Characterisation of food product innovation with reference to bioactive functional food product development: an Asia-Pacific study

A thesis presented in partial fulfilment of the requirements for the degree of
Doctor of Philosophy at

Institute of Food, Nutrition and Human Health

Massey University, New Zealand

by

Rao Sanaullah Khan

July 2014

DECLARATION

The thesis entitled, "*Characterisation of food product innovation with reference to bioactive functional food product development: an Asia-Pacific study"* is submitted to Massey University for the degree of Doctor of Philosophy. I, Rao Sanaullah Khan, declare that this thesis is the outcome of my research work. The material used from other sources is acknowledged. I also certify that the work contained in the thesis, or any part thereof, has not been previously submitted for a degree, diploma or other qualifications.

Signed……..….

Student ID: 07222191

Full Name: Rao Sanaullah Khan

Acknowledgement

All praise be to Allah/God, the Lord of the worlds!

I would like to express my sincere gratitude to Dr. John Grigor, Dr. Mike Boland, Mr Alan Win and Prof. Dr. Ray Winger for their continuous encouragement, tremendous assistance and guidance in completing this research. As advisors and supervisors, they have provided me with constructive critiques to refine the contents. The completion of this research work would not be possible without their valuable support and guidelines. Their extensive knowledge, strong analytical skills and commitment to the excellence of research and teaching have truly benefited this thesis.

A special thanks to Dr. Jones Beatrix and one of his PhD student (Insha ullah) for guiding me in doing the statistical analysis.

I would also like to acknowledge Massey University for providing excellent research and student facilities.

All the participants of this research (Food Manufacturing companies in New Zealand and Singapore) have provided me with their time and valuable inputs to complete this research project. I extend my sincere gratitude to all of them and wish them best of luck in their future endeavours.

This research has been completed with the financial support of Higher Education Commission of Pakistan and Riddet Institute New Zealand as part of the Riddet CoRE (Centre of Research Excellence) Platform 4.3 *Future Foods* programme. Other collaborating partners in conducting this research in Singapore were Spring Singapore and Food Innovation Resource Centre, Singapore. Their services cannot be ignored in succeeding this research project to its completion.

Last, but not least, many thanks to all my family members, friends and colleagues for their unconditional love and support throughout my PhD studies.

Publications

1. Khan, R. S., Grigor, J., Winger, R. J., & Win, A. (2013). Functional food product development-opportunities and challenges for food manufacturers. *Trends in Food Science & Technology*(30), 27-37.

   This article was cited in few days of its publication in numerous places such as;

   http://www.nutraingredients.com/Research/New-innovation-models-are-needed-to-boost-the-functional-food-NPD-processes
   http://eurobiz.jp/2013/03/proof-positive/

2. Khan, R. S., Grigor, J., Win, A., & Boland, M. (2013). Differentiating aspects of product innovation processes in the food industry: an exploratory study on New Zealand. British Food Journal (accepted for publication)

Conference

New Zealand Institute of Food Science Technology (NZIFST) conference 2011. Firm orientation and NPD approaches towards functional food development: A census of New Zealand food manufacturers (Poster Presentation)

Abbreviations

NPD= New Product Development

FFPD= Functional food product development

FF= Functional foods

MNE= multinational enterprise

MO= Market oriented

PDO= Product oriented

PRO= Process oriented

ORO= Organisational oriented

IRGS= To increase range of goods/services

IMS= To increase market share

ENMO= To exploit new market opportunities

I**RC**= To increase responsiveness to consumers

RC= To reduce cost

IKSC= To increase knowledge sharing with consumers

Table of contents

List of Figures

List of Tables

Abstract

Functional foods, being one of the major food categories of the global health and wellness market, are becoming a major focus of new product development (NPD) in the food industry. These food products are associated with a higher return on investment by securing competitive advantage. The development of functional foods is more complex than traditional food New Product Development (NPD), calling for a concerted effort from researchers and NPD experts to explore and understand the functional food product development (FFPD) process in more detail. The current review in this field has reported that there is a need to evolve from a traditional NPD approach, towards an integrative and innovative approach involving cooperative networks and techniques of commercialization. However there is little practical evidence on how much progress has been made to date. Therefore this research was designed to investigate the food product innovation process of food manufacturing in the Asia-Pacific region (New Zealand and Singapore) with reference to functional foods development by applying a mixed-method approach i.e., quantitative and qualitative techniques.

Results showed (22% response in New Zealand) that overall a market oriented NPD approach dominated most of the factors of the innovation process in the food manufacturing sector. Major aims and mode of product development indicated a closed NPD approach (>80% NPD done alone) where increasing the range of goods and service to increase the responsiveness to customers and consumers was ranked the highest. Similarly cooperative networks seem to be dominated by ingredient suppliers and customers. These kinds of approaches are again an indication of a traditional NPD approach which was also evident in the commercialization strategies of NPD where a lower preference for protecting intellectual property rights existed. Attaining competitive edge and creating market opportunity are major drivers for FFPD. This is reflective of the business challenges in domestic markets as well as international markets where most food manufacturers fall short of attaining and maintaining competitive edge due to fierce competition in rapidly changing food markets.

A comparative account of NPD practices between registered New Zealand food companies that are doing some sort of functional foods development (Group 1) and those that are not (Group 2) showed a significant difference ($P<0.05$) in the aims and mode of NPD between Group 1 and Group 2. Further it was observed that food companies in Group 1 have significantly ($P<0.05$) more diverse external collaborations with broader aims to collaborate,

in comparison with food companies in Group 2. This is a positive step toward developing an external resource base, which is essential in developing functional foods. This attitude should be encouraged in future innovation polices as being critical to value-added food product innovations in New Zealand. Apart from these differences, food companies are still pursuing a traditional NPD approach (independent and closed NPD); with loose Intellectual Property (IP) protection practices irrespective of type of innovation activity. Similar comparative analysis showed that there was no difference in the innovation process of food companies in Singapore. Hence it can be inferred that in New Zealand and Singapore the food manufacturing sector needs to identify the factors of sustained competitive advantage. According to a resource-based view (RBV) of attaining competitive advantage, heterogeneity in resources and capabilities is essential at a national level of innovation system to create competitive behaviour among stakeholders. The prevalent scenario of homogeneous resources and capabilities can be changed by facilitating the development of technological collaborations among the stakeholders at a national level. In relation to this change, there is a need to create awareness among the stakeholders about the factors needed for developing unique and inimitable resources, and dynamic capabilities in food manufacturing.

Overall it can be concluded that the current closed NPD model is suited to incremental innovations and is exposed to exploitation by the powerful retailers (customers). Further the emerging health wellness market segment requires a change in NPD attitude where futuristic needs and demands of consumers are met through understanding consumer attitudes towards foods and their life-style. Therefore a change in NPD approach from a closed and linear model to an open and interactive NPD model is suggested to perform better in future. Research-oriented collaborations need to be strengthened in their scope and content to develop the innovative capabilities and capacities of Small & Medium Enterprises SME's with future value-added food production. However, this is a challenging task for food companies who are small enough to employ NPD professionals to develop that interactive NPD model where internal capabilities are leveraged with external resources to enhance the novelty of product innovations. Government may have to work in close collaboration with manufacturers of functional foods to evolve a regulatory framework that is compatible with domestic and international market regulations.

1. Introduction

1.1. Background

Functional foods can be defined as having *"beneficial effects on target functions in the body beyond nutritional effects in a way that is relevant to health and well-being and/or the reduction of disease"* (Diplock et al., 1999). These food products have shown a compound global annual growth rate of 8.6% in the 10 years to 2012 (Euromonitor, 2010d). With this type of growth, more and more food manufacturing companies are including functional food development as part of their NPD portfolio (Matthyssens, Vandenbempt, & Berghman, 2008). Other drivers rating highly on the agenda for developing these specialized health-oriented food products include attaining a competitive edge (Mark-Herbert, 2002) and securing a higher return on NPD investment (Lagorce, 2009).

1.2. Research problem

The orthodox NPD processes, which characterise most of the food industry's approach to NPD, can be considered seriously flawed in developing these innovative health-oriented food products. The food industry displays higher failure rates of new products than any other manufacturing industry, with some reports estimating a new product launch failure rate of more than 90% (Hardy, 2010; Ziggers, 2005). One of the main reasons for such a high failure rate is the wide-spread reliance on 'me too' products. These products rarely last more than two years in the market. Conversely, truly innovative food products, which constitute less than 2% of all NPD launches, have been estimated to have a success rate of around 25% (Hardy, 2010). Therefore, the importance of re-evaluating NPD processes, with the potential for improving return on investment and maintaining a competitive edge cannot be overemphasised. In addition food businesses need to consider customising their NPD practices to take into consideration the changing market environment where increasing health awareness and concern among consumers is raising a number of challenges which product developers need to face (Bech-Larsen, Poulsen, & Grunert, 1999; Euromonitor, 2010a; Frewer, Scholderer, & Lambert, 2003).

Successful functional food product development processes have been suggested to evolve from reorientation of NPD practices from a dominantly market-oriented to a product-oriented NPD approach (Gehlhar, Regmi, Stefanou, & Zoumas, 2009). Enhanced collaboration with external partners (Broring, Cloutier, & Leker, 2006) and building strong market brands (commercialization) (Mark-Herbert, 2004) are also considered important factors. Radical or

novel functional food NPD can be expected to create a number of possibly insurmountable problems if a traditional food NPD process is adopted (Mark-Herbert, 2004; Matthyssens et al., 2008). Besides having technical complexities, there are quite stringent regulatory requirements to be met before the added health benefits of functional food products can be claimed in the market (B. B. Butchko & Petersen, 2006; H. H. Butchko, Petersen, & Benjamin, 2005; EU, 2000). Furthermore, food product development usually focuses on meeting consumers' needs in the short term, with little investment in R&D activities (Broring, 2008; Broring et al., 2006; Costa & Jongen, 2006; Gehlhar et al., 2009; Mark-Herbert, 2004; Matthyssens et al., 2008). In contrast, functional food NPD demands extended and extensive R&D activities with a comparatively longer time to development (Heasman & Mellentin, 2001; Hoban, 1998; Traill & Mueulenberg, 2002). In this scenario a collaborative NPD program with research-oriented institutions has been suggested to provide an effective means to cope with the challenges of these technological intricacies and complexities. The focus of these collaborations may be on understanding technological developments, and/or on processes related to proof of efficacy and/or meeting food labelling regulations (Barbara & Francesco, 2012). This may induce a change in the knowledge generation approach of traditional food NPD from acquiring synthetic knowledge to developing analytical knowledge (particularly in nutrition and human physiology) (Jones & Jew, 2007). Thus a new approach is likely to be needed, to supplement current NPD activities, for example adopting collaborative NPD activities to reduce the risk and cost of developing such innovative food products (Beckeman & Skjoldebrand, 2007; Ritter & Gemunden, 2003).

Effective launch of functional food products and extended access to consumers for developing trust in buying these products is beyond the individual capacities and capabilities of most food companies. A network across industries (involving collaborating partners in commercialization as well) may be exploited to enhance consumer awareness and acceptance of new functional food products (Traill & Mueulenberg, 2002). However, collaborative NPD and commercialization may bring its own management challenges in terms of ownership. This requires sophisticated and comprehensive IP policies among the collaborating partners of NPD (Mark-Herbert, 2004; Sadler, 2005) to secure premium return on investment.

1.3. Research questions

The current literature lacks any published guidelines or standard procedures and processes for developing successful functional food products. However, a few studies have tried to

understand and suggest better ways of developing functional foods (Gehlhar et al., 2009; Mark-Herbert, 2004; Matthyssens et al., 2008; Traill & Mueulenberg, 2002). Therefore it is essential to empirically investigate the perceptions of drivers of and barriers to functional food product development with respect to the overall innovation process of food manufacturing companies. In this regard, a national level comparison of functional food development practices between countries may give a better understanding of innovation approaches adopted by the food companies. These practices can be benchmarked against relevant literature and recommended practices for developing functional foods. Hence an empirical study into the current NPD practices of food manufacturers in Asia-Pacific region, i.e. New Zealand and Singapore, was conducted to investigate the critical aspects of value innovation such as orientation towards innovation/NPD (Gehlhar et al., 2009; Traill & Mueulenberg, 2002), cooperative network (Chiaroni, Chiesa, & Federico., 2011; Dahlander & Gann, 2010) and commercialization techniques (Menrad, 2003; Sarkar & Costa, 2008).

1.4. Aims, Objectives and Hypothesis

The aims and objectives of this study were as follows:

Aims:

To provide insight into practices that would improve the development of functional foods. Through:

- understanding the innovation processes and practices currently used by the food manufacturing industry (in New Zealand and Singapore) and,
- understanding the current perceptions of personnel managing functional food development.

