development success by eliminating failing projects early to free up resources for other projects. He explained how the company develops and implements their product development processes:

> *We developed these ourselves. You might have failed products, but the thing is that we try not to fail by stopping projects if we see they are going to fail. It is better to stop a project and start on another project that might deliver more value to the company than to keep pursuing a project that we know is not going to do very well. There are a whole lot of different criteria that you have to meet as you go through the process.*

Overall, the analysis of the interview results support applying innovative product development practices for radical product innovation. The best practices utilised, arranged in order of popularity, were a compelling business case (Company A, B, C, D, and E), well executed product development activities (Company A, B, C, D, and E), a full-time project leader (Company A and E), a multi-disciplinary team (Company A and E), a project champion (Company A), and a well-structured product development process (Company E). An interesting finding was that many companies conducted radical product development using an informal product development process. This showed that a flexible product development process could work for radical product innovation. Nevertheless, it is pointed out that Company E (who had a well-structured product development process as well as being the largest and well trained in product development) has a significantly greater number of radical product innovations than the other companies. It is suggested that a formal or well-structured product development process may lead to more radical product innovations because the available resources are utilised more productively, ignoring the company size and training effect. Following this, the research hypothesis related to innovative product development capability as a causal variable is listed and discussed below.

> **H12**: Innovative product development capability has a positive effect on radical product innovation.

All the participating companies had utilised some or a majority of the best practices for radical product innovation. This gives credibility to **H12**.

5.3.6 The influence of company characteristics

5.3.6.1 Company age

Based on the interviews conducted, company age seems to have a negative effect on product innovativeness for Companies A, B, and C. As they grew older, they appear to have focused more on incremental product innovation.

For Company A, at the time of the interview, the participant was focused on *"process development"* which included increasing yield and lowering cost. They were also working with Plant & Food Research (a New Zealand crown research institute) to find new health applications for their existing products. However, they did not appear to have considered new product categories. It is possible they had not reached the limit of their blackcurrant extraction technology or it could be that they didn't want to compete with Company A2, who still owned the company and had their own product ranges.

For Company B, after many years in the business, the director has slowed down to spend more time with her family. She pointed out that she never wanted to *"build an empire."* At the time of the interview, she was only experimenting with improvements/revisions to existing products and adding a new product line. She also opined that by having a single supplier (Company B1) has constrained the growth of her company.

For Company C, their current focus was on improving their product offering and controlling cost. They also relied on their manager and suppliers to provide them with new recipes. At the time of the interview, the manager said that he has a new idea for combining his restaurant business with the shop (Company C), in order to reduce cost and improve service, but that idea is not as radical as his idea of introducing gelato back then.

On the other hand, Company D, despite being an incrementally orientated company, continued to introduce new products with a spur of innovative products from time to time via purchases of other companies or through new machines. Moreover, the company had started expanding their distribution into Australia. This indicated that the company was able to maintain their level of product innovativeness.

Company E was much the same. They continued to strengthen their internal innovation capability and introduced innovative products. This suggested that having an innovative product innovation strategy and strong research facilities could maintain radical product innovation for a large established company.

Overall, the interview results give legitimacy to the research hypothesis that younger companies are more accepting of innovative products than older companies (**H13**). Older companies become less innovative due to success, maturity, and accumulated resources. However, it is possible for a company to escape this orientation through a relentless innovation culture (Tellis & Golder, 1996), an innovative/bold product innovation strategy (Cooper, 2011), and a strong/radical research facility (Leifer et al., 2000).

5.3.6.2 Company size

Based on the interviews conducted, company size seems to have a positive impact on product innovativeness. The interview results suggest that all companies, regardless of their sizes are capable of radical product innovation. However, their size seems to influence the total number of radical product innovations being introduced in these companies.

Micro and small sized companies (Companies A, B, C, and D), have had only one or two radical product innovations over the time of their existence. As they become successful, they seem to have focused more on incremental and moderate product innovations to stay competitive. Due to limited personnel, these companies seem to have become tied up with incremental and moderate projects. On the other hand, the large sized company (Company E) does not suffer from these factors due to more personnel being available and having a product innovation strategy that directs top management attention and resources towards radical projects.

Overall, the interview results give credibility to the research hypothesis that larger New Zealand food and beverage companies are more likely to introduce radical products than smaller companies (**H14**). The reasons for this are that they have more resources and top management attention to conduct radical product development. A minimum size of 50+ full-time employees (between small and medium sized company) could be the threshold of size, as suggested by Rama and Tunzelmann (2008) to properly fund the launch of radical products.

5.3.6.3 Company foreign ownership

Since all the participating companies were fully New Zealand owned, it was not possible to make comments regarding foreign ownership (**H15**). Few companies were willing to participate in the interview; it was not possible to find a willing fully overseas owned innovative food and beverage company in the Manawatu-Wanganui region.

5.3.7 Potential moderators

The interviews suggested that certain external forces (called "other drivers" in the interview structure, section 4.4.2) could moderate the level of innovation being achieved.

5.3.7.1 High level of competition

It appeared that competition could moderate the level of product innovativeness being achieved in all companies.

Company A faced *"plenty of competition"* and consequently, had to rely on their internal innovation capability and R&D-driven alliances to differentiate their products to stay competitive.

Company B also benefitted from competition because they had to use "perceived quality" as a strategy to differentiate because they could not compete with cheaper products in the same market. The director had to innovate through additions to existing product lines and repositioning to stay competitive. However, by her own admission, she was not very successful as she lost some customers to low cost competitors.

Company C faced competition from other shops that had introduced similar products. However, the company stayed competitive by regularly monitoring their competitors and introducing new flavours and products. The manager also considered combining the shop with their restaurant business to lower cost and improve service to stay in competition.

Company D did not face much competition. The director explained that New Zealand confectionary manufacturers tended to focus on their own product ranges. This low level of competition may further explain the director's weak desire to pursue radical product innovation.

Company E found it tough to compete in mature overseas markets. As a result, they began targeting emerging overseas markets that had high growth. This strategy required investing in new production and marketing infrastructures and leveraging their internal innovation capability to develop new products specifically for these markets. So far, this strategy had been successful in driving growth for the company.

Overall, a high level of competition can drive a company to be more innovative. However, achieving sustainable competitive advantage is difficult because they often compete with larger overseas companies. In most cases, they gain long-term competitive advantage from their internal innovation capability and alliances. This indicated the importance of developing and utilising their internal innovation capability and alliances, not only for enabling radical product innovation, but for sustainable competitive advantage.

5.3.7.2 Made in New Zealand Branding

Being made in New Zealand, as a manufacturing context, is seen in the literature as an unfavourable situation for product innovativeness due to geographical isolation and small local population (Hong et al., 2016; OECD, 2007). Despite that, Companies A, B, and E (who are all exporters) leveraged on made in New Zealand branding.

For Company A, having their products being labelled “made in New Zealand” gave them competitive advantage. The participant explained the superiority of the New Zealand environment for growing blackcurrants:

> *New Zealand is a pretty good place to grow blackcurrants. We get in [Location] and South Island strong frost, which means that we get fruit set and a strong level of sunlight which are believed to be associated with a high level of anthocyanin.*

For Company B, made in New Zealand branding for Manuka honey created consumer trust and a superior perceived quality. When asked about the importance of made in New Zealand branding, the participant said:

> *Yes. Oh, very important. One of the things about Manuka honey’s success is that people know that it is New Zealand honey. No honey is allowed to come to New Zealand. So, there is no chance of mixing.*

For Company E, New Zealand branding promoted their products by creating a “clean and green image” to the customer. The participant said:

> *Yeah, it does. I think we probably don’t do it quite enough. The old clean and green branding. I think the New Zealand brand is important particularly in Asian countries. I also think being grass-fed adds value as well, in some parts of the world. You see cows in a paddock rather than being in a barn.*

For Company C and D who sold their product domestically, made in New Zealand branding was less important.

Overall, New Zealand as a manufacturing context can be a plus as well as a minus. On the negative side, the distance to overseas markets and a lack of skilled employees create resource uncertainty for New Zealand food and beverage companies. On the positive side, the relative geographical isolation gives New Zealand food and beverage companies a unique ecology, leading to unique food products such as the New Zealand Manuka honey and New Zealand blackcurrant products. This emphasises the importance of protecting the New Zealand environment and food safety reputation for the whole industry.

5.3.7.3 Market education

In all companies, market education is critical during the commercialisation stage of radical product innovation. The word *"educate"* was repeated by most participants. Market education is different from the marketing activities involved in incremental product innovation because radical product innovation involves a new core technology and core value proposition that are discontinuities from other products in the marketplace. As a result, radical product innovation requires companies to educate the consumer about the discontinuities.

For Company A, the participant referred to the need to set up sale offices and working with a larger company to educate the Japanese consumers about the health benefits of New Zealand blackcurrants. This effort to create market demand also benefited their competitors. They also had to compete with other functional foods such as blueberries and bilberries.

For Company B, the participant talked about the challenge of convincing retailers to buy packaged honey instead of bulk honey. She also organised a seminar to educate the Japanese people about New Zealand Manuka honey. She believed her new product (propolis) was not doing well, despite being scientifically better, due to a failure to educate the market.

For Company C, the Manager talked about hiring an Italian chef to help educate the local consumer about gelato. Despite gelato being known in other marketplaces, the company still needed to educate the market about the difference between traditional ice cream and gelato.

For Company D, the company relied on external partners to conduct marketing activities. Nevertheless, the director talked about a new product that failed due to a lack of market education. The director said:

> *That was an example of me believing there was a demand for the product. It was a variation of another popular product. This other popular product still sells and continues to sell very well, since it has been in the market for a long time. I thought an adaptation or a slight variation on that popular product would have worked but didn't. I think probably the main reason for that is people didn't really know or understood what the product was.*

For Company E, the Technical Manager talked about the market knowledge that was needed to introduce the low-fat cheese product into Australia. He also gave an example of an innovative product that failed due to a lack of market knowledge. He said:

> *We probably were the first to put a probiotic cheese into the Australian market. It went quite well for a while, but people weren't prepared to pay more money for it. Consumers had more of a mindset on cultured yogurt having probiotic than they did with cheese. If we launched that today, it might go much better because people are more aware nowadays.*

Overall, the field observations indicate the importance of market education in radical product innovation. Customers, like companies, can have a low absorptive capacity. Subsequently, more resources (investment, effort, and time) are needed to give consumers (including relevant external partners) the knowledge about the radical product, so that they could discern its true value over competing products (within and across the product category), leading to a purchase decision or market demand (which could benefit all the companies in the product category). This factor is particularly relevant for the food and beverage industry because consumers are more conservative (e.g. reluctant to try new products).

5.3.7.4 Government regulations

Government regulations seem to have had some negative impact on product innovativeness in the companies. This is somewhat expected because food and beverage products are highly regulated. This adds both technical and resource uncertainty.

Technical uncertainty includes ensuring their product and process innovations comply with the health and food safety regulations. For Company E, this includes ensuring that their products will not infringe intellectual property of others.

Some companies also seem to experience resource uncertainty as a result of changing regulations. The director of Company B gave an example of how a government regulation change caused them to lose a product stock. She recommended more consultation and advance notice from the government—particularly for smaller companies who have limited resources—to avoid future problems. Company D didn't have such an issue since few regulation changes happened in confectionery manufacturing.

Overall, many companies are affected to a certain extent by government regulations. This reflects the power government has in either incentivising or retarding radical product innovation.

5.4 Chapter Summary

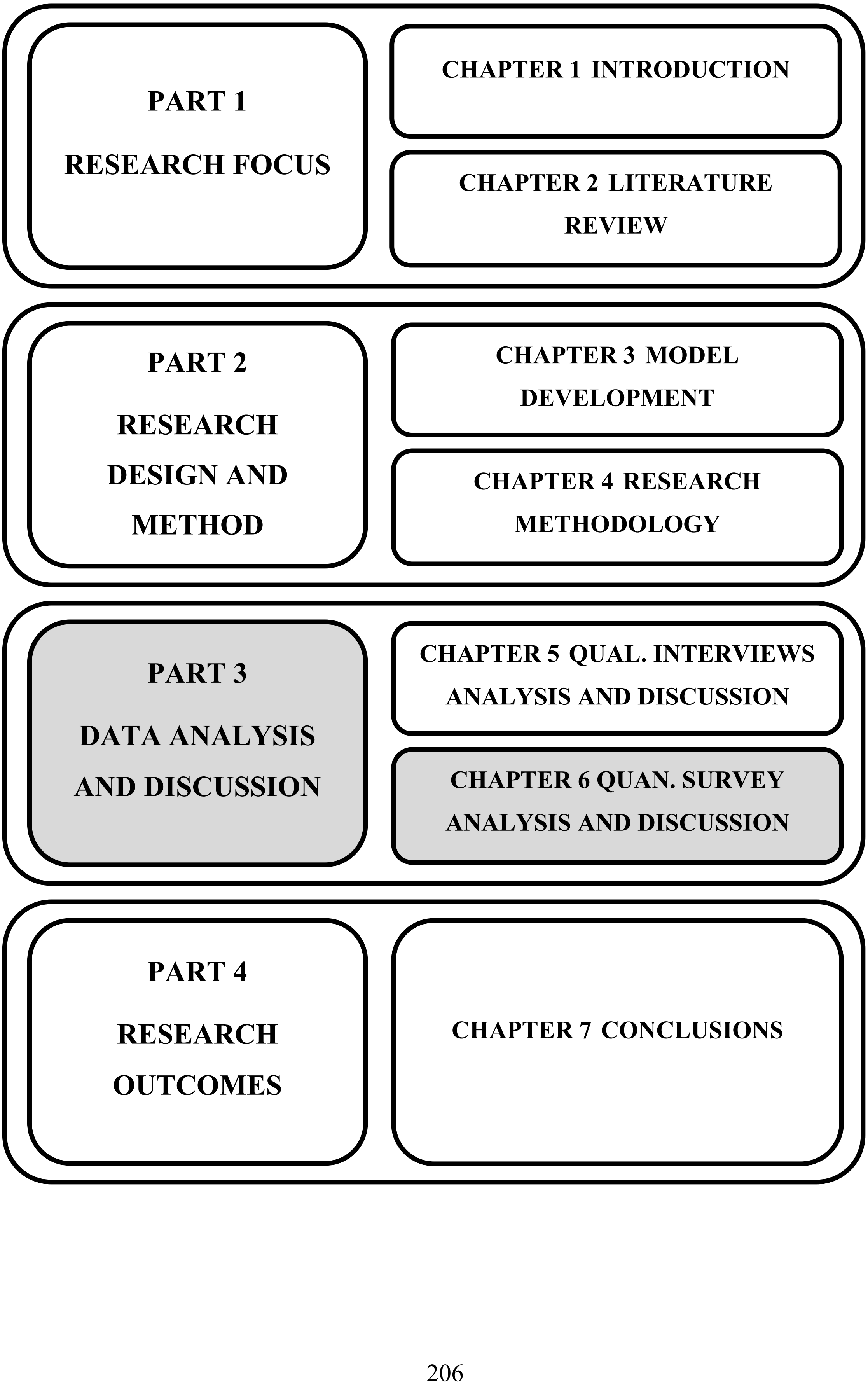
This chapter presented the interview findings with an accompanying discussion. In total, five food and beverage companies in the Manawatu-Wanganui region of New Zealand participated in the interviews. These companies were successful in their markets and had introduced several innovative products.

The analysis of the interview results reaffirmed the importance of all five identified determinants of radical product innovation and provided legitimacy and practical context to research hypotheses that were developed from the literature in a previous chapter. For these companies, company characteristics, company age (negatively) and company size (positively) seemed to have had an effect on product innovativeness, providing some practical context to the corresponding hypotheses. As mentioned at the beginning of this chapter, findings from qualitative field data were used to prepare the survey questionnaire (Chapter 4); these field data were also used in some instances to interpret quantitative data analysis results (the next chapter) from a practical perspective.

In addition, qualitative data analysis suggested that a high level of competition (seemingly positively), made in New Zealand branding (seemingly positively), market education (seemingly positively), and Government regulations (seemingly negatively) could be potential moderators of radical product innovation. There are not sufficient grounds to consider the above moderators to augment the theoretical model derived earlier (e.g. this is a small case study). A smaller model is always chosen over a larger model in science (i.e. parsimony) unless the latter can provide additional explanation of the explained variable. As a result, these potential moderators will not be considered in the theorisation of radical product innovation.

The quantitative survey data analysis and discussion are presented in the next chapter (Chapter 6).

PART 3: DATA ANALYSIS AND DISCUSSION



CHAPTER 6 QUANTITATIVE SURVEY DATA ANALYSIS AND DISCUSSION

6.1 Chapter Overview

This chapter presents the quantitative survey results and discussion. Data screening is presented first in section 6.2 to ensure that the quantitative data that are used in the statistical analysis are not influenced by outliers, irregular patterns, wrong coding (e.g. for Likert scales only an integer between 1 to 7 is acceptable) or a large number of missing values. Descriptive statistics on the survey participants and their companies are presented in section 6.3. Test results of hypotheses that involve statistical techniques partial least squares path modelling (PLSPM) and a general linear model (multi-factor ANOVA) are analysed in sections 6.4 and 6.5 respectively. Discussion of the data analysis test results (i.e. the results of hypothesis testing) from a theoretical and practical standpoint are covered in section 6.6. Finally, section 6.7 provides a chapter summary that highlights how the research questions have been answered through the quantitative survey data analysis.

6.2 Data Screening

From 1,144 companies that were invited to participate in the online survey via Google Forms, 145 responded. Out of this, 137 responses were usable (see section 6.2.1), resulting in a 12% usable response rate, which is a satisfactory outcome (Evans & Mathur, 2005; Manfreda, Berzelak, Vehovar, Bosnjak, & Haas, 2008). More importantly, 137 valid cases meet the minimum sample requirement; the minimum sample size required for testing the researcher's hypothesised theoretical model on radical product innovation (Figure 3.12) is 84 cases, based on the guidelines provided by Cohen (1992) on power analysis for multiple regression involving four predictors[5] for a medium effect size (i.e. a medium actual R^2 value of 0.13, as defined by Cohen (1992)).

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[5] The most complex (the least parsimonious) predictor-response regression equation is the regression equation that predicts Innovative Product Development Capability; this variable is predicted by four predictors (see Figure 3.12 or Figure 6.5). The more complex the equation becomes, the greater the sample size required to attain the desired statistical power (J. Cohen, 1992).

6.2.1 Testing for unusual data entries

In the initial step of data analysis, the data were screened for data entry errors, non-target responses, suspicious response patterns, and missing data. No outliers were found to exist, which may be attributable to the 1 to 7 scale being used—for example, few respondents strongly agreeing to some statements (i.e. a score of 7) has to be expected, in the context of the research and therefore cannot be treated as an unusually high score warranting removal.

Next, data entry errors were inspected. Any data with unusual characters and/or out of range values were rejected. The only acceptable characters for the part two of the survey relevant to the seven-point Likert scale were integers from 1 to 7. As expected, all responses (excluding missing data) contained integers 1 to 7, meaning that Google Forms has correctly auto-coded the responses. Thus, no response had to be removed.

Next, non-target responses (responses that did not belong to the target industry) were inspected. All responses were classified according to the Australia New Zealand Standard Industry Code (ANZSIC) 2006 industrial classification. Two responses were removed for not being in the food and beverage industry (they were manufacturers of non-food products) and one response was removed for not being a registered New Zealand company.

Suspect response patterns were inspected next by eyeballing the data to find any repeating, increasing, decreasing, and switching response patterns that could indicate unengaged responses (Downes-Le Guin, Baker, Mechling, & Ruylea, 2012). No response had to be removed as no suspect response pattern was found.

Lastly, data were analysed for missing values. Usually, a case (a data row/response) is rejected if the number of missing values exceeds 15%, although for PLSPM, lower thresholds have been recommended (Hair et al., 2017; Kim & Curry, 1977). Since, there were thirty-one seven-point Likert scale survey items, a response with 5 or more missing values was removed from the survey data. Five responses were removed for having significant missing values (more than 4 missing values). Next came the question of missing values per data field/column (indicator). Hair et al. (2017) recommended that a reasonable level of missing values for partial least squares path modelling (PLSPM) is less than 5% missing per indicator. Table 6.1 shows that indicator (IOCC_6) has the highest number of missing values at 3 (3/137 = 2.2% missing). Consequently, no response had to be removed on the grounds of the high proportion of missing data of an indicator.

Table 6.1: Summary of Missing Values for Indicators

Indicator	Missing		Valid N
	N	Percent (N*100/137)	
IOCC_6	3	2.2%	134
IPDC_1	2	1.5%	135
IPDC_6	2	1.5%	135
IIC_1	2	1.5%	135
PI_1	1	0.7%	136
IOCC_1	1	0.7%	136
IOCC_5	1	0.7%	136
IOCC_7	1	0.7%	136
IOCC_8	1	0.7%	136
IPDC_3	1	0.7%	136
IIC_4	1	0.7%	136
ENC_3	1	0.7%	136

In total, out of the 145 responses received, eight responses were removed: three for non-target responses and five for significant missing values, resulting in 137 usable responses.

6.2.2 Testing for common method bias

As mentioned earlier elsewhere (section 4.5.4), Harman's single factor test (Harman, 1976) was used to test for common method bias via Principal Components Analysis (PCA) of the survey data. If the PCA of the survey items results in a single factor (component), the responses are deemed to suffer from common method bias (Conway & Lance, 2010; Podsakoff et al., 2003).

The PCA analysis, performed via Minitab 18 software on the survey data containing Likert style responses resulted in nine factors, based on Kaiser Criterion of Eigenvalues > 1.0 (Kaiser, 1958); the Eigenvalues of nine factors were found to be 7.26, 2.65, 2.13, 1.82, 1.68, 1.48, 1.27, 1.19, and 1.02 in the un-rotated solution. In addition, the first component extracted only 23.42% (7.26/31) of the total variability of the measures, suggesting that no single common factor exists (Podsakoff et al., 2003). Thus, the PCA suggested that the responses were free from common method bias.

6.2.3 Testing for non-normal distribution

PLSPM is a nonparametric statistical method. This means that in a strict sense, PLSPM does not rely on the parametric assumption of normally distributed data. Nevertheless, it is important to examine the distribution of the data to ensure no extreme non-normality exists; significant non-normal data can distort/bias the PLSPM analysis (Hair et al., 2017). The other justification for investigating significant departures from normality is because the general linear model (GLM) used to test some hypotheses (hypotheses related to RQ3) relies on parametric assumptions, although GLM is sufficiently robust for minor departures from normality (Mardia, 1971; Morrison, 2005).

In order to test for non-normal distribution, Hair et al. (2017) recommend examining two measures of distribution: skewness and kurtosis. Skewness is a measure of distribution symmetry (typically a skewness value greater than +1 or lower than -1 indicates a skewed distribution), and kurtosis is a measure of distribution width (typically a kurtosis value greater than +1 means the distribution is too peaked, and less than -1 means it is too flat). Variables with skewness and kurtosis values exceeding these guidelines are considered to have non-normal distributions and should be examined carefully (Hair et al., 2017).

Table 6.2 shows descriptive statistics of all the indictors. Most indicators have their skewness and kurtosis values within the +1 and -1 range (Table 6.2) which mean they have a normal distribution. Nevertheless, a few indicators show extreme values (skewness and kurtosis > +/-1.5) out of the recommended range: TMIC_1 (-1.52, 2.55), TMIC_2 (-1.26, 1.60), TMIC_3 (-1.49, 1.86), TMIC_5 (-1.74, 3.77), and IOCC_3 (-1.28, 2.69).

The non-normal distribution for TMIC_1, TMIC_2, TMIC_3 and TMIC_5 indicate that the construct *Top Management Innovation Capability* (TMIC) suffers from a non-normal distribution. The negative skewness indicates that many participants viewed their top management's capability for managing innovation very positively (6s and many 7s in the seven-point Likert scale). The high kurtosis also suggests that many companies had a similar perception of themselves as the data were closely focused (peaked) around the high mode value. This non-normal distribution of the construct TMIC could be caused by the participants' tendency to see their top management team or themselves (if they were the top manager) as more innovative, leading to higher value answers. As previously stated, PLSPM is a nonparametric statistical method so the TMIC indictors can still be used for analysis.

Any bias brought about by the indicator IOCC_3 is considered benign since it is the only one non-normal indicator out of 8 indicators used to operationalise the *Innovative Organisational Culture Capability* (IOCC) construct.

Table 6.2: Descriptive Statistics

Indicator	Mean	StDev	Skewness	Kurtosis
PI_1	5.60	1.50	-1.20	1.00
PI_2	4.20	2.10	-0.17	-1.38
PI_3	5.27	1.59	-1.16	0.70
PI_4	5.04	1.71	-0.75	-0.38
TMIC_1	6.26	0.92	-1.52	2.55
TMIC_2	5.95	1.11	-1.26	1.60
TMIC_3	5.74	1.51	-1.49	1.86
TMIC_4	5.55	1.23	-0.33	-0.99
TMIC_5	6.02	1.22	-1.74	3.77
IOCC_1	5.52	1.57	-1.10	0.48
IOCC_2	4.29	1.84	-0.22	-1.00
IOCC_3	5.94	1.08	-1.28	2.69
IOCC_4	4.93	1.39	-0.35	-0.23
IOCC_5	4.79	1.62	-0.42	-0.53
IOCC_6	5.52	1.33	-0.84	0.44
IOCC_7	5.02	1.49	-0.49	-0.39
IOCC_8	4.20	1.73	-0.33	-0.73
IPDC_1	4.66	1.93	-0.66	-0.76
IPDC_2	5.18	1.49	-0.80	0.18
IPDC_3	4.64	2.02	-0.56	-0.95
IPDC_4	5.41	1.27	-0.81	0.55
IPDC_5	4.55	1.57	-0.40	-0.40
IPDC_6	4.42	1.56	-0.55	-0.09
IIC_1	4.72	1.73	-0.50	-0.67
IIC_2	5.45	1.37	-1.06	0.94
IIC_3	5.66	1.31	-1.22	1.19
IIC_4	6.10	0.85	-0.94	0.98
ENC_1	5.59	1.29	-1.04	1.01

Indicator	Mean	StDev	Skewness	Kurtosis
ENC_2	2.55	1.72	1.03	0.15
ENC_3	4.03	1.85	-0.12	-1.07
ENC_4	5.12	1.51	-0.80	0.32

6.3 Descriptive Statistics on Respondents and Companies

To ensure that the respondents are the target participants, the respondents' designations (job titles) were requested in the survey. The responses range from top management designations such as director, owner, managing director, and executive director, to top product development designations such as operation manager, product development manager, innovation manager, R&D technologist, and marketing manager. This indicates that the respondents are within the target participants.

Figure 6.1 depicts the distribution of the respondents' companies by age. The figure shows that the majority of responses are from companies founded after 1951. This suggests that most New Zealand food and beverage companies are relatively young companies (there are only a few vintage companies). The lower number of vintage companies is consistent with the expected New Zealand companies' survival rate where the number of surviving companies decrease overtime.

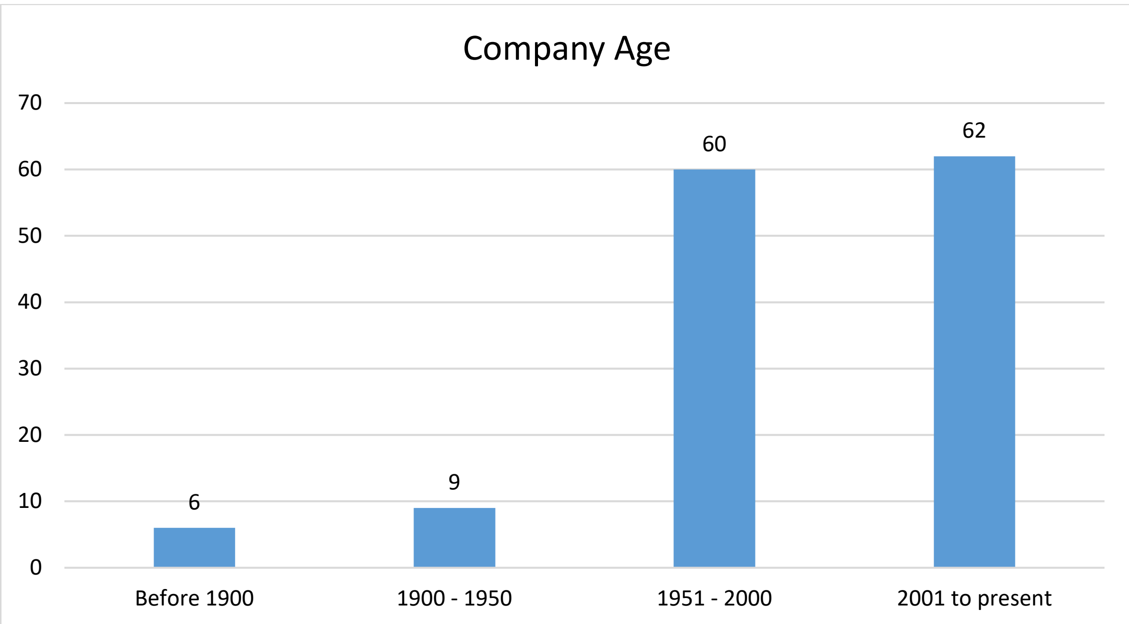

Figure 6.1: Distribution of the companies by age

Figure 6.2 depicts the distribution of companies by level of new product introduction over the past five-year period (2011 – 2016). The figure shows that the majority of companies have introduced at least one or more new products within the last five-year period. Only three companies seem to have introduced no new products during this period. This may not necessarily indicate these three companies have had no product innovation activity. The qualitative phase of the study revealed that one of the companies (Company B) did not introduce any new products because they had no reason to do so during the five-year period examined.

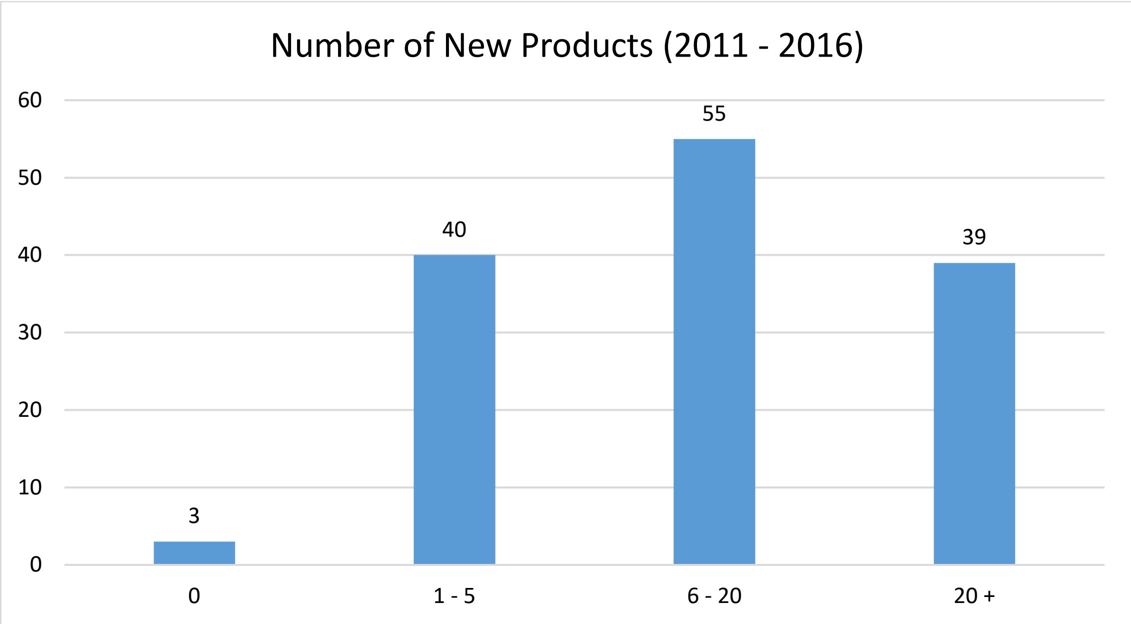

Figure 6.2: Distribution of the companies by level of new product introduction

Figure 6.3 depicts the distribution of companies by the level of New Zealand ownership. The figure shows that majority of companies that participated in the survey are fully New Zealand owned, whereas approximately 12% are either partially or overseas majority owned. This is unfortunate because not having sufficient observations in the second and third levels (categories) means that company ownership as a factor may fail to show the statistical significance in statistical tests involving that factor due to low statistical power.

According to Wilkinson et al. (2015), around 37% of the top 100 New Zealand food and beverage companies (based on revenue) are overseas owned. Here, it is likely that smaller New Zealand food and beverage companies (by revenue) would attract less interest from foreign companies resulting in higher participation from New Zealand owned companies.

Figure 6.4 depicts the distribution of the companies by size—the size being taken as the number of full-time employees employed in the company. According to Statistics New Zealand (2016), 90% of all New Zealand companies (515,046) had 0 – 5 employees, 9% had 6 – 49 employees, 0.6% had 50 – 99 employees, and 0.4% had 99 + employees. The

Figure 6.4 implies that more small and large companies are being represented in the sample. It may be that the New Zealand food and beverage industry has a relatively higher number of small and large companies given the large contribution of the industry to the New Zealand economy.

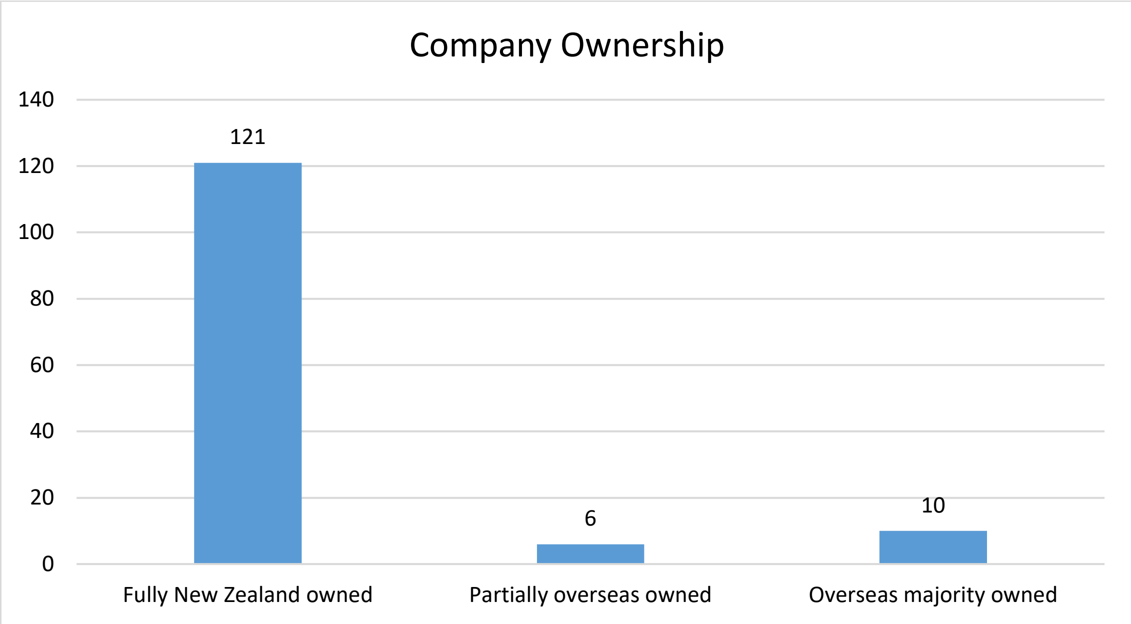

Figure 6.3: Distribution of the companies by level of New Zealand ownership

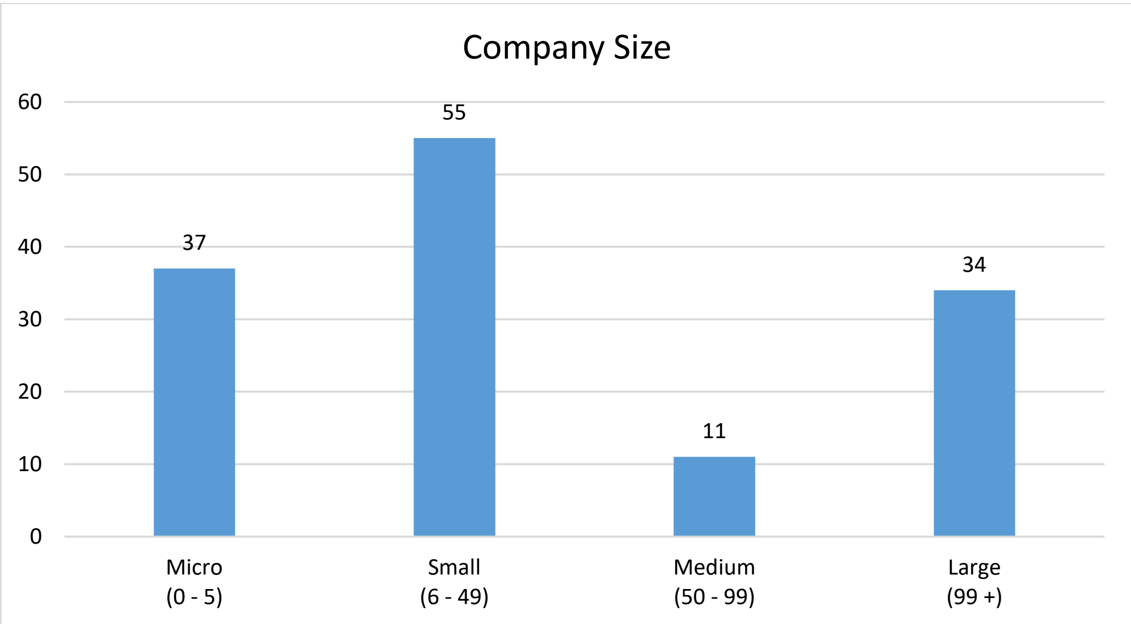

Figure 6.4: Distribution of the companies by size

The general conclusion from the analysis of survey data on company characteristics is that there is no overwhelming evidence to suggest that a particular category of respondents is over-represented or under-represented to suggest *non-response bias* of survey data.

6.4 PLSPM Hypothesis Test Results to Answer RQ2

In parametrising the statistical models, the structural model (also known as the outer model in PLSPM) involving the hypothesised relationships between latent variables has to be specified first in structural equation modelling (SEM)—in the present research, PLSPM is specified via SmartPLS 3 software. Based on the hypothesised theoretical model (previously presented in section 3.6.1, Figure 3.12), the structural model contains six latent variables (constructs): top management innovation capability (TMIC), internal innovation capability (IIC), external networking capability (ENC), innovative organisational culture capability (IOCC), innovative product development capability (IPDC), and product innovativeness (PI).

After specifying the structural model, in SEM, the measurement model (also known as the outer model in PLSPM) needs to be specified to initiate parameter estimation. The measurement model indicates how each latent variable is operationalised via their corresponding measures (indicators). Traditional positivistic assumption on latent variables is that latent variables exist out there irrespective of their indicators and that indicators are mere reflections of their underlying constructs; this requires indicators to co-vary strongly with their underlying latent variable (Borsboom, Mellenbergh, & Van Heerden, 2003; Coltman, Devinney, Midgley, & Venaik, 2008; Diamantopoulos & Siguaw, 2006). This reflective measurement perspective (the default option in SEM) was adopted in operationalising all six constructs, as there was no reason to believe that they should be operationalised as non-traditional latent variables.[6] Thirty-one survey items previously operationalised in section 4.5.2 were assigned to their respective constructs to form the measurement model. All the missing values (there were 17 of them) were replaced using the "mean replacement" option incorporated in SmartPLS 3 (case-wise deletion is the other option available).

6 In general, a latent variable can be classified as a non-traditional latent variable either because the latent variable is so abstract that two hierarchical levels (a second-order) are required to represent the construct or because the construct is formative in nature, in that the meaning of the construct is formed entirely by its underlying measures.

To establish reliability of the measurement models (scales), internal consistency reliability is assessed in section 6.4.1. Having established the reliability of the measurement scales, the validity of the constructs (construct validity) in terms of convergent validity and discriminant validity is examined in section 6.4.2. These assessments are necessary requirements in PLSPM as well as any other latent variable path modelling techniques (Gefen & Straub, 2005; Hair et al., 2017). Having established the reliability and validity of the measurement models, the structural model containing the hypothesised relationships is presented in section 6.4.3.

6.4.1 Internal consistency reliability

Internal consistency reliability measures how reliable the survey items are in reflecting their allocated constructs. Internal consistency reliability is measured using Cronbach's alpha coefficient or the composite reliability coefficient. Cronbach's alpha (Cronbach, 1947) provides an estimate of reliability based on the intercorrelations of the indicators. It assumes equal weight (same outer loadings for all indicators of the construct), which is not entirely rational for PLSPM (Hair et al., 2017). On the other hand, composite reliability (Werts, Linn, & Jöreskog, 1974) takes into consideration different outer loadings of the indictor variables and uses the variance and covariance value of the indicators in the estimate. According to Hair et al. (2017), although Cronbach's alpha coefficient and composite reliability coefficient are both used in reliability assessment, they are likely to underestimate and overestimate the internal consistency reliability respectively; for this reason, Hair et al. (2017) recommend the use of both measures in tandem because true reliability (as a single score) usually lies between the two estimated coefficients. According to Hair et al. (2017), a Cronbach's alpha value and a composite reliability value that falls between 0.70 and 0.90 are considered satisfactory, while a lower acceptable threshold of 0.60 can still be accepted in exploratory research, where operational definition of a construct could be at early stages of development; further, according to them, any values below 0.60 indicates lack of internal consistency reliability. Figures shown in Table 6.3 indicate that all constructs that constitute the theoretical model (Figure 6.5) possess an adequate level of internal consistency reliability, given that this study is an exploratory study and most scales are being tested for the first time. It is important to note that some indicators had to be excluded to improve internal consistency reliability and scale validity. The details are given in the next sub-section (section 6.4.1.1).

Table 6.3: The Reliability Statistics

Construct (Label)	Cronbach's Alpha (α)	Composite Reliability (CR)
Product Innovativeness (PI)	0.62	0.78
Top Management Innovation Capability (TMIC)	0.77	0.84
Internal Innovation Capability (IIC)	0.63	0.78
External Networking Capability (ENC)	0.64	0.85
Innovative Organisational Culture Capability (IOCC)	0.79	0.86
Innovative Product Development Capability (IPDC)	0.75	0.84
Note: As mentioned earlier, acceptable thresholds for reliability coefficients are: ≥ 0.60 for exploratory research and ≥ 0.70 for established constructs.		

6.4.1.1 Exclusion of unsuitable indicators

In a new measurement system, it is highly unlikely that all the measures that have been initially identified as underlying measures (hence survey items) do pass the statistical thresholds for acceptability on reliability and validity (Hair et al., 2017; Hinkin, 1995; Nunnally & Bernstein, 1994).

Hair et al. (2017) recommend removing an indicator that returns an outer loading less than 0.40, meaning a correlation between the measure and its assigned construct is less than 0.40; it is hard to justify that a measure belongs to its assigned construct when there is a low correlation between the measure and its assigned construct. Further, Hair et al. (2017) advocate removing indicators that return outer loadings between 0.40 and 0.70 based on their effect on convergent validity (defined in the next section), internal consistency reliability, and content validity. Weak outer loadings reduce internal consistency reliability as well as the construct's Average Variance Extracted (AVE), which is a measure that is being used in assessing convergent validity and discriminant validity (Fornell & Larcker, 1981).

To improve the reliability of the scale of the construct external networking capability (ENC), indicators ENC_1 and ENC_4 were removed (low outer loadings). Indicators ENC_1 and ENC_4 represent "informal networks" and "customer collaboration" respectively. Exclusion of these two indicators means that ENC gets re-defined (better defined in a statistical sense) as "outsourcing and alliances" based on the remaining two indicators of ENC. In the discussion (section 6.6.1.3), it is argued that ENC continues to capture (if not better) the original intent for ENC.

To improve the reliability of innovative organisational culture capability (IOCC), indicators IOCC_3, IOCC_4, IOCC_5 were removed (low outer loadings). The three indicators removed represent three organisational orientations on organisational innovativeness posited by Gatignon and Xuereb (1997): "customer orientation", "technological orientation", and "competitor orientation" respectively. In the discussion (section 6.6.1.4), it is argued that removal of the said three indicators do not significantly compromise the meaning of IOCC as the three organisational orientations are subsumed in the remaining indicators of IOCC.

To improve the reliability of innovative product development capability (IPDC), indicators IPDC_2 and IPDC_4 were removed (low outer loadings). The two indicators removed represent "a project champion" and "a compelling business case" respectively. The removal of the two indicators significantly increased the reliability of IPDC. The implication of removal of the indicators is covered in the discussion (section 6.6.1.5).

Finally, indicators PI_1, TMIC_5, IIC_4, and IOCC_6 were also considered for removal (low/moderate outer loading as shown in Table 6.4), but these indicators were not removed as it was desirable to retain these indicators to maintain content validity and internal consistent reliability. Fieldwork (Chapter 5) that preceded the survey research showed that TMIC_5 ("building relationships with external partners") is an important indicator for capturing the role top managers play in encouraging external networking capability. PI_1 ("micro technological discontinuity") was retained based on Garcia and Calantone (2002), who recommend using all four indicators (PI_1 to PI_4) when evaluating the innovativeness of a product. IIC_4 and IOCC_6 were not removed due to the negative impact on internal consistency reliability of their assigned constructs.

Table 6.4 shows that all indicators except PI_1, TMIC_5, IIC_4, and IOCC_6 (as mentioned earlier the above named indicators were retained for content validity and internal consistent reliability, but still within acceptable range) return loadings greater than 0.70, a desired condition for construct validity (further explained in the next section under convergent validity) suggested by Hair et al. (2017).

Table 6.4: Loadings of the Indicators Retained and the AVE of Each Construct

Construct	Indicator	Indicator Loading
Product Innovativeness (PI) **AVE = 0.47**	PI_1	0.52
	PI_2	0.73
	PI_3	0.73
	PI_4	0.74
Top Management Innovation Capability (TMIC) **AVE = 0.52**	TMIC_1	0.74
	TMIC_2	0.75
	TMIC_3	0.69
	TMIC_4	0.79
	TMIC_5	0.62
Internal Innovation Capability (IIC) **AVE = 0.47**	IIC_1	0.74
	IIC_2	0.71
	IIC_3	0.70
	IIC_4	0.58
External Networking Capability (ENC) **AVE = 0.74**	ENC_2	0.83
	ENC_3	0.89
Innovative Organisational Culture Capability (IOCC) **AVE = 0.54**	IOCC_1	0.73
	IOCC_2	0.80
	IOCC_6	0.68
	IOCC_7	0.74
	IOCC_8	0.74
Innovative Product Development Capability (IPDC) **AVE = 0.57**	IPDC_1	0.81
	IPDC_3	0.72
	IPDC_5	0.74
	IPDC_6	0.75
For all indicators, $p < 0.001$		

6.4.2 Convergent validity and discriminant validity

Convergent validity refers to the extent to which measures that are being considered to be theoretically related to their underlying construct converge strongly enough in a correlational sense (i.e. high indicator loading), to suggest that they reflect the construct (Campbell & Fiske, 1959; Gefen & Straub, 2005).

While a weak indicator loading (weak correlation between the indicator and its theoretical construct) affects convergent validity of the construct, the average variance extracted

(AVE) remains an important overall measure for establishing convergent validity of a construct (Fornell & Larcker, 1981). AVE is defined as "the grand mean value of the squared loadings of the indicators associated with the construct" (Hair et al., 2017, p. 114). In other words, it is an indicator of the average amount of variance of the indicators explained by their assigned construct (Gefen & Straub, 2005; Hair et al., 2017). The generally accepted AVE value for an acceptable level of convergent validity is 0.50 or higher (Fornell & Larcker, 1981; Hair et al., 2017). An AVE value greater than 0.50 indicates that the construct explains more than half of the variance of its indicators, while an AVE lower than 0.50 indicates that more than half of the variance of the indicators is explained by measurement error, rather than the construct (Chin, 1998; Fornell & Larcker, 1981). However, an AVE slightly less than 0.50 can be accepted so long as their composite reliability meets the prescribed threshold (≥ 0.60) (Fornell & Larcker, 1981).

After all the indicators, but the excluded ones, were chosen, the reliability statistics (Cronbach's alpha and composite reliability) for the six constructs of the hypothesised model were calculated via SmartPLS 3 (Table 6.3); these plus indicator loadings (outer loadings) and AVE of the constructs are shown in Table 6.4. Given that this research attempted to identify new determinants of radical product innovation in the New Zealand food and beverage industry, the threshold level of reliability for an exploratory study was considered; thus, Cronbach's alpha ≥ 0.60, composite reliability ≥ 0.60, high indicator loadings, and an AVE ≥ 0.50 were considered acceptable.

As shown in Table 6.3, all constructs pass the Cronbach's alpha and composite reliability assessments. For AVE (Table 6.4), only two constructs (PI and IIC) return values slightly less than 0.50 (= 0.47). However, since they are both close to the threshold and have composite reliability greater than 0.60, they were considered acceptable. Consequently, the measurement models were considered to have acceptable internals of consistency reliability and convergent validity.

Discriminant validity is an assessment to confirm that a construct is truly distinct from other constructs. Hair et al. (2017) recommended three criteria for assessing discriminant validity.

6.4.2.1 The loading cross-loading criterion for establishing discriminant validity

The first criterion used in establishing discriminant validity is a loading cross-loadings comparison. As the name implies, outer loadings of each indicator are calculated to examine their loadings. It is expected that an indicator's outer loading should be notably higher than its cross-loadings (i.e. an indicator's correlations with other constructs) to establish discriminant validity (Gefen & Straub, 2005). Gefen and Straub (2005) suggested that while a loading in excess of 0.70 suggests convergent validity, a cross loading less than 0.60 suggests discriminant validity. If this does not become the case (i.e. a cross-loading that is as strong as the loading), it could be argued that a particular indicator could represent another construct, making discriminant validity uncertain.

Table 6.5 provides a comparison of loadings and cross-loadings for all the indicators. It shows no particular concerns as loadings are higher than the cross-loadings for all indicators. In addition, cross-loadings are all below 0.60, providing strong evidence of discriminant validity.

Table 6.5: Loadings and Cross-Loadings

Indicator	Construct					
	PI	**TMIC**	**IIC**	**ENC**	**IOCC**	**IPDC**
PI_1	**0.52**	0.24	0.08	0.19	0.30	0.27
PI_2	**0.73**	0.24	0.20	0.30	0.46	0.44
PI_3	**0.73**	0.28	0.26	0.01	0.33	0.34
PI_4	**0.74**	0.17	0.23	0.10	0.46	0.32
TMIC_1	0.18	**0.74**	0.32	0.02	0.26	0.06
TMIC_2	0.23	**0.75**	0.31	0.05	0.23	0.00
TMIC_3	0.30	**0.69**	0.28	0.14	0.29	0.34
TMIC_4	0.15	**0.79**	0.36	0.07	0.22	0.23
TMIC_5	0.31	**0.62**	0.14	0.18	0.36	0.21
IIC_1	0.29	0.40	**0.74**	-0.17	0.26	0.21
IIC_2	0.21	0.21	**0.71**	-0.04	0.39	0.28
IIC_3	0.20	0.25	**0.70**	-0.28	0.15	0.16
IIC_4	0.02	0.19	**0.58**	-0.20	0.09	0.12
ENC_2	0.04	0.00	-0.35	**0.83**	0.08	0.05
ENC_3	0.33	0.21	-0.08	**0.89**	0.27	0.20
IOCC_1	0.46	0.21	0.22	0.12	**0.73**	0.35
IOCC_2	0.58	0.26	0.24	0.20	**0.80**	0.49
IOCC_6	0.20	0.44	0.29	0.11	**0.68**	0.38
IOCC_7	0.30	0.39	0.29	0.18	**0.74**	0.48
IOCC_8	0.51	0.16	0.25	0.17	**0.74**	0.53

Indicator	Construct					
	PI	TMIC	IIC	ENC	IOCC	IPDC
IPDC_1	0.52	0.17	0.28	0.11	0.55	**0.81**
IPDC_3	0.32	0.19	0.18	0.08	0.38	**0.72**
IPDC_5	0.36	0.20	0.24	0.25	0.47	**0.74**
IPDC_6	0.27	0.23	0.17	0.00	0.42	**0.75**

6.4.2.2 The Fornell and Larcker (1981) criterion for establishing discriminant validity

The second criterion used in establishing discriminant validity is the Fornell-Larcker criterion (Fornell & Larcker, 1981). This procedure compares the square root of the AVE of the construct with the correlations the construct has with other constructs. The Fornell-Larcker criterion for discriminant validity requires the square root of the AVE of a construct to be greater than the highest correlation the construct has with another construct. This indicates that a construct correlates more strongly with its assigned indicators than with other constructs. The correlations in Table 6.6 clearly meet the Fornell-Larcker criterion for discriminant validity.

Table 6.6: Correlations Between Constructs Relative to the Square Roots of their AVE Values

	PI	TMIC	IIC	ENC	IOCC	IPDC
PI	*0.69*					
TMIC	0.33	*0.72*				
IIC	0.29	0.39	*0.68*			
ENC	0.23	0.13	-0.23	*0.86*		
IOCC	0.57	0.38	0.34	0.21	*0.74*	
IPDC	0.51	0.26	0.29	0.15	0.61	*0.76*
Note: The diagonal elements are the square root of the AVE of the construct; non-diagonal elements are the correlations.						

6.4.2.3 HTMT criterion for establishing discriminant validity

The third criterion used for establishing discriminant validity, the most recent ones being added to the PLSPM literature, is the assessment of the heterotrait-monotrait ratio (HTMT) of correlations. HTMT is defined as "the average of the heterotrait-heteromethod correlations (i.e. the correlations of indicators across constructs measuring different phenomena), relative to the average of the monotrait-heteromethod correlations (i.e. the correlations of indicators within the same construct)" (Henseler, Ringle, & Sarstedt, 2015, p. 121). According to Henseler et al. (2015) and Hair et al. (2017), HTMT criterion offers a more reliable way of testing discriminant validity compared to the previous two criteria (especially the first criterion), which tend to clear at best, marginally acceptable measurement scales. HTMT values above 0.90 indicates a lack of discriminant validity; however, a more conservative threshold value of 0.85 can also be used (Henseler et al., 2015). In addition, through bootstrapping at 5,000 subsamples in SmartPLS 3, a confidence interval of the HTMT can be determined (Hair et al., 2017). If the value 1 is included within the confidence interval of the HTMT, this can also indicate a lack of discriminant validity (i.e. two constructs not being empirically distinct) (Henseler et al., 2015).

Table 6.7 depicts the HTMT assessment results. The figures show all combinations of constructs have their HTMT values lower than 0.85 and their bias corrected 95% confidence intervals do not include value 1. Consequently, the HTMT values indicate discriminant validity. It is noted that because the HTMT criterion is new (and arguably has not been sufficiently scrutinised by others), it is yet to be used in research papers.

Table 6.7: HTMT Assessment

	PI	**TMIC**	**IIC**	**ENC**	**IOCC**	**IPDC**
PI						
TMIC	0.48 [0.27, 0.68]					
IIC	0.45 [0.24, 0.60]	0.55 [0.36, 0.70]				
ENC	0.39 [0.18, 0.50]	0.22 [0.10, 0.29]	0.42 [0.21, 0.62]			
IOCC	0.77 [0.63, 0.90]	0.50 [0.30, 0.69]	0.46 [0.26, 0.60]	0.28 [0.12, 0.43]		
IPDC	0.70 [0.52, 0.85]	0.33 [0.17, 0.44]	0.40 [0.21, 0.56]	0.23 [0.09, 0.33]	0.77 [0.62, 0.90]	
Note: Figures within parenthesis show 95% confidence intervals of the HTMT						

In summary, discriminant validity has been established based on all three criteria. Having established reliability and validity of the measurement scales, the next stage of the data analysis is testing the hypothesised theoretical relations in the theoretical model (section 6.4.3).

6.4.3 Test results on the hypothesised theoretical model

In this section, the focus shifts from the outer model (the measurement system) to the inner model (hypothesised theoretical relationships between constructs).[7] In testing a structural model, the following three questions need to be answered at a minimum (Chin, 1998; Hair et al., 2017):

- Does the hypothesised theoretical model as a whole fit the data well? Stated alternatively, is the overall goodness of fit (global goodness of fit) of the model to data meeting acceptable thresholds used in PLSPM?
- Is there support to retain each of the hypothesised theoretical relationships? Stated alternatively, is each of the hypothesised structural relationships statistically significant?
- If the answer to the second question above is yes, what are the sizes of the relationships and what are the sizes of direct and indirect relationships between the cause and effect?

6.4.3.1 Statistical evidence on the global goodness of fit (GoF) of the model to data

Since the PLSPM optimisation algorithm does not globally optimise the statistical parameters (e.g. structural regression coefficients and indicator loadings) as in traditional structural equation modelling, there is no widely accepted global GoF index used in PLSPM (Hair et al., 2017). PLSPM optimisation involves a series of locally optimised measurement models and structural models using the least squares regression approach (Grigg & Jayamaha, 2014; Hair et al., 2017). As such, in PLSPM, the global goodness of fit (GoF) of the model to data is argued through a series of measures that examine the quality of the measurement model and the structural model (Chin, 1998; Henseler & Sarstedt, 2013). Since the quality of the measurement model has been found to be

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7 Strictly speaking, this statement is not correct as far as the global goodness of fit (Global GoF) of a model is concerned from a structural equation modelling perspective, because both the measurement model and the structural model contribute to the global fit. Global GoF is defined later.

acceptable based on a series of quality criteria mentioned earlier (e.g. in terms of internal consistency reliability coefficients, AVE, indicator loadings, and various criteria used for assessing discriminant validity), the only quality criteria considered in this section are those that relate to the inner model (Figure 6.5). While the coefficient of determination (R^2) of the endogenous constructs—constructs that have been predicted by the predictor constructs—remains the most widely used quality criterion for assessing the quality of the inner model, several other criteria have also been recommended in the literature (for details see Henseler and Sarstedt, 2013). The latest understanding on PLSPM, which is a fast evolving statistical technique, is that in general, a model providing good predictive capabilities is considered to be a model that provides a good overall fit to data (Henseler, Hubona, & Ray, 2016; Henseler & Sarstedt, 2013). The R^2 of the constructs and hence the final verdict on the overall goodness of fit of the model to data (conclusion: good), is covered in the next section.

6.4.3.2 Statistical significance of the hypothesised relationships and their sizes and effects

Since PLSPM is a nonparametric approach, as mentioned earlier, the statistical significance of model parameters in PLSPM are determined empirically, using either bootstrapping or jackknifing (Hair et al., 2017). Hair et al. (2017) recommend bootstrapping 5,000 subsamples (each subsample to be equal to the original sample in size), and as such, the number of subsamples was set to 5000 in SmartPLS 3. Figure 6.5 depicts the estimated path coefficients, and their statistical significance, along with the R^2 values of the endogenous constructs. The bias corrected 95% confidence intervals of the path coefficients (based on the bootstrapping results) are provided in Table 6.8.

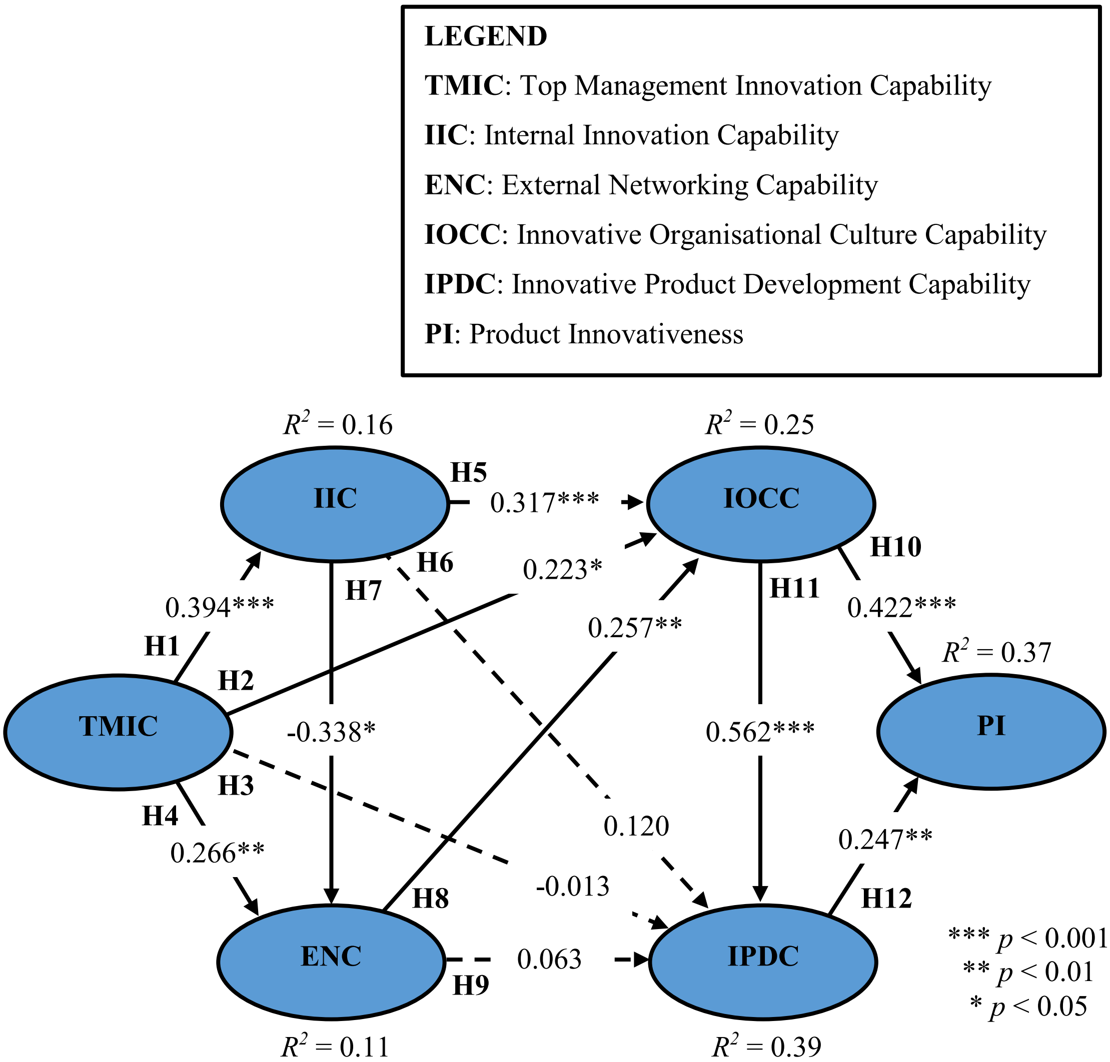

Figure 6.5: Estimated path coefficient in the structural model and their significance

Table 6.8: Model Path Coefficients and Statistical Significance

	Path Coefficients	*t* Values	*p* Values	95% Confidence Interval	Significant ($p < 0.05$)?
TMIC → IIC	0.394	4.906	0.000	[0.158, 0.518]	Yes
TMIC → IOCC	0.223	2.236	0.025	[0.005, 0.397]	Yes
TMIC → IPDC	-0.013	0.127	0.899	[-0.224, 0.179]	No
TMIC → ENC	0.266	2.608	0.009	[0.017, 0.431]	Yes
IIC → IOCC	0.317	3.639	0.000	[0.126, 0.464]	Yes
IIC → IPDC	0.120	1.248	0.212	[-0.072, 0.301]	No
IIC → ENC	-0.338	2.183	0.029	[-0.555, -0.057]	Yes
ENC → IOCC	0.257	3.007	0.003	[0.069, 0.409]	Yes
ENC → IPDC	0.063	0.735	0.463	[-0.109, 0.232]	No
IOCC → PI	0.422	5.762	0.000	[0.259, 0.550]	Yes
IOCC → IPDC	0.562	6.904	0.000	[0.384, 0.703]	Yes
IPDC → PI	0.247	2.863	0.004	[0.058, 0.399]	Yes

The p values associated with path coefficients show all the hypothesised path relationships being significant at 0.05 significance level (i.e. $p < 0.05$), except the following:

- TMIC → IPDC ($p = 0.899$)
- IIC → IPDC ($p = 0.212$)
- ENC → IPDC ($p = 0.463$)

The above non-supported structural paths suggest that top management innovation capability (TMIC), internal innovation capability (IIC), and external networking capability (ENC) do not have a direct relationship with innovative product development capability (IPDC). Results in Figure 6.5 suggest that instead, the aforesaid causal variables (the three determinants TMIC, IIC, and ENC) influence IPDC indirectly, through innovative organisational culture capability (IOCC). This suggests the important role IOCC plays as a mediator in linking IPDC with the previous three determinants. In addition, both IOCC and IPDC have a strong positive relationship with PI at 0.422 and 0.247 respectively. Together they explain 37% of PI variation, which means that they have a large effect on PI (based on $R^2 > 26\%$ rule of thumb for a large effect, as prescribed by Cohen (1992)).