Objectives:

I. To investigate the new product development practices, major aims of NPD, mode of NPD and organizational orientation towards NPD.
II. To investigate the cooperative network of food companies i.e., who are the major external partners and what kind of activities are done in partnership with them.
III. To investigate the commercialization tools of NPD such as protection of innovation (intellectual property rights), marketing tools and major challenges.
IV. To investigate the perception of food manufacturing firms towards various ***drivers*** of FFPD

V. To investigate the perception of food manufacturing firms towards various ***barriers*** of FFPD

There were number of hypothesis tested later in the thesis (a detailed description of underpinning theory is given in section 3.3.1. These hypotheses are:

H1: There is a difference in NPD orientation between companies manufacturing functional foods and other food companies.

H2: There is a difference in external collaborative links between companies manufacturing functional foods and other food companies.

H3: there is a difference in commercialization techniques between companies manufacturing functional foods and other food companies.

2. Review of Literature

2.1.Introduction

This review focuses on the need and extent that food businesses need to evolve from current traditional NPD practices to engage in successful FFPD. A brief literature-based *comparison between traditional food NPD and FFPD* is presented, followed by a stepwise discussion on proposed distinguishing FFPD features. This sets the *context of functional food product development* in the food industry; and connected to this a change is required in *knowledge generation activities for functional foods development* (from synthetic knowledge to analytical knowledge) and involvement of external partners/stakeholders. The subsequent section is dedicated to highlighting the importance of establishing diverse *collaborative networks and arrangements* for enhancing the innovation capability of the firm, with examples from current models being adopted by some leading multinational companies. Various entry strategies for new functional food products are described with examples from leading food companies in the section: c*ommercialization of functional foods - an argument for collaborations*. Some concluding propositions are given for managing these collaborations more effectively under the section; *managing collaborations*. Finally, overall conclusions are drawn from current literature and practices.

2.2.Definition and history of functional foods

Generally "*functional foods are those foods which are aimed at improving health related conditions or preventing such conditions"*(Frewer et al., 2003). Moreover, these foods have been described as nutraceuticals, nutritional foods, pharma-foods, medical foods, super foods, designer foods and functional foods (Playne, Bennett, & Smithers, 2003) providing identified health benefits. There are a number of definitions (Table 2.1). Among these definitions, the most robust and specific definition is provided by International Life Science Institute (North America and Europe). This definition stresses the importance of scientific substantiation of the effects functional foods have on human physiology beyond adequate nutrition. The major markets such as Japan, USA and Europe have different regulations and legislative frameworks to define these foods. Hence, after more than 30 years of functional food inception, there is no single universally acknowledged definition of these foods (Krystallis, Maglaras, & Mamalis, 2008).

Functional food legislation has had a disjointed development through the different approaches of regulatory bodies in different countries. Historically, the surge for better

nutrition started early in 1950's when researchers started to examine the relationship between nutrition and degenerative diseases such as heart problems linked to fat consumption. With ongoing research and development in healthy nutrition, a new concept emerged in the food industry, namely the concept of functional food products (Heasman & Mellentin, 2001). A more systematic and comprehensive approach adopted by the Japanese Government in 1986 led to the development of a new category of foods defined as ***FOSHU*** (Food for special Dietary Use). By 1991, under the Nutrition Improvement Law the Ministry of Health and Welfare (MHW) in Japan (1991) presented a working definition of ***FOSHU*** -"*processed foods containing ingredients that aid specific bodily functions in addition to being nutritious*" (Menrad, 2003; Ministry of Health, 2013; Siro, Kaplona, Kaplona, & Lugasi, 2008). These newly defined foods had the following differentiating criteria;

1. Exert health or physiological effect
2. In the form of ordinary food, not pill or capsule.
3. Part of normal routine diet.

After this revolutionary start initiated by the Japanese government, USA and Europe responded with various institutions trying to define this new category of foods whilst regulatory bodies tackled the issues around how these foods fitted under current food or medicine law. In USA, Food and Drug Administration is the body which guides for making nutrient claim, structure/function claim (e.g. Calcium is good for bones) and health claim. Only health claims are required to have a pre-approval from FDA based upon publically available scientific evidence (Baker, Brady, & Mary., 2012). In Europe, General Food Law Regulation; EC178/2002, deals with all foods including functional foods or any other food. There are numerous rules under this regulation which deals with different kind of foods such as dietetic foods, supplements, novel foods etc. European Food Safety Authority (EFSA) is responsible for overseeing these rules and regulations for its implementation. For novel foods EC 258/97 is used which classify these foods/ingredients into various classes depending upon their history of use in foods (Baker et al., 2012).

In Canada these kinds of food products are regulated as a sub-category of drugs. The relevant regulation for them is called Natural Health Product Regulation which defines and classifies these products and set criteria for attaining efficacy, quality and safety (Baker et al., 2012).

Table 2. 1. Definition of functional foods as defined by various governing bodies in Japan, USA and Europe

Country	Defining Body	Definitions
USA	International Life Sciences Institute of North America (ILSI NA)	"those foods which provide health benefits beyond ba nutrition through the presence of physiologically active components"
USA	Institute of Medicine of the USA-National Academy of Sciences	"those foods in which the concentrations of one or m ingredients have been manipulated or modified to enh their contribution to a healthful diet"
Japan	Ministry of Health, Labour and Welfare	"processed foods containing ingredients that aid spec bodily functions in addition to being nutritious"
Europe	International Life Sciences Institute (ILSI Europe)	"a food can be regarded as functional if it is satisfacto demonstrated to beneficially affect one or more targ functions in the body, beyond adequate nutritional effec way which is relevant to either an improved state of h and well-being, or reduction of risk of disease"

As the functional food market increased dramatically in value, governmental bodies in developed markets have had to tackle the issues around functional food legislation more closely. At the national level, the framework for health regulations, type of health claim and nutritional information required on the label varies significantly between nations. However, efforts are being made in EU, Australia and New Zealand to bring some sort of regional harmony to regulating these functional food products (FSANZ, 2013; "Regulation (EC) No. 1924/2006 of the European Parliament and of the Council of 20 December 2006 on nutrition and health claims made on foods," 2007). In this regard, an effort was made to bring consistency among the health regulations for these functional foods across the EU in 2006 (H. H. Butchko & Petersen, 2005; Coppens, Fernandes da Silva, & Pettman, 2006). It has resulted in laying down the basic principles of legislations for these claims. The European Food Safety Authority (EFSA) thus has issued the list of approved health claims with scientific evidence which can be used for these foods (Verhagen, Vos, Francl, Heinonen, & van Loveren, 2010). In addition the EFSA has also published a list of claims which cannot be used due to lack of scientific evidence (Coppens et al., 2006; EU, 2000). Manufacturing companies now have to be very specific in making their health claim and careful in manufacturing products to ensure efficacy (Bech-Larsen & Scholderer, 2007; Verhagen et al., 2010).

Food Standards Australia New Zealand has recently published its new food standard to regulate nutrition content claims and health claims on food labels (FSANZ, 2013). This new food standard will guide the food manufacturers to make accurate claims pertaining to nutrition content and health, such as “low in fat”, and these claims need to meet the criteria set out in the standard e.g., a claim stating ‘good source of calcium’ will need to have calcium in that food more than the amount of calcium specified in the Standard. Two types of health claim have been defined in this standard i.e. a general level health claim and a high level health claim. A general level health claim refers to a nutrient or substance effect on a health function which is not a serious disease or a biomarker of a serious disease e.g. ‘calcium is good for bones and teeth’. Whereas a high level health level claim refers to a nutrient or substance in a food with its effect on serious disease or a biomarker of a serious disease e.g. ‘high calcium diets may reduce the risk of osteoporosis’ or ‘phytosterol may reduce blood cholesterol’.

Functional foods from a legislative perspective could be defined as foods with substantiated health claims presented on food labels. However, for this thesis a definition adopted based on

legislation is problematic. This is primarily due to the differences in legislation between countries (as described in this section) which may also be changed during the course of the study. Therefore in this research definition of functional food is as "***food products that contain compounds from natural sources that have added health benefits for the human body. Examples are bioactive peptides from milk (or whey), herbal extracts (such as ginseng), omega-3 fatty acids (from fish) and lycopene (from tomatoes).***"Further examples of functional food products with their functionality are presented in appendix I.

2.3.Functional foods market

2.3.1. Global Market

The main consumer motive for purchasing functional foods is the growing desire to use foods either to help prevent chronic illnesses such as cardiovascular disease, Alzheimer's disease and osteoporosis, or to optimize health, for example by increasing energy, boosting the immune system or generation of wellbeing (Regmi & Gehlhar, 2005; Sadler, 2005).This need has led to one of the fastest growing food sectors, with a compound annual growth rate of 8.6% in the 10 years to 2012 (Euromonitor, 2010b). The emergence of a new market segment called 'Health and Wellness' reached a global value of more than US$ 700 billion in 2012 and is expected to hit US$ 1 trillion by 2017. This segment incorporates fortified/functional foods, but also includes organic foods, "better for you" food and beverages (BFY), "naturally healthy" (NH) foods, products catering to food intolerance, vitamins and dietary supplements, traditional herbal products, slimming products and sports nutrition. Of this market, the functional foods part alone was valued at US$168 billion in a global market that is 2.5 times the size that of vitamins and dietary supplements (Euromonitor, 2010a)

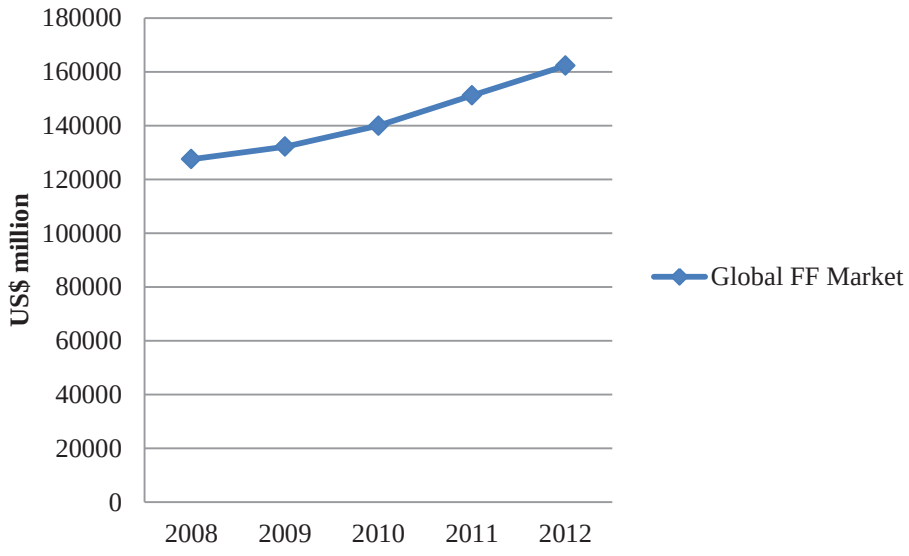


Figure 2. 1. Global retail sale value of functional foods ((Euromonitor, 2010a, 2010c)

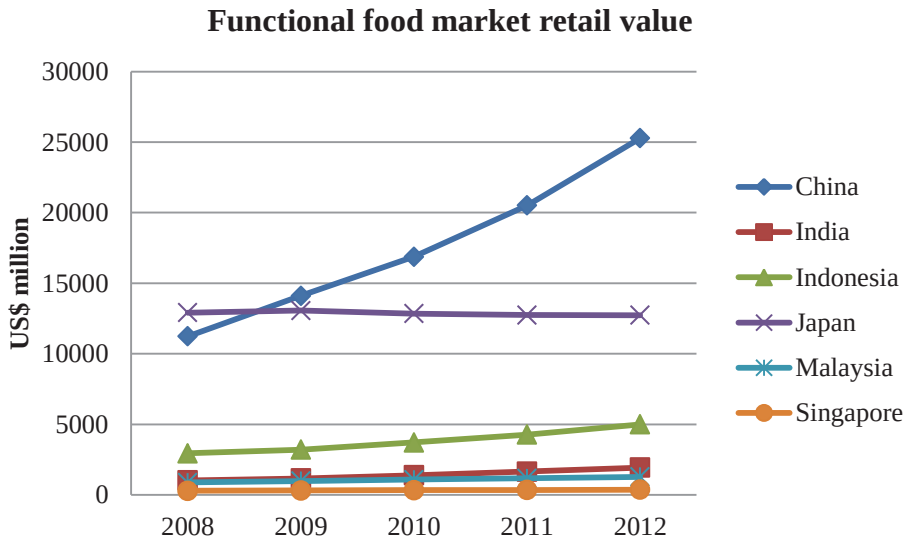


Figure 2. 2. Comparative market size of various Asian countries over the last five years (Euromonitor, 2013a)

Data for year-on-year growth shows that China, India and Indonesia are constantly growing in this segment of the functional food market (Figure 2.4). The future forecast shows that by 2017, the functional food market in China will reach more than US$ 47 billion from the current value of US$ 25 billion i.e., a 100% increase in the next five years . Other big markets in Asia are Japan and Indonesia.