The total effect of a cause construct on an effect construct (Figure 6.5) is depicted in Table 6.9. If one variable (say variable A) is causally related to another variable (say variable C) through one or more other mediating variables (say variable B), the total effect refers to the sum of the direct effect of the cause variable on the effect variable (e.g. A on C) and the indirect effect of the cause variable on the effect variable through the mediating variable/s (e.g. A on C through B). For example, Table 6.9 shows that TMIC has a total effect of 0.133 on ENC. This effect can be partitioned as follows:

Direct effect of TMIC → ENC = 0.266 (the path coefficient shown in Figure 6.5)

Indirect effect of TMIC → IIC → ENC = 0.394 * (-0.338) = -0.133 (relevant path coefficients shown in Figure 6.5)

Thus, *total effect* of TMIC on ENC = 0.266 (direct) – 0.133 (indirect) = 0.133 ---- (1)

A detailed discussion on the causal inferences implied in the path diagram (Figure 6.5) is covered in the discussion section (section 6.6.2). In relation to *determinants* of PI, results in Table 6.9 show that IOCC has the strongest total effect on PI at 0.561, followed by IPDC (at 0.247), TMIC (at 0.225), ENC (at 0.160), and IIC (at 0.153). TMIC, IIC, and ENC also have a strong effect on IPDC through IOCC with value of 0.257, 0.228, and 0.208 respectively. This indicates significant interaction between determinants leading to PI.

Only one effect TMIC → ENC total effect is found not significant. This is due to IIC acting as a negative mediator between TMIC and ENC. The negative relationship between IIC and ENC implies that as companies increase their IIC by investing more on their IIC (i.e. building up their internal competencies), they become less likely to collaborate with external partners; this may be because such companies already have the required competencies to innovate. It is possible that the effect of TMIC on ENC, through the mediating effect from IIC, depends on the nature of the company. These and other direct and indirect effects are discussed in detail in the discussion section (section 6.6.2).

Table 6.9: Total Effects and Their Statistical Significance

	Total Effect	*t* Values	*p* Values	95% Confidence Intervals	Significant ($p < 0.05$)?
TMIC → IIC	0.394	4.906	0.000	[0.158, 0.518]	Yes
TMIC → IOCC	0.382	4.057	0.000	[0.143, 0.529]	Yes
TMIC → IPDC	0.257	2.565	0.010	[0.003, 0.414]	Yes
TMIC → ENC	0.133	1.159	0.246	[-0.164, 0.307]	No
TMIC → PI	0.225	3.267	0.001	[0.065, 0.339]	Yes
IIC → IOCC	0.230	2.409	0.016	[0.026, 0.395]	Yes
IIC → IPDC	0.228	2.317	0.021	[0.003, 0.391]	Yes
IIC → ENC	-0.338	2.183	0.029	[-0.555, -0.057]	Yes
IIC → PI	0.153	2.468	0.014	[0.007, 0.256]	Yes
ENC → IOCC	0.257	3.007	0.003	[0.069, 0.409]	Yes
ENC → IPDC	0.208	2.227	0.026	[0.008, 0.379]	Yes
ENC → PI	0.160	2.853	0.004	[0.033, 0.258]	Yes
IOCC → PI	0.561	11.631	0.000	[0.449, 0.642]	Yes
IOCC → IPDC	0.562	6.904	0.000	[0.384, 0.703]	Yes
IPDC → PI	0.247	2.863	0.004	[0.058, 0.399]	Yes

Table 6.10 summarises the hypothesis results related to RQ2 along with a brief justification. **H3**, **H6**, and **H9** are rejected due to non-significant relationships while **H7** is rejected due to the negative relationship (a plausible explanation for this was given), which is contrary to the causal direction hypothesised.

Table 6.10: Hypothesised Model Results

Hypothesis	Hypothesis Supported?	Justification
H1: Top management innovation capability has a positive effect on internal innovation capability.	Yes	The corresponding path coefficient (TMIC → IIC) was found to be positive (0.394) and significant ($p < 0.001$).
H2: Top management innovation capability has a positive effect on innovative organisational culture capability.	Yes	The corresponding path coefficient (TMIC → IOCC) was found to be positive (0.223) and significant ($p < 0.05$).
H3: Top management innovation capability has a positive effect	No	The corresponding path coefficient (TMIC → IPDC) was

Hypothesis	Hypothesis Supported?	Justification
on innovative product development capability.		found to be non-significant (p = 0.899) at 0.05 level.
H4: Top management innovation capability has a positive effect on external networking capability.	Yes	The corresponding path coefficient (TMIC → ENC) was found to be positive (0.266) and significant ($p < 0.01$).
H5: Internal innovation capability has a positive effect on innovative organisational culture capability.	Yes	The corresponding path coefficient (IIC → IOCC) was found to be positive (0.317) and significant ($p < 0.001$).
H6: Internal innovation capability has a positive effect on innovative product development capability.	No	The corresponding path coefficient (IIC → IPDC) was found to be non-significant (p = 0.212) at 0.05 level.
H7: Internal innovation capability has a positive effect on external networking capability.	No, their relationship is likely negative.	The corresponding path coefficient (IIC → ENC) was found to be negative (-0.338) and significant ($p < 0.05$).
H8: External networking capability has a positive effect on innovative organisational culture capability.	Yes	The corresponding path coefficient (ENC → IOCC) was found to be positive (0.257) and significant ($p < 0.01$).
H9: External networking capability has a positive effect on innovative product development capability.	No	The corresponding path coefficient (ENC → IPDC) was found to be non-significant (p = 0.463) at 0.05 level.
H10: Innovative organisational culture capability has a positive effect on radical product innovation.	Yes	The corresponding path coefficient (IOCC → PI) was found to be positive (0.422) and significant (p < 0.001).
H11: Innovative organisational culture capability has a positive effect on innovative product development capability.	Yes	The corresponding path coefficient (IOCC → IPDC) was found to be positive (0.562) and significant (p < 0.001).
H12: Innovative product development capability has a positive effect on radical product innovation.	Yes	The corresponding path coefficient (IPDC → PI) was found to be positive (0.247) and significant (p < 0.01).

A comprehensive answer to RQ2 has been provided in section 6.6.2, upon discussion of the above results.

6.5 Test Results on Multi-factor Analysis of Variance to Answer RQ3

Since multiple factors (company ages, company size, and type of ownership) were hypothesised to have an effect on product innovativeness (this is in addition to IOCC and IPDC posited in the theoretical model), a multi-factor analysis of variance (ANOVA), in the form of a general linear model (GLM), was conducted in Minitab 18 to test the effect of individual company characteristics—age, size, and ownership—on the response variable, product innovativeness (PI). For the purpose of the GLM, the score of PI was taken as the arithmetic mean of all four indicators of PI: micro technological discontinuity, macro technological discontinuity, micro marketing discontinuity, and macro marketing discontinuity. This provided a single product innovativeness score in a scale between 1 and 7 (since the constituent variables of PI are also in a 1 to 7 scale, and the scores are averaged) for each of the companies (i.e. each respondent).

Since ANOVA of any form is based on parametric assumptions, it requires the response variable to have an approximately normal distribution. It is well known that single factor ANOVA (i.e. one-way ANOVA) and multi-factor ANOVA are robust for a certain degree of departure from normality (Harwell, Rubinstein, Hayes, & Olds, 1992; Mardia, 1971; G. Norman, 2010). Prior to multi-factor ANOVA, the scores of PI were tested both parametrically (Anderson-Darling normality test) and graphically (histogram and normal probability plot) for normality to examine to what extent PI meets a normal distribution.

Figure 6.6 indicates that PI follows a non-normal distribution because the p value is less than 0.005.[8] The histogram of PI scores in Figure 6.7 shows the distribution of PI compared to the normal distribution, which suggests that the distribution is not too far from normal. As such, given the robustness of ANOVA methods for violations from normality, it was decided that the departure from normality was not too substantial to consider any scale transformation. However, the multi-factor ANOVA presented in this section was repeated for a transformed scale (the scale transformation was done to make the non-normal scale of PI almost normal) to verify that the conclusions made in this

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[8] The null hypothesis of the AD test is that data come from a normal distribution and the alternative hypothesis is that data come from a non-normal distribution. The AD index reported in Figure 6.6 is also informative because at 5% significance level, any AD value that exceeds 0.752 is considered non-normal (D'Agostino, 1986).

section remained the same for the transformed scale (see Appendix F for results based on the transformed scale).

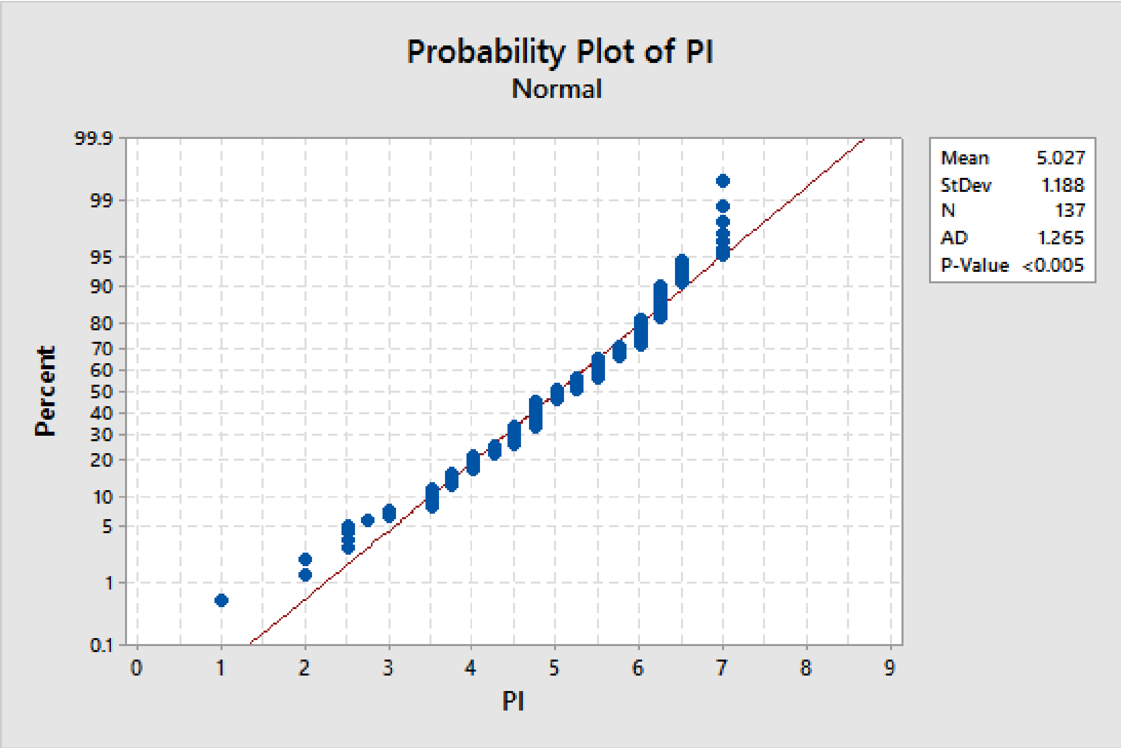

Figure 6.6: Probability plot and Anderson-Darling test of PI

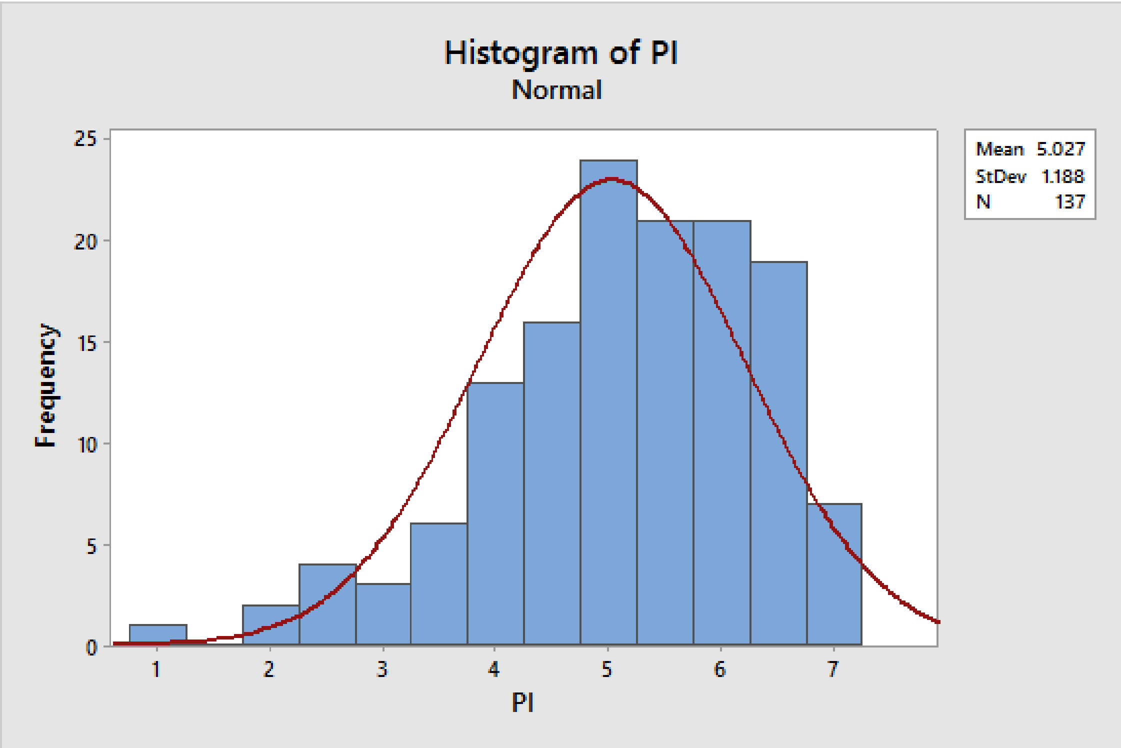

Figure 6.7: Histogram plot of PI against the normal distribution for the same mean and standard deviation

Table 6.11 shows the factorial ANOVA table based on Minitab 18 output displayed on the session window.

Table 6.11: Factorial ANOVA Results

Source	**DF**	**Adj SS**	**Adj MS**	**F-Value**	**P-Value**
Age	3	18.364	6.1213	4.76	0.004
Size	3	16.717	5.5724	4.33	0.006
Ownership	2	1.257	0.6287	0.49	0.615
Error	128	164.666	1.2865		
Lack-of-Fit	16	13.721	0.8575	0.64	0.848
Pure Error	112	150.945	1.3477		
Total	136	191.960			
R^2 = 14.22%; Adjusted R^2 = 8.86%					

The ANOVA results indicate that age and size have a significant effect on PI ($p = 0.004$ and $p = 0.006$ respectively) while ownership does not ($p = 0.615$). Equally importantly, both age and size seem to have a similar effect (in size) on product innovativeness because both factors result in similar F ratios: 4.76 and 4.33 respectively[9]. The model's Lack-of-Fit is also not significant ($p = 0.848$), which along with the residual plots (Figure 6.8) mean that the model is adequate[10]. The coefficient of determination (R^2) attributable to the proportion of total variability being explained by the three factors (=14.22%) is not large (slightly above 13%, which can be regarded as a medium effect size, based on the rule of thumb values prescribed by Cohen (1992)), given that IOCC and IPDC remain the main predictors of PI. It is important to note that PI as a phenomenon is being predicted by the theoretical model on radical product innovation phenomenon (see Figure 6.5 for R^2 of PI) and company characteristics are just control variables.

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9 The F statistic of a factor is the ratio between explained variance due to the factor, relative to the unexplained variance by the factors (model).

10 The residual plots of PI (Figure 6.8) show that assumptions on GLM are met. Normal probability plot and the histogram show that the distribution of residuals does not depart significantly from normality. The versus fits plot shows that residuals show equal variance for all fitted (predicted) values of PI. Finally, the versus order plot does not show any trend to suggest that observations are not independent.

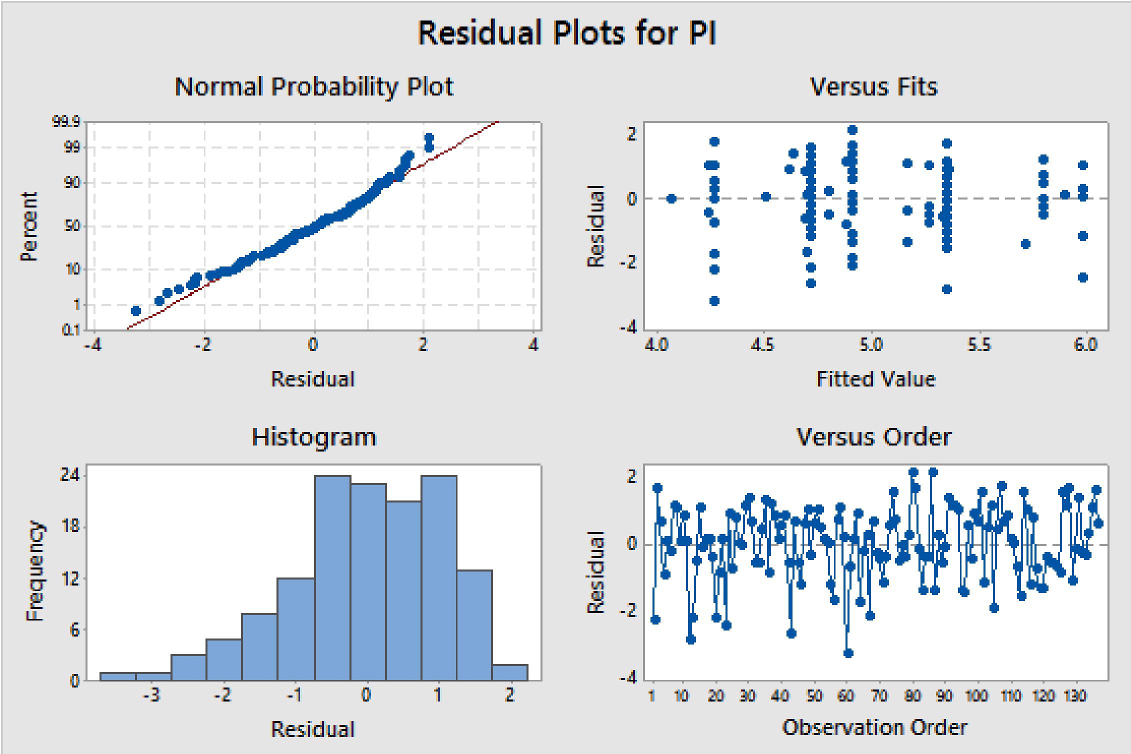


Figure 6.8: The residual plots of PI

Figure 6.9 presents the main effects plot comparing the effect of age, size, and ownership on mean PI. The company characteristics are coded as follows: Age (“2001 to present” = 1, “1951 – 2000” = 2, “1900 – 1950” = 3, and “before 1900” = 4); Size (“0 – 5” = 1, “6 – 49” = 2, “50 – 99” = 3, and “99 +” = 4); and Ownership (“fully New Zealand owned” = 1, “partially overseas owned” = 2, and “overseas majority owned” = 3).

The main effects plot of PI clearly shows that younger companies return higher mean PI scores compared to their older counterparts. This implies that innovative new food and beverage products are more likely to be introduced by young companies. It supports the hypothesis **H13** that younger New Zealand food and beverage companies are more receptive to innovative product ideas.

Furthermore, the main effects plot of PI clearly shows that the mean PI increases with the size, implying that medium to large companies introduce more innovative products than micro to small companies. This suggests that medium to large companies have an advantage over micro to small companies when it comes to radical food product innovation. A further discussion on this can be found in the discussion section (section 6.6.3).

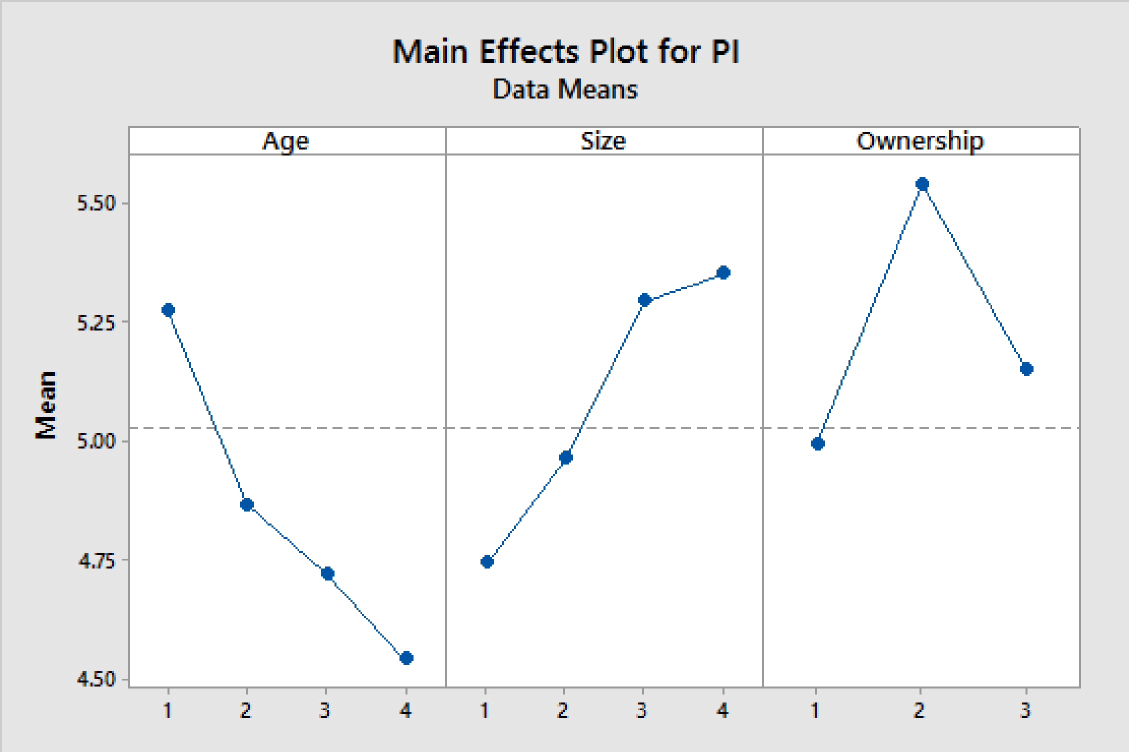


Figure 6.9: Main effects plot comparing age, size, and ownership effect on mean PI

Lastly, the main effects plot of PI and ANOVA results show that there is no clear relationship between ownership and PI, which suggests that nationality of ownership may not affect product innovativeness. Nevertheless, the small sample size of partially overseas owned and overseas majority owned companies (6 and 10 respectively), means that statistical power is inadequate to reject the null hypothesis (H_0: ownership has no effect on product innovativeness), if it is in fact false. Power analysis shows that a sample size of 20 is required in each category to achieve an approximate 80% chance (i.e. Power = 0.80) of rejecting a false null hypothesis. Thus, it is inconclusive whether nationality of ownership could influence product innovativeness.

In addition, an interaction plot is provided to investigate any interactions between the two significant company characteristics (i.e. age and size). The interaction plot, shown in Figure 6.10, shows no interaction between age and size.

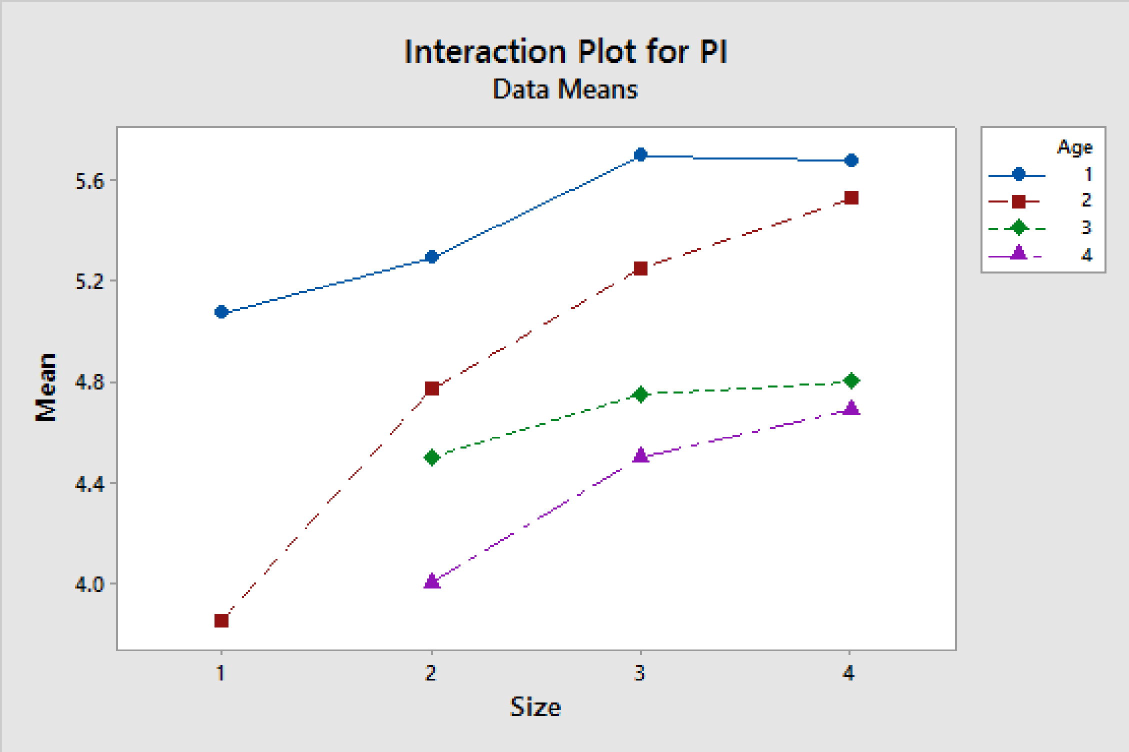


Figure 6.10: Interaction plot between age and size

Finally, to control for the effects of IOCC and IPDC on mean PI, a hierarchical regression analysis was conducted. Both IOCC and IPDC were calculated as the arithmetic mean of their retained indicators (IOCC_1, IOCC_2, IOCC_6, IOCC_7, and IOCC_8 for IOCC, and IPDC_1, IPDC_3, IPDC_5, and IPDC_6 for IPDC).

Table 6.12 shows the factorial ANOVA table based on Minitab 18 output displayed on the session window with IOCC and IPDC included in the analysis. The table shows IOCC, IPDC, age, and size highly significant at 5% confidence level and the model's R^2 value of 41.64%. When age and size are removed, the R^2 value reduces to 35.95%. This significant but practically small reduction in predictive power of the model (-5.69) reinforces that age and size as predictors on PI are not as practically significant predictors as IOCC and IPDC. Nevertheless, company age and size are useful for identifying the salient features of a highly innovative company and are explored further in section 6.6.4.

Table 6.12: Factorial ANOVA Results with IOCC and IPDC

Source	DF	Adj SS	Adj MS	F-Value	P-Value
IOCC	1	17.391	17.3906	19.87	0.000
IPDC	1	4.140	4.1399	4.73	0.031
Age	3	8.025	2.6751	3.06	0.031
Size	3	7.071	2.3571	2.69	0.049
Error	128	112.020	0.8752		
Lack-of-Fit	121	105.260	0.8699	0.90	0.639
Pure Error	7	6.760	0.9658		
Total	136	191.960			

In summary, both the ANOVA results and main effects plot support **H13** and **H14** but the finding on **H15** remains inconclusive due to small sample size of partially overseas owned and overseas majority owned companies. Table 6.13 shows the hypothesis results related to RQ3 along with a brief justification. As mentioned earlier, a more detailed discussion of the hypothesis results is provided in section 6.6.3.

Table 6.13: Hypothesised Company Characteristics Results

Hypothesis	Hypothesis Supported?	Justification
H13: There is a greater level of acceptance for product innovativeness in younger New Zealand food and beverage companies than in older companies.	Yes	Positive main effect and it is significant ($p < 0.01$)
H14: Larger New Zealand food and beverage companies are more likely to have a higher level of product innovativeness than smaller counterparts.	Yes	Positive main effect and it is significant ($p < 0.01$)
H15: New Zealand owned food and beverage companies are more innovative than overseas owned companies.	Inconclusive (Failed to reject H_0)	Inconclusive; failed to reject H_0 most probably due to small sample sizes for partially overseas owned and overseas majority owned companies

A comprehensive answer to RQ3 has been provided in section 6.6.3, upon discussion of the above results.

6.6 Discussion

6.6.1 Discussion on the determinants of radical product innovation

From the partial least squares path modelling analysis conducted in section 6.4, all the five causal variables as determinants of radical product innovation were supported by the results. Each of the determinants and their indicators are discussed below in the following sections to shed more light on how the determinants of radical product innovation relate to one another in predicting and explaining product innovativeness (section 6.6.1.1 to 6.6.1.5).

6.6.1.1 Top management innovation capability as the determinant of radical product innovation

Top management innovation capability (TMIC in Figure 6.5) is defined as the ability of top management to manage radical product innovation in their organisation. The capability is proposed as the most important determinant of radical product innovation because top management have the responsibility of driving the whole organisation. As shown in the theoretical model on radical product innovation phenomenon (e.g. Figure 6.5), TMIC acts as the exogenous construct that drives other determinants of radical product innovation.

Based on the internal consistency reliability measured in section 6.4.1, top management innovation capability as a construct retains all of its five indicators. This includes being highly involved with the project, providing the project direction, willing to pursue the project, allocating sufficient financial resources, and building relationships with external partners. How top management innovation capability can determine radical product innovation is discussed below.

Firstly, top management can be highly involved with the radical project. They can take part in radical product development themselves as observed in the micro-small companies interviewed (Company A, B, C, and D), or set project criteria and provide feedback to the radical project team during project reviews as observed in the large company interviewed (Company E). This finding is consistent with the literature (e.g. Booz et al., 1982; Holahan et al., 2014; Leifer et al., 2000).