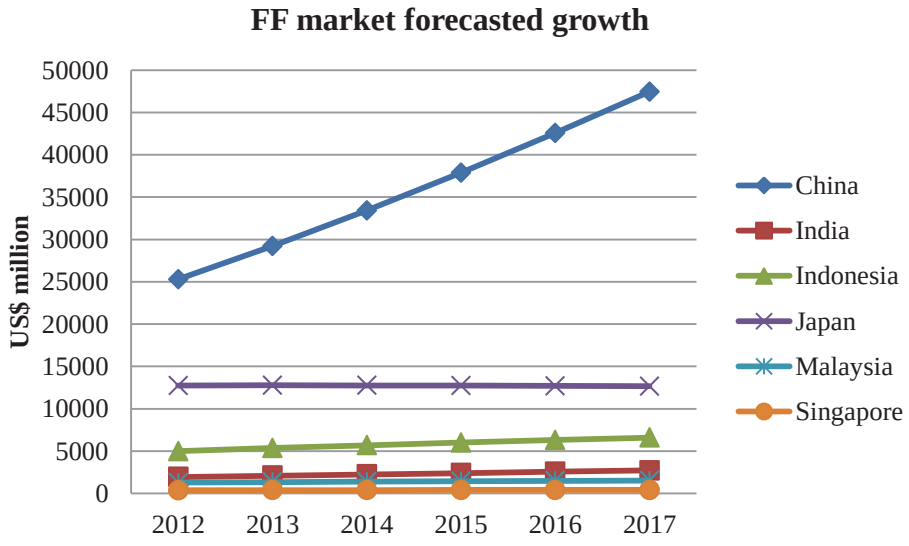


Figure 2. 3. Forecast growth of functional food market in Asia (Euromonitor, 2013a)

2.3.2. USA market

The USA over the last five years has experienced some ups and downs mainly because of the economic recession which first hit in 2008-09 and then again in 2011. The previous five years' data (2008-2012) indicate that the USA functional food market is maintaining a constant value of around US$ ~32 billion with health and wellness being 5.5 % of the total sales of packaged food (Euromonitor, 2013a).

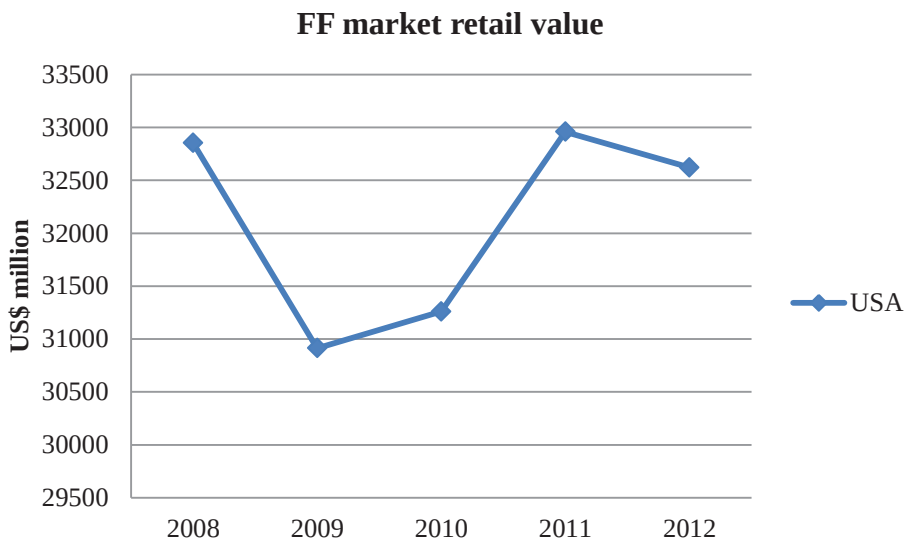


Figure 2. 4. Functional food market in the USA (Euromonitor, 2013a)

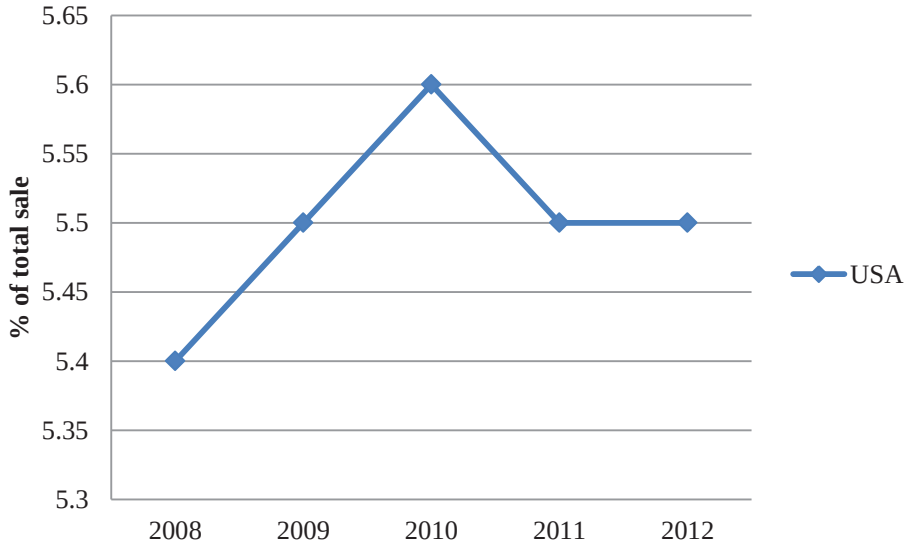


Figure 2. 5. Health &Wellness as % of total market in USA (Euromonitor, 2013a)

Comparative data on projected forecasts of the functional food market growth suggest that China will overtake the USA by 2014. This is based upon current prices and fixed exchange rates (Euromonitor, 2013a). At the end of 2017, China will have a lead of approximately US$ 12,773.8 million over the USA market.

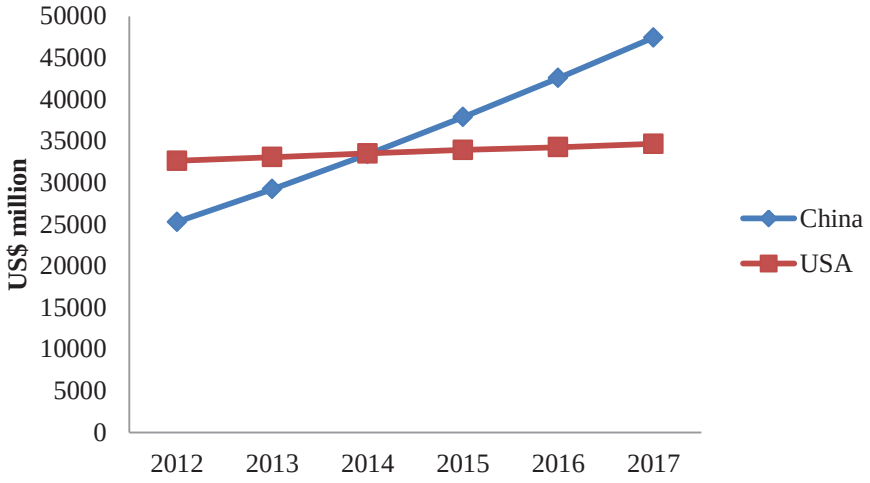


Figure 2. 6. Comparative projected forecast of the value of the functional food market in China and USA (Euromonitor, 2013a)

2.3.3. UK, Australia and New Zealand market

The UK, being a mature market in processed foods, is another big yet steady market for functional foods. Australia and New Zealand are comparatively new in functional foods and the market is still developing significantly.

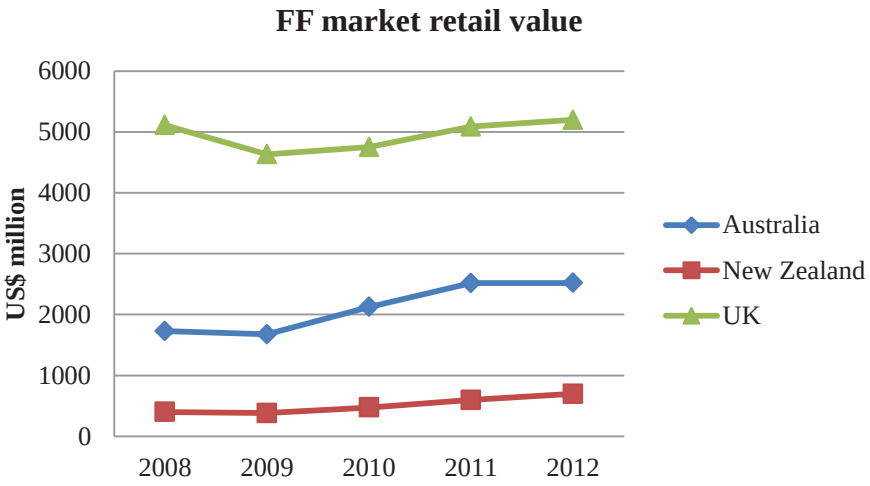


Figure 2. 7. Comparative functional food market in UK, Australia and New Zealand (Euromonitor, 2009a, 2010b, 2013a)

Based upon current prices and previous growth patterns, it has been forecasted that New Zealand and Australia may experience steady growth in functional foods while the UK may maintain its present value (Euromonitor, 2013a) .

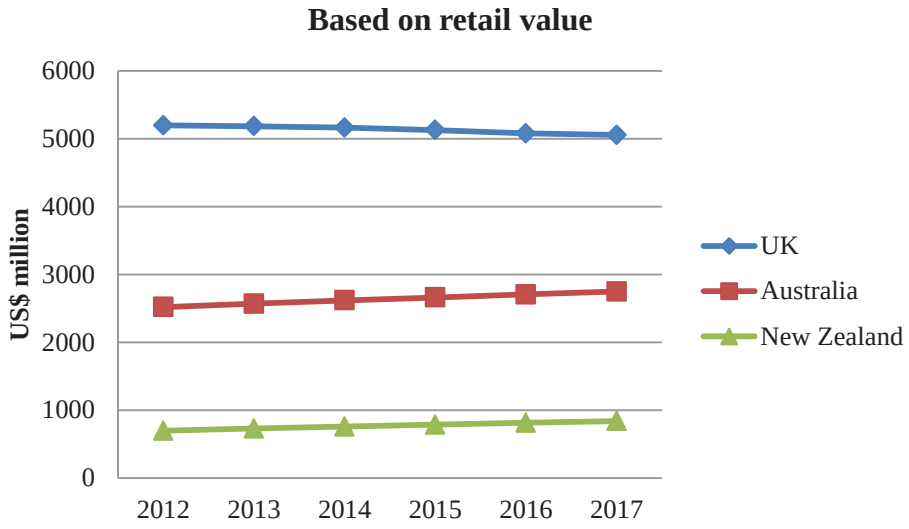


Figure 2. 8. Comparative forecasted retail value of functional food market (Euromonitor, 2013a)

2.3.4. The need for functional foods development in New Zealand

New Zealand is a significant food producer, producing about five times the amount of food needed to feed its population and exporting the surplus. Its food and beverage export count for 2.5% of global trade in foods and beverages (Kevin., Graeme., Russell., & Johns, 2012). The food and beverage sector in New Zealand contributes more than 50% of the export earnings from merchandise trade. This sector employs every fifth individual of the New Zealand population directly or indirectly (Mallard, 2007). Recently the New Zealand government has committed itself to lift New Zealand's export economy from 30% to 40% of its GDP by 2025 which means a doubling of its exports (Government, 2012). This will mean lifting the export value of the food and beverage sector from 23billion NZ$ to 53billion NZ$. Adding value to food production is critically important to achieving the stated goals. In this regard the government has already started working to transform its food manufacturing enterprises from a volume and price mind-set to creating value (Government, 2012) and securing intellectual property rights (Marshall. et al., 2012); an essential factor in producing value added food products (Mark-Herbert, 2002; Matthyssens, Vandenbempt, & Berghman, 2008).

The prices of manufacturing output increased to 4% while the volume for meat and dairy products fell to 10.1%. The huge drop in volume of meat and dairy with a comparatively lower drop in sales value indicates the rise in price of commodities. It was seen that dairy products prices rose to 29.6% while the other food manufacturing commodities fell to 8.4% (Ashley-Jones, 2010). This situation suggests that fluctuation in demand for dairy products in the international market dictates the fate of trade for New Zealand manufacturing industries at large. Moreover, dairy products are one of major contributors of export earnings for New Zealand in the international market. Therefore, it is critically important for the food industry of New Zealand to be versatile in manufacturing value added food products. Firstly this will reduce the sole reliance on dairy and meat produce in the international market. Secondly it will increase the return on investment and enable the food manufacturers to attain competitive edge in the global food market (Kevin. et al., 2012).

The New Zealand food industry is an appropriate model for the global food industry, to develop an understanding of NPD processes for functional foods (Government, 2012; Kevin. et al., 2012). New Zealand is considered an appropriate model because: the export food industry makes products similar to those in other markets, competing successfully in international markets; the economy is that of a developed country with the typical infrastructure and legislative environment of a developed country (OECD, 2007) and the food industry size is sufficiently small to allow coverage of the whole industry. Further, New Zealand has a substantial immigrant population from all around the world and hence it can serve as a suitable place for understanding a wide range of consumer attitudes towards functional food. It is noted that New Zealand has often been used as a test market by pharmaceutical companies for similar reasons.

2.4. Functional food product development context

Over the last two decades different food, pharmaceutical and retail businesses alike have been motivated to enter this lucrative market, with the potential to gain higher returns and to generate a competitive edge (Kleef, Trijp, Luning, & Jongen, 2002; Lagorce, 2009). However, the high failure rate of conventional new food products launched into this market does not make easy reading for people managing the NPD process (Hardy, 2010; Hoban, 1998). The product development process for new functional food products has been described as complex, expensive and risky (Kleef et al., 2002; Siro et al., 2008).

2.4.1. Radical/discontinuous product innovation approach for FFPD

Functional food product development may be carried out on the principals of radical/discontinuous product innovation process which differ from conventional NPD approach. Because discontinuous innovations have a higher degree of technological uncertainty and longer development time with a sequence of innovations (Garcia & Calantone, 2002; Veryzer, 1998). Other factors such as lack of customer familiarity and uncertainty of suitable applications also affect the NPD method for these products. Market assessment and financial analysis prior to beginning of these products rarely possible since the customers and consumers cannot comprehend these products fully (Veryzer, 1998). Rather a prototype is developed to explore and formulate the application technology and assess the technical aspect of the product.

Functional food product development can be argued to manage from the perspective of discontinuous product innovation as it involves uncertainty in technology and market. It cannot be driven by the customers as is the case for traditional food NPD because customers are usually not fully aware of proprietary new technologies and thus unable to appreciate these products (Veryzer, 1998). Therefore early involvement with customers is not favorable to test product ideas or collect data until a product application is formulated and developed. Hence conventional NPD approach of managing these product innovations may not suitable.

2.4.2. A case of Pharmaceutical NPD approach for FFPD

The literature suggests that the category of functional food products is a fusion between food technology and clinical nutrition (Heasman & Mellentin, 2001) (Figure 2.9). The basic NPD driver in pharmaceutical companies is to develop new drugs that can meet the unmet medical needs of population (Gupta, Pawar, & Smart, 2007). An increased competitive business environment has even forced the traditional linear NPD model in pharmaceutical companies to give away discovery, development and commercialization of NPD to specialist organisations. However these companies already have well established mechanism to ensure intellectual property rights and hence a higher return on investment can be expected if the product meets the unmet needs of population (Gupta et al., 2007). On similar ground the case of functional food product development in food industry may resemble closely to new pharmaceutical NPD trends where external collaborations in a well secured manner are sought to develop truly new products that can truly meet the unmet needs of consumers. The issues of health regulations and drug regulations pertaining to the development of these products need to be carefully managed by regulatory bodies to ensure protection of the

consumer whilst also avoiding undue barriers to NPD innovative practices in the food area. Thus successful development can only be ensured if regulations for these products are brought into some sort of harmony to effectively guide the manufacturers (Frewer et al., 2003; FSANZ, 2013; Ray, 2004; "Regulation (EC) No. 1924/2006 of the European Parliament and of the Council of 20 December 2006 on nutrition and health claims made on foods," 2007).

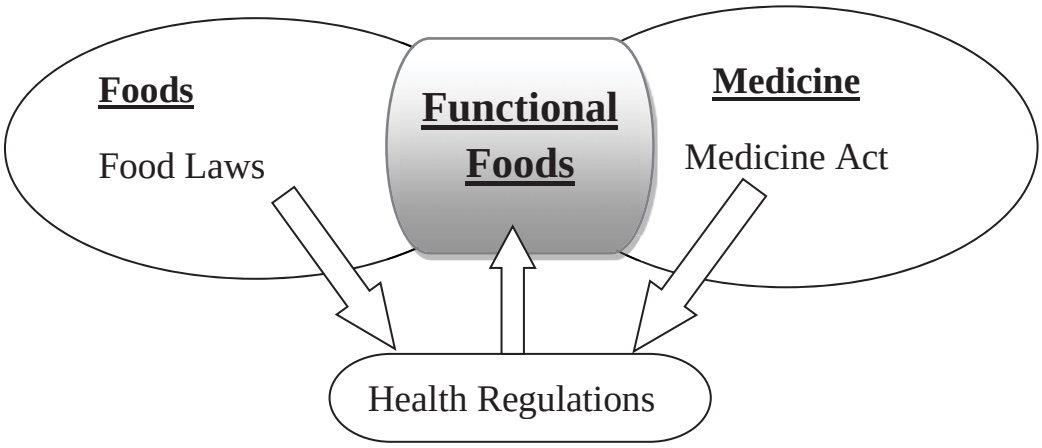


Figure 2. 9. Conceptual presentation of functional foods development (Frewer et al., 2003)

A study by Mark-Herbert in 2004 suggested "*Industrial marriage*" as the way forward for developing new functional food products. This implies collaborative product development by pharmaceutical and food manufacturers, with sharing of resources and skills for effective functional food development. One such example was the introduction of a probiotic product in the USA market by the joint efforts of CAG functional foods and Swedish biotech business. However, this venture suffered serious difficulties among the partners due to intellectual property rights and brand ownership issues (Mark-Herbert, 2003). The grey area where food and health markets merge (Broring et al., 2006) has generated a need for new competencies for personnel and enterprises working in functional food product development (FFPD) (Mark-Herbert, 2002). A number of important factors have been offered in the literature for successful FFPD. These include inter-industry relationships (Beckeman & Skjoldebrand, 2007; Bhaskaran, 2006; Marsh, 2003; Salavou, Baltas, & Lioukes, 2004; Siedlok, Smart, & Gupta, 2010) and research-oriented collaborative networks (Beckeman & Skjoldebrand, 2007; Broring et al., 2006; Siedlok et al., 2010).

2.5.The innovation dilemma of the food industry

Innovation has been associated with economic activity and profit earnings for businesses (Costa & Jongen, 2006; Kelly, 2009; Sarkar & Costa, 2008; Traill & Mueulenberg, 2002). However, the food industry has been characterized as a market searcher rather than a market developer, owing to variety of factors such as consumers' risk aversion, shortening of product life-cycle by the introduction of low-cost imitators (such as private labels), lack of an innovation climate and restrictive health and safety regulations (Bhaskaran, 2006; Broring, 2008; Ronteltap, Van Trijp, Renes, & Frewer, 2007). While line extensions may serve the purpose of keeping attention directed towards the main brands of the company, the food industry earns only 21% of their turnover from NPD launches, which is well below the consumer packaged goods sector industry average of 38% (Ziggers, 2005). A vast majority of new food products are "me too" products (77%) and only 1-2% of new food products can be considered truly innovative products (Costa & Jongen, 2006; Hardy, 2010). Recently, a rising trend in the health and wellness market has provided an opportunity for addressing this balance and moving towards truly differentiated innovative functional food products (Euromonitor, 2010d; Hardy, 2010; Matthyssens, Vandenbempt, & Berghman, 2006; Ziggers, 2005). Truly differentiated food products having unique customer values can also be viewed favorably in the wake of an increasingly competitive consumer goods market (Gehlhar et al., 2009). Further, access to consumers is now mainly through the giant retailers (Menrad, 2003) and consumers no longer consider private labels as a weak alternative to branded food products (Hardy, 2010). This situation is especially challenging for branded food manufacturers, who want to maintain their leading edge while being competitive in price and quality of products (Gehlhar et al., 2009). Those companies who want to move out of traditional competitive behavior and enter into new markets (Matthyssens et al., 2008) will need to develop unique competencies to out-perform their competitors in technological and production skills whilst making their business viable in the long-term (Mark-Herbert, 2003). Although not all functional foods launched in the past or to be launched in the future have been and will be classified as radical new products (create demand previously unrecognized by the consumer (Garcia & Calantone, 2002)); a truly differentiated innovative functional food product development program (a discontinuity either in technology or marketing (Garcia & Calantone, 2002)) will be an effective tool for maintaining competitiveness while increasing turnover/profits from NPD (Lagorce, 2009; Ziggers, 2005). Moreover, FFPD may cause a departure from the existing traditional NPD practices and business attitudes towards innovation and production skills and systems (Ziggers, 2005).

2.6. Comparison between traditional food NPD and FFPD

The traditional NPD process in the food industry has been well studied and documented. Comprehensive reviews (Benner et al., 2003; Earle, 1997; Graf & Saugy, 1999; Jacqueline et al., 2007; Rudolph, 1995; Stewart-Knox & Mitchell, 2003; Van Kleef, Van Trijp, & Luning, 2005) have identified a variety of factors and procedures to conduct NPD projects successfully. Various models of NPD have been reported in the literature e.g., Kotler and Armstrong (1991) p.287; Urban and Hauser (1993); MacFie (1994) p.48; Booz, Allen and Hamilton (1982); (Graf & Saugy, 1999) and Fuller (1994) (as cited in Rudder, Ainsworth, & Holgate, 2001), with various associated stages and success factors. However, four basic critical stages of NPD i.e., product strategy development, product design and development, product commercialization, and product launch and post-launch, are common to all these models (Earle, 1997). The working principle of these NPD models is the decision-making process based upon the information coming out of each stage before proceeding to the next stage of product development. However, the experience and knowledge of a company may modify or even avoid certain steps, and decision-making rules may depend upon the degree of novelty and complexity of new products being developed. Furthermore, incremental innovations may require a shorter time for development, while long-life-cycle products (radical innovations) encapsulating new scientific knowledge (Todtling, Lehner, & Kaufmann, 2009) will require longer times for development with greater attention from NPD managers to control cost (Winger, 2009). Importantly, the emergence of new science, technology and marketing knowledge may push the NPD model into an interactive model rather than a linear model. This will demand more concentrated efforts from NPD managers to establish intra-organizational and extra-organizational links in order to employ the broader scientific and technological resources required to stimulate innovation.

Still there is little consensus as to what is the right or wrong way of doing NPD in the food industry (Rudder et al., 2001).Various approaches have been argued to suit the geographic location, market size, economic environment and cultural aspects of the firm. Therefore, it is not surprising that although functional food product development dynamics have been debated quite intensely in the literature over the last decade, the successful FFPD process still remains unresolved for the food manufacturers, academics and researchers alike (Broring, 2008; Broring et al., 2006; Heasman & Mellentin, 2001; Mark-Herbert, 2002, 2003, 2004; Matthyssens et al., 2008; Playne et al., 2003; Siedlok et al., 2010; Stanton, Ross, Fitzgerald, & Van Sinderen, 2005).

In order to develop a better understanding of the FFPD process, a brief comparative summary of prominent features as reflected in the current body of literature between these two kinds of NPD processes is presented in Table 2. 2. It presents a comparative insight of how strategies might need to evolve from current practice, taking into consideration the current business environment of the food manufacturing industry. The information on the challenges created by the emerging factors i.e. orientation towards innovation, knowledge generation, development of the resource base of a company, collaborative networks and arrangements and commercialization strategies, is still being collated and explored (Benkouider, 2004; Heasman & Mellentin, 2001; Mark-Herbert, 2002, 2003, 2004; Matthyssens et al., 2006, 2008; Ray, 2004). These factors may play a critical role in FFPD activities and will be discussed and argued in succeeding sections in the light of current practices and literature.