Secondly, top management can provide direction to the radical project. They can provide direction by establishing formal product innovation strategy and product development process. The formal product innovation strategy ensures that the company's product development effort is in alignment with the company's overall business strategy. It can be a result of top management's strategic vision, such as new product vision with mass market appeal (Tellis & Golder, 1996), new technology vision (Reid et al., 2015), and new market vision (O'Connor & Veryzer, 2001). In addition, the formal product development process ensures that the product development team follows a proper procedure to reduce risks and delays. This is particularly relevant for larger companies that could have many ongoing projects. It is also useful for allocating resources, evaluating project performance, and reducing failures as discovered in the interview with the Company E. This finding is consistent with the literature (e.g. Booz et al., 1982; Cooper, 2011; Slater et al., 2014).

Thirdly, top management need to be willing to pursue the radical project because radical projects are long term in nature and can sometimes replace existing products or competencies. Top management need to be willing to pursue radical projects in spite of these drawbacks, which is a strategic decision. This is reflected in their support and encouragement for radical product innovation. This finding is consistent with the literature (e.g. Cooper, 2011; McDermott & O'Connor, 2002; Tellis & Golder, 1996).

Fourthly, top management are responsible for allocating sufficient financial resources for the radical project. Often, top management are supportive of radical projects but are unwilling to commit financially to them (Cooper, 2011; Tellis & Golder, 1996). Without sufficient funding, radical product can lose out to more urgent or faster return projects. In all the companies interviewed, top management provided sufficient financial resources to their radical projects in order to open new offices, buy new machines, and educate markets. This finding is consistent with the literature (e.g. Holahan et al., 2014; Slater et al., 2014; Tellis & Golder, 1996).

Lastly, top management can build relationships with external partners. Top management can leverage their network to gain access to external resources for their organisation. As discovered in many of the companies interviewed (Company A, B, C, and D), top management were directly responsible for building long term relationships (i.e. alliances) with key external partners such as suppliers, manufacturers, and distributors. This finding is consistent with the literature (e.g. McDermott, 1999; Verganti, 2008).

6.6.1.2 Internal innovation capability as the determinant of radical product innovation

Internal innovation capability (IIC in Figure 6.5) is defined as the ability of an organisation to develop and utilise its in-house technological and market competency for radical product innovation. Strong internal innovation capability enables a company to solve technical and marketing problems in radical product innovation. It is a result of a company's accumulated learning and resource investments and needs to be constantly adjusted as the business environment evolves.

Based on the internal consistency reliability measured in section 6.4.1, internal innovation capability as a construct retains all of its four indicators. This includes having strong in-house technological competency, having strong in-house market competency, utilising in-house technological competency, and utilising in-house market competency. How internal innovation capability can determine radical product innovation is discussed below.

Firstly, strong in-house technological competency is needed to overcome technical uncertainty associated with the development of new technologies. These technological competencies are a result of the company's investment in developing their engineering and manufacturing know-how and resources. This finding is consistent with the literature (e.g. Danneels, 2002; McDermott & O'Connor, 2002; Rubera et al., 2012).

Secondly, strong in-house market competency is needed to overcome market uncertainty associated with the development of new value propositions. These market competencies are a result of the company's investment in developing their marketing and distribution know-how and resources. This finding is consistent with the literature (e.g. Danneels, 2002; McDermott & O'Connor, 2002; Rubera et al., 2012).

Thirdly, companies need to utilise their in-house technological competency. They can accomplish this by exploiting or leveraging their existing technological competencies to develop new technologies or by choosing radical projects with high synergy to their existing in-house technological competency. This finding is consistent with the literature (e.g. Kleinschmidt & Cooper, 1991; Prahalad & Hamel, 1990; Tellis & Golder, 1996).

Lastly, companies need to utilise their in-house market competency. They can accomplish this by exploiting or leveraging their existing market competencies to develop new value propositions or by choosing radical projects with high synergy to their existing in-house market competency. This finding is consistent with the literature (e.g. Kleinschmidt & Cooper, 1991; Prahalad & Hamel, 1990; Tellis & Golder, 1996).

6.6.1.3 External networking capability as the determinant of radical product innovation

External networking capability (ENC in Figure 6.5) is defined as the ability of an organisation to collaborate with external partners for radical product innovation. External partners are individuals or organisations outside the control of a company. Companies with strong external networking capability can identify and gain access to the valuable resources controlled by key external partners and successfully exploit or leverage them for radical product innovation.

Based on the internal consistency reliability measured in section 6.4.1, external networking capability as a construct retains only two of the four indicators initially chosen. The indicators that are retained are outsourcing and alliances, while the indicators that are removed are informal networks and customer collaboration. How external networking capability can determine radical product innovation in the light of the new meaning based on the two indicators retained, and the two indicators removed, is discussed below.

Firstly, companies need to be capable of outsourcing. It is risky for a company to maintain all the competencies in-house because a product design change can quickly make them obsolete (Olleros, 1986). Moreover, most companies simply do not have all the necessary competencies to conduct radical product innovation (McDermott & O'Connor, 2002). This leads to the need for outsourcing, allowing companies to focus on their core competencies. From the interview results, all companies had chosen to outsource certain competencies they were not good at, while keeping their core competencies in-house when developing radical products. This finding is consistent with the literature (e.g. McDermott & O'Connor, 2002; Olleros, 1986).

Secondly, companies can benefit from a long-term relationship or alliance with external partners. According to McDermott (1999), there are three reasons why companies pursue alliances: market-driven, manufacturing-driven, and R&D-driven. These alliances are supported by the interview results. This finding is consistent with the literature (e.g. McDermott, 1999; Verganti, 2008).

Informal networks being removed as an indicator suggests that a large network (or clusters) is not related to external networking capability. External networking capability allows a company to identify and access valuable resources that are controlled by a few external partners. In other words, these resources are not available to everyone. Knowing a large number of people (i.e. informal networks) may not be sufficient to access these resources. Thus, rejection of informal networks on statistical grounds (low reliability) seems to have some practical grounding. Informal networks may become relevant if the valuable resources are readily available within the network, such as is the case with incremental product innovation.

Customer collaboration being removed as an indicator suggests that working with customers may not stand out, as part of external collaboration. Not every customer is suitable to participate in radical product innovation because they do not have the right attitudes, knowledge, and needs (Lettl, 2007). In addition, alliances as an indicator can mean working with customers for certain companies. For example, several of the interviewed companies consider their distributors, who they have established long-term working relationships with, as their customers. Thus, rejection of customer collaboration on statistical grounds (low reliability) seems to have some practical grounding.

Accordingly, by virtue of being the two empirically supported constituents of external networking capability, it is argued that the ability to identify and access the key external partners (i.e. outsourcing) and establishing long-term collaboration with them (i.e. alliances) may be better indicators of external networking capability than informal networks and customer collaboration.

6.6.1.4 Innovative organisational culture capability as the determinant of radical product innovation

Innovative organisational culture capability (IOCC in Figure 6.5) is defined as the ability of an organisation to cope with high uncertainty created by radical product innovation. Radical product innovation, as considered in this study, has the highest degree of uncertainty. Hence, an organisation that can tolerate a high degree of uncertainty is more likely to pursue radical product innovation.

Based on the internal consistency reliability measured in section 6.4.1, innovative organisational culture capability as a construct retains only five of the eight indicators initially chosen. The indicators that are retained are relentless innovation, entrepreneurial orientation, learning orientation, well communicated product innovation strategy, and appropriate employee performance metrics; the indicators that are removed are customer orientation, technological orientation, and competitor orientation. How innovative organisational culture capability can determine radical product innovation in the light of the new meaning based on the five indicators retained and the three indicators removed, is discussed below.

Firstly, relentless innovation is needed to overcome organisational inertia created by accumulated resources and experience. According to Tellis and Golder (1996), relentless innovation means the company is committed to continuous product innovation, even at the cost of cannibalising their existing products and investments.

Secondly, entrepreneurial orientation is needed to pursue high risk projects in anticipation of high returns. According to Hult et al. (2004), entrepreneurial orientation means the company is willing to enter a new business or renewing their existing business in order to generate growth.

Thirdly, learning orientation is needed to cope with failures from radical product innovation. According to Hult et al. (2004), learning orientation means the company is willing to experiment and learn from their failures.

Fourthly, well communicated product innovation strategy is needed to create employee support for radical product innovation. According to Cooper (2011), well communicated product innovation strategy means the company's product innovation strategy is robust, clearly defined, and disseminated across the whole organisation.

Lastly, appropriate employee performance metrics are needed to incentivise employee's commitment towards radical projects. Employees can see radical projects as high risk for their career. Therefore, they may become reluctant to participate in those projects (O'Connor & McDermott, 2004). Hence, appropriate employee performance metrics are needed to incentivise employees and overcome this resistance (Cooper, 2011; Leifer et al., 2000).

Interestingly, the indicators of innovative organisational culture capability that were removed—customer orientation, technological orientation, and competitor orientation—are the indicators posited by Gatignon and Xuereb (1997), but not by others. As mentioned earlier, these indicators are removed because they show low outer loadings (poor relationship with the construct), suggesting that they do not seem to reflect innovative organisational culture capability. It is suggested that the five indicators retained adequately represent different facets of innovative organisational culture capability and that the three indicators being removed are redundant. Relentless innovation emphasises the willingness to satisfy both current and future customer demands, which captures customer orientation; entrepreneurial orientation seeks new business opportunities including facing new competitors, which captures the competitor orientations; and learning orientation encourages experimentation such as playing with new technologies, which captures the technological orientation. Hence, removing the three indicators does not compromise the overall meaning of the determinant. Removing the three indicators is consistent with the literature, in the sense, innovative organisational culture capability has been represented without these indicators (e.g. Cooper, 2011; Hult et al., 2004; Leifer et al., 2000; Tellis & Golder, 1996).

6.6.1.5 Innovative product development capability as the determinant of radical product innovation

Innovative product development capability (IPDC in Figure 6.5) is defined as the ability of an organisation to conduct radical product development. It embodies best radical product development practices based on the current literature.

Based on the internal consistency reliability measured in section 6.4.1, innovative product development capability as a construct retains only four of the six indicators initially chosen. The indicators that are retained are a full-time project leader, a multi-disciplinary team, a well-structured product development process, and well executed product development activities (a more structured process for a higher level of uncertainty); the indicators that are removed are a project champion and a compelling business case. How innovative product development capability can determine radical product innovation in the light of the new meaning based on the four indicators retained, and the two indicators removed, is discussed below.

Firstly, a full-time project leader is suitable for radical product development because without a committed full-time project leader, a radical project can become suboptimal, as the project leader works on other projects. This finding is consistent with the literature (e.g. Booz et al., 1982; Cooper, 2011; Holahan et al., 2014).

Secondly, a multi-disciplinary team is suitable for radical product development because a multi-disciplinary team allows for diversity in training and knowledge sharing for the development of new technology and value proposition. This finding is consist with the literature (e.g. Booz et al., 1982; Cooper, 2011; Holahan et al., 2014).

Thirdly, a well-structured product development process is suitable for radical product development because a well-structured product development process brings in structure and control. This helps reduce project risks and uncertainties. This finding is consistent with the literature (e.g. Booz et al., 1982; Cooper, 2008; Holahan et al., 2014).

Lastly, well executed product development activities mean bringing in more structure as the project level of uncertainty increases. The inclusion of this indicator reinforces this study's position that more structure is needed to cope with high level of uncertainty created by radical product innovation, and not more flexibility. This is consistent with the literature (e.g. Cooper, 2011; Cooper & Kleinschmidt, 1987; Holahan et al., 2014).

The project champion being removed as an indicator of innovative product development capability seems to suggest that the role of a project champion is less vital for building that capability. A full-time project leader and formal product development process can protect radical projects, eliminating the need of a project champion. A compelling business case being removed as an indicator of innovative product development capability suggests that a compelling business case may be better associated with the project's commercial outcome rather than its degree of innovativeness. Radical product innovation, based on its definition, is expected to be compelling as a business case from the fuzzy front end of the development. Hence, it is argued that both indicators being not considered as indicators of innovative product development capability makes some practical sense.

6.6.2 Theoretical relationship between the determinants of radical product innovation and the interpretation of the results from a practical perspective

The measurement model (Figure 6.5) shows most of the theoretical relationships being significant. However, as shown earlier, three relationships were not found to be significant. These three relationships are the direct relationships that top management innovation capability, internal innovation capability, and external networking capability have with innovative product development capability. In addition, the relationship between internal innovation capability and external networking capability was found to be negative—a finding contrary to what was hypothesised. To explain and discuss the direct and indirect effects of the causal variables on effect variables, the measurement model is partitioned into several sections (section 6.6.2.1 to 6.6.2.5), each corresponding to a specific effect variable. The theoretical relationships between the determinants and their interpretations from a practical perspective are provided within these sections.

6.6.2.1 Causal antecedents of product innovativeness

Looking at the two causal antecedents of product innovativeness in Figure 6.11, it is clear that innovative organisational culture capability (IOCC) has a direct effect of 0.422 on product innovativeness (PI) and an indirect effect of 0.139 (= 0.562 * 0.247) through innovative product development capability (IPDC), resulting in a total effect of 0.561 (= 0.422 + 0.139), which is substantial. This finding is consistent with the literature that have posited that companies with innovative organisational culture are more willing to pursue radical product innovation than those without it (e.g. Chandy & Tellis, 1998; Herrmann et al., 2006; Tushman & O'Reilly, 1996). Similarly for IPDC, companies that utilise innovative product development practices are better prepared to successfully conduct radical product development (e.g. Cooper, 2011; Holahan et al., 2014; McDermott & O'Connor, 2002), leading to a total effect of 0.247 between IPDC and PI.

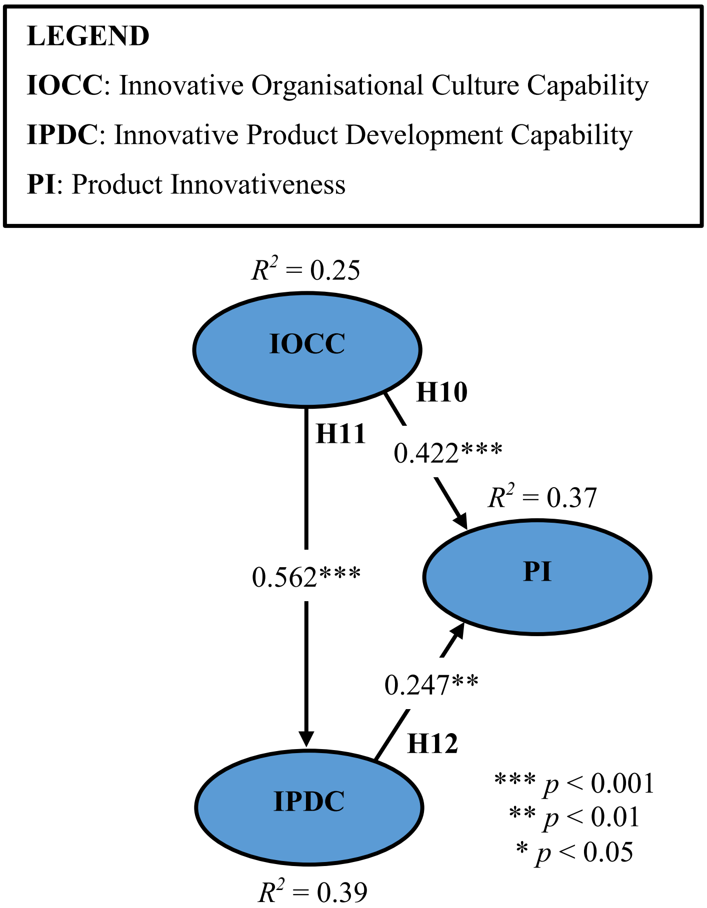


Figure 6.11: The direct and indirect effects of the two causal antecedents of PI

From a practical perspective, companies with innovative organisational culture or strong IOCC mean that they are willing to take more risks in pursuing innovative products with high returns (i.e. being entrepreneurial). They are also more receptive to product ideas that could make their existing products and/or investments obsolete. This orientation is similar to the "willingness to cannibalise" originally proposed by Chandy and Tellis (1998) and "willingness to abandon investments" later developed by Herrmann et al. (2006). In these companies, organisational inertia or core rigidities are less likely to be an issue because they have a strong determination to develop their products to commercialisation, despite any difficulty—that is, relentless innovation (Tellis & Golder, 1996) and learning orientation to learn from failures (Hult et al., 2004). Furthermore, the innovation objectives (i.e. product innovation strategy) are likely to be well communicated across the whole organisation and valuable employees or innovators are recognised and rewarded through appropriate employee performance metrics, creating the right climate and environment for innovation, as recommended by Cooper (2011) and Leifer et al. (2000).

Similarly, companies who utilise innovative product development practices or have strong IPDC can conduct radical product development more efficiently and effectively. Examples of innovative product development practices include having a full-time project leader to commit to each radical project and a multi-disciplinary product development team. As the projects become more complex or uncertain, companies put in more effort in understanding the challenges in order to reduce risks. This means ending poorly performing projects early so that they can devote resources towards projects that are more likely to succeed. Most importantly, companies should have a formal product development process, such as a Stage-Gate process (Cooper, 2008).

The strong relationship between IOCC and IPDC (total effect of 0.562) also supports the proposed research hypothesis **H11** that innovative organisational culture leads to more adoption of innovative product development practices across the whole organisation. This relationship is consistent with the model posited by Slater et al. (2014). Moreover, a new argument here is that this relationship could be bidirectional. Slater et al. (2014) only consider a unidirectional relationship in their model. However, based on the interview finding from Company E, it is very likely that IPDC can positively affect IOCC as well. This is because IPDC allows the companies to reduce risks associated with radical product development through more structure and control. This implies that the companies can better cope with uncertainties leading to more positive beliefs towards radical product ideas. This finding supports the finding of Herrmann et al. (2006) that links innovative product development practices to supportive innovation culture (i.e. willingness to abandon investments). The conclusion is that this study sheds new insights onto existing literature on how PI is caused via IOCC and IPDC.

6.6.2.2 Causal antecedents of innovative organisational culture capability

Looking at the three causal antecedents of innovative organisational culture capability (IOCC), in Figure 6.12, it is clear that top management innovation capability (TMIC) causes the most effect on IOCC both directly and indirectly through the mediating variables, internal innovation capability (IIC) and external networking capability (ENC). This indicates the important role TMIC plays in establishing IIC and ENC, leading to IOCC.

LEGEND

TMIC: Top Management Innovation Capability

IIC: Internal Innovation Capability

ENC: External Networking Capability

IOCC: Innovative Organisational Culture Capability

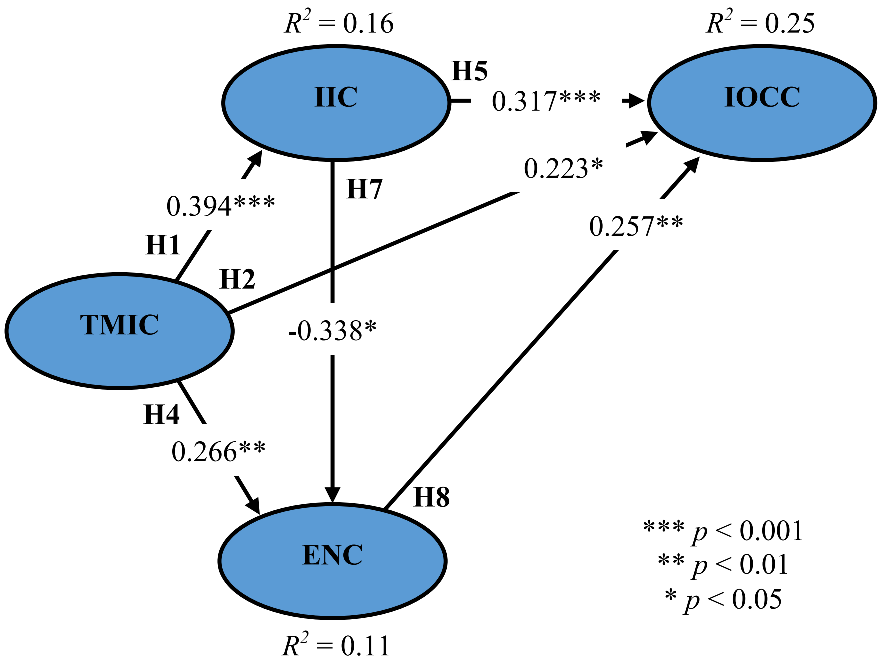


Figure 6.12: The direct and indirect effects of the three causal antecedents of IOCC

The total effect of TMIC on IOCC (= 0.382) can be partitioned into direct and indirect effects as follows.

Direct effect of TMIC on IOCC = 0.223

Indirect effect of TMIC on IOCC via ENC = (0.266 + 0.394 * -0.338) * 0.257 = 0.034

Indirect effect of TMIC on IOCC via IIC = 0.394 * 0.317 = 0.125

Total effect of TMIC on IOCC = 0.223 + 0.034 + 0.125 = 0.382

From Figure 6.12, it is clear that the indirect effect of TMIC on IOCC, through the mediating variables IIC and ENC, is weakened by the negative effect of IIC on ENC (-0.338). This negative relationship between IIC and ENC is unexpected since it was originally hypothesised that IIC would have a positive effect on ENC, according to the theory of absorptive capacity (Cohen & Levinthal, 1990). Still, Cohen and Levinthal

(1990) did point out the possibility for a negative effect due to the not-invented-here (NIH) syndrome, where a company resists accepting innovative ideas from outside in favour of internally originated ideas.

In regard to the present study, the negative effect may indicate the same (existence of NIH syndrome) in New Zealand food and beverage companies. It is also possible that the idea of open innovation is not widely adopted by the New Zealand food and beverage companies (an expected outcome for the food and beverage industry (Bigliardi & Galati, 2013b; Sarkar & Costa, 2008)), making them more likely to rely on IIC at the cost of ENC. This negative relationship is discussed in greater detail in section 6.6.2.4.

IIC have the total effect of 0.230 on IOCC. The total effect of IIC on IOCC is partitioned into direct and indirect effect as follows.

Direct effect of IIC on IOCC = 0.317

Indirect effect of IIC on IOCC via ENC = -0.338 * 0.257 = -0.087

Total effect of IIC on IOCC = 0.317 - 0.087 = 0.230

Again, the negative relationship between IIC and ENC contributes negatively to the total effect IIC has on IOCC. This suggests that a strong IIC can contribute both positively and negatively to IOCC: positively by giving the company the ability to solve technical and market problems effectively, and negatively by making the company more close-minded, leading to myopia. However, the positive effect appears to significantly outweigh the negative effect—an expected outcome consistent with the literature that recommends companies to leverage their internal competencies when pursuing radical product innovation (e.g. Kleinschmidt & Cooper, 1991; Prahalad & Hamel, 1990; Tellis & Golder, 1996).

ENC has a total effect of 0.257 on IOCC (ENC has only a direct effect on IOCC). This shows that having good relationships with external partners can give companies confidence to pursue radical product innovation—an expected outcome consistent with the literature (e.g. Herrmann et al., 2006; McDermott, 1999; Verganti, 2008).

From a practical perspective, top management can directly encourage innovative organisational culture by establishing clear and robust product innovation strategy and objectives, and communicating them across their organisation (Cooper, 2011; Earle et al., 2001). They also need to set up appropriate employee performance metrics (Leifer et al., 2000). By being involved and providing support to innovative projects, top management can demonstrate their values, beliefs, and assumptions to their organisation, leading to an innovative organisational culture (Slater et al., 2014).

Lastly, both IIC and ENC can positively contribute to the innovative organisational culture by providing the companies with the competencies (from internal and external sources) needed to overcome uncertainties. However, as observed empirically, a strong IIC can contribute negatively to ENC. This finding is something that was unexpected and possible explanations are provided in section 6.6.2.4 when covering the causal antecedents of ENC.

6.6.2.3 Causal antecedents of innovative product development capability

Looking at the four causal antecedents of innovative product development capability (IPDC) in Figure 6.13, it is clear that only innovative organisational culture capability (IOCC) has a significant direct relationship with IPDC (= 0.562). Top management innovation capability (TMIC), internal innovation capability (IIC), and external networking capability (ENC) have no significant direct effect on IPDC at 0.05 significance level. However, these three determinants have an indirect effect on IPDC through the mediating variable, IOCC.

Based on the prior calculations in section 6.6.2.2, IOCC is mostly affected by TMIC (total effect = 0.382), followed by ENC (total effect = 0.257), and IIC (total effect = 0.230). This indicates that TMIC plays the biggest role in establishing IPDC through IIC, ENC, and IOCC. This relationship is consistent with the literature that highlights the role top management play in setting up innovative product development practices in their organisation (e.g. Cooper, 2011; Earle et al., 2001; Leifer et al., 2000). However, the relationship does not seem to be as straightforward as the literature seems to suggest. For example, Slater et al. (2014) posit a direct relationship between senior leadership and radical product innovation process in their hypothetical model. However, this relationship is not supported on the empirical analysis conducted in this study. TMIC seems to drive IPDC via the mediating relationships involving other determinants.

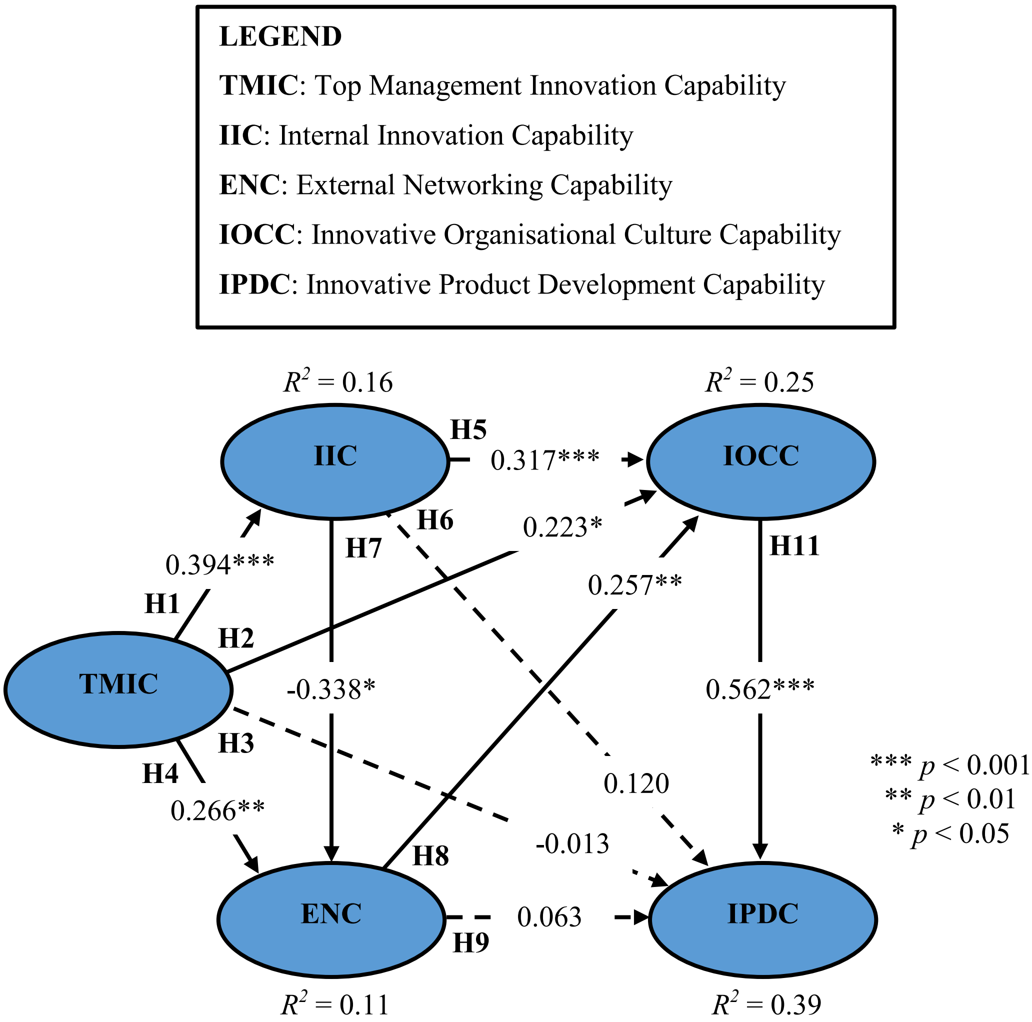


Figure 6.13: The direct and indirect effects of the two causal antecedents of IPDC

A plausible explanation as to why TMIC, IIC, and ENC have no direct relationship with IPDC is that these determinants by themselves do not cause the adoption of innovative product development practices. For individual employees to adopt innovative product development practices, they need to feel a need to adopt these practices; a possibility is that a sizable proportion of organisations that responded to the survey have cultures that resist change and/or weak change management climates. If their values, beliefs, and assumptions are not in alignment with those of their top management, it is possible they would not want to follow the practices imposed upon them by the top management. This argument is similar to the argument provided by Tushman and O'Reilly (1996); they argue that the companies need to have the right organisational innovation culture before they can conduct radical product development. Without the right organisational innovation culture, top management are likely to face strong organisational resistance to radical product innovation (Cooper, 2011; Leifer et al., 2000; Tushman & O'Reilly, 1996). Companies with the right innovative organisational culture are likely to adopt innovative product development practices more successfully (Cooper, 2008).

From a practical perspective, a company's IPDC is greatly dependant on its IOCC, and IOCC is greatly dependent on TMIC. Therefore, top management should ensure their companies have the right organisational culture (if not, they have to act as change agents) before attempting to implement innovative product development practices. In practice, this means top management needs to establish a robust product innovation strategy and appropriate employee performance metrics (or human resource strategy) that are well communicated across the organisation. Top management should also have values, beliefs, and assumptions that are favourable for innovation, such as relentless innovation, entrepreneurship, and openness to experimentation. Once the right organisational culture/climate is created, top management should find it easier to implement innovative product development practices across the whole organisation. Lastly, IIC and ENC still have some impacts on IPDC via IOCC. Top management should ensure the internal competencies and external partners are in alignment with their company's overall product innovation strategy to avoid incompatibility (Leonard-Barton, 1992; Tushman & O'Reilly, 1996).

6.6.2.4 Causal antecedents of external networking capability

Looking at the two causal antecedents of external networking capability (ENC) in Figure 6.14, it is clear that top management innovation capability (TMIC) has a direct effect of 0.266 on ENC, which is consistent with the literature (e.g. McDermott, 1999; Slater et al., 2014; Verganti, 2008). However, TMIC's indirect effect on ENC via the mediating variable, internal innovation capability (IIC), has a negative value of -0.133 (being 0.394 * -0.338). This negative indirect effect significantly lowers the total effect TMIC has on ENC (0.266 – 0.133 = 0.133) to the point that at 5% significance level, TMIC has no significant total effect on ENC (see Table 6.9).

As mentioned earlier in section 6.6.2.2, the negative relationship between IIC and ENC is an unexpected result. The negative relationship indicates that New Zealand food and beverage companies are less likely to collaborate (or lose an ability to collaborate effectively) as they strengthen their IIC. This finding is different from other country studies of the food and beverage industry (Martinez & Briz, 2000; Siriwongwilaichat &

Winger, 2004). This points to the cause of the negative relationship being due to a unique nature of food and beverage companies in New Zealand. Some possible explanations for the negative relationship are provided as follows.

Firstly, New Zealand food and beverage companies could be suffering from the not-invented-here (NIH) syndrome. Since food consumers are generally conservative, food and beverage companies are more likely to focus on their core products and invest in specialised investments (such as specialised knowledge, training, processes, machines, and equipment). In the long run, this can lead to a situation of the NIH syndrome where a company is less likely to collaborate or seek external knowledge (Cohen & Levinthal, 1990). This situation is similar to the situation where a company is too committed on its core competencies or specialised investments (Chandy & Tellis, 1998; Leonard-Barton, 1992).