Table 2. 2. A summarized comparison of major factors influencing traditional food NPD and FFPD in the light of current literature

Critical factors for functional food development	Traditional food NPD features	Functional Food NPD features
1.Orientation towards innovation	Predominantly market-oriented R&D/NPD- competing in existing market (Hardy, 2010; Heasman & Mellentin, 2001; Traill & Mueulenberg, 2002), generating and disseminating market intelligence (Kohli & Bernard, 1990)	More product-oriented NPD - developing new markets by exploiting technological supremacy (Gehlhar et al., 2009; Kleef et al., 2002; Traill & Mueulenberg, 2002)
2.Knowledge generation	Prevalent synthetic knowledge - learning by doing (trial & error) (Asheim & Coenen, 2005) Low-tech R&D focus on cost reduction (Winger, 2009)	More focus on analytical novel knowledge - learning by exploring (extensive R&D (Traill & Mueulenberg, 2002)), creation of endogenous and exogenous knowledge to build globally unique competencies (Asheim & Coenen, 2005; Siedlok et al., 2010), focused on extensive R&D, time and financial resources (Mark-Herbert, 2004) for developing scientific standards and food technological complexities (Kleef et al., 2002)
	Generally consumer driven - demand pull (Moskowitz & Hartmann, 2008; Traill & Mueulenberg, 2002) Outperforming by marketing skills (Traill & Mueulenberg, 2002)	Generally health awareness trends & technological push (Benkouider, 2003; Jones & Jew, 2007; Kleef et al., 2002; McNaughton & Green, 2002) Out-competing (technological supremacy+ market knowledge) (Traill & Mueulenberg, 2002)

3. Development of resource base of a company	Rely on internal capabilities and resources (closed innovation) (Earle, 1997; Sarkar & Costa, 2008; Van der Meer, 2007)	Adopt open source development or open innovation (Broring, 2008; Broring et al., 2006) Develop a combination of technical/medical & production skills (Mark-Herbert, 2004; Matthyssens et al., 2008)& marketing skills
4.Collaborative networks and arrangements	Generally single/sole supplier interactions, short-term/one time interactions; predominantly-ingredient suppliers and consumers (Traill & Mueulenberg, 2002); seeking technical solutions from ingredient suppliers (Sadler, 2005), however, some evidence of diverse/open collaborations e.g., P&G (Pringles-potato crisps with pictures and words)(Huston & Sakkab, 2006)	Diverse and multiple stakeholder interactions (Ray, 2004; Sarkar & Costa, 2008; Siedlok et al., 2010), continuous and persistent relationships- building trust (Mortara & Minshall, 2011), stretch the boundaries of industrial competitors: New competitors & partners e.g., pharmaceuticals, ingredients suppliers, research organizations, research institutes (Beckeman & Skjoldebrand, 2007; Broring et al., 2006; Hardy, 2010; Matthyssens et al., 2006; Ray, 2004; Siedlok et al., 2010)
5.Commercialization strategy	Efficient marketing skills (Traill & Mueulenberg, 2002), generally trademarks and confidentiality agreements	Develop new markets: size and trust of the consumers (Ray, 2004); Securing IP and brand ownership & marketing campaigns (Mark-Herbert, 2003, 2004); Establish networks to enhance the scope and speed to market using diverse channels (Sarkar & Costa, 2008)

2.6.1. Orientation towards NPD/innovation

A firm's readiness to participate in successful FFPD may be strategically related to its willingness to engage in true innovations, which is in turn related to the orientation and core competencies of the business (Sarkar & Costa, 2008; Traill & Mueulenberg, 2002). Established firms tend to be conservative in developing radical innovations because there are constraints within the organizational structure, such as departmental boundaries, non-supportive culture and general inertia (Dess, Lumpkin, & McKee, 1999; Stopford, Charles, & Baden-Fuller., 1994). Traditionally, the focus of NPD in a food business is responding to current consumers' demands (market oriented NPD) or on cost reduction by incorporating cheaper raw materials, the use of effective technologies, or more efficient processing techniques (Bhaskaran, 2006). This is described as a process-orientated approach to innovation (Gehlhar et al., 2009). There is less focus on developing technical skills to improve the novelty of product innovations.

Market orientation has been one of the key success factors of an NPD program (Cooper, 2003), however, successful FFPD requires additional technological capabilities and

innovation capacities of a firm (Mark-Herbert, 2004; Nieto & Santamaria, 2007) to incorporate new nutritional science and technology, concurrent with emerging market demands, into new food products simultaneously. Incremental innovations cause discontinuity only in either marketing or technology, whereas true radical innovations may cause discontinuity in both technology and marketing (Beckeman & Skjoldebrand, 2007), thus providing a leading edge in the market and breaking the traditional competitive circle. A shift from a dominantly market-oriented NPD to more product-oriented NPD within a company may be a positive step to introduce truly differentiated product innovations (Bryan & Ferrell, 2000; Gehlhar et al., 2009). These changes can be expected to influence the prioritization of core competences of a company to be built in–house, while outsourcing supplementary skills or competencies (Traill & Mueulenberg, 2002). Other factors such as the size and nature of ownership of a company may play a critical role in its orientation towards FFPD program (Gehlhar et al., 2009). It has been argued that branded manufacturers may have a better chance of developing innovative functional food products by exploiting their product-oriented technological skills and established marketing resources (Gehlhar et al., 2009). Recently some trends have been observed in reorientation of NPD portfolios towards the "Health and Wellness" market by leading food companies with some positive results (Table 2. 3) (Euromonitor, 2009b).

Table 2. 3. Reorientation of portfolio towards long-term H&W commitment (Euromonitor, 2009b)

Company	Health and Wellness Pledge	% H&W Global Market Value Share
Nestle SA	To be the world's leading wellness and nutrition company	3.5
DANONE Group	100% health portfolio	3.1
Kraft Foods	Understanding nutrition	1.8
Unilever	Vitality mission	1.5
Heinz	The pure foods company	<0.1

2.6.2. Knowledge generation in FFPD

The required knowledge generation in functional food product development has been described as "*the exploration and transformation of diet-disease link/relation or concept,*

generated by the nutritional, food science or even biotechnology, into consumable food products which will offer unique consumer value with a greater economic activity eventually" (Howe, 2000; Jones & Jew, 2007). The knowledge process in FFPD can be summarized as generating research focusing on the improvement of a physiological function in the human body by a functional food ingredient (similar to the pharmaceutical industry), with successful ingredients then being incorporated into new food products and tested for efficacy (Bech-Larsen & Scholderer, 2007; Heasman & Mellentin, 2001; Jones & Jew, 2007; Menrad, 2003; Siro et al., 2008). The series of events related to the development of these food products can be summarized in Figure 2. 10.

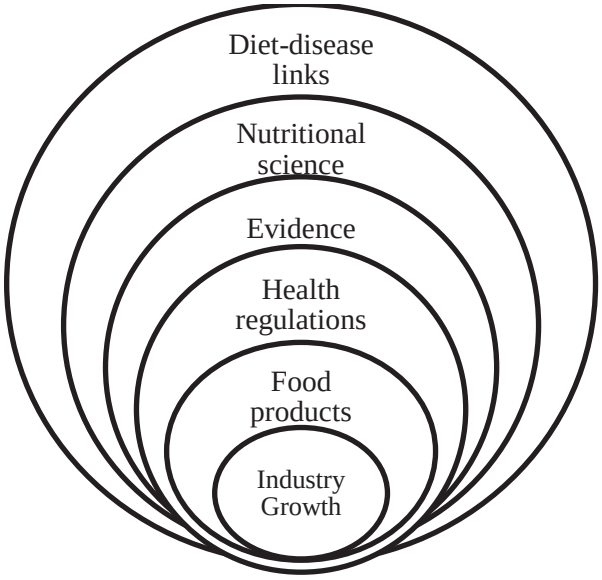


Figure 2. 10. General pattern of new functional food development (Jones & Jew, 2007).

In these extensive knowledge generation activities, new specialist skills are required to generate analytical knowledge (which can then be converted into fundamentally innovative new functional food products), attaining proven clinical efficacy, extended product development time, securing intellectual property (IP) and lastly financial resourcing of FFPD projects. Scientifically proven health claims and subsequent acquisition of exclusivity rights of using novel ingredients in functional food products has been observed as a critical factor in ultimate success of these food product in the market (Hardy, 2010). The acquisition of such evidence can be a difficult task considering the traditional historical perspective of the food industry with limited R&D budgets (typically less than 2% of turnover) and a lack of time to conduct effective clinical trials (Heasman & Mellentin, 2001; Mark-Herbert, 2002, 2004;

Matthyssens et al., 2008; Siro et al., 2008). Pharmaceutical companies are better equipped technically to provide clinical efficacy of novel bioactive ingredients (Hardy, 2010) due to their experience in the medical regulatory process and generating scientifically proven data for medicinal licenses (Broring et al., 2006; Diestre & Rajagopalan, 2012) and higher margins on product that can support much greater R&D spending, typically of the order of 15% of turnover. However, pharmaceutical businesses lack experience and skills in understanding how to compete successfully in food markets. This dilemma offers opportunities for collaborations. Therefore, future knowledge generation activities in FFPD may focus on attaining adequacy in technological development, testing medical effects clinically and building a market position (Mark-Herbert, 2004) while working in close collaboration with technologically better equipped businesses such as biotech/pharma, nanotech firms emerging as novel ingredient suppliers and specialized research organizations (Universities and Technological Institutes) (Mark-Herbert, 2004; Nieto & Santamaria, 2007; Sarkar & Costa, 2008; Todtling et al., 2009; Traill & Mueulenberg, 2002). Academic institutes and universities also offer an inexpensive and lower risk source of new scientific and technological knowledge (explorative intent) in accumulating the necessary knowledge for developing truly innovative food products (Nieto & Santamaria, 2007; Tether, 2002). This is essential for the food industry where the R&D budget is very scarce. However, the ability to capitalize on this source of knowledge will depend upon the organizational structure and approach towards innovation, involving champions leading the process of adoption, or gatekeepers managing the firm's interface with the external environment (Chiaroni et al., 2011). The selection and management of these collaborations to optimize the significant knowledge generation activities required for FFPD identified in this section will now be discussed.

2.6.3. Collaborative networks and arrangements

An overall integration of the innovation strategy into the business strategy and an in-depth understanding of inside capabilities versus outside resource availability (Tether, 2002) is pre-requisite for an efficient and effective bridging of resources needed in the new innovation models (Geoff, 2010; Tether, 2002). It also requires a careful selection process of external partners to efficiently bridge the resources required by a business (Nieto & Santamaria, 2007). Hence it can be deduced that identifying viable external partners is largely dependent upon the company's vision defined by its innovation models (Heasman & Mellentin, 2001). Further the types of innovation (i.e., value innovation, strategic innovation, technology

innovation, incremental innovations, radical innovations etc.) that a company wants to generate for attaining and maintaining the competitive edge of its business will guide its way to selection of external partners (Christensen, Johnson, & Rigby, 2002; Traill & Mueulenberg, 2002; Van der Meer, 2007).

2.6.3.1. Traditional collaborations and changing trends

The main traditional and still current collaborative arrangement (and for some businesses sole collaborator arrangement) in the food industry is with the ingredient supplier/house (Hardy, 2010; Khan, Grigor, Winger, & Win, 2013; Matthyssens et al., 2008; Traill & Mueulenberg, 2002). This is a strong traditional arrangement where food manufacturers gain significant benefit by pushing R&D costs upstream to these companies. These food ingredient manufacturing companies are continuously introducing new ingredients with improved performance (Matthyssens et al., 2008). In the past, ingredient suppliers have provided services to their manufacturing customers ranging from developing customized new ingredients to marketing of new formulations. Some suppliers are now emerging as full-service providers (Figure 2. 11) (Sadler, 2005).

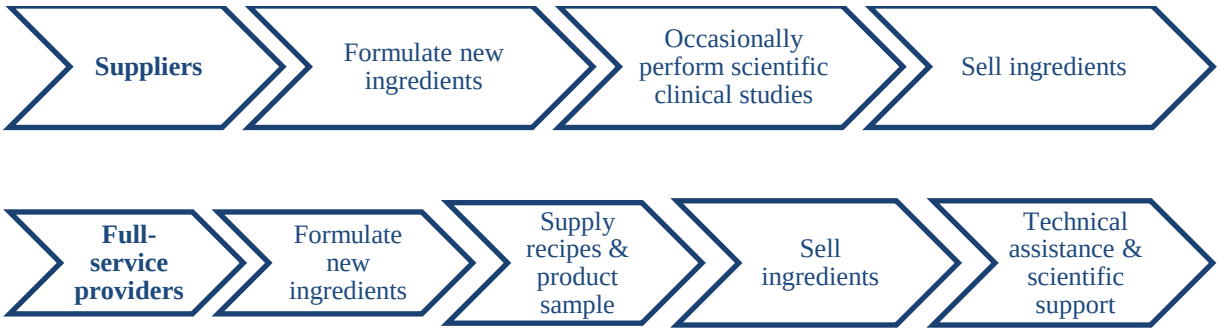


Figure 2. 11. Food ingredient suppliers and full-service providers (Sadler, 2005).