Secondly, New Zealand food and beverage companies could be suffering from a lack of open innovation mindset or a *closed innovation mindset* where a company only generates, develops, and commercialises its own ideas (Chesbrough, 2003). The closed innovation mindset means the company is less willing to collaborate with external partners, typically at the cost of their product innovativeness performance (Beckeman et al., 2013; Saguy & Sirotinskaya, 2014; Ziggers, 2005). Based on the previous discussion in section 3.4.3, the reasons food and beverage companies reject open innovation mindset include a lack of trust and communication, incremental product innovation orientation, and a low level of competitive pressure. As suggested by Martinez et al. (2014), food and beverage companies need a dedicated architecture for collaboration; this includes having supportive organisational structures, supportive management actions, collaboration mindset, and IP protection mechanisms. New Zealand food and beverage companies may also need to adopt a new product development process that is based on the open innovation model as suggested by Khan (2014).

Lastly, New Zealand food and beverage companies could be suffering from the unique New Zealand contextual factors of small population and relative geographical isolation. Small population means there are fewer local external partners to work with. The geographical isolation means higher cost to collaborate, especially with external partners located in other countries. These innovation challenges could force New Zealand food and beverage companies to rely on their IIC instead of ENC for product innovation, resulting in the negative relationship between IIC and ENC.

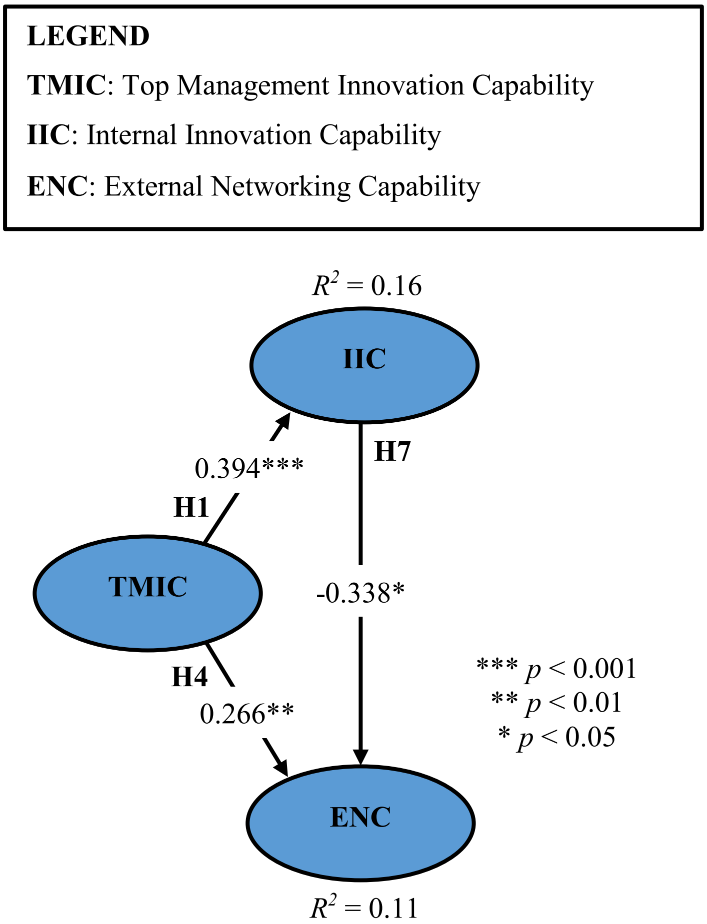


Figure 6.14: The direct and indirect effects of the two causal antecedents of ENC

From a practical perspective, there are several forms of relationships a company can pursue with external partners depending on their needs such as alliances, contracts, and partnerships (McDermott, 1999; Olleros, 1986; Teece, 1986). Top management can also contribute to building these relationships by representing the company themselves. This is particularly so in small companies (flat organisational structures) where top management is usually directly responsible for building relationships with external partners.

Lastly, companies need to be aware of their tendency to overvalue IIC over ENC. It is recommended for future study to investigate the cause of the negative relationship between IIC and ENC. Still, some practical recommendations based on the possible reasons are provided. First, companies can remedy the NIH syndrome by having a policy that promotes more communication and sharing of information among the project teams and external sources (Katz & Allen, 1982). Second, top management can promote an open innovation mindset in their organisation by preparing a dedicated architecture for collaboration (Martinez et al., 2014), or selecting an innovation project that promotes exploration (Danneels, 2002). Lastly, the food clusters in New Zealand can help companies connect with valuable external partners, reducing cost and saving time.

6.6.2.5 Causal antecedent of internal innovation capability

Looking at the one causal antecedent of internal innovation capability (IIC) in Figure 6.15, it is clear that top management innovation capability (TMIC) has a total effect (a direct effect only) on IIC of 0.394, which is consistent with the literature (e.g. Cooper, 2011; Earle et al., 2001; Slater et al., 2014).

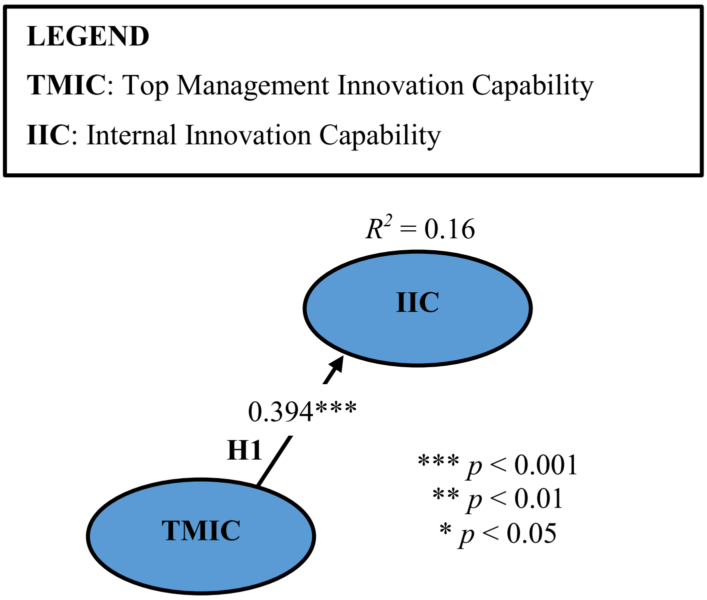


Figure 6.15: The direct effect of the one causal antecedent of IIC

From a practical perspective, top management can develop their organisation's internal competencies through their product innovation strategy. The product innovation strategy guides the resource allocation and project selection of the company (Cooper, 2011). This indicates the critical role top management play in determining their organisation's ability to stay competitive. This is because their decision will determine how IIC evolves in the company over time (Danneels, 2002; Leonard-Barton, 1992; McDermott & O'Connor, 2002). Consequently, top management need to be capable of selecting the resources and projects that increase the value (i.e. competitiveness) of the IIC of the company. Teece (1986) recommends companies investing in internal resources that are critical to the product's core technology and value proposition that are also difficult to duplicate by competitors—at the same time, outsourcing complementary and supplementary resources that are easily duplicated. Predictive tools such as the S-Curve (Foster, 1986), industry phase (Abernathy & Utterback, 1978), disruptive innovation model (Christensen & Raynor, 2003), technological discontinuities (Anderson & Tushman, 1990), technological evolution (Sood & Tellis, 2005), and technology roadmapping (Phaal et al., 2004) are useful in reducing uncertainties and project selection. Most importantly, top managements' mass market vision, persistence, financial commitment, relentless pursuit of innovation, and IIC leverage can determine the long-term competitive advantage of their company (Tellis & Golder, 1996).

6.6.2.6 Conclusion of the discussion on the interconnectedness of the determinants of radical product innovation

The relationships hypothesised in the path model containing the determinants of radical product innovation was discussed in detail in section 6.6.2, partitioning the cause and effect relationships, taking one endogenous variable at a time as the effect/explained variable. In the previous section (section 6.6.1), each determinant of radical product innovation was discussed. Thus, it is argued that RQ2 has been answered comprehensively in this chapter.

6.6.3 Company characteristics affecting product innovativeness

From the multi-factor analysis of variance in section 6.5, factors of company age and company size are found to have a significant effect on product innovativeness in New Zealand food and beverage companies, whereas the factor of company ownership (fully New Zealand owned, partially overseas owned, and overseas majority owned) is found to have no significant effect on product innovativeness. A discussion on these findings, paying attention to the three hypotheses on the effects of company characteristics on radical product innovation (hypotheses **H13**, **H14**, and **H15** in section 3.6.2 in Chapter 3) follows.

6.6.3.1 Company age

The company age is found to have a negative effect on the product innovativeness of New Zealand food and beverage companies, supporting the hypothesis (**H13**) that "there is a greater level of acceptance for product innovativeness in younger New Zealand food and beverage companies than in older companies." The practical perspective of the test result of **H13** can be interpreted as follows.

Younger New Zealand food and beverage companies need to introduce more innovative products for survival and growth, relative to their older counterparts. These young companies are likely to be industry entrants (e.g. start-ups) or spinoff companies from industry incumbents or universities as a result of their scientific research. To survive and thrive, these companies need to gain market share and generate revenue. One of the ways they can achieve this is by introducing innovative products, in order to differentiate themselves in their marketplace. This explanation is consistent with the literature (Abernathy & Utterback, 1978; Tushman & Anderson, 1986).

Over time, as these companies achieve success in their marketplace (i.e. gain maturity), they introduce less innovative products. One reason is simply that they no longer need innovative products to succeed (they are already established). This was found to be the case in Company A, B, and C interviewed; during their early years these companies had introduced radical products; currently the three companies focus primarily on incremental product innovation to maintain their market share. Company D and E on the other hand continue to maintain same level of product innovativeness to satisfy their desire for growth.

Another potential explanation of **H13** test result (from a practical perspective) is that companies become less innovative over time due to accumulated resources and experience (Balasubramanian & Lee, 2008; Tushman & O'Reilly, 1996). With more accumulated resources and experience, it becomes more costly for companies to make major changes to them (Abernathy & Utterback, 1978; Balasubramanian & Lee, 2008). The high adjustment cost often leads to organisational inertia or core rigidities that inhibits companies from pursuing radical product innovation (Leonard-Barton, 1992; Tushman & O'Reilly, 1996). Consequently, older companies are less likely to accept innovative product ideas because they require too much adjustment to their accumulated resources and experience.

On the contrary, Capitanio et al. (2010), Ziggers (2005), Martinez and Briz (2000), and Rama and Tunzelmann (2008) identify accumulated resources and good R&D experience as being necessary for radical food product innovation. These resources are a function of the company's internal innovation capability instead of the company age. This is because radical product innovation often obsoletes existing internal competencies (e.g.

accumulated resources and R&D experience), forcing the companies to transform them. The companies that are unable to transform their internal competencies are said to suffer from age-related innovativeness deficiency. This makes this finding consistent with Capitanio et al. (2010), who found a weak negative relationship between company age and new product adoption in the Italian food industry.

In summary, empirical data support **H13** and there is a practical basis for the test results.

6.6.3.2 Company size

The company size is found to have a positive effect on the product innovativeness of New Zealand food and beverage companies, supporting the hypothesis (**H14**) that "larger New Zealand food and beverage companies are more likely to have a higher level of product innovativeness than smaller counterparts". Medium to large companies are found to introduce more innovative products compared to micro to small companies.

The reason why medium and large companies are more innovative than micro and small companies could be that large companies are more capital intensive (a plus point for research and development) and they have a larger customer base to work on in introducing new products. Another reason could be that larger companies can better respond to changes in macro environmental factors and forces. Today, food product development is becoming more complex due to increasing regulation and sophisticated consumer needs (Bigliardi & Galati, 2013a; Figiel & Kufel, 2016). More resources in the form of specialised personnel are likely needed in this situation. This is supported by the interview findings where a larger company (Company E) introduced a much higher number of radical product innovations compared to smaller companies.

According to Rama and Tunzelmann (2008), smaller food and beverage companies may need to surpass a minimum company size to successfully launch new products. This is supported by data in the sense for 6-49 size category, the mean PI score was below 5 (5 is "somewhat agree" while 6 is "agree"); whereas for the 50-99 size category, the mean score jumped above 5.25 as shown in Figure 6.9 (in section 6.5). Hence, the data suggests that the minimum company size for New Zealand food and beverage companies to successfully launch new products is 50+ full-time employees.

Nevertheless, smaller food and beverage companies could innovate and compete with larger companies by building alliances with other companies. They can also seek funding and assistance from the New Zealand Government, Crown Research Institutes, Universities, and New Zealand food innovation hubs. Moreover, smaller companies can become more agile, in being more responsive to changing customer needs; the smaller companies could use web resources (e.g. the internet) to compensate for any lack of specialised knowledge to remain innovative. These balancing acts notwithstanding, data analysis shows that the size has almost the same effect as the age on product innovativeness, as shown earlier using the *F* ratios of age and size in factorial analysis of variance (Table 6.11).

In summary, the findings are consistent with the expected outcome on **H14** and the majority of literature supports the proposition that larger food and beverage companies introduce more innovative products (e.g. Baregheh et al., 2012; Capitanio et al., 2010; Martinez & Briz, 2000; Tomas et al., 2014; Ziggers, 2005).

6.6.3.3 Company foreign ownership

The factor of company foreign ownership (3 levels were chosen) is found to be non-significant, meaning that at 0.05 significance level, there is no empirical support for **H15**: "New Zealand owned food and beverage companies are more innovative than overseas owned companies". This finding is similar to the finding by Siriwongwilaichat and Winger (2004) albeit in a different context; they found a non-significant relationship between ownership (foreign versus local) and product innovativeness, in Thai food manufacturing companies. However, in the case of the present research, the non-significant result could be attributable to low statistical power due to not having sufficient data on partially New Zealand owned and overseas majority owned companies (see Figure 6.3).

Based on the overseas studies by Sadowski and Sadowski-Rasters (2006) and Guadalupe et al. (2012), foreign companies often purchase domestic food and beverage companies based on their innovation performance and potential growth. The foreign companies then transfer superior technologies, knowledge, and organisational practices to the acquired companies, boosting their innovation performance. This suggests that having access to overseas investments can be beneficial for New Zealand food and beverage companies, whose resources are often limited due to the small local population.

It is argued that foreign ownership is also not without its baggage. Foreign ownership can bring different values and expectations that could negatively affect the acquired companies. For example, company founders could leave the company after it was acquired and take with them the company's top management innovation capability. Similarly, the change in organisational practices could negatively affect the company's entrepreneurial characteristics. Given New Zealand's strong scientific research base and training and its innovative national culture, it could be that New Zealand owned companies are as innovative (if not more innovative) as overseas owned companies.

In summary, the findings on **H15** is inconclusive since there were not enough overseas owned companies to confidently reject the possibility of a false null hypothesis. It is suggested that having a foreign ownership or investment from overseas companies can be beneficial for New Zealand food and beverage companies so long as they do not negatively affect the determinants of radical product innovation.

6.6.3.4 Overall conclusion on the effect of characteristics on product innovativeness

The overall conclusion is that discussion of test results on the three research hypotheses on company characteristics (age, size, and type of ownership) enabled the researcher to answer the third research question (RQ3): "what company characteristics affect product innovativeness in the New Zealand food and beverage industry?".

It is important to note that more discussion was provided in the previous chapter (qualitative data analysis and discussion) on RQ3.

6.6.4 Salient features of a highly innovative New Zealand food and beverage company

There is nothing better than a theoretical model to predict and explain a phenomenon. The theoretical model (tested via PLSPM empirically) explains how PI is caused. Thus, it could be argued that a highly innovative New Zealand operated food and beverage company is a company that excels in TMIC, IIC, ENC, IOCC, and IPDC, although IIC was found to be affecting PI negatively, via ENC. This coupled with the fact that a theoretical model explains only part of the story (R^2 values of endogenous variables were ranging between 0.11 to 0.39 as shown in Figure 6.5) means that additional investigations need to be done to discuss the salient features of highly innovative New Zealand operated food and beverage companies.

For aforementioned reasons, the salient features of highly innovative New Zealand food and beverage companies are identified by triangulating the results from the theoretical model (PLSPM), ANOVA results on company characteristics, and qualitative interview data analysis (Chapter 5).

First, all the survey respondents (137 companies) are ranked according to their mean product innovativeness (PI) scores from highest to lowest. These respondents are then separated into three groups: highly innovative companies, moderately innovative companies, and low innovative companies. The cut off points are one standard deviation away from the mean of all mean PI scores (mean = 5.03, SD = 1.19). Thus, highly innovative companies have their mean PI scores higher than 6.22, moderately innovative companies have their mean PI scores between 3.84 and 6.22, and low innovative companies have their mean PI scores lower than 3.84. Figure 6.16 shows the distribution of respondents' companies by their degree of innovativeness. Of all the respondents, there are 22 low innovative companies, 89 moderately innovative companies, and 26 highly innovative companies.

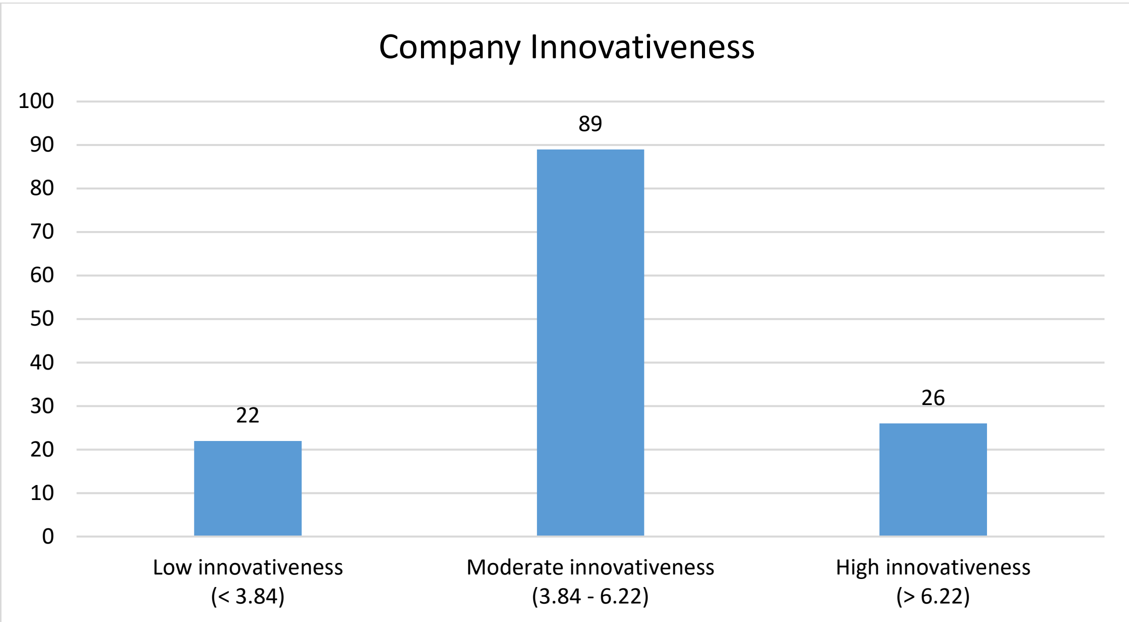


Figure 6.16: Distribution of the companies by innovativeness

Participants from four of the five companies interviewed (Company B, C, D, and E) also participated in the survey. Their company characteristics (age and size), mean determinant scores (calculated according to the mean of retained indicators) and mean PI scores are provided in Table 6.14 (thankfully, the respondents of the four companies that were interviewed provided their contact details in the quantitative survey, which enabled the researcher to identify these companies).

The mean PI scores for Company B and C suggest that they are low innovative companies, which is expected, given they have become less innovative due to their maturity (company age). Company E has the highest PI score (= 7, which is the maximum a company can score); this is an expected result given their strong research facilities. Interestingly, Company D, who referred to themselves as an incrementally orientated company, returned a moderately innovative score. This reflects the fact that they constantly introduce new products, driven by top management (Company D returns a high TMIC score).

Table 6.14: Mean Determinant Scores, and Mean PI Scores of the Companies Interviewed, Along with Their Characteristics

Company	Age	Size	TMIC	IIC	ENC	IOCC	IPDC	PI
B	1951-2000	0-5	3.4	4.25	2	1.8	2.75	2 (Low)
C	2001-present	6-49	5.4	2.5	7	3.2	1.75	2.5 (Low)
D	1951-2000	6-49	6.2	5	2.5	3	2	4.5 (Moderate)
E	2001-present	99+	6.4	7	3.5	6.6	7	7 (High)

Furthermore, their mean determinant scores show consistent patterns with the PLSPM results where they become more innovative as their determinant scores increase. The only outlier is the high ENC score for Company C but low PI (= 2.5). Company C appears to rely on their suppliers (the fieldwork suggested so), possibly for new ingredients and formulas, more than their own internal competencies. As a result, they would be investing more in their ENC at the cost of their IIC; this is reflected in their low IIC score.

In the following sections (sections 6.6.4.1 through to 6.6.4.3), companies from each group of innovativeness are randomly selected, and additional qualitative data are collected from these companies through their publicly available administrative records, in order to explore their salient features.

6.6.4.1 Highly innovative New Zealand food and beverage companies

Highly innovative companies are companies that return a mean PI score higher than 6.22 (with 7 being the maximum). Based on PLSPM results, highly innovative New Zealand food and beverage companies will return high determinant scores. In addition, the ANOVA results indicate that highly innovative companies tend to be medium to large (50+ full-time employees) in size and young (founded since 2001) in age. Company E matches with all the predicted characteristics and determinant scores.

From the additional qualitative data collected on highly innovative companies (of the 26 highly innovative companies, only one were unidentifiable and remained anonymous), it was revealed that these companies have an established position in their marketplace and are often recognised as innovators with many innovation awards. These companies like to promote their products based on their originality (e.g. new-to-market technologies and/or value propositions) and superiority to competing products.

Top management often play a big role as the chief innovator in smaller companies and their innovation capability comes from their prior experience in the industry. In larger companies, top management see product innovation as a competitive strategy for their companies.

Highly innovative companies also have diverse internal competencies and external relationships. The internal competencies range from R&D facility, production facility, sales office, and distribution facility, for example. The external relationships in these companies are often in the form of alliances and partnerships with other companies both domestic and international. Some highly innovative companies partner with the Crown Research Institutes (e.g. Plant and Food Research) to develop many of the world's first products.

Lastly, highly innovative companies have both an innovative organisational culture and innovative product development practice. Their cultures (i.e. values, beliefs, and assumptions) often include relentless innovation, risk taking, and experimentation, while their product development practices focus on delivering innovative and superior new products. It is important to note that the salient features described here on highly innovative companies apply to the aggregate and that there will always be exceptions (outlier organisations).

6.6.4.2 Moderately innovative New Zealand food and beverage companies

Moderately innovative companies are companies that return a mean PI score between 3.84 and 6.22. Based on PLSPM results, moderately innovative New Zealand food and beverage companies will have moderately high determinant scores. In addition, the ANOVA results predict that these companies tend to be small to medium (6-99 full-time employees) in size and young-mature (founded before 2001) in age. The characteristics and determinant scores of Company D support these predictions.

From the additional qualitative data collected (wherever possible), these companies have an established position in their market. Moderately innovative companies promote their new products based on their superior quality and reliability and less on originality and innovativeness.

Top management in moderately innovative companies also drive innovations in both small and large companies. However, their role as the innovator is not as prominent and recognisable as in highly innovative companies.

Most moderately innovative companies also seem to have diverse internal competencies and external relationships. However, they are not as sophisticated as highly innovative companies. Some companies also seem to rely on the Crown Research Institutes to help conduct R&D.

Lastly, the moderately innovative companies appear to have some innovative organisational culture and innovative product development practices. Their cultures often include continuous innovation and process improvement, while their product development practices focus on delivering superior new products. Again, the reader is cautioned that the salient features described here on moderately innovative companies apply to the aggregate and that there will always be outlier organisations.

6.6.4.3 Low innovative New Zealand food and beverage companies

Low innovative companies are companies that return a mean PI score less than 3.84 (1 being the minimum possible). Based on PLSPM results, low innovative New Zealand food and beverage companies will return low determinant scores. In addition, the ANOVA results predict that these companies tend to be micro (0-5 full-time employees) in size and young-mature (founded before 2001) in age. This is mostly consistent with the characteristics and determinant scores of Company B and Company C.

From the additional qualitative data collected (wherever possible), these companies have an established position in their marketplace. In this situation, the companies rely on product packaging and branding to differentiate since their products are pretty similar to others in the market.

Top management in low innovative New Zealand food and beverage companies still tend to have a role in product development. However, their attention is on incremental product innovation rather than radical product innovation.

Low innovative New Zealand food and beverage companies appear to have a limited range of internal competencies and external relationships. Their internal competencies and external relationships tend to be limited to those needed for their core products.

Lastly, low innovative New Zealand food and beverage companies tend to have a certain degree of innovative organisational culture and innovative product development practices. Some companies do tend to promote continuous product innovation and process improvement, and their product development practices focus on refining and improving their current products.

6.6.4.4 Conclusions on salient features of highly innovative New Zealand food and beverage companies

Findings based on mean PI scores of the respondents, empirical test results on the hypothesised theoretical model on PI, ANOVA results on PI, and publicly available administrative records of companies (ones that are identifiable via the survey) were all triangulated to provide a more reliable discussion on RQ4: “what are the salient features of a highly innovative New Zealand food and beverage company?”.

Instead of observing the results of highly innovative companies only, the results of moderately innovative and low innovative companies were discussed to show how highly innovative New Zealand food and beverage companies can be reliably distinguished from other companies. Thus, it is argued that RQ4 has been answered adequately in this chapter.

6.7 Chapter Summary

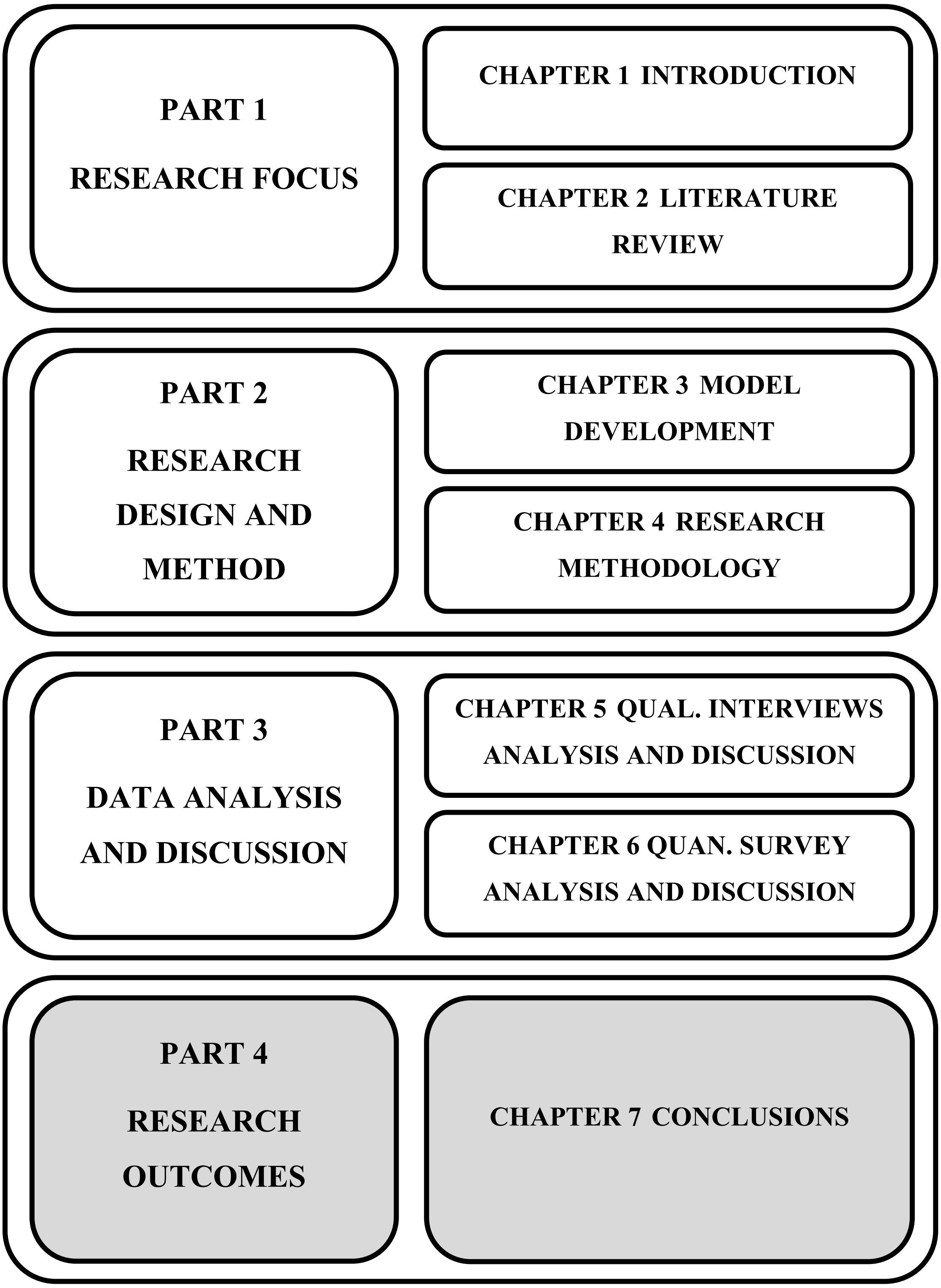
This chapter analysed and discussed the survey data in order to answer the four research questions. In total, 137 responses were used in the analysis. Table 6.15 presents a summary of the survey findings for each of the four research questions. The next chapter concludes the research by summarising what was achieved in each research objective by way of answering the research questions, along with implications for future research. The limitations, delimitations, and assumptions are also being discussed.

Table 6.15: Summary of Survey Findings

Research Question	Findings
RQ1 What are the determinants of radical product innovation in the New Zealand food and beverage industry?	The following determinants were shown to be valid and reliable determinants of radical product innovation (RPI). The determinants were validated using convergent and discriminant validity assessment as part of PLSPM. • **Top management innovation capability** – Top management play a critical role in enabling and driving other RPI determinants. • **Internal innovation capability** – Strong internal innovation capability enables a company to solve technical and marketing problems in RPI. • **External networking capability** – Collaboration with external partners allows a company to exploit or leverage external resources for RPI. • **Innovative organisational culture capability** – Innovative organisational culture allows a company to cope with high uncertainty created by RPI. • **Innovative product development capability** – Innovative product development practices increase a chance of successful radical product development. In the case of some determinants, the operational definitions had to be re-defined as not all measures (survey items) that were considered to be reflective of the constructs were found to be reliable and/or valid. The implications of the meaning of the constructs (determinants) in the light of items removed was exemplified and discussed.
RQ2 How do the identified determinants of radical product innovation relate to one another in predicting and explaining product innovativeness?	The theoretical model explains how the identified determinants relate to one another in predicting and explaining product innovativeness. The majority of these relationships (research hypotheses) in the theoretical model were supported by data except **H3**, **H6**, **H7**, and **H9**. Failing to show support for **H3**, **H6**, and **H9** implies that top management innovation capability, internal innovation capability, and external networking capability do not have a direct relationship with innovative product development capability. Failing to show support for **H7** implies that New Zealand food and beverage companies with strong internal innovation capability are less likely to collaborate with external partners. The implications of hypothesis test results were discussed in detail (in some instances findings of the qualitative data analysis covered in the previous chapter were used to bolster the discussion) from a theoretical and practical perspective to comprehensively answer RQ2.