The full-service business model may become more common within the ingredient industry as it offers a wider range of applications to manufacturers including: the ability to create recipes; product samples; and, provide technical assistance and scientific support. These full-service providers have the ability to secure their business innovations with patents and trademarks, which may support the fostering of radical product innovations in the food industry (Mortara & Minshall, 2011; Sadler, 2005). This may prove helpful in broadening the resource base by establishing collaborative networks with these suppliers to innovate radical functional food products (Asheim & Coenen, 2005; Earle, 1997; Kleef et al., 2002; Stewart-Knox & Mitchell, 2003), having completed a significant amount of clinical work on their ingredient. However,

the complexity of FFPD and the cost of clinical trials may challenge the capacities of the ingredient houses and put them into a new competitive environment with other industrial players, such as packaging technology providers, equipment suppliers, biotech/nanotech firms, research institutes and specialized business research facilities (Siedlok et al., 2010). Moreover, the legislation leaning towards proving clinical efficacy of products rather than ingredients in certain markets (Ronteltap et al., 2007) will return the onus back on the food manufacturer to prove clinical efficacy. Therefore a more diverse network of external partners to develop robust commercialization strategies for enhancing consumer awareness and acceptance of these radical food product innovations (Sarkar & Costa, 2008; Siedlok et al., 2010) may push manufacturers to work in close collaboration with variety of external partners. A comparison of collaborations ranging from acquiring a technical solution to a broader spectrum of NPD launch is been presented in Table 2. 4.

Table 2. 4. Emerging trends in collaborative NPD arrangements in the food industry

Trends	Important Features	Examples
Traditional collaboration- Sole ingredient supplier	Resolving a specific technical issue	Incorporation of unstable ingredient: Omega-3 fatty acids - Ocean Nutrition - flour like powder which is easy to use in breads and pasteurized juices (Sadler, 2005).
		Improving taste and texture: bitter blockers – Linguagen (a flavor company) - ingredient taste masker (Sadler, 2005)
New trends- 1. Open innovation **2. Cross-fertilization and innovation** **3. Alliance**	Multipurpose and greater interaction over extended period of time	Improving bioavailability: lactose intolerant - PepsiCo and Procter & Gamble - PepsiCo's Tropicana containing Calcium; brand FruitCal – good taste & texture (Sadler, 2005) Partners synergies and mutual benefits: Tate & Lyle collaborated with Canadian hot drinks specialist-A. Holliday; distributing green tea extract outside North America with a combination of polydextrose (Hardy, 2010) Health claims to functional foods and drinks: Global food and drink companies (Unilever, Coca-Cola and PepsiCo) intermingle with traditional drug and over-the- counter (OTC) manufacturers, biotechnology and pharmaceutical companies to attain health claims for functional foods and drinks (Hardy, 2010) Leveraging technological applications: Alliance between Kraft Foods and Medisyn allowed Kraft Foods to penetrate offensively into functional food growth while Medisyn (small niche, Minnesota based pharmaceutical/biotechnology company) will apply its proprietary technology to its known chemicals and compounds for functional food products (Hardy, 2010).

2.6.3.2. Identifying and selecting collaborators - open innovation and open source development

It has been argued in previous sections that heterogeneous networks of collaborative partners in developing innovative food products will become increasingly more prevalent compared to homogenous network of only one type of partner (Chiaroni et al., 2011; Nieto & Santamaria, 2007). Especially, the role of pharmaceutical and nutraceuticals companies, food ingredient companies, packaging companies, nanotech firms and research institutes are important in functional food development (Chiaroni et al., 2011; Mark-Herbert, 2004; Sarkar & Costa, 2008; Tether, 2002). However, one critical aspect in establishing productive collaborations with these potential external partners will be internal capabilities and a receptive company culture to absorb the external knowledge (Hillebrand & Biemans, 2004; Mortara & Minshall, 2011). In the current literature (Hardy, 2010; Heasman & Mellentin, 2001), the open innovation/open source innovation model as adopted by General Mills, Kraft and Cadbury, and the named *"connect+develop"* model introduced by Proctor & Gamble (P&G) have shown promising results in identifying and selecting external partners and developing cooperative networks within the organization as well as outside the organization. Although it has been difficult to implement such models, the advantages are diverse, particularly with respect to reduction of time to market and broadening the nature of innovation (Hardy, 2010).

"Connect+develop" model: This strategy to connect with external partners is to use proprietary networks such as *Technology Entrepreneurs* who write the technology briefs defining the problem. These experts then interact with universities and industry researchers, and form supplier networks. Further, some open networks complementary to proprietary networks can be employed: *Nine Sigma* connects companies that have science and technology problems to companies, universities, government and private labs and consultants that have solutions. *InnoCentive* is similar to *Nine Sigma* but it works on narrowly-defined scientific problems. *YourEncore* brings high-performing retired scientists and engineers to client businesses and *Yet2.com* is an online market for intellectual property exchange (in and out technology transfer) which P&G created to foster the connect-and-develop model. Thus an internal culture change has occurred in P&G from an internally focused and deeply centralized R&D to a more open approach to its innovation solutions.

Invention to connection model: A worldwide innovation network, the "G-WIN" program, has been created by General Mills. G-WIN generates new ideas through interaction with suppliers, retailers, inventors, academic institutions and other food firms (Hardy, 2010). It is assisted by 'Innovation Squads' of 10-15 longstanding company personnel to leverage in-house staff networks for generating new product ideas and solutions (Hardy, 2010).

Hub and spoke model: This is an innovation model generated by Kraft Foods Inc. with a focus on metrics and networks of the overall system and strategies for open innovation through a central team supplemented with "technical scouts". It uses various tools to identify potential suppliers for developing technological innovations, i.e. supplier relationship segment assessment, and an innovation potential diagnostic tool.

Therefore various approaches of innovation may define the nature and extent of external partners' involvement NPD of a company. However, it can be suggested that heterogeneous networks of collaborative partners may be more effective in developing truly innovative food products compared to homogenous networks of only one type of partner (Chiaroni et al., 2011; Nieto & Santamaria, 2007). Especially the role of pharmaceutical/nutraceuticals companies, food ingredient companies to packaging companies, nanotech firms, crown research institutes etc., (Chiaroni et al., 2011; Mark-Herbert, 2004; Sarkar & Costa, 2008; Tether, 2002) may become more important in functional foods development, one of fastest growing sector of food industry (Euromonitor, 2010d) (Figure 2. 12).

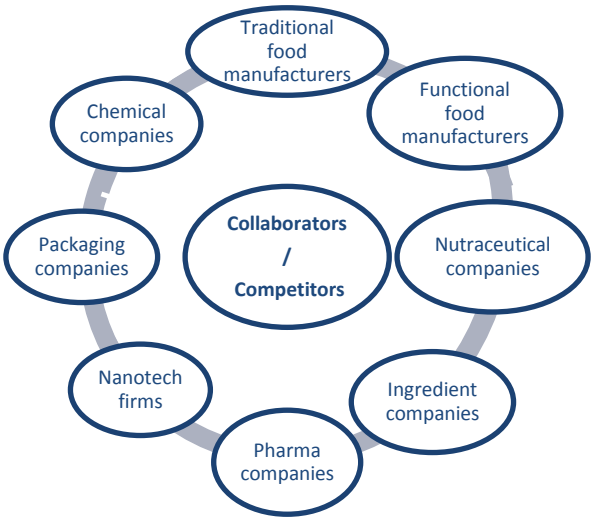


Figure 2. 12. Potential new collaborators/competitors in functional food industry (Ray, 2004; Sarkar & Costa, 2008)

2.6.3.3.Scope of collaborations

Innovation is no longer considered as an individual's action, rather it is a collective action where well-coordinated and cooperated activities are focused on generating new economic activity (Tether, 2002). The increasingly diversified nature of functional food product development activities has been argued extensively in the previous sections of this review. Hence cooperation can go beyond the supply chain, with motivations other than competitive behavior, such as in developing common standards, selective competitive behavior and dealing with common problems such as those of regulatory challenges (Tether, 2002; Van der Meer, 2007). In this scenario, traditional and conservative food manufacturers may have to rethink their approach towards innovation and adopt a more open and flexible innovation business model in order to develop and enhance external knowledge absorption and technological skills. A higher technological requirement in functional food product development also commands the need for a diverse network of collaborations with external partners (new industries with new competitors, firms, distribution channels, and new marketing activities (Garcia & Calantone, 2002)) to enhance innovation capabilities. This developing innovation dilemma suggests that future development of functional foods will rely upon developing new strategic alliances to enhance knowledge generation and resource sharing with diverse external partners (Kleef et al., 2002; Mark-Herbert, 2003).

There are two approaches to open innovation or open source development: explorative (searching for novel knowledge and technologies) and exploitative (maximizing the internal knowledge and technology applications) (Chiaroni et al., 2011; Van de Vrande, DeJong, Vanhaverbeke, & deRochemont, 2009; Van der Meer, 2007). Both approaches are central to the scope of interaction among the partners. Generally multinational enterprises (MNEs) have formal structures around collaborations, while SMEs tend to adopt less formal approaches and hence have restricted engagement with external partners (Mortara & Minshall, 2011; Van de Vrande et al., 2009). This may be one of the reasons why in general there is low innovative behavior in SMEs (Bougrain & Haudeville, 2002). However, as the business grows, links with external partners have to be formalized in order to manage these collaborations efficiently (Mortara & Minshall, 2011) as well as to manage intellectual property rights of the partners and to minimize liabilities. Recently P & G has been able to double its success rate by working through a formal and structured network of various hubs located in different countries (Huston & Sakkab, 2006). In contrast, General Mill allows a

more open and general access to its external partners and customers to submit innovative ideas or solutions to specific problems.

Thus the scope of interaction depends upon the content and intent of partners involved in collaboration (Cagliano, Chiesa, & Manzini, 2000; Chiaroni et al., 2011). The phase of the innovation process will also affect the scope of interaction. A sustained collaboration tends to increase the trust between collaborating partners which is essential in effective knowledge and resource sharing (Tether, 2002). Two approaches to formalization of external links and networks have been observed, i.e. personalized and institutionalized (Cagliano et al., 2000). Both have advantages and disadvantages to suit different organizational structures and innovation policies. Institutionalized contacts are more permanent and long-lasting (Cagliano et al., 2000), however, these contacts may require a more comprehensive policy towards these collaborations and innovations. Institutionalized contacts have a better chance of sustaining collaborations and thus to develop organizational capabilities to innovate truly differentiated new products consistently.

2.6.3.4. Clusters- an argument for regional collaborations

Clustering of industrial partners and competitors has been observed as a positive step in upgrading the innovative potential of manufacturing industries owing to technological spillover and knowledge sharing (Asheim & Coenen, 2005; Beckeman & Skjoldebrand, 2007; Furman, Porter, & Stern, 2002; Todtling et al., 2009). It helps in enhancing the perception of new technologies by close interactions such as site visits and face to face interactions. Clusters have been defined as "*geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries and associated institutions (universities, standards agencies, and trade associations) in particular fields that compete but also co-operate*"(Porter, 2000). *Food Valley* in the Netherlands is an example where food innovation success has been enhanced by clustering industrial players. More formal integrations of industrial players have been observed in other countries such as regional clusters turning into regional systems of innovation and even national systems of innovation (Diez & Kiese, 2009) e.g., Scania-Sweden and Rogland-Norway (Asheim & Coenen, 2005) and the industrial system of silicon valley in the U.S.A. (Hardy, 2010).

Generally there are two types of initiatives for clustering; bottom-up (several entrepreneurs involved in technological innovations) and top-down (public sector and policy makers) (Beckeman & Skjoldebrand, 2007). The case of FFNPD, due to its complexity of

technological and social aspects (Health & Wellness trends/consumer awareness), may require a combination of the above mentioned approaches. Further, clustering may have its influence on technological development in two dimensions i.e., region-specific and firm-specific clustering (Cantwell & Molero, 2003). The region-specific dimension implies the demographic diversification of regional clusters to attain technological diversification, which is important for creating flexible technological trajectory. It will help to maintain and attain international new technological trends without being locked-in to a traditional technological trajectory i.e., effective linkage of small firms with international industrial players. While firm-specific characteristics of technological development implies the importance of internal capabilities and capacities of the firm to absorb external knowledge (Asheim & Coenen, 2005). Thus internationalization of learning and knowledge generation in an economy as a result of either centralization or decentralization of R&D in these clusters (McNaughton & Green, 2002) may play crucial roles in enhancing the innovation capabilities of SMEs in the food industry (Beckeman & Skjoldebrand, 2007; McNaughton & Green, 2002). On the contrary, if a region is clustered by a large number of SMEs which lack a strong network of collaboration with national research institutes or multinational companies, they may lag behind in technological development e.g., as happened in *Third Italy* clusters where SMEs clustered in a region and locked-in a traditional technological trajectory, rather than adopting an international technological trajectory (Asheim & Coenen, 2005; Bhaskaran, 2006; Traill & Mueulenberg, 2002). However, the inherent power imbalance between the hub firm (some big MNE's to monopolize and dominate the industrial growth pattern) and the smaller firms (some SME's who want to compete in this competitive knowledge-based economy) may become a serious challenge for managing these clusters/networks (Beckeman & Skjoldebrand, 2007; Bhaskaran, 2006). Further, demographics of the industry, i.e. location and concentration of industrial players in a region, are the important factors in defining the effectiveness of clusters in innovations as has been seen in frozen food development in the USA in 1923 and subsequent formation of the Frozen Food Institute in Sweden, which worked as a spider for networking among interested companies and individuals. These industrial clusters can be linked to increase the competitiveness of industry and enhance the nation's competitive edge in the global economy (Beckeman & Skjoldebrand, 2007; Porter, 2000). However, the role of government at the microeconomic level can help in removing obstacles to growth and upgrading of existing clusters, which are a source of foreign investment and increasing exports. Government institutes (universities, think tanks, vocational training providers, standards-setting agencies, trade associations) in a cluster can

provide specialized research, information, training and technical support at a lower cost (Porter, 2000). Hence, it is also critically important for the food industry in countries where SME's comprise a major part of industry i.e., Europe (France, Spain, Italy, the Netherlands (Traill & Mueulenberg, 2002; Ziggers, 2005), New Zealand (Ashley-Jones, 2010), to access government-financed research facilities to bridge technological and skill gaps (Nieto & Santamaria, 2007) in order to play a key role in functional food development in a region (Van de Vrande et al., 2009).

2.6.4. Commercialization of functional foods

Functional food products require a trusted brand with sound market recognition that will help in building consumer confidence in buying these products (Matthyssens et al., 2008). A comprehensive business strategy for commercialization of new functional food products requires building a brand to get consumer recognition, acquiring proprietary ingredients to ensure exclusive rights to sale and securing efficient scientifically-proven health claims through clinical studies (Hardy, 2010; Mark-Herbert, 2003). It will also require getting approvals from regulatory authorities in most jurisdictions. Protection of innovation in the food industry, which previously may have gone unnoticed (Mark-Herbert, 2003; Mortara & Minshall, 2011), and the brand ownership may appear as major barriers to successful commercialization of collaborative FFPD (Mark-Herbert, 2003).

One of the critical factors in developing functional food markets has been the maturity of processed food markets in a region (Figure 2. 13), which will facilitate the trust of consumers in buying processed packaged foods and to try new food products (Ray, 2004). The development of these markets requires time and resources, e.g. the Japanese functional food market, where almost 80% of functional foods are standard foods, has shown a growth rate of 15% over the last 15 years (Ray, 2004). Effective government support in the form of financial resources and regulatory structure to validate the safety and efficacy of functional foods can boost consumer confidence. A compatible legislative system to develop legislation consistent with market growth will enhance the confidence of manufacturers to engage actively in FFPD (Ray, 2004).

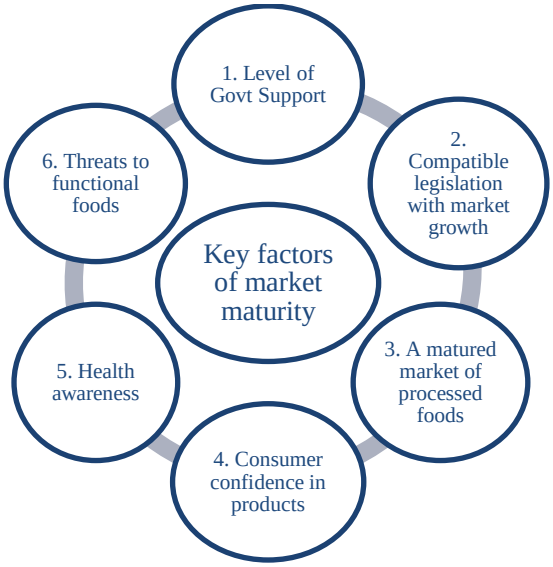


Figure 2. 13. Key factors of processed foods market maturity

2.6.4.1. Various market entry strategies

Various strategies such as joint ventures with competitors within or outside the industry in the form of brand image differentiation, new brands through research-oriented collaborating partners, and exploiting existing brand value (Table 2. 5), have been observed in the functional food market (Lynch, 2006; Sadler, 2005). The introduction of new health/functional food products through subsidiaries of big companies has been found to be effective in avoiding the risks of damaging existing brand image, in case of failure of the new launch (Sadler, 2005). Further, the reputation of a subsidiary in a region may be used to effectively introduce new functional food products into the market. Merger and acquisition activity (Euromonitor, 2009b; Lynch, 2006), particularly big manufacturing companies acquiring smaller companies, notably those that have an existing niche functional food market capability, is another important strategy. Examples are PepsiCo acquiring Tropicana & SoBe, Nestle acquired PowerBar in 2002 and Unilever owns Flora or Becel in Europe (Sadler, 2005).

Table 2. 5. Commercialization trends in new functional food products (Sadler, 2005; Sarkar& Costa, 2008)

Trends	Motives	Examples
Joint ventures	Brand image: differentiator	1. Rice Dream Heart Wise: Cargill with Hain Celestial- 2003 2. 8th Continent soymilk: DuPont and General Mills- 2000
	Research oriented co-branding partners	Food company Nestle & cosmetic company L'Oreal - Laboratories Innev (2002) introduces supplements aimed at cosmetic and beauty concern e.g., skin firming & anti-aging supplements[1]
	Brand value	Shiseido (cosmetic company) & Coca-Cola, Japan 2004: skin-firming drinks & fashion (functional body mist)
Branding	Building consumer trust	Coca-Cola & ingredient company: Minute Maid Premium Heart Wise - functional juice with phytosterols.
Marketing	Shift in Focus -Science-on scientific credibility -Method of Action -Market additional benefit	1. DanActive - Probiotics drink in US by DANONE: Focus on immunity health rather than bacterial population in the product created a whole new audience. 2. Lutein - shift from muscular degeneration of eye to antioxidant activity has made a wider appeal to all the consumers 3. Omega-3 - for Alzheimer's disease & arthritis to depression & general mood health, can increase its market penetration
	Creating value network (Sarkar & Costa, 2008)	Calgene (genetically modified tomatoes) creating network across - seed firms, farmers, packers, legislators, retailers & consumers

Inclusion of a novel food ingredient is one of the main cornerstones of successful FFPD(Howe, 2000). However, the trust of consumers with regard to the functionality and safety of that ingredient relies largely on its source. Therefore, branding the ingredient from a well reputed manufacturer has been found a useful tool in building this trust (Sadler, 2005). Further, targeting a broader audience to increase the sales volume and penetration into various segments of the food market (mass market, preventive market, at risk and sufferers

[1]L'Oreal and Nestlé announce the signing of an agreement for the creation of a joint company called Laboratories INNEOV. The company's mission is to develop the market for cosmetic nutritional supplements on a global basis. The company, which is owned 50% by L'Oreal and 50% by Nestlé, will have its headquarters in France (RELEASES, 2002).

market) has been suggested to be important in the successful commercialization of these food products (Hardy, 2010; Mark-Herbert, 2003; Sadler, 2005). A recent trend in marketing focus from specific health benefits to more general health effects has been observed for many products (Sadler, 2005), with the aim of attaining higher return on investment and sales volume through more general consumer appeal. Another effective commercialization strategy has been observed in the form of creating value networks through inter-relationships with other stakeholders in the industry (Chiaroni et al., 2011). This can have multiple advantages such as reduction in time to market, thereby effectively counteracting the initial consumer's resistance and attaining a comparatively speedy return on investment. Complexity of the network however may turn out to be daunting for some managers, particularly as networks grow in size (Sarkar & Costa, 2008).

2.7. Managing collaborations

A key argument made in this chapter is that FFPD requires a more open and flexible approach towards its product development activities (Heasman & Mellentin, 2001; Matthyssens et al., 2008). The ability to successfully make transitions to accommodate a new technological paradigm is an important ingredient of success in competing for leading edge innovations and requires careful management of the process (Euromonitor, 2009b). Two approaches to developing collaborations have been identified: *strategic need-driven collaborations* can induce the formation of strong ties among potential collaborators to solve specific needs, whereas *interdependence-driven collaborations* often exist among collaborators who already have established contacts, networks and prior collaborations. These collaborations are often continuous and recurrent (Taran, 2007) due to the experience in handling the tensions and differences among the actors involved. Further, management of the perceived cultural differences and the expectations among the partners is critical to maximize the effectiveness of these collaborations and networks (Taran, 2007). The dependence of interaction upon institutionalized contacts rather than personalized contacts favors better management solutions. Therefore it is critical to develop institutionalized networks across organizations and industries to have long-lasting interaction and trust.

Management has focused on open innovation models to maximize the use of both external and internal resources to enhance the innovation capability of the firm (Chiaroni et al., 2011; Mortara & Minshall, 2011; Van der Meer, 2007). Further the drivers to engage in open innovation models take their roots from the original motives of adopting such models, which

are mainly characterized as defensive (reducing cost and risks) and offensive (stimulating growth). These motives lead companies to develop collaborations in pursuing ambidexterity and the types of inbound (internal use of external knowledge) and outbound innovation activities (external exploitation of internal knowledge) will affect the approaches adopted to manage these collaborations (Mortara & Minshall, 2011). The mode of knowledge flow i.e. outside-in or inside–out, and technology exploitation or technology exploration will define the management skills required to make use of external collaborations (Chiaroni et al., 2011). Technology exploitation may involve activities such as venturing, IP-outward licensing and innovative initiatives from non-R&D workers while technology exploration may involve activities such as customer involvement, external networking, external participation, outsourcing R&D and inward licensing of IP (Chiaroni et al., 2011; Mortara & Minshall, 2011). In addition, ignoring the cultural makeup of an organization and its subsequent management may also affect the working of collaborations as the perception of "not-invented-here" (NIH) may create hindrance in maximizing the output for developing innovation capabilities (Chiaroni et al., 2011). Firms providing intellectual property rights (inside-out) to collaborating partners may develop a comprehensive strategy to manage intellectual assets while outside-in organizations may require efficient market and technical knowledge to make best use of IP flowing into the company. Two-directional flow involving resource sharing and knowledge transfer or technology transfers will require a balance of both the aforementioned approaches (Dahlander & Gann, 2010; Van der Meer, 2007). Firms will need to develop skills of alliance management in their top management and NPD personnel who are involved in managing these collaborations will need to have skills to ensure smooth working collaborative networks that are productive. A similar concept of centralization/decentralization of R&D management in MNEs may also be applicable to management of collaborative activities in these open innovation models (Mortara & Minshall, 2011) where firms may choose to have more centralized monitoring of these activities or may adopt regional centers. Procter and Gamble adopted the "connect and develop" model via a centralized control and decision making function (Mortara & Minshall, 2011).

2.8.Conclusions and implications for future research

The development of innovative bioactive functional food products may require a paradigm shift in the process of food product development. The traditional models of NPD primarily suit incremental innovations, where speed to market is critical and the changes made in food products are typically small and low risk. However, recently the NPD processes in the food

industry have exhibited some revolutionary changes in the wake of emerging challenges of developing radically innovative food products and concepts, such as the P&G connect+develop model and the General Mills open innovation model. New consumer trends of 'Health and Wellness' are getting concentrated focus from leading multinational companies such as Nestle, DANONE Group, Unilever, Heinz and Kraft Foods. This suggests that a reorientation of the NPD portfolio with a shift towards a more product-oriented NPD in the business innovation model may become the focus of future development in the food industry. In connection with this, a special focus on analytical knowledge generation activities and resource development (technological and marketing advantage) of a company may be seen as interrelated and equally critical for successful FFPD in future. Moreover the clinical information required to validate food products containing efficacious doses of bioactive materials, meeting international regulatory constraints, requires a high level of multidisciplinary, advanced science collaboration which is essentially beyond the resources of a single company. The challenges of resource expansion and time reduction may be met through various techniques, such as open source development and open innovation, collaborative R&D activities and developing collaborative networks (pharmaceutical/biotech companies, research institutes and ingredient suppliers). A clear motive for adopting such open innovation models or collaborations is central to the identification of which core competencies should be developed in-house while outsourcing the supplementary skills and resources. Instead of one-time interactions, it is imperative for companies to maintain sustained and trusted inter-organizational relationships with diverse external partners in order to successfully proceed in complex NPD activities of functional foods. In addition, some new management skills will need to be embedded in the management portfolio of a company for establishing effective and efficient network links with internal and external networks of innovation. These networks should be institutionalized rather than personalized in order to secure long-term benefits from these arrangements.

Commercialization of new functional food products may pose serious challenges in protecting intellectual property rights in order to secure a higher premium. Brand ownership in the case of a collaborative product development may require a comprehensive policy to maintain and enhance the brand image in new markets. Enabling a competitive innovation environment in the food industry will also depend upon a government support network that enhances collaborative knowledge development and resource sharing activities among stakeholders (academics, industry and research institutes). This is critically important for

SMEs, which are more prone to avoid the challenges of establishing strategic collaborations with external partners due to the lack of resources and skills to adapt themselves in a rapidly changing innovation environment.