Research Question	**Findings**
RQ3 What company characteristics affect product innovativeness in the New Zealand food and beverage industry?	Hypothesis test results (multifactor ANOVA) confirmed that the factors "company age" and "company size" influence product innovativeness in the New Zealand food and beverage industry. This implies that young (started in 2001 or later) and medium to large size (50+) companies are likely to introduce more innovative products than older and smaller companies because they have more resources and less organisational inertia. The factor "type of ownership" was not supported by data, and hypothesis test results were discussed in detail to comprehensively answer RQ3.
RQ4 What are the salient features of a highly innovative New Zealand food and beverage company?	The theoretical model on RPI phenomenon, mean scores of product innovativeness, ANOVA test results on company characteristics, qualitative data analysis findings, and administrative records of companies were triangulated to comprehensively answer RQ4. In brief, a highly innovative New Zealand food and beverage company tend to have a high degree of the five determinants of RPI and is young (founded since 2001) and medium to large in size (50+). There will always be some innovative maverick companies that will not fit this profile!

PART 4: RESEARCH OUTCOMES



CHAPTER 7 CONCLUSIONS

7.1 Chapter Overview

This chapter concludes the study. Section 7.2 recapitulates the basis of this study, for the benefit of the reader. Section 7.3 covers achievements against each research objective. Section 7.4 covers knowledge contributions of this study to the discipline of product development. Section 7.5 covers the contribution of this study to the practice of product development. Section 7.6 covers the limitations, delimitations, and assumptions of the study. Section 7.7 provides further research recommendations (directions for further research). Finally, section 7.8 concludes this thesis with some final thoughts.

7.2 Recapitulating the Basis of this Research

The food and beverage industry is an important industry in New Zealand and the government plans to triple food and beverage export earnings in the next 15 years. Although radical product innovation is an obvious solution to increase productivity through high value added products, many industries around the world struggle with the idea of radical product innovation—let alone radical food and beverage product innovation. Very little is known, at least in a New Zealand food and beverage industry setting, what causes radical product innovation. This important study was undertaken to fill this gap.

This research aims to explain the radical product innovation phenomenon in the New Zealand food and beverage industry. Its overarching research question chosen for the study is: *what are the determinants of radical product innovation in the New Zealand food and beverage industry, and how do they explain product innovativeness?* This overarching research question was partitioned into four research questions, well informed by the extant literature (Chapter 2). The basis of the research objectives, as shown in the introduction chapter, are these four research questions, in the sense, each research question has a matching, specific research objective (RQ1 with objective 1, RQ2 with objective 2 etc.). In addition, two general objectives were also specified.

The main focus of this chapter is to show how each objective was achieved by comprehensively answering each research question, and how the study makes knowledge contributions and practical contributions to the industry (managerial recommendations).

For ease of reading, the four specific research objectives (first outlined in section 1.4) are repeated as follows.

1. To investigate the determinants of radical product innovation in the New Zealand food and beverage industry (how this objective was achieved by answering RQ1 is given in section 7.3.1).

2. To analyse the relationship between the determinants of radical product innovation and product innovativeness (how this objective was achieved by answering RQ2 is given in section 7.3.2).

3. To identify the company characteristics that affect product innovativeness in the New Zealand food and beverage industry (how this objective was achieved by answering RQ3 is given in section 7.3.3).

4. To identify the salient features of a highly innovative New Zealand food and beverage company (how this objective was achieved by answering RQ4 is given in section 7.3.4).

The two general research objectives (first outlined in section 1.4) are as follows.

1. To contribute new knowledge to product development discipline on the determinants of radical product innovation in the New Zealand food and beverage industry (how this objective was achieved is explained in section 7.4).

2. To provide managerial recommendations to the New Zealand food and beverage companies on how to encourage more radical product innovation in their organisations (how this objective was achieved is explained in section 7.5).

7.3 Achievements against Research Objectives

7.3.1 Answers to research question 1 to achieve objective 1

RQ1 What are the determinants of radical product innovation in the New Zealand food and beverage industry?

In total, five determinants of radical product innovation in the New Zealand food and beverage industry are identified via literature. These determinants are factors that affect the propensity of a company to pursue radical product innovation. They were conceptualised based on organisational capabilities (resource-based view theory) with the New Zealand food and beverage industry as the context. The identified determinants were content-validated through qualitative interviews with five innovative New Zealand food and beverage companies. The validity of these determinants as theoretical constructs, based on the operationalisation used in this research (a quantitative survey questionnaire derived from the literature as shown in section 4.5.2), was tested based on survey data collected from 137 New Zealand food and beverage companies, using the partial least squares path modelling (PLSPM) modelling technique (section 6.4).

From the five determinants, innovative organisational culture capability has the strongest total effect on product innovativeness at 0.561, followed by innovative product development capability (= 0.247), top management innovation capability (= 0.225), external networking capability (= 0.160), and internal innovation capability (= 0.153). The five determinants of radical product innovation in the New Zealand food and beverage industry are summarised as follows.

Determinant 1 – Top management innovation capability

Top management innovation capability (TMIC) can be nominally defined as the top management's ability to manage radical product innovation in their organisation. Top management do not have a direct relationship with radical product innovation. Instead, they drive the four other determinants leading to radical product innovation. This makes top management innovation capability the primary antecedence of radical product innovation. The characteristics of this capability include:

- Top management are highly involved with radical projects.
- Top management provide direction to radical projects.

- Top management are willing to pursue radical projects.
- Top management provide sufficient financial resources to radical projects.
- Top management build external relationships for radical projects.

Further details are found in section 6.6.1.1.

Determinant 2 – Internal innovation capability

Internal innovation capability (IIC) can be nominally defined as an organisation's ability to develop and utilise its in-house technological and market competency for radical product innovation. Strong internal innovation capability enables a company to develop new technologies and value propositions. Examples of in-house technological competency are manufacturing plant and equipment, manufacturing know-how, engineering know-how, and quality assurance tools; and examples of in-house market competency are knowledge of customer needs and processes, distribution and sales channels, communication channels, and company/brand reputation. The characteristics of this capability include:

- Having strong in-house technological competency.
- Having strong in-house market competency.
- Utilising in-house technological competency for radical projects.
- Utilising in-house market competency for radical projects.

Further details are found in section 6.6.1.2.

Determinant 3 – External networking capability

External networking capability (ENC) can be nominally defined as an organisation's ability to collaborate with external partners for radical product innovation. Strong external networking capability enables a company to identify and access valuable resources controlled by key external partners for radical product innovation. The characteristics of this capability include:

- Outsourcing certain competencies for radical projects.
- Building alliances (long-term relationships) with key external partners.

Further details are found in section 6.6.1.3.

Determinant 4 – Innovative organisational culture capability

Innovative organisational culture capability (IOCC) can be nominally defined as an organisation's ability to cope with high uncertainty created by radical product innovation. A company with an innovative organisational culture can tolerate high uncertainty and is more willing to accept and pursue radical product innovation. The characteristics of this capability include:

- Relentless innovation.
- Entrepreneurial orientation.
- Learning orientation.
- Having a clearly defined, robust, and well communicated product innovation strategy.
- Having appropriate employee performance metrics.

Further details are found in section 6.6.1.4.

Determinant 5 – Innovative product development capability

Innovative product development capability (IPDC) can be nominally defined as an organisation's ability to conduct radical product development. A company with innovative product development practices has a better chance to successfully identify, develop, and commercialise radical products. The characteristics of this capability include:

- A full-time project leader.
- A multi-disciplinary team.
- A well-structured or formal product development process.
- An adaptable product development process that increases structure (or control) as the project becomes more uncertain (or risky).

Further details are found in section 6.6.1.5.

In answering RQ1, the study made inroads into the present body of literature because it was shown that some facets of some determinants do not properly apply to at least the New Zealand food and beverage context, the boundary of the study (a detailed discussion is provided in section 6.6.1). A good example is the construct (determinant) ENC, where only two of the four facets (measures, in a psychometric sense) seemed to shape the meaning of ENC, leading the researcher to argue that the ability to identify the key external partners (i.e. outsourcing) and establishing long term collaboration with them (i.e. alliances) may be better indicators of ENC than informal networks and customer collaboration.

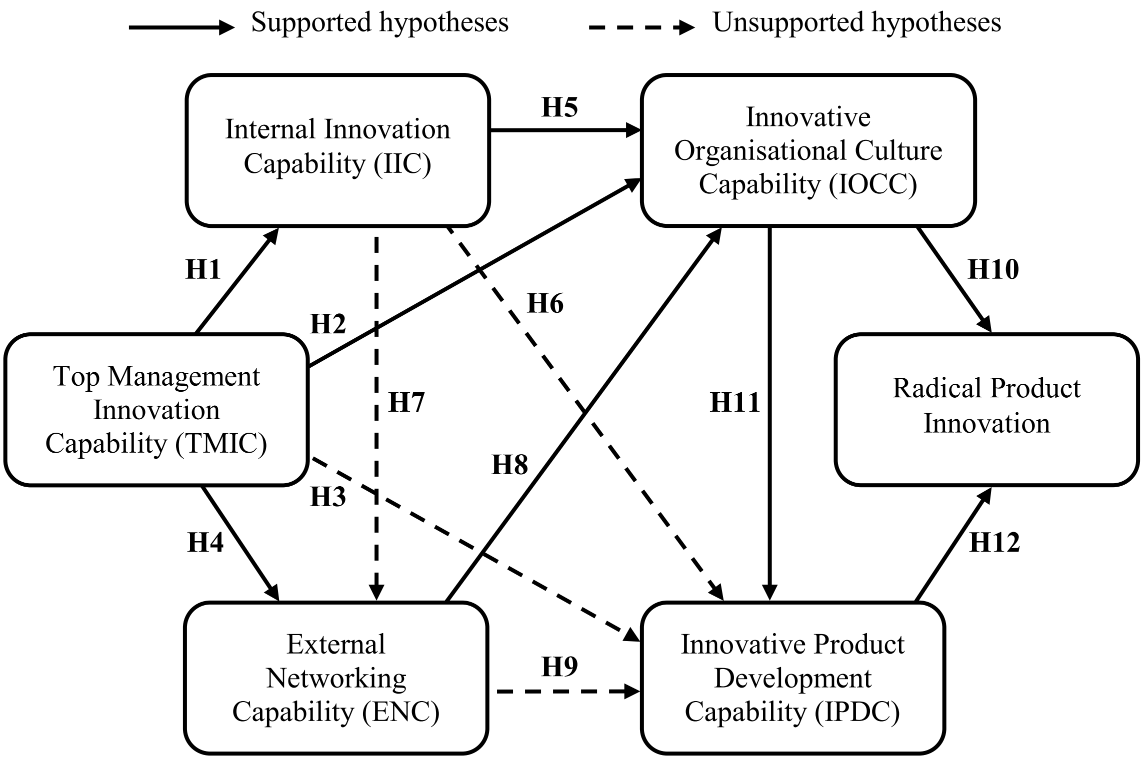
Since each construct was shown to be predicting and explaining in a theoretically (section 6.4.3) and a practically meaningful way (section 6.6.2), it is concluded that the study answers the first research question comprehensively.

7.3.2 Answers to research question 2 to achieve objective 2

RQ2 How do the identified determinants of radical product innovation relate to one another in predicting and explaining product innovativeness?

Stated simply, the causal predictive theoretical model involving the five determinants as explanatory variables and product innovativeness as the explained variable, showing which hypothesised relationships are significant and which are not, answers RQ2. This theoretical model is referred to as the final theoretical model.

The final theoretical model of radical product innovation is presented in Figure 7.1 (the reader may refer to Figure 6.5 in the previous chapter for the estimated strengths of the relationships and their statistical significance). The model shows the interrelationships among the five determinants and product innovativeness (depicted as “Radical Product Innovation” in Figure 7.1). As mentioned earlier, the model was tested through the PLSPM using the quantitative survey data from 137 New Zealand food and beverage companies. The bold arrows represent supported relationships and dash arrows represent unsupported relationships. Unsupported relationships do not invalidate the researcher’s theory because each determinant is linked to another determinant directly or indirectly (i.e. via another determinant) through one or more supported relationships. The relationships (**H1** through to **H12**) are briefly explained as follows.



0.05 significance level (i.e. $p < 0.05$) was used to seek support for the hypotheses

Figure 7.1: Final theoretical model

H1: Top management innovation capability has a positive effect on internal innovation capability (**supported**).

What this supported hypothesis means is that top management establish the product innovation strategy which guides the project selection and resource allocation leading to the development and utilisation of internal competencies (IIC).

H2: Top management innovation capability has a positive effect on innovative organisational culture capability (**supported**).

What this supported hypothesis means is that top management create an innovative organisational culture (IOCC) by demonstrating their commitment to radical projects, establishing a clearly defined, robust, and well communicated product innovation strategy, and setting up appropriate employee performance metrics.

H3: Top management innovation capability has a positive effect on innovative product development capability (**not supported**).

The above unsupported hypothesis means that the data fail to support the hypothesis that TMIC has a direct relationship with IPDC. However, TMIC does affect IPDC indirectly through IOCC. From a practical perspective, this means that top management affect IPDC by establishing a formal product development process that is communicated across their organisation and being involved in radical projects (e.g. setting up project criteria, participating in gate reviews, and giving feedback).

H4: Top management innovation capability has a positive effect on external networking capability (**supported**).

What this supported hypothesis means is that top management can build relationships with external partners. In smaller companies, top management often are directly responsible for building relationships with key external partners. In larger companies, they accomplish this by investing in internal competencies and policies that promote external collaboration.

The supported hypotheses **H1**, **H2**, and **H4** clearly show the role top management play towards radical product innovation by building IIC, IOCC, and ENC. This justifies the label TMIC for the role they play.

H5: Internal innovation capability has a positive effect on innovative organisational culture capability (**supported**).

What this supported hypothesis means is that IIC enables the company to cope with high uncertainty by solving technical and marketing problems, thus enhancing the IOCC.

H6: Internal innovation capability has a positive effect on innovative product development capability (**not supported**).

The above unsupported hypothesis means that the data fail to support the hypothesis that IIC does have a direct relationship with IPDC. However, the indirect relationship through IOCC means that IIC plays its part in building IPDC. From a practical perspective, this means that IIC assists the radical product development team by reducing uncertainty during radical product development, which manifests as an increase in IOCC.

> **H7**: Internal innovation capability has a positive effect on external networking capability (**not supported** because a statistically significant negative relationship was observed instead of a positive relationship).

IIC was found to be negatively related to ENC in this study, contradicting the literature (Martinez & Briz, 2000; Siriwongwilaichat & Winger, 2004). It is proposed that the food and beverage companies in New Zealand could be suffering from three possible conditions: the not-invented-here (NIH) syndrome (prejudice against external ideas and innovations), a closed innovation mindset, and a high cost of collaboration (due to small local population and geographical isolation). However, future study is required to identify the cause.

The general conclusion on the IIC → ENC relationship is that IIC can have both a positive effect as well as a negative effect on ENC, depending on the nature of the company being considered.

> **H8**: External networking capability has a positive effect on innovative organisational culture capability (**supported**).

What this supported hypothesis means is that ENC enables the company to cope with high uncertainty by providing access to valuable external resources, which manifests as an increase in IOCC.

> **H9**: External networking capability has a positive effect on innovative product development capability (**not supported**).

The above unsupported hypothesis means that the data fail to support the hypothesis that ENC does have a direct relationship with IPDC. However, ENC brings an indirect positive effect on IPDC via IOCC. Again, from a practical perspective, this mediating relationship can be interpreted as ENC assisting the radical product development team by reducing uncertainty during radical product development.

H10: Innovative organisational culture capability has a positive effect on radical product innovation (**supported**).

What this supported hypothesis means is that IOCC makes the company more willing to accept and pursue radical product ideas, leading to more radical product innovation.

H11: Innovative organisational culture capability has a positive effect on innovative product development capability (**supported**).

What this supported hypothesis means is that IOCC assists the radical product development team in coping with high uncertainty during radical product development. This relationship could be bidirectional where IPDC also makes the company more tolerant of high uncertainty.

H12: Innovative product development capability has a positive effect on radical product innovation (**supported**).

What this supported hypothesis means is that IPDC makes the company more competent at radical product development, leading to more radical product innovation.

Having tested and interpreted the hypothesis test results both theoretically and practically, it is concluded that the study answers the second research question comprehensively.

7.3.3 Answers to research question 3 to achieve objective 3

RQ3 What company characteristics affect product innovativeness in the New Zealand food and beverage industry?

Company characteristics that could affect product innovativeness in the New Zealand food and beverage industry are company age, company size, and company foreign ownership (details in section 3.5). These company characteristics were tested through multi-factor ANOVA analysis using the quantitative survey data from 137 New Zealand food and beverage companies. The test results (**H13** through to **H15**) are summarised below.

H13: There is a greater level of acceptance for product innovativeness in younger New Zealand food and beverage companies than in older companies (**supported**).

What the above supported hypothesis means is that in general, younger New Zealand food and beverage companies introduce more innovative products than older companies. It was argued that this is because younger companies are driven to introduce innovative products and succeed, but as they mature, they are less likely to stay innovative due to success and accumulated resources and experience. It is acknowledged that this argument cannot be tested empirically, within a cross section study such as the present study. Such claims need to be more robustly tested through a time series (panel) study.

H14: Larger New Zealand food and beverage companies are more likely to have a higher level of product innovativeness than smaller counterparts (**supported**).

What the above supported hypothesis means is that in general, larger New Zealand food and beverage companies introduce more innovative products than smaller companies. This is because they have more resources to conduct radical product development. The minimum company size to successfully launch new products as suggested by the data is 50+ full-time employees for New Zealand food and beverage companies, as shown in Figure 6.9 in the previous chapter.

Although **H13** and **H14** are supported by the data, the effects of both age and size on PI (radical product innovation) are not large (based on low R^2 in ANOVA as well as the main effects plot), but the combined effect of these factors is not trivial either ($R^2 = 0.14$ in Table 6.11 translates to a "medium effect size" in social and behavioural sciences, as explained in the previous chapter). Moreover, practically speaking, both factors had the same effect (approximately the same sum of squares or explained variation in ANOVA table shown in Table 6.11 in the previous chapter) meaning that one is unlikely to be more influential than other.

H15: New Zealand owned food and beverage companies are more innovative than overseas owned companies (**not supported**).

It was argued that failing to support the above hypothesis is probably attributable to low statistical power resulting from not having a sufficient number of cases in non-New Zealand owned companies. Thus, it is inconclusive whether or not New Zealand owned food and beverage companies are more innovative than overseas owned companies. Nevertheless, it is suggested that foreign investments can benefit New Zealand companies whose resources are limited so long as the foreign investments do not negatively affect the determinants of radical product innovation in the acquired companies. A large proportion of top New Zealand food and beverage companies are foreign owned. Although, one can speculate that these companies are innovative product-development-wise, it could be that a sizable proportion of the top overseas food and beverage companies play safe by being incrementally innovative. Further research is needed in this area.

Having tested and interpreted the test results of **H13** through to **H15**, both theoretically and practically, it is concluded that the study answers the third research question comprehensively.

7.3.4 Answers to research question 4 to achieve objective 4

RQ4 What are the salient features of a highly innovative New Zealand food and beverage company?

The salient features of a highly innovative New Zealand food and beverage companies were identified by triangulating results based on quantitative approaches and the field studies (qualitative data collected from 5 companies). More specifically, the final theoretical model explains how radical product innovation is caused (hypotheses test results on RQ1 and RQ2 enhanced this explanation). Analysis of mean PI scores to answer RQ3 enabled the study to identify highly innovative companies from the rest. Qualitative data analysis added richness to the study by being able to study the characteristics of companies that were at various levels of innovativeness (product-development-wise). Additional qualitative data (more technically, administrative records) collected from highly, moderately, and low innovative companies (determined based on their PI scores) provided further depth to the investigation on RQ4.

The study found that a highly innovative New Zealand food and beverage company tends to score highly in the five determinants of radical product innovation. As discussed earlier, being young (founded since 2001) typically makes these companies very driven to introduce new products. Furthermore, as discussed earlier, in general, a company that is medium to large in size (50+ full-time employees) enables that company to successfully launch new products more often (based on the analysis of mean PI scores).

Analysis of additional qualitative data seems to indicate that in general, a company is likely to promote their products based on their originality (innovativeness) and superiority over competing products. In highly innovative companies, top management were found to be highly involved with product development and these companies had a product innovation strategy that promoted innovative projects. Moreover, these companies seemed to have diverse and well-developed internal competencies and external relationships. Finally, these companies are imbued with innovative organisational cultures and innovative product development practices.

It is concluded that RQ4 has been answered comprehensively.

7.4 Knowledge Contributions to the Discipline of Product Development

Three knowledge contributions are made to the discipline of product development.

7.4.1 Meaning or operationalisation of the determinants of radical product innovation

The study identified and validated five determinants of radical product innovation in relation to the New Zealand food and beverage industry. In doing so, the study answers the calls by Khan (2014) and Marsh (2004) for a greater understanding and support for radical product innovation in the New Zealand food and beverage industry. The study also uncovered some definitional changes for some determinants. ENC is a case in point. In the product development field, companies that are high in ENC are expected to be high in outsourcing, alliances, informal network activity, and customer collaboration. The study showed that only the first two facets (indicators) shape the meaning of ENC in the New Zealand food and beverage industry, based on PLSPM results.

7.4.2 Relationships between the determinants of radical product innovation

The study proposed and tested a new theoretical model to explain the radical product innovation phenomenon, building upon the existing knowledge, based on the work of Chang et al. (2012) and Slater et al. (2014). Empirical data analysis (i.e. PLSPM) showed that the model predicts and explains how product innovativeness is caused. Whilst the model alone is a contribution to new knowledge, the study suggested that bidirectional relationships could exist between innovative organisational culture capability and innovative product development capability; it is acknowledged that no such bidirectional relationship was tested (this was not possible within a cross-sectional design and also PLSPM does not allow bidirectional relationships to be specified). More importantly, the study showed up a negative relationship between IIC and ENC, which requires further investigation (NIH syndrome, a closed innovation mindset, and a high cost of collaboration were proposed as interim reasons for this unusual finding). The empirical data analysis also highlighted the important mediating role IOCC plays in justifying the effects (to be more technically precise, total effects) of TMIC and ENC on other determinants (some of the paths leading out from TMIC and ENC were found to be non-significant).

7.4.3 Profiles or characteristics of radically innovative companies

The study identified three company characteristics that could affect product innovativeness in the New Zealand food and beverage industry. Company age was found to have a negative relationship with PI due to accumulated resources and experience (this was the basis of the corresponding hypothesis), which is consistent with most findings conducted overseas. Company size was found to have a positive relationship with PI, which again is consistent with most overseas findings. Company ownership type did not show any relationship with PI but this finding, as mentioned earlier, is inconclusive due to the limited samples of overseas owned companies (fully owned and partially owned). Findings on the effects of company characteristics on PI being consistent with overseas studies does not provide anything exciting, but it is a knowledge claim because this study was conducted within the boundary of food and beverage companies in New Zealand.

7.5 Contributions to the Practice of Product Development

Based on the overall findings of the study, five sets of managerial recommendations are made for food and beverage companies in New Zealand. It is possible companies in other industries in New Zealand could benefit from these recommendations, given the generalisation considerations in section 4.6. This is because companies in other industries in New Zealand share the same New Zealand unique contextual factors and that the food and beverage industry has a similar set of determinants of radical product innovation to other industries. Nevertheless, caution is advised when applying these recommendations for other companies beyond the food and beverage industry in New Zealand because certain determinants may be more or less important in different industrial contexts.

Firstly, companies can use the characteristics of the five determinants of radical product innovation described in section 7.3.1 as a guideline to improve their product innovativeness performance.

Secondly, the final theoretical model (Figure 7.1) helps a company prioritising which determinant to improve. Although the purpose of a theoretical model is to predict and/or explain a phenomenon of interest, because the explained variable (final outcome variable) in this study is PI, the model can be used to reliably distinguish successful radical product development efforts from unsuccessful radical product development efforts. Assuming the company already has a strong top management innovation capability, in the short term, the company should focus on improving their innovative organisational culture capability followed by innovative product development capability. This is to avoid organisational resistance. In the long term, the company should focus on improving their internal innovation capability followed by external networking capability. This is because these two capabilities are much more difficult to duplicate and substitute by competitors, leading to sustainable competitive advantage.

Thirdly, top management need to consider how their product innovation strategy (i.e. project selection and resource allocation) can affect the development of their company's internal competencies (i.e. in-house technological and market competency). Past studies show that the decisions of top management can either enhance, destroy, or stretch internal competencies. Consequently, top management should develop internal competencies according to their company's overall business strategy and market situation to ensure they stay valuable for the company. In addition, top management should attempt to reduce their tendency to overvalue internal innovation capability over external networking capability by adopting practices and processes that promote external collaboration or open innovation mindset.

Fourthly, companies need to ensure that their new radical products actually contribute to superior product advantage in the eyes of the customers. They may also need to invest in educating the market, not only for their immediate customers, but also for internal stakeholders, external partners, and potential end consumers as well.

Lastly, coming back to company characteristics, smaller companies can compete with larger companies by using their external networking capability to exploit or leverage external resources. Older companies can escape vagaries of a mature company—success traps and accumulated resources and experience—by having a product innovation strategy that favours radical projects and internal competency development. Bringing in foreign investments can also be beneficial. However, companies should be cognisant of the fact that foreign ownership could negatively affect the five determinants of radical product innovation because foreign ownership could affect the existing culture of a company. Attracting capital is one thing and changing the dynamics of a social entity is a completely different thing, which can go horribly wrong!

7.6 Research Limitations, Delimitations, and Assumptions

7.6.1 Limitations and delimitations

Four research limitations are identified.

Firstly, the theoretical model is tested only within the New Zealand food and beverage industry context, which is the boundary or a delimitation of this study. However, the study does not make a comparative assessment to gauge to what extent the New Zealand context differs from seemingly similar and different contexts within the food and beverage industry. Such a multi country study was not considered due to time, human, and financial resource limitations (a doctoral study is an independent study although a research consortium can employ doctoral researchers and other researchers to handle large scale projects). Consequently, the generalisability of this study to other populations remains unanswered.

Secondly, how the determinants of radical product innovation lead to commercial success is not considered in this research. This is due to the difficulty of measuring the commercial outcome of radical product innovation as it is greatly dependent on market timing. As a result, the identified determinants are related to radical product innovation as an outcome (i.e. the product is launched into the marketplace). Whether it becomes a commercial success or not depends on additional factors not considered in this study. For example, well known success factors of product innovation such as a compelling business case and collaboration with customers are not included as study variables.

Thirdly, the qualitative interview design could have been improved by involving a second researcher to review the data during the data collection process (Brink, 1993) and having the participants validate the interview transcript and the final themes and concepts (Noble & Smith, 2015). These practices were not implemented because the qualitative interview phase was considered less crucial than the quantitative survey phase.

Lastly, in regard to presenting "outsourcing" as an indicator of ENC, the behavioural statement "we prefer to outsource when developing new products" could have been rephrased as "we are willing to outsource certain competencies when developing new products" in the questionnaire before launching the full-blown survey. This slip was due to the researcher's evolving understanding of "outsourcing" in a new product development context and also to a certain extent, naivety on the part of the researcher, who thought at the time of conducting the survey that a pilot test could pick up ill-defined statements.

7.6.2 Assumptions

It was assumed that the invitees would respond to the survey personally and that they would not outsource the job to a colleague! It was also assumed that the survey invitees (more correctly the survey respondents) understood the statements in the questionnaire without too much ambiguity. It was also assumed that the respondents paid enough attention (i.e. did not do a rushed job) to the statements in the questionnaire and that they would respond to the survey without prejudice. Further, it was also assumed that the probability of responding to the survey remains approximately the same across all categories of companies invited (e.g. large versus small, old versus new, foreign versus New Zealand owned). Clearance of data via post hoc statistical tests (e.g. Harman's single factor test on common method bias) provides some confidence to the researcher that these assumptions are probably true.

7.7 Future Research Recommendations

Five future research recommendations are proposed.

Firstly, future research may investigate the determinants of radical product innovation in other contexts, within and outside the food and beverage industry to understand the true impact of the context of this study. The New Zealand food and beverage industry is an example of a successful and mature New Zealand industry. The determinants of radical product innovation identified in this study could be tested in other industries within New Zealand since they share a similar national and cultural context. This will help validate the findings of this research in a broader context.

Secondly, future research may investigate how companies change their product development orientations as they age. As mentioned earlier, a cross-sectional study such as this study cannot make strong claims on causal relationships, particularly when time dependant variables such as age are involved. It is well known that correlational research has low internal validity. Researchers may consider longitudinal/panel studies to study how age affects radical product innovation.

Thirdly, future research may investigate the cause of the negative relationship between IIC and ENC. The negative effect of IIC on ENC came as a surprise and the generalisability of this relationship across New Zealand remains an attractive proposition (NIH syndrome, a closed innovation mindset, and a high cost of collaboration were just tentative explanations for the negative relationship).

Fourthly, future research may investigate how mature New Zealand food and beverage companies stay innovative. The interview results from Company A, B, and C suggested that these companies became less innovative over time due to success and accumulated resources and experience. Does this mean these companies can no longer conduct radical product innovation? How can these companies ensure they are not at risk of disruptive innovation? What more could we learn from companies such as Company D and E who have managed to stay innovative? Answers to these questions cannot only make contribution to academia but also to the practice of product development. For example, the answers could give companies a better mechanism to maintain their product innovativeness, theoretical model (Figure 7.1) notwithstanding!

Lastly, future research may investigate the impact of foreign ownership on the product innovativeness of New Zealand food and beverage companies; this could be accomplished by analysing a different probability sampling technique that provides adequate sample sizes across all categories of ownership.

7.8 Final Thoughts

A doctoral study in soft sciences can go horribly wrong for number of reasons: specifying unattainable goals, specifying a wrong theoretical model(s), collecting wrong data (e.g. bad operationalisations of constructs, biased responses), insufficient responses, wrong data analytic techniques, plus a myriad of controllable and uncontrollable factors. A great deal of care has been given to ensure that this study does not suffer from the above mistakes.

In one sentence, this study can be summarised as follows. "This study provides a parsimonious explanation of the radical product innovation phenomenon, using the New Zealand food and beverage industry as a context to enable academia and the practitioner to better understand the phenomenon within the given context."

PI has been used as a marker in this study to distinguish a very high level of product innovativeness to very low level of product innovativeness to accommodate the fact that incremental to radical product innovation can be represented in a continuum. As the famous statistician George Box (1976) once said "all models are wrong, but some models are useful." The researcher has done his best to ensure that his models belong to the "useful" category.

REFERENCES

Aarikka-Stenroos, L., & Lehtimäki, T. (2014). Commercializing a radical innovation: Probing the way to the market. *Industrial Marketing Management*, *43*(8), 1372–1384. https://doi.org/10.1016/j.indmarman.2014.08.004

Abernathy, W. J., & Clark, K. B. (1985). Innovation: Mapping the winds of creative destruction. *Research Policy*, *14*(1), 3–22. https://doi.org/10.1016/0048-7333(85)90021-6

Abernathy, W. J., & Utterback, J. M. (1978). Patterns of industrial innovation. *Technology Review*, *80*(7), 40–47.

Anderson, A. M. (2011). New Zealand-A hotbed of radical innovation. Surprising? *PDMA Visions Magazine*.

Anderson, A. M. (Ed.). (2017). *Product development and management body of knowledge: A guidebook for training and certification*. Chicago: PDMA.

Anderson, P., & Tushman, M. L. (1990). Technological discontinuities and dominant designs: A cyclical model of technological change. *Administrative Science Quarterly*, *35*(4), 604–633. https://doi.org/10.2307/2393511

Australian Bureau of Statistics. (2016). Innovation in Australian business, 2014-15: Novelty. Retrieved August 3, 2017, from http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/8158.0Main Features92014-15

Avermaete, T., Viaene, J., Morgan, E. J., Pitts, E., Crawford, N., & Mahon, D. (2004). Determinants of product and process innovation in small food manufacturing firms. *Trends in Food Science and Technology*, *15*(10), 474–483. https://doi.org/10.1016/j.tifs.2004.04.005

Balasubramanian, N., & Lee, J. (2008). Firm age and innovation. *Industrial and Corporate Change*, *17*(5), 1019–1047. https://doi.org/10.1093/icc/dtn028

Barcellos, M. D. de, Aguiar, L. K., Ferreira, G. C., & Vieira, L. M. (2009). Willingness to try innovative food products: A comparison between British and Brazilian consumers. *Brazilian Administration Review*, *6*(1), 50–61. https://doi.org/10.1590/S1807-76922009000100005

Baregheh, A., Rowley, J., Sambrook, S., & Davies, D. (2012). Innovation in food sector SMEs. *Journal of Small Business and Enterprise Development*, *19*(2), 300–321. https://doi.org/10.1108/14626001211223919

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99–120. https://doi.org/10.1177/014920639101700108

Barrena-Figueroa, R., & Garcia-Lopez-de-Meneses, T. (2013). The effect of consumer innovativeness in the acceptance of a new food product. An application for the coffee market in Spain. *Spanish Journal of Agricultural Research*, *11*(3), 578–592. https://doi.org/10.5424/sjar/2013113-3903

Beck, K., Beedle, M., Van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., … Thomas, D. (2001). *Manifesto for agile software development*. Retrieved from http://www.agilemanifesto.org

Beckeman, M., Bourlakis, M., & Olsson, A. (2013). The role of manufacturers in food innovations in Sweden. *British Food Journal*, *115*(7), 953–974. https://doi.org/10.1108/BFJ-09-2010-0164

Beckeman, M., & Skjöldebrand, C. (2007). Clusters/networks promote food innovations. *Journal of Food Engineering*, *79*(4), 1418–1425. https://doi.org/10.1016/j.jfoodeng.2006.04.024

Bers, J. A., Dismukes, J. P., Miller, L. K., & Dubrovensky, A. (2009). Accelerated radical innovation: Theory and application. *Technological Forecasting and Social Change*, *76*(1), 165–177. https://doi.org/10.1016/j.techfore.2008.08.013

Bigliardi, B., & Galati, F. (2013a). Innovation trends in the food industry: The case of functional foods. *Trends in Food Science and Technology*, *31*(2), 118–129. https://doi.org/10.1016/j.tifs.2013.03.006

Bigliardi, B., & Galati, F. (2013b). Models of adoption of open innovation within the food industry. *Trends in Food Science and Technology*, *30*(1), 16–26. https://doi.org/10.1016/j.tifs.2012.11.001

Booz, Allen, & Hamilton. (1982). *New products management for the 1980s*. New York: Booz, Allen and Hamilton Inc.

Borsboom, D., Mellenbergh, G. J., & Van Heerden, J. (2003). The theoretical status of latent variables. *Psychological Review*, *110*(2), 203–219.

https://doi.org/10.1037/0033-295X.110.2.203

Box, G. E. P. (1976). Science and Statistics. *Journal of the American Statistical Association*, *71*(356), 791–799.

Brentani, U. de, & Reid, S. E. (2012). The fuzzy front-end of discontinuous innovation: Insights for research and management. *Journal of Product Innovation Management*, *29*(1), 70–87. https://doi.org/10.1111/j.1540-5885.2011.00879.x

Bridges, J., & Downs, D. (2000). *No. 8 wire: The best of kiwi ingenuity*. Auckland: Hodder Moa Beckett Publishers Ltd.

Brink, H. I. L. (1993). Validity and reliability in qualitative research. *Curationis*, *16*(2), 35–38. https://doi.org/10.4102/curationis.v16i2.1396

Bryman, A., & Bell, E. (2015). *Business research methods* (4th ed.). Oxford, United Kingdom: Oxford University Press.

Calantone, R. J., Chan, K., & Cui, A. S. (2006). Decomposing product innovativeness and its effects on new product success. *Journal of Product Innovation Management*, *23*(5), 408–421. https://doi.org/10.1111/j.1540-5885.2006.00213.x

Cameron, A., & Massey, C. (1999). *Small and medium sized enterprises: A New Zealand perspective*. Auckland: Addison Wesley Longman New Zealand Ltd.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin*, *56*(2), 81–105. https://doi.org/10.1037/h0046016

Capitanio, F., Coppola, A., & Pascucci, S. (2010). Product and process innovation in the Italian Food Industry. *Agribusiness*, *26*(4), 503–518. https://doi.org/10.1002/agr.20239

Cardinal, L. B. (2001). Technological innovation in the Pharmaceutical industry: The use of organizational control in managing research and development. *Organization Science*, *12*(1), 19–36. https://doi.org/10.1287/orsc.12.1.19.10119

Chandy, R. K., & Tellis, G. J. (1998). Organizing for radical product innovation: The overlooked role of willingness to cannibalize. *Journal of Marketing Research*, *35*(4), 474–487. https://doi.org/10.2307/3152166

Chandy, R. K., & Tellis, G. J. (2000). The incumbent's curse? Incumbency, size, and radical product innovation. *Journal of Marketing*, *64*(3), 1–17. https://doi.org/10.1509/jmkg.64.3.1.18033

Chang, Y. C., Chang, H. T., Chi, H. R., Chen, M. H., & Deng, L. L. (2012). How do established firms improve radical innovation performance? The organizational capabilities view. *Technovation*, *32*(7–8), 441–451. https://doi.org/10.1016/j.technovation.2012.03.001

Chen, Q., Anders, S., & An, H. (2013). Measuring consumer resistance to a new food technology: A choice experiment in meat packaging. *Food Quality and Preference*, *28*(2), 419–428. https://doi.org/10.1016/j.foodqual.2012.10.008

Chesbrough, H. W. (2003). The era of open innovation. *MIT Sloan Management Review*, 35–42.

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (pp. 295–336). New Jersey: Lawrence Erlbaum Associates.

Chiu, W.-H., Chi, H.-R., Chang, Y.-C., & Chen, M.-H. (2016). Dynamic capabilities and radical innovation performance in established firms: A structural model. *Technology Analysis & Strategic Management*, *28*(8), 965–978. https://doi.org/10.1080/09537325.2016.1181735

Christensen, C. M. (1997). *The innovator's dilemma: When new technologies cause great firms to fail*. Boston, Massachusetts: Harvard Business School Press.

Christensen, C. M., & Raynor, M. E. (2003). *The innovator's solution: Creating and sustaining successful growth*. Boston, Massachusetts: Harvard Business School Press.

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155–159. https://doi.org/10.1038/141613a0

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quaterly*, *35*(1), 128–152. https://doi.org/10.2307/2393553

Collis, J., & Hussey, R. (2014). *Business research: A practical guide for undergraduate and postgraduate students* (4th ed.). Great Britain: Palgrave Macmillan.

Colombo, M. G., Krogh, G. von, Rossi-Lamastra, C., & Stephan, P. E. (2017). Organizing for radical innovation: Exploring novel insights. *Journal of Product Innovation Management*, *34*(4), 394–405. https://doi.org/10.1111/jpim.12391

Coltman, T., Devinney, T. M., Midgley, D. F., & Venaik, S. (2008). Formative versus reflective measurement models: Two applications of formative measurement. *Journal of Business Research*, *61*(12), 1250–1262. https://doi.org/10.1016/j.jbusres.2008.01.013

Conway, J. M., & Lance, C. E. (2010). What reviewers should expect from authors regarding common method bias in organizational research. *Journal of Business and Psychology*, *25*(3), 325–334. https://doi.org/10.1007/s10869-010-9181-6

Cooper, R. G. (2005). New products-What separates the winners from the losers and what drives success. In K. B. Kahn (Ed.), *The PDMA handbook of new product development* (2nd ed., pp. 3–28). New Jersey: John Wiley & Sons.

Cooper, R. G. (2008). Perspective: The Stage-Gate® idea-to-launch process—Update, what's new, and NexGen systems. *Journal of Product Innovation Management*, *25*(3), 213–232. https://doi.org/10.1111/j.1540-5885.2008.00296.x

Cooper, R. G. (2011). Perspective: The innovation dilemma: How to innovate when the market is mature. *Journal of Product Innovation Management*, *28*(s1), 2–27. https://doi.org/10.1111/j.1540-5885.2011.00858.x

Cooper, R. G., & Kleinschmidt, E. J. (1987). New products: What separates winners from losers? *Journal of Product Innovation Management*, *4*(3), 169–184. https://doi.org/10.1111/1540-5885.430169

Coriolis, & MBIE. (2014). *iFAB 2013 F&B industry overview*. Retrieved from http://www.mbie.govt.nz/info-services/sectors-industries/food-beverage/documents-image-library/NZ Food - Beverage Overview 2013 -PDF 3.7 MB.pdf

Coriolis, & MBIE. (2017). *The investor's guide to the New Zealand processed food industry 2017*. Retrieved from http://www.mbie.govt.nz/info-services/sectors-industries/food-beverage/documents-image-library/folder-2017-investors-guides/investors-guide-to-the-new-zealand-processed-food-industry-2017.pdf

Coriolis, & MBIE. (2018). *Emerging growth opportunities in New Zealand food &*

beverage. Retrieved from http://www.mbie.govt.nz/info-services/sectors-industries/food-beverage/documents-image-library/2018-guides/emerging-growth-opportunities-nz-food-beverage.pdf

Coviello, N. E., & Joseph, R. M. (2012). Creating major innovations with customers: Insights from small and young technology firms. *Journal of Marketing*, *76*(6), 87–104. https://doi.org/10.1509/jm.10.0418

Creswell, J. W. (2014). *Research Design: Qualitative, quntitative, and mixed methods approaches* (4th ed.). United States of America: SAGE Publications.

Cronbach, L. J. (1947). Test “reliability”: Its meaning and determination. *Psychometrika*, *12*(1), 1–16. https://doi.org/10.1007/BF02289289

D’Agostino, R. B. (1986). Tests for the normal distribution. In R. B. D’Agostino & M. A. Stephens (Eds.), *Goodness-of-Fit Techniques*. New York: Marcel Dekker.

Danneels, E. (2002). The dynamics of product innovation and firm competences. *Strategic Management Journal*, *23*(12), 1095–1121. https://doi.org/10.1002/smj.275

Danneels, E., & Kleinschmidt, E. J. (2001). Product innovativeness from the firm’s perspective: Its dimensions and their relation with project selection and performance. *Journal of Product Innovation Management*, *18*(6), 357–373. https://doi.org/10.1111/1540-5885.1860357

de-Magistris, T., Pascucci, S., & Mitsopoulos, D. (2015). Paying to see a bug on my food: How regulations and information can hamper radical innovations in the European Union. *British Food Journal*, *117*(6), 1777–1792. https://doi.org/10.1108/BFJ-06-2014-0222

Diamantopoulos, A., & Siguaw, J. A. (2006). Formative versus reflective indicators in organizational measure development: A comparison and empirical illustration. *British Journal of Management*, *17*(4), 263–282. https://doi.org/10.1111/j.1467-8551.2006.00500.x

Downes-Le Guin, T., Baker, R., Mechling, J., & Ruylea, E. (2012). Myths and realities of respondent engagement in online surveys. *International Journal of Market Research*, *54*(5), 1–21. https://doi.org/10.2501/IJMR-54-5-000-000

Drucker, P. F. (1994). *Innovation and entrepreneurship: Practice and principles*. Oxford:

Butterworth-Heinemann Ltd.

Earle, M. (1997a). Changes in the food product development process. *Trends in Food Science and Technology*, *8*(1), 19–24. https://doi.org/10.1016/S0924-2244(96)20009-3

Earle, M. (1997b). Innovation in the food industry. *Trends in Food Science & Technology*, *8*(1997), 166–175. https://doi.org/10.1016/S0924-2244(97)01026-1

Earle, M., Earle, R., & Anderson, A. M. (2001). *Food product development*. Cambridge, England: Woodhead Publishing Limited.

Easton, B. (2016a). "Economy", Te Ara - the Encyclopedia of New Zealand. Retrieved March 7, 2017, from http://www.teara.govt.nz/en/economy

Easton, B. (2016b). "Economy - The European economy: a history", Te Ara - the Encyclopeida of New Zealand. Retrieved March 7, 2017, from http://www.teara.govt.nz/en/economy/page-10

ECR Europe. (1999). *Efficient product introductions: The development of value-creating relationships*.

Eling, K., Griffin, A., & Langerak, F. (2016). Consistency matters in formally selecting incremental and radical new product ideas for advancement. *Journal of Product Innovation Management*, *33*, 20–33. https://doi.org/10.1111/jpim.12320

Espino-Rodríguez, T. F., & Padrón-Robaina, V. (2006). A review of outsourcing from the resource-based view of the firm. *International Journal of Management Reviews*, *8*(1), 49–70. https://doi.org/10.1111/j.1468-2370.2006.00120.x

Evans, J. R., & Mathur, A. (2005). The value of online surveys. In *Internet Research* (Vol. 15). https://doi.org/10.1108/10662240510590360

Figiel, S., & Kufel, J. (2016). Food product innovations and the main consumer trends. *Oeconomia*, *15*(3), 5–14.

Fonterra. (2016). Research and innovation. Retrieved January 24, 2017, from http://www.fonterra.com/global/en/About/Research+and+Innovation

Fonterra. (2018). About us. Retrieved July 14, 2018, from https://www.fonterra.com/nz/en/about.html

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39–50. https://doi.org/10.2307/3151312

Foster, R. N. (1986). *Innovation: The attacker's advantage*. New York: Summit.

Galizzi, G., & Venturini, L. (2008). Nature and determinants of product innovation in a competitive environment of chaning vertical relationships. In R. Rama (Ed.), *Handbook of innovation in the food and drink industry* (pp. 51–80). New York: The Haworth Press.

Garcia, R., & Calantone, R. (2002). A critical look at technological innovation typology and innovativeness terminology: A literature review. *Journal of Product Innovation Management*, *19*(2), 110–132. https://doi.org/10.1111/1540-5885.1920110

Gatignon, H., & Xuereb, J.-M. (1997). Strategic orientation of the firm and new product performance. *Journal of Marketing Research*, *34*(1), 77–90. https://doi.org/10.2307/3152066

Gefen, D., & Straub, D. (2005). A practical guide to factorial validity using PLS-Graph: Tutorial and annotated example. *Communication of the Association for Information Systems*, *16*(1), 91–109.

Gerwin, D., & Barrowman, N. J. (2002). An evaluation of research on Integrated Product Development. *Management Science*, *48*(7), 938–953. https://doi.org/10.1287/mnsc.48.7.938.2818

Golder, P. N. (2000). Historical method in marketing research with new evidence on long-term market share stability. *Journal of Marketing Research*, *37*(2), 156–172. https://doi.org/10.1509/jmkr.37.2.156.18732

Golder, P. N., Shacham, R., & Mitra, D. (2009). Innovations' origins: When, by whom, and how are radical innovations developed? *Marketing Science*, *28*(1), 166–179. https://doi.org/10.1287/mksc.1080.0384

Golder, P. N., & Tellis, G. J. (1993). Pioneer advantage: Marketing logic or marketing legend? *Journal of Marketing Research*, *30*(2), 158–170. https://doi.org/10.2307/3172825

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, *17*(S2), 109–122. https://doi.org/10.1002/smj.4250171110

Grigg, N. P., & Jayamaha, N. P. (2014). Measuring quality and excellence: On the role of structural equation modelling in quality and business excellence research. In P. K. Chopra (Ed.), *Quality, excellence and statistical measurement: A tribute to professor Gopal K. Kanji* (pp. 323–348). London: Wisdom House.

Guadalupe, M., Kuzmina, O., & Thomas, C. (2012). Innovation and foreign ownership. *American Economic Review*, *102*(7), 3594–3627. https://doi.org/10.1257/aer.102.7.3594

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 105–117). Thousand Oaks, CA: Sage.

Gustafson, B. (n.d.). "Muldoon, Robert David - Economic policy and problems", from the Dictionary of New Zealand Biography. Retrieved March 10, 2017, from http://www.teara.govt.nz/en/biographies/6m1/muldoon-robert-david/page-7

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). *A primer on partial least squares structural equation modeling (PLS-SEM)* (2nd ed.). California: Sage Publications.

Harman, H. H. (1976). *Modern factor analysis* (3rd ed.). Chicago: University of Chicago Press.

Harwell, M. R., Rubinstein, E. N., Hayes, W. S., & Olds, C. C. (1992). Summarizing Monte Carlo results in methodological research: The one- and two-factor fixed effects ANOVA cases. *Journal of Educational Statistics*, *17*(4), 315–339. https://doi.org/10.2307/1165127

Haynes, S. N., Richard, D. C. S., & Kubany, E. S. (1995). Content validity in psychological assessment: A functional approach to concepts and methods. *Psychological Assessment*, *7*(3), 238–247. https://doi.org/10.1037/1040-3590.7.3.238

Hayton, J. C., George, G., & Zahra, S. A. (2002). National culture and entrepreneurship: A review of behavioral research. *Entrepreneurship Theory and Practice*, *26*(4), 33–52. https://doi.org/10.1177/104225870202600403

Heidenreich, S., & Handrich, M. (2015). What about passive innovation resistance? Investigating adoption-related behavior from a resistance perspective. *Journal of*

Product Innovation Management, *32*(6), 878–903. https://doi.org/10.1111/jpim.12161

Henderson, R. M., & Clark, K. B. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly*, *35*(1), 9–30. https://doi.org/10.2307/2393549

Henseler, J., Hubona, G., & Ray, P. A. (2016). Using PLS path modeling in new technology research: updated guidelines. *Industrial Management & Data Systems*, *116*(1), 2–20. https://doi.org/10.1108/IMDS-09-2015-0382

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8

Henseler, J., & Sarstedt, M. (2013). Goodness-of-fit indices for partial least squares path modeling. *Computational Statistics*, *28*(2), 565–580. https://doi.org/10.1007/s00180-012-0317-1

Herrmann, A., Gassmann, O., & Eisert, U. (2007). An empirical study of the antecedents for radical product innovations and capabilities for transformation. *Journal of Engineering and Technology Management*, *24*(1–2), 92–120. https://doi.org/10.1016/j.jengtecman.2007.01.006

Herrmann, A., Tomczak, T., & Befurt, R. (2006). Determinants of radical product innovations. *European Journal of Innovation Management*, *9*(1), 20–43. https://doi.org/10.1002/cplx.20110

Hinkin, T. R. (1995). A review of scale development practices in the study of organizations. *Journal of Management*, *21*(5), 967–988. https://doi.org/10.1177/014920639502100509

Hofstede, G. (2011). Dimensionalizing cultures: The Hofstede model in context. *Online Readings in Psychology and Culture*, *2*(1), 1–26. https://doi.org/10.9707/2307-0919.1014

Holahan, P. J., Sullivan, Z. Z., & Markham, S. K. (2014). Product development as core competence: How formal product development practices differ for radical, more innovative, and incremental product innovations. *Journal of Product Innovation*

Management, *31*(2), 329–345. https://doi.org/10.1111/jpim.12098

Holden, M. T., & Lynch, P. (2004). Choosing the Appropriate Methodology: Understanding Research Philosophy. *The Marketing Review*, *4*(4), 397–409. https://doi.org/10.1362/1469347042772428

Hong, S., Oxley, L., McCann, P., & Le, T. (2016). Why firm size matters: investigating the drivers of innovation and economic performance in New Zealand using the *Business Operations Survey*. *Applied Economics*, *48*(55), 5379–5395. https://doi.org/10.1080/00036846.2016.1178843

Huergo, E., & Jaumandreu, J. (2004). How does probability of innovation change with firm age? *Small Business Economics*, *22*(3/4), 193–207. https://doi.org/10.1023/B:SBEJ.0000022220.07366.b5

Hult, G. T. M., Hurley, R. F., & Knight, G. A. (2004). Innovativeness: Its antecedents and impact on business performance. *Industrial Marketing Management*, *33*(5), 429–438. https://doi.org/10.1016/j.indmarman.2003.08.015

Johannessen, J.-A., Olsen, B., & Lumpkin, G. T. (2001). Innovation as newness: What is new, how new, and new to whom? *European Journal of Innovation Management*, *4*(1), 20–31. https://doi.org/10.1108/14601060110365547

Joseph, R. (2008). *Investigating the role of customers and other external influencers in radical new product development - a network apprach* (University of Auckland). Retrieved from https://researchspace.auckland.ac.nz/handle/2292/3397

Kahn, K. B., Kay, S. E., Slotegraaf, R. J., & Uban, S. (Eds.). (2013). *The PDMA handbook of new product development* (3rd ed.). Hoboken, N.J.: Wiley.

Kaiser, H. F. (1958). The varimax criterion for analytic rotation in factor analysis. *Psychometrika*, *23*(3), 187–200. https://doi.org/10.1007/BF02289233

Katz, R., & Allen, T. J. (1982). Investigating the Not Invented Here (NIH) syndrome: A look at the performance, tenure, and communication patterns of 50 R & D Project Groups. *R & D Management*, *12*(1), 7–12. https://doi.org/10.1111/j.1467-9310.1982.tb00478.x

Khan, R. S. (2014). *Characterisation of food product innovation with reference to bioactive functional food product development: An Asia-Pacific study*. Massey University, New Zealand.

Khan, R. S., Grigor, J., Winger, R., & Win, A. (2013). Functional food product development – Opportunities and challenges for food manufacturers. *Trends in Food Science & Technology*, *30*(1), 27–37. https://doi.org/10.1016/j.tifs.2012.11.004

Kim, J., & Curry, J. (1977). The treatment of missing data in multivariate analysis. *Sociological Methods & Research*, *6*(2), 215–240. https://doi.org/10.1177/004912417700600206

Kleinschmidt, E. J., & Cooper, R. G. (1991). The impact of product innovativeness on performance. *Journal of Product Innovation Management*, *8*(4), 240–251. https://doi.org/10.1111/1540-5885.840240

Kock, A., Gemünden, H. G., Salomo, S., & Schultz, C. (2011). The mixed blessings of technological innovativeness for the commercial success of new products. *Journal of Product Innovation Management*, *28*(s1), 28–43. https://doi.org/10.1111/j.1540-5885.2011.00859.x

Kotler, P., & Armstrong, G. (2014). *Principles of marketing: Global edition* (15th ed.). United States of America: Pearson Education.

Kukull, W. A., & Ganguli, M. (2012). Generalizability: The trees, the forest, and the low-hanging fruit. *Neurology*, *78*(23), 1886–1891. https://doi.org/10.1212/WNL.0b013e318258f812

Kutner, M. H., Nachtsheim, C. J., Neter, J., & Li, W. (2005). *Applied linear statistical models* (5th ed.). Boston: McGraw-Hill/Irwin.

Kyrgidou, L. P., & Spyropoulou, S. (2013). Drivers and Performance Outcomes of Innovativeness: An Empirical Study. *British Journal of Management*, *24*(3), 281–298. https://doi.org/10.1111/j.1467-8551.2011.00803.x

Kyriakopoulos, K., Hughes, M., & Hughes, P. (2016). The role of marketing resources in radical innovation activity: Antecedents and payoffs. *Journal of Product Innovation Management*, *33*(4), 398–417. https://doi.org/10.1111/jpim.12285

Lagnevik, M., Sjoholm, I., Lareke, A., & Ostberg, J. (2003). *The dynamics of innovation clusters: A study of the food industry*. Great Britain: Edward Elgar.

Lawshe, C. (1975). A quantitative approach to content validity. *Personnel Psychology*, (28), 563–575. https://doi.org/10.1111/j.1744-6570.1975.tb01393.x

Lee, H., & Markham, S. K. (2016). PDMA comparative performance assessment study (CPAS): Methods and future research directions. *Journal of Product Innovation Management*, *33*, 3–19. https://doi.org/10.1111/jpim.12358

Leifer, R., McDermott, C. M., O'Connor, G. C., Peters, L. S., Rice, M. P., & Veryzer, R. W. (2000). *Radical innovation: How mature companies can outsmart upstarts*. Boston, Massachusetts: Harvard Business School Press.

Leonard-Barton, D. (1992). Core capabilities and core rigidities: A paradox in managing new product development. *Strategic Management Journal*, *13*, 111–125. https://doi.org/10.1002/smj.4250131009

Lettl, C. (2007). User involvement competence for radical innovation. *Journal of Engineering and Technology Management - JET-M*, *24*(1–2), 53–75. https://doi.org/10.1016/j.jengtecman.2007.01.004

Leung, L. (2015). Validity, reliability, and generalizability in qualitative research. *Journal of Family Medicine and Primary Care*, *4*(3), 324. https://doi.org/10.4103/2249-4863.161306

Liker, J. K., & Morgan, J. M. (2006). The Toyota Way in services: The case of lean product development. *Academy of Management Perspectives*, *20*(2), 5–20. https://doi.org/10.5465/amp.2006.20591002

Maes, J., & Sels, L. (2014). SMEs' radical product innovation: The role of internally and externally oriented knowledge capabilities. *Journal of Small Business Management*, *52*(1), 141–163. https://doi.org/10.1111/jsbm.12037

Mallette, M., & Barone, D. (2013). On using google forms. *The Reading Teacher*, *66*(8), 625–630. https://doi.org/10.1002/TRTR.1169

Manfreda, K. L., Berzelak, J., Vehovar, V., Bosnjak, M., & Haas, I. (2008). Web surveys versus other survey modes: A meta-analysis comparing response rates. *International Journal of Market Research*, *50*(1), 79–104. https://doi.org/10.1177/147078530805000107

March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, *2*(1), 71–87. https://doi.org/10.1287/orsc.2.1.71

Mardia, K. V. (1971). The effect of nonnormality on some multivariate tests and robustness to nonnormality in the linear model. *Biometrika*, *58*(1), 105–121.

https://doi.org/10.1093/biomet/58.1.105

Markham, S. K., & Lee, H. (2013). Product development and management association's 2012 comparative performance assessment study. *Journal of Product Innovation Management*, *30*(3), 408–429. https://doi.org/10.1111/jpim.12025

Markides, C. C., & Geroski, P. A. (2005). *Fast second: How smart companies bypass radical innovation to enter and dominate new markets*. United States of America: John Wiley & Sons, Inc.

Marquis, D. G. (1982). The anatomy of successful innovations. In M. L. Tushman & W. L. Moore (Eds.), *Readings in the management of innovation* (pp. 42–50). Boston: Pitman.

Marsh, D. (2004). *An investigation into the determinants of innovation in the New Zealand biotechnology sector* (University of Waikato). Retrieved from http://hdl.handle.net/10289/2549

Martinez, M. G., & Briz, J. (2000). Innovation in the Spanish food & drink industry. *International Food and Agribusiness Management Review*, *3*(2), 155–176. https://doi.org/10.1016/S1096-7508(00)00033-1

Martinez, M. G., Lazzarotti, V., Manzini, R., & García, M. S. (2014). Open innovation strategies in the food and drink industry: Determinants and impact on innovation performance. *International Journal of Technology Management*, *66*(2/3), 212. https://doi.org/10.1504/ijtm.2014.064588

Massey University. (2015). *Code of ethical conduct for research, teaching and evaluations involving human participants*. Retrieved from http://www.massey.ac.nz/massey/fms/Human Ethics/Documents/MUHEC Code 2015.pdf?CA6CFFFAA5150271FD193A0B0C56C5CF

Massey University. (2017). Human ethics: Online application and notification procedures. Retrieved July 24, 2017, from http://www.massey.ac.nz/massey/research/research-ethics/human-ethics/forms-and-procedures.cfm

McCann, P. (2009). Economic geography, globalisation and New Zealand's productivity paradox. *New Zealand Economic Papers*, *43*(3), 279–314. https://doi.org/10.1080/00779950903308794

McDermott, C. M. (1999). Managing radical product development in large manufacturing firms: A longitudinal study. *Journal of Operations Management*, *17*(6), 631–644. https://doi.org/10.1016/S0272-6963(99)00018-2

McDermott, C. M., & O'Connor, G. C. (2002). Managing radical innovation: An overview of emergent strategy issues. *Journal of Product Innovation Management*, *19*(6), 424–438. https://doi.org/10.1111/1540-5885.1960424

McNally, R. C., Cavusgil, E., & Calantone, R. J. (2010). Product innovativeness dimensions and their relationships with product advantage, product financial performance, and project protocol. *Journal of Product Innovation Management*, *27*(7), 991–1006. https://doi.org/10.1111/j.1540-5885.2010.00766.x

Mertens, D. M. (2007). Transformative paradigm: Mixed methods and social justice. *Journal of Mixed Methods Research*, *1*(3), 212–225. https://doi.org/10.1177/1558689807302811

Min, S., Kalwani, M. U., & Robinson, W. T. (2006). Market pioneer and early follower survival risks: A contingency analysis of really new versus incrementally new product-markets. *Journal of Marketing*, *70*(1), 15–33. https://doi.org/10.1509/jmkg.2006.70.1.15

Ministry of Business, Innovation and Employment. (2012). *Building innovation progress report*. Retrieved from http://www.mbie.govt.nz/info-services/business/business-growth-agenda/2012/building-innovation

Ministry of Business, Innovation and Employment. (2014). *The small business sector report 2014*. Retrieved from http://www.mbie.govt.nz/info-services/business/business-growth-agenda/sectors-reports-series/the-small-business-sector-report-and-factsheet

Ministry of Business, Innovation and Employment. (2015). *Business growth Agenda: Towards 2025 - Building innovation chapter*. Retrieved from http://www.mbie.govt.nz/info-services/business/business-growth-agenda/towards-2025

Ministry of Business Innovation and Employment. (n.d.). New Zealand food & beverage directory: About. Retrieved from http://directory.foodandbeverage.govt.nz/about

Ministry of Economic Development, The Treasury, & Statistics New Zealand. (2011).

Economic development indicators 2011. Retrieved from http://www.med.govt.nz/about-us/publications/publications-by-topic/economic-indicators/economic-development-indicators-2011

Morgan, D. L. (2007). Paradigms lost and pragmatism regained: Methodological implications of combining qualitative and quantitative methods. *Journal of Mixed Methods Research*, *1*(1), 48–76. https://doi.org/10.1177/2345678906292462

Morrison, D. F. (2005). *Multivariate analysis of variance*. New York: Wiley.

Neyman, J., & Pearson, E. S. (1928). On the use and interpretation of certain test criteria for purposes of statistical inference. *Biometrika*, *20A*, 175–240, 263–294. https://doi.org/10.2307/2331945, 10.2307/2332112

Noble, H., & Smith, J. (2015). Issues of validity and reliability in qualitative research. *Evidence-Based Nursing*, *18*(2), 34–35. https://doi.org/10.1136/eb-2015-102054

Norman, D. A., & Verganti, R. (2014). Incremental and radical innovation: Design research vs. technology and meaning change. *Design Issues*, *30*(1), 78–96. https://doi.org/10.1162/DESI

Norman, G. (2010). Likert scales, levels of measurement and the “laws” of statistics. *Advances in Health Sciences Education*, *15*(5), 625–632. https://doi.org/10.1007/s10459-010-9222-y

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.; McGraw-Hill, Ed.). New York.

O’Connor, G. C., & McDermott, C. M. (2004). The human side of radical innovation. *Journal of Engineering and Technology Management*, *21*(1–2), 11–30. https://doi.org/10.1016/j.jengtecman.2003.12.002

O’Connor, G. C., & Rice, M. P. (2013). A comprehensive model of uncertainty associated with radical innovation. *Journal of Product Innovation Management*, *30*(1), 2–18. https://doi.org/10.1111/jpim.12060

O’Connor, G. C., & Veryzer, R. W. (2001). The nature of market visioning for technology-based radical innovation. *Journal of Product Innovation Management*, *18*(4), 231–246. https://doi.org/10.1111/1540-5885.1840231

O’Reilly, C. A., & Tushman, M. L. (2011). Organizational ambidexterity in action: How managers explore and exploit. *California Management Review*, *53*(4), 5–22. https://doi.org/10.1525/cmr.2011.53.4.5

OECD. (2007). *OECD reviews of innovation policy: New Zealand*. Retrieved from OECD Publishing website: http://dx.doi.org/10.1787/9789264037618-en

OECD, & Statistical Office of the European Communities. (2005). *Oslo Manual: Guidelines for collecting and interpreting innovation data* (3rd ed.). https://doi.org/10.1787/9789264013100-en

Olleros, F.-J. (1986). Emerging industries and the burnout of pioneers. *Journal of Product Innovation Management*, *3*(1), 5–18. https://doi.org/10.1111/1540-5885.310005

Ornstein, M. (2013). *A companion to survey research*. London: Sage Publications.

Peteraf, M. A. (1993). The cornerstones of competitive advantage: A resource-based view. *Strategic Management Journal*, *14*(3), 179–191. https://doi.org/10.1002/smj.4250140303

Phaal, R., Farrukh, C. J. P., & Probert, D. R. (2004). Technology roadmapping-A planning framework for evolution and revolution. *Technological Forecasting and Social Change*, *71*(1–2), 5–26. https://doi.org/10.1016/S0040-1625(03)00072-6

Pisano, G. P. (2015). You need an innovation strategy. *Harvard Business Review*, *93*(6), 44–54.

Plant & Food Research. (2017). Kiwifruit. Retrieved June 12, 2017, from http://www.plantandfood.co.nz/page/our-research/breeding-genomics/key-crops/kiwifruit/

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance*. United States of America: The Free Press.

Porter, M. E. (1998). Clusters and the new economics of competition. *Harvard Business Review*, (November), 77–90.

Prahalad, C., & Hamel, G. (1990). The core competence of the corporation. *Harvard*

Business Review, *68*(3), 79. https://doi.org/10.1007/3-540-30763-X_14

Rabionet, S. E. (2011). How I learned to design and conduct semi-structured interviews: An ongoing and continuous journey. *The Qualitative Report*, *16*(2), 563–566. Retrieved from http://www.nova.edu/ssss/QR/QR16-2/rabionet.pdf

Rama, R., & Tunzelmann, N. von. (2008). Empirical studies of innovation in the food and beverage industry. In R. Rama (Ed.), *Handbook of innovation in the food and drink industry* (pp. 13–50). New York: The Haworth Press.

Rawson, E. (2014). The world's smallest apple. Retrieved July 21, 2018, from Stuff website: http://www.stuff.co.nz/business/unlimited/10383718/The-worlds-smallest-apple

Rea, L. M., & Parker, R. A. (2014). *Designing and conducting survey research: A comprehensive guide* (4th ed.). San Francisco, CA: Jossey-Bass.

Reid, S. E., Roberts, D., & Moore, K. (2015). Technology vision for radical innovation and its impact on early success. *Journal of Product Innovation Management*, *32*(4), 593–609. https://doi.org/10.1111/jpim.12221

Reinders, M. J., Frambach, R. T., & Schoormans, J. P. L. (2010). Using product bundling to facilitate the adoption process of radical innovations. *Journal of Production and Innovation*, 1127–1140. https://doi.org/10.1111/j.1540-5885.2010.00775.x

Riddet Institute. (2011). *Floreat scientia: Celebrating New Zealand's agrifood innovation*. Auckland N.Z.: Wairau Press.

Ringle, C. M., Wende, S., & Becker, J.-M. (2015). *SmartPLS 3*. Retrieved from http://www.smartpls.com

Rinne, T. A. (2011). Cultural limits to innovation in New Zealand. In J. R. Fairweather (Ed.), *Proceedings of the international conference on invention, innovation and commercialisation with special emphasis on technology users innovation* (pp. 133–146). Retrieved from http://hdl.handle.net/10182/3831

Rinne, T. A., & Fairweather, J. (2011). An international comparison of models of innovation and their implications for New Zealand. In *Research Report No. 323*. Christchurch, New Zealand: Agribusiness and Economics Research Unit, Lincoln University.

Rockit Trading Company. (n.d.). Our story. Retrieved June 11, 2017, from http://rockitapple.com/about-us/#Wrapper

Rubera, G., & Droge, C. (2013). Technology versus design innovation's effects on sales and Tobin's Q: The moderating role of branding strategy. *Journal of Product Innovation Management*, *30*(3), 448–464. https://doi.org/10.1111/jpim.12012

Rubera, G., Ordanini, A., & Calantone, R. (2012). Whether to integrate R&D and marketing: The effect of firm competence. *Journal of Product Innovation Management*, *29*(5), 766–783. https://doi.org/10.1111/j.1540-5885.2012.00936.x

Sadowski, B. M., & Sadowski-Rasters, G. (2006). On the innovativeness of foreign affiliates: Evidence from companies in The Netherlands. *Research Policy*, *35*(3), 447–462. https://doi.org/10.1016/j.respol.2006.01.003

Saguy, I. S., & Sirotinskaya, V. (2014). Challenges in exploiting open innovation's full potential in the food industry with a focus on small and medium enterprises (SMEs). *Trends in Food Science and Technology*, *38*(2), 136–148. https://doi.org/10.1016/j.tifs.2014.05.006

Sandberg, B., & Aarikka-Stenroos, L. (2014). What makes it so difficult? A systematic review on barriers to radical innovation. *Industrial Marketing Management*, *43*(8), 1293–1305. https://doi.org/10.1016/j.indmarman.2014.08.003

Sarkar, S., & Costa, A. I. A. (2008). Dynamics of open innovation in the food industry. *Trends in Food Science & Technology*, *19*(11), 574–580. https://doi.org/10.1016/j.tifs.2008.09.006

Schumpeter, J. A. (1934). *The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle*. Cambridge, Mass.: Harvard University Press.

Schumpeter, J. A. (1942). *Capitalism, socialism & democracy*. New York: Harper.

Silver Fern Farms. (2018). Our strategy. Retrieved June 2, 2018, from http://www.silverfernfarms.com/our-company/our-strategy/

Singleton, J. (2008). An economic history of New Zealand in the nineteenth and twentieth centuries. Retrieved March 10, 2017, from https://eh.net/encyclopedia/an-economic-history-of-new-zealand-in-the-nineteenth-and-twentieth-centuries/

Siriwongwilaichat, P., & Winger, R. J. (2004). Technical knowledge for food product innovation in Thailand. *Agribusiness*, *20*(3), 233–252. https://doi.org/10.1002/agr.20017

Slater, S. F., Mohr, J. J., & Sengupta, S. (2014). Radical product innovation capability: Literature review, synthesis, and illustrative research propositions. *Journal of Product Innovation Management*, *31*(3), 552–566. https://doi.org/10.1111/jpim.12113

Song, X. M., & Montoya-Weiss, M. M. (1998). Critical development activities for really new versus incremental products. *Journal of Product Innovation Management*, *15*(2), 124–135. https://doi.org/10.1111/1540-5885.1520124

Sood, A., & Tellis, G. J. (2005). Technological evolution and radical innovation. *Journal of Marketing*, *69*, 152–168. https://doi.org/10.1509/jmkg.69.3.152.66361

SPATNZ. (2017). Shellfish Success - Kiwi scientists harvesting the result of unlocking New Zealand Greenshell™ mussel secrets. Retrieved June 11, 2017, from http://www.spatnz.co.nz/#new-page

Squires, L., Juric, B., & Cornwell, T. B. (2001). Level of market development and intensity of organic food consumption: Cross-cultural study of Danish and New Zealand consumers. *Journal of Consumer Marketing*, *18*(5), 392–409. https://doi.org/10.1108/07363760110398754

Statistics New Zealand. (2010). *Innovation in New Zealand: 2009*. Wellington, New Zealand: Statistics New Zealand.

Statistics New Zealand. (2011). *Innovation in New Zealand: 2011*. Retrieved from http://www.stats.govt.nz/browse_for_stats/businesses/business_growth_and_innovation/innovation-in-new-zealand-2011.aspx

Statistics New Zealand. (2016). New Zealand business demography statistics: At February 2016. Retrieved November 20, 2018, from https://www.stats.govt.nz/information-releases/new-zealand-business-demography-statistics-at-february-2016

Steenkamp, J.-B. E. M., Hofstede, F. ter, & Wedel, M. (1999). A cross-national investigation into the individual and national cultural antecedents of consumer innovativeness. *Journal of Marketing*, *63*(2), 55–69.

https://doi.org/10.2307/1251945

Stewart-Knox, B., & Mitchell, P. (2003). What separates the winners from the losers in new food product development? *Trends in Food Science & Technology*, *14*(1–2), 58–64. https://doi.org/10.1016/S0924-2244(02)00239-X

Story, V. M., Daniels, K., Zolkiewski, J., & Dainty, A. R. J. (2014). The barriers and consequences of radical innovations: Introduction to the issue. *Industrial Marketing Management*, *43*(8), 1271–1277. https://doi.org/10.1016/j.indmarman.2014.09.001

Straub, D., Boudreau, M.-C., & Gefen, D. (2004). Validation guidelines for IS positivist research. *Communications of the Association for Information Systems*, *13*(24), 380–427. https://doi.org/10.17705/1CAIS.01324

Szymanski, D. M., Kroff, M. W., & Troy, L. C. (2007). Innovativeness and new product success: insights from the cumulative evidence. *Journal of the Academy of Marketing Science*, *35*(1), 35–52. https://doi.org/10.1007/s11747-006-0014-0

Talke, K., Salomo, S., Wieringa, J. E., & Lutz, A. (2009). What about design newness? Investigating the relevance of a neglected dimension of product innovativeness. *Journal of Product Innovation Management*, *26*(6), 601–615. https://doi.org/10.1111/j.1540-5885.2009.00686.x

Tatikonda, M. V., & Rosenthal, S. R. (2000). Technology novelty, project complexity, and product development project execution success: A deeper look at task uncertainty in product innovation. *IEEE Transactions on Engineering Management*, *47*(1), 74–87. https://doi.org/10.1109/17.820727

Teece, D. J. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research Policy*, *15*(6), 285–305. https://doi.org/10.1016/0048-7333(86)90027-2

Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, *28*, 1319–1350. https://doi.org/10.1002/smj.640

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilties and strategic management. *Strategic Management Journal*, *18*(7), 509–533. https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z

Tellis, G. J., & Golder, P. N. (1996). First to market, first to fail? Real causes of enduring market leadership. *Sloan Management Review*, *37*(2), 65–75.

Tellis, G. J., Prabhu, J. C., & Chandy, R. K. (2009). Radical innovation across nations: The preeminence of corporate culture. *Journal of Marketing*, *73*(1), 3–23. https://doi.org/10.1509/jmkg.73.1.3

The Treasury. (2016). *New Zealand economic and financial overview 2016*. Retrieved from http://www.treasury.govt.nz/economy/overview/2016

Tomas, R. N., Rosales, F. P., Batalha, M. O., & Alcantara, R. L. C. (2014). Analyzing effects of external integration on innovations outcomes in large and non-large Brazilian food companies. *British Food Journal*, *116*(6), 984–999. https://doi.org/10.1108/BFJ-01-2013-0001

Tushman, M. L., & Anderson, P. (1986). Technological discontinuities and organizational environments. *Administrative Science Quarterly*, *31*(3), 439–465. https://doi.org/10.2307/2392832

Tushman, M. L., & O'Reilly, C. A. (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. *California Management Review*, *38*(4), 8–30. https://doi.org/10.1080/09652540903536982

University of Auckland Business Review. (2001). The knowledge wave... creating kiwi prosperity. *University of Auckland Business Review*, *3*(2), 8–22. Retrieved from http://www.uabr.auckland.ac.nz/files/articles/Volume3/v3i2-knowledge-wave.pdf

Utterback, J. M. (1994). *Mastering the dynamics of innovation: How companies can seize opportunities in the face of technological change*. Boston, Massachusetts: Harvard Business School Press.

Verganti, R. (2008). Design, meanings, and radical innovation: A metamodel and a research agenda. *Journal of Product Innovation Management*, *25*(5), 436–456. https://doi.org/10.1111/j.1540-5885.2008.00313.x

Verganti, R. (2009). *Design-driven innovation: Changing the rules of competition by radically innovating what things mean*. Boston, Massachusetts: Harvard Business Press.

Veryzer, R. W. (1998). Discontinuous innovation and the new product development process. *Journal of Product Innovation Management*, *15*(4), 304–321.

https://doi.org/10.1111/1540-5885.1540304

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*(2), 171–180. https://doi.org/10.1002/smj.4250050207

Werts, C. E., Linn, R. L., & Jöreskog, K. G. (1974). Intraclass reliability estimates: Testing structural assumptions. *Educational and Psychological Measurement*, *34*, 25–33. https://doi.org/10.1177/001316447403400104

West, S. J. (1980). *Product development and the New Zealand food industry*. Massey University.

Wilkinson, V., Morris, T., & Hall, N. (2015). *The investor's guide to the New Zealand food and beverage industry 2015*. Retrieved from http://www.mbie.govt.nz/info-services/sectors-industries/food-beverage/information-project/investor-guides

Winger, R., & Wall, G. (2006). *Food product innovation: A background paper*. Rome: Food and Agriculture Organization of the United Nations.

Winter, G. (2000). A comparative discussion of the notion of "validity" in qualitative and quantitative research. *The Qualitative Report*, *4*(3&4), 12. Retrieved from http://www.nova.edu/ssss/QR/QR4-3/winter.html

Zespri. (2015). Inaugural symposium showcases kiwifruit innovation. Retrieved January 24, 2017, from http://www.zespri.com/companyinformation/newsroom/inaugural-symposium

Ziggers, G. W. (2005). Radical product innovation in the Dutch food industry: An empirical exploration. *Journal of Food Products Marketing*, *11*(3), 3–25. https://doi.org/10.1300/J038v11n03

APPENDIX A: Interview Invitation

MASSEY UNIVERSITY
ENGINEERING

Drivers of Successful Radical Product Innovation

Dear Product Development Professional,

New to the world or radical product innovation is important for long term business growth and national prosperity. There are many successful radical product innovations by New Zealand companies. However, the drivers that made these products successful are unknown.

Massey University is conducting a research into the drivers of successful radical product innovation. The aim of this research is to analyze the drivers of successful radical product innovation in New Zealand companies. The research will produce new knowledge on radical product innovation and encourage more successful radical product innovations by New Zealand companies.

Your company has been chosen because one of your products is classified as new to the world or radical product innovation. I would like to interview you or relevant person in your company to discuss how your company conducts new product development projects. Your input is important as it will help us identify drivers and challenges faced by New Zealand companies during radical product development. The result of the research will expectedly benefit your company and others in New Zealand.

The interview is approximated to take one hour and will be conducted at a time and place that is convenient for you. It will be open ended to allow exploration and discussion. Data will be collected through hand written note and audio recording for transcription purpose. Please be assured that any data or information collected will be treated with confidentiality. No commercially sensitive or personally identifiable information will be reported in the research publication. You can request a summary of the research findings once it is concluded as a participant.

We would appreciate it if you can participate in this research. Please let me know when the convenient time and place is for you. Or I will give you a call to arrange the meeting. If you have any questions please feel free to contact my supervisor or me.

Best regards,

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APPENDIX B: Interview Questions

Julawit Pitrchart

Interview Questions

Following are the interview structure:

Introduce myself. State research aim and objectives. Provide reasons for contacting the company.

About the company:

1. What products do you manufacture?
2. How do you manufacture your products?
3. How are your products different from other similar products in the market?
4. Who are your target customers?
5. How do you sell your products to them?

About the interviewee:

6. What is your responsibility in the company?

About the company's product development process:

7. Is your company developing any new products at the moment?
8. Can you describe the process your company uses to develop a new product?
9. Why does your company develop new products?

About the company's radical product innovation strategy:

10. How do you define a radical product innovation? Can you give me an example?
11. Is your company pursuing radical product innovation? If so, why? If not, why not?

Select an innovative product:

12. Can you explain to me more about this product by your company?
13. What was the motivation for this product?
14. How is this product different from other similar products in the market?
15. How successful was the product?

Stage 1: Opportunity recognition:

16. Where did the idea come from?
17. Who was involved?

Stage 2: Idea development:

18. How did you know the idea was good?

Stage 3: Business analysis:

19. Did you conduct any analysis to validate the idea?

Stage 4: Development:

20. How did you develop the idea into the final product?
21. Who from the company was involved?
22. Did you work with anyone outside the company? (Customers, suppliers, government agencies, consultants, etc.)

Stage 5: Testing & validation:

23. How did you manufacture the final product?
24. How did you obtain the raw materials?

Stage 6: Commercialisation:

25. How did you launch the product into the market?
26. How is the product doing now?

Testing for other drivers

27. What factors you believe make your new products successful?
28. What are the biggest challenges you face when developing new products?
29. Have you ever had a fail product? What happened?

Interview is coming to an end, ending questions:

30. How can this research benefit your business?

Thank you for your time.

** *End* **

APPENDIX C: Survey Invitation

MASSEY UNIVERSITY
ENGINEERING

Drivers of Product Innovation in New Zealand Food and Beverage Industry: A Survey

Dear Product Development Professional,

Massey University is conducting research into the drivers of product innovation in New Zealand Food and Beverage (F&B) industry. The aim of this research is to determine and analyse the drivers of product innovation in order to encourage more successful product innovation by New Zealand companies. An online survey is designed to collect the information required.

We would like to invite you or relevant person in your company who is responsible for new product development projects to participate in the survey. The survey will take 10 - 15 minutes to complete.

Please be assured that all data collected will be treated with confidentiality and no personally identifiable information will be reported in the research publication.

Your input is important as it will help us identify drivers of product innovation. The result of the research will expectedly benefit your company and others in New Zealand. You can request a summary of the research findings once it is concluded as a participant.

We would really appreciate your kind participation in the survey. If you have any questions, please feel free to contact my supervisor or me.

The survey can be completed online here: http://goo.gl/forms/j8J6phwQjQ

Best regards,

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APPENDIX D: Survey Questionnaire

MASSEY UNIVERSITY
ENGINEERING

Drivers of Product Innovation in New Zealand Food and Beverage Industry

A Survey

Project Description and Invitation

Massey University is conducting research into the drivers of product innovation in New Zealand Food and Beverage (F&B) industry. The aim of this research is to determine and analyse the drivers of product innovation in order to encourage more successful product innovation by New Zealand companies. The information is collected through this survey.

Your input is important as it will help us identify drivers of product innovation. The result of the research is expected to benefit your company and others in New Zealand.

Participant Identification

This research is limited to companies in the New Zealand F&B industry. This includes manufacturers, processors, producers, and wholesalers of food and beverage products.

The Managing Director or relevant personnel responsible for the company's new product development projects is invited to participate in the survey.

Survey Procedures

The survey will ask you questions about you and your company, new products, top management team, company culture, product development practice, internal capability, and collaboration with other companies. The survey will take 10 - 15 minutes to complete.

Data Management

All data collected will be treated with confidentiality and presented in collated form to preserve confidentiality of the data source.

1

MASSEY UNIVERSITY
ENGINEERING

Participant's Rights

If you decide to participate, you have the right to:

- Decline to answer any particular questions.
- Withdraw your survey data from the study within two weeks of the survey.
- Ask any questions about the study at any time during participation.
- Provide information on the understanding that your name will not be used.
- Be given access to a summary of the project findings when it is concluded.

Project Contacts

If you have any questions, please feel free to contact me or my supervisor.

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Ethical Concerns

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher named above is responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher, please contact Dr Brian Finch, Director, Research Ethics, telephone 06 356 9099 ext. 86015, email humanethics@massey.ac.nz.

Please provide information and your opinion on the followings:

You and your company

What is your job title? ____

What is your company name? ____

What year was your company founded? (circle one)

Before 1900 1900 - 1950 1951 - 2000 2001 to present

How many new products were introduced by your company during the last five years (2011 - 2016)? (circle one)

0 1 - 5 6 - 20 20 +

Is your company a New Zealand owned company? (circle one)

Fully New Zealand owned Partially overseas owned Overseas majority owned

What is the number of full-time employees your company currently employs? (circle one)

0 – 5 6 – 49 50 – 99 99 +

New products introduced during the last five years (2011 – 2016)

We have utilised available technologies (e.g. formula, ingredient, machinery, packaging material, and process) to develop our new products.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

We have invented new technologies (e.g. formula, ingredient, machinery, packaging material, and process) that were not available in the marketplace to develop our new products.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

We have utilised available value propositions (i.e. reasons to buy product) to sell our new products.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

We have introduced new value propositions (i.e. reasons to buy product) that were not available in the marketplace to sell our new products.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

Top management team

Top management are highly involved with new product development projects.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

Top management provide direction for new product development projects.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

Top management are willing to pursue new products that could replace existing products.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

Top management provide sufficient financial resources to new product development projects.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

Top management build relationships with other companies.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

Company culture

We aim to be the innovation leader in our market.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

We pursue high risk projects (i.e. product innovations) in hope for high return.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

We closely follow our customers' needs and demands.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

We closely follow new technologies and scientific developments.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

We closely follow our competitors' actions.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

We encourage staff learning of new ideas and experimentation.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

We clearly communicate the innovation objective (i.e. product strategy) across our organisation.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

Meeting the innovation objective (i.e. product strategy) is a part of employee performance review.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

Product development practice

We have specifically assigned project leaders for each new product development project.

Strongly Disagree	1	2	3	4	5	6	7	*Strongly Agree*

Project champion has important role in new project success. Project champion is defined as a passionate supporter of the project.

Strongly Disagree	1	2	3	4	5	6	7	*Strongly Agree*

We employ multi-disciplinary teams. For example, personnel from different functions are actively involved in a new product project at the same time.

Strongly Disagree	1	2	3	4	5	6	7	*Strongly Agree*

We have clearly defined project objectives (e.g. manufacturing requirement, product specification, and target market).

Strongly Disagree	1	2	3	4	5	6	7	*Strongly Agree*

Our product development process is well structured.

Strongly Disagree	1	2	3	4	5	6	7	*Strongly Agree*

We adapt our product development process according to the project's level of uncertainty. More structured process for high level and less for low level.

Strongly Disagree	1	2	3	4	5	6	7	*Strongly Agree*

Internal capability

We invest in building our own technology capability (e.g. production capability, research facility, and technological knowledge).

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

We invest in building our own marketing capability (e.g. brand recognition, customer knowledge, and distribution network).

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

We utilise our existing technology capability (e.g. production capability, research facility, and technological knowledge) to develop our new products.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

We utilise our existing marketing capability (e.g. brand recognition, customer knowledge, and distribution network) to sell our new products.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

Collaboration with other companies

We can easily communicate with other people outside our company.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

We prefer to outsource when developing new products.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

We closely collaborate with other companies when developing new products.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

We closely collaborate with our customers when developing new products.

Strongly Disagree 1 2 3 4 5 6 7 *Strongly Agree*

This is the end of the survey. Thank you for participating.

If you are interested in this research outcome, please provide your email address here:

If you have any comment or feedback regarding this survey, please provide them here:

APPENDIX E: Low Risk Notification Acceptance Letter

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA

30 October 2013

Julawit Pitrchart
[redacted]

Dear Julawit

Re: Drivers of Radical Product Innovation in New Zealand Companies

Thank you for your Low Risk Notification which was received on 9 October 2013.

Your project has been recorded on the Low Risk Database which is reported in the Annual Report of the Massey University Human Ethics Committees.

The low risk notification for this project is valid for a maximum of three years.

Please notify me if situations subsequently occur which cause you to reconsider your initial ethical analysis that it is safe to proceed without approval by one of the University's Human Ethics Committees.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

> *"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.*
>
> *If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 350 5249, e-mail humanethics@massey.ac.nz".*

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to provide a full application to one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

J. O'Neill

John G O'Neill (Professor)
Chair, Human Ethics Chairs' Committee and
Director (Research Ethics)

cc Prof Allan Anderson
School of Engineering and Advanced Technology
PN456

Mr John Gawith
School of Engineering and Advanced Technology
PN456

Prof Don Cleland, HoS
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APPENDIX F: Multi-factor Analysis of Variance to Answer RQ3 Based on a Transformed Scale for Product Innovativeness

Because the scores of product innovativeness (PI) show a certain degree of non-normality, the multifactor analysis of variance (ANOVA) was also performed through a transformed scale. This appendix shows the multi-factor ANOVA results based on this transformed scale.

Table H1 provides a comparison of the Anderson-Darling normality test for three data transformation. The data formed using the Johnson transformation is found to be normally distributed and as a result is used for ANOVA analysis.

Table H1: Transformation Result Comparison

Transformation	Anderson-Darling Value	*p* Value	Normal Distribution? ($p > 0.05$)
No transformation	1.265	< 0.005	No
Log base 10	4.174	< 0.005	No
Box-Cox transformation ($\lambda = 2$)	0.808	0.036	No
Johnson transformation ($p = 0.05$)	0.664	0.081	Yes

The ANOVA result using the Johnson transformed data is provided in Table H2.

Table H2: ANOVA Result

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Age	3	13.300	4.4332	5.03	0.002
Size	3	11.577	3.8589	4.38	0.006
Ownership	2	1.228	0.6139	0.70	0.500
Error	128	112.721	0.8806		
Lack-of-Fit	16	9.708	0.6067	0.66	0.827
Pure Error	112	103.013	0.9198		
Total	136	132.165			

The ANOVA result indicates that age and size have a significant impact on the mean PI ($p = 0.002$ and $p = 0.006$ respectively) while ownership does not ($p = 0.500$). The model Lack-of-Fit is not significant ($p = 0.827$) and has R^2 value of 14.71% which indicates the three company characteristics are not good predictors of PI. This is a good indication as it suggests the theoretical model is a better predictor of PI.

Next, Figure H1 presents the main effects plot comparing the effect of age, size, and ownership on mean PI. The company characteristics are coded as follows: Age ("2001 to present" = 1, "1951 – 2000" = 2, "1900 – 1950" = 3, and "before 1900" = 4); Size ("0 – 5" = 1, "6 – 49" = 2, "50 – 99" = 3, and "99 +" = 4); and Ownership ("fully New Zealand owned" = 1, "partially overseas owned" = 2, and "overseas majority owned" = 3).

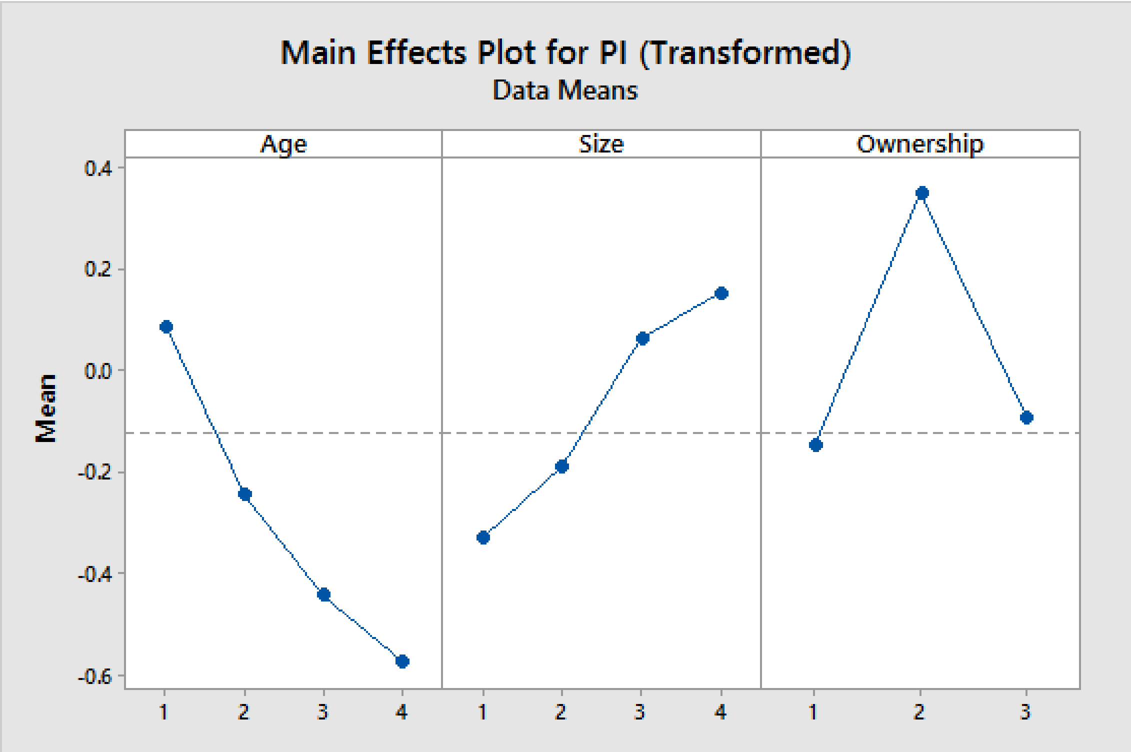

Figure H1: Main effects plot comparing age, ownership, and size effect on mean product innovativeness (transformed)

The main effects plot clearly shows younger companies having higher mean PI compared to older companies. This means that innovative new food and beverage products are more likely to be introduced by young companies. It supports the hypothesis **H13** that young food and beverage companies are more accepting of innovative product ideas.

Furthermore, medium to large companies are found to introduce more innovative products than micro to small companies. This suggests that medium to large companies have advantage over micro to small companies when it comes to innovative food product development given their number of employees.

Lastly, there is no clear difference regarding ownership, which suggests that nationality of ownership may not affect product innovativeness. Nevertheless, due to a small sample size of partially overseas owned and overseas majority owned companies (6 and 10 respective), the current predictive power for one-way ANOVA is approximately 0.27. In other words, given the current sample size of 6 for partially overseas owned companies, the ANOVA test only has a 27% chance of detecting a statistically significant difference between the 3 group means when that difference truly exists. A minimum sample size of 20 is required for approximate 0.80 power. Thus, it is inconclusive whether nationality of ownership could influence product innovativeness.

In summary, both the ANOVA result and main effects plot support **H13** and **H14**. However, **H15** is inconclusive due to the small sample size of partially overseas owned and majority overseas owned companies. This result is consistent with the non-transformed data result in section 6.5.

GLOSSARY

Ancillary components: The supporting technologies and mechanisms used in the product (Golder et al., 2009).

Auxiliary benefits: The way core value proposition is delivered to the customer including additional customer services and benefits (Kotler & Armstrong, 2014).

Core technology: The central technology used in the product (Golder et al., 2009).

Core value proposition: The fundamental reason the customer buys the product (Kotler & Armstrong, 2014).

Incremental product innovation: The introduction of a new product that involves a new-to-company core technology and/or core value proposition.

New technology innovation: The introduction of a new product that involves a new-to-market core technology.

New value proposition innovation: The introduction of a new product that involves a new-to-market core value proposition.

Product innovation: "The introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses" (OECD & Statistical Office of the European Communities, 2005, p. 48).

Product innovation process: "A disciplined and defined set of tasks, steps, and phases that describe the normal means by which a company repetitively converts embryonic ideas into saleable products or services" (Kahn et al., 2013, p. 463).

Product innovativeness: "A measure of the potential discontinuity a product (process or service) can generate in the marketing and/or technological process" (Garcia & Calantone, 2002, p. 113).

Radical product innovation: The introduction of a new product that involves a new-to-market core technology and core value proposition.

Radical product innovation determinant: The factor that affects the propensity of a company to pursue radical product innovation (Herrmann et al., 2007).

Technology: "The processes by which an organisation transforms labour, capital, materials, and information into products and services of greater value" (Christensen, 1997, p. xiii).

Value proposition: "A short, clear, simple statement of how and on what dimensions a product concept will deliver value to prospective customers" (Kahn et al., 2013, p. 475).