Thus a clear orientation towards innovation in adopting a new innovation model followed by a comprehensive strategy of pursuing relevant knowledge and resources through more extensive collaborative networks may lead the way for innovative new functional food products in future. The perception of certain drivers of and barriers to FFPD among the stakeholders needs further empirical investigation to formulate better future FFPD strategies.

Therefore following research questions are put into investigation in this research project;

1. Is there a difference in ***NPD approach*** of food companies due to their involvement in functional foods development?
2. Is there a difference in ***external NPD collaborative arrangements*** of food companies due to their involvement in functional foods development?
3. Is there a difference in ***NPD commercialization approach*** of food companies due to their involvement in functional foods development?

3 Methodology

3.1 Introduction

This chapter initially describes the research approach taken in investigating the aims and objectives of this thesis. The theoretical framework of the research is then presented. From this theoretical framework specific hypotheses are constructed for further investigation. A detailed review and description of the cited methods and tools of data collection have also been included with a justification for selecting particular methods. Techniques for data analysis are also covered.

A. Review of Methodologies available

3.2 Research Approach

The main aim of the thesis was to provide insight into practices that would improve the development of functional foods . Therefore firstly a reference model of value creation in the food manufacturing sector was proposed based upon previous literature (as presented in Chapter 2). This theoretical model is then presented as a reference point for analysing and comparing the current innovation activities of food companies in creating value added (functional food) products.

3.3 Theoretical framework of research & hypothesis

According to the resource based view (RBV) of competitive advantage, resources and capabilities of a firm should be heterogeneous and inimitable to attain sustained competitive advantage (Barney, 1991; Margaret, 1993). These heterogeneous and inimitable resources can serve as a tool to implement differentiated strategies in order to attain competitive advantage. The potential of a resource to secure competitive advantage depends upon four attributes:

1. it must be able to exploit opportunities or neutralize threats;
2. it must be unique among competing firms;
3. it must be imperfectly imitable;
4. there cannot be a substitute for this resource. (Barney, 1991; Margaret, 1993)

These four attributes are regarded as an indicator of heterogeneity and inimitability of a firm's resources to obtain competitive advantage. These resources and capabilities can lead to differentiated innovations in a firm and thus break the traditional competitive cycle. Thus

truly differentiated functional (radically innovative) food products are thought of as critically important in the food industry to out-perform traditional competitors (Heasman & Mellentin, 2001; Mark-Herbert, 2002; Matthyssens et al., 2008) and can be considered a case in point in terms of RBV. The example of such foods could be *Probi Bravo Friscus* (Swedish based Probi in collaboration with Skanemejerier). This product is thought to be the world's first scientifically proven drink to boost the immune system (Hardy, 2010, p. 84). Similar functional food examples can be found from the emerging areas of nanotechnology, biotechnology and preservation technology. These developments have made large multi-national food companies turn away from closed NPD models to open innovation models to ensure better access to intellectual property (IP), new technologies and knowledge (Hardy, 2010). This approach can be explained from a resource based view (RBV) of attaining sustained competitive advantage where radical functional food product development will drive these food companies to identify and create unique resources for implementing differentiated innovation strategies and policies.

Resource acquisition is one strategy towards building inimitability and heterogeneity, and can be achieved by outsourcing and developing collaborative networks through vertical integration i.e., cooperating along the food supply chain (Broring, 2008; Chung-Yean, Canan, & Nallan, 2012). Outsourcing has been regarded as a favourable approach in situations where higher technological innovations are to be developed and profit margins are higher- a case of radical functional food product development (Hoecht & Trott, 2006) . However outsourcing with strategic alliance may be less effective in developing strong relationships. Rather joint ventures may serve as more strong and effective means of generating long term relationships and thus resource building (Bougrain & Haudeville, 2002; Emden, Calantone, & Droge, 2006). In a similar antecedent, some leading multinational food companies have adopted new models of innovation (open innovation) to broaden their resource base and capabilities for developing truly differentiated food products (Barbara & Francesco, 2012). Examples of such models are the *connect and develop model* by Procter & Gamble (Huston & Sakkab, 2006) and the *open innovation model* used by General Mills (Hardy, 2010). These new innovation models suggest that diversified resources and capabilities can be acquired through establishing networks and collaborations within industry and outside industry. Ultimately these new approaches enable these organizations to implement differentiated strategies more efficiently and effectively.

Functional food NPD dynamics have been recently studied with various practices and models proposed (Broring, 2008; Broring et al., 2006; Heasman & Mellentin, 2001; Jones & Jew, 2007; Siro et al., 2008) such as open innovation model (this has been comprehensively reviewed in Chapter 2). Successful functional food product development should include three cornerstone areas of research and collaboration, incorporating technological developments, clinical testing and building a market position (Figure 3. 1).

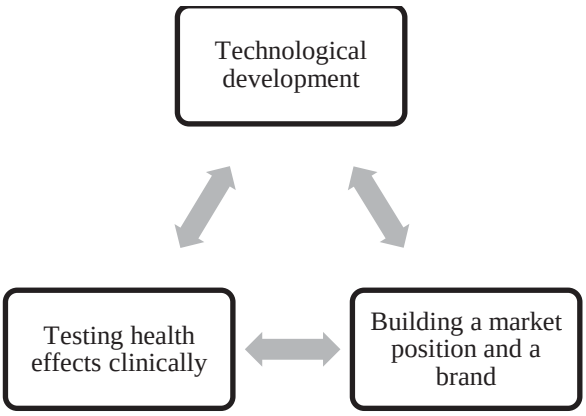


Figure 3. 1. Cornerstones of successful new functional food product development program (Mark-Herbert, 2004)

Industry convergence (as discussed in Chapter 2) between the food and pharmaceutical industries has been linked to functional food development, due to the skills and competencies residing in the two industries complementing each other (Broring et al., 2006). Collaborative NPD aimed at synchronizing the technical skills of the pharmaceutical industry and the marketing knowledge of the food industry may induce a serious divergence from traditional NPD practices. A shift from a closed NPD program, traditional in the food industry, to more open source development in food product development practices, with better management of risk, will serve more closely functional food innovation activities. Therefore value creation in the food manufacturing industry to attain sustained competitive edge can be analysed from the perspective of the resource-based view of management, where some firms may have unique resources and dynamic capabilities to generate innovative functional food products which cannot be replicated by the competitors. Dynamic capabilities means "firms' ability to integrate, build, and reconfigure internal and external competence to address a rapidly changing environment" (Teece, Pisano, & Shuen, 1997). Therefore RBV may suggest that value innovation can be brought about by developing those distinguishing resources and capabilities which are unique. This could mean certain innovation characteristics of a manufacturing organization will be critically important in developing unique functional food

product development. The current literature suggest these characteristics are: **orientation towards its NPD** (Gehlhar et al., 2009; Traill & Mueulenberg, 2002); **cooperative network** (Chiaroni et al., 2011; Dahlander & Gann, 2010) ; and its **commercialization techniques** (Menrad, 2003; Sarkar & Costa, 2008). These factors have been argued as being critically important in value creation in NPD when a company tries to develop an integrated innovation approach aimed at increasing the novelty of food product innovations (Figure 3. 2). This defines the theoretical framework of the research reported here, and is further explained below. It is hypothesised that food companies may differ in their resource endowments leading to differential innovation activities (T. John, Eric, Mark, & Jon, 2007).

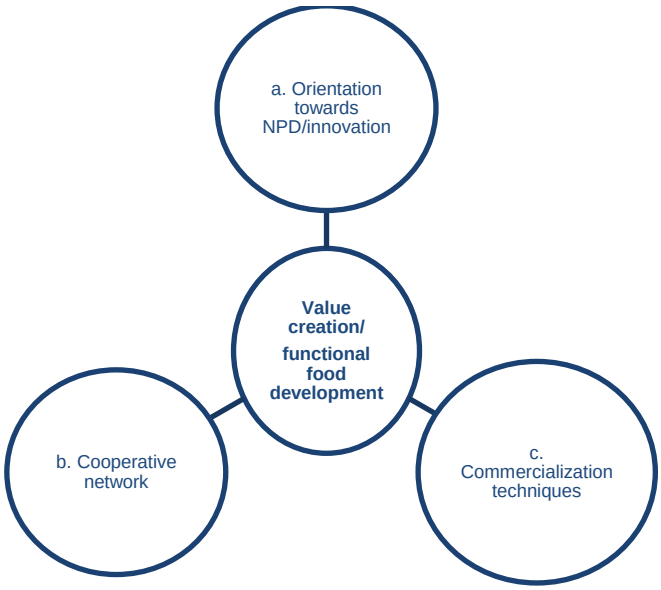


Figure 3. 2. Theoretical framework of research

3.3.1 Hypothesis development

This overall theoretical framework was also used as a reference in terms of understanding differences in the innovation characteristics of food companies manufacturing functional food products against those that are not developing functional food products.

3.3.1.1 Orientation towards NPD/innovation

Innovation policies of businesses have a significant effect on the strategies and activities of NPD (Beverland, Ewing, & Matanda, 2006; Gehlhar et al., 2009; Traill & Mueulenberg, 2002). A clear-cut orientation towards innovation will provide clear guidelines to top management and NPD managers to select the appropriate skills to be built in-house while outsourcing supplementary skills (Traill & Mueulenberg, 2002). Such an orientation also helps in defining the breadth and depth of external links, which are crucial to knowledge uptake and resource building. Therefore, it is critical to understand the firm orientation

towards NPD in order to understand the perception of risks and opportunities in developing radically innovative food products such as functional foods. Four kinds of innovation orientation have been described in the literature, namely market-oriented, product-oriented, process-oriented and organization-oriented (Gehlhar et al., 2009; OECD, 2005) .

It has been argued that food companies are generally heavily customer focused which is bound to develop market oriented NPD policies (T. John et al., 2007). Further customer focused NPD is associated with incremental innovations where responsiveness to customer needs is addressed in short time and low investment. A strong market oriented NPD is effective in responding to current consumer needs but will fall short of predicting emerging future needs (Broring et al., 2006). Therefore for food companies, who want to lead in food product innovations, a focus on new developments in nutrition and relevant technologies should be sustained. It has been proposed that a shift from dominantly market oriented NPD to product-oriented NPD will present higher chances of developing successful innovative food products (such as functional food products) (Gehlhar et al., 2009).

Therefore it is proposed:

H1: There is a difference in NPD orientation between companies manufacturing functional foods and other food companies.

3.3.1.2 Cooperative network

The food industry traditionally relies solely on its internal capabilities and resources, which are limited in terms of their potential to innovative radically (Sarkar & Costa, 2008). This may be one of the reasons for the lower degree of novelty in food product innovations and thus a higher failure rate of NPD. With the emergence of the health and wellness market, innovation capabilities and resources of traditional food companies are seriously challenged, as these health oriented food products (functional foods) require considerably more time and cost to develop (Mark-Herbert, 2004; Matthyssens et al., 2008; Sadler, 2005). As discussed earlier in this chapter, the challenges can be managed by bringing in relevant external resources and capabilities to support internal product development activities. The establishment of effective organizational networks for bridging capabilities and capacities between organizations to enhance the degree of novelty in product innovations has been argued as one of the most distinctive features of high-tech, research-intensive industries (Siedlok et al., 2010). Therefore collaborative functional food product development has been suggested as a fundamental factor for the future success of food companies with limited

resources and skills. It is even more crucial for SME's. These companies usually lack the resources and skills to engage in truly innovative product development ventures (Sarkar & Costa, 2008; Van de Vrande et al., 2009). As a result, cooperative networks may co-evolve with the emergence of functional food product development. Hence it is proposed:

H2: There is a difference in external collaborative links between companies manufacturing functional foods and other food companies.

3.3.1.3 Commercialization tools/techniques

The introduction of truly innovative food products requires new activities and resources to create markets and distribution channels. Technology-oriented new products require extended resources for good communication with end-users, building national and international distribution channels and accessing market and customer information (Aarikka-Stenroos & Sandberg, 2012). Marketing of functional foods has been debated extensively in recent studies (Bech-Larsen et al., 1999; Bech-Larsen & Scholderer, 2007; Frewer et al., 2003; Kleef et al., 2002; Siro et al., 2008). Various effective strategies have been suggested (Menrad, 2003; Ray, 2004; Sarkar & Costa, 2008). The main challenges are the effective communication of the claimed health benefits and good distribution channels for getting broad access to target consumers (Heasman & Mellentin, 2001). A more formalized non-linear commercialization approach has been reported to be more successful for radically innovative products where various actors (research institutes, universities, government agencies, suppliers, distributors and industry associations) may all contribute to awareness building, including customer education and trial opportunities (Aarikka-Stenroos & Sandberg, 2012). In the case of functional foods, health professionals and health-related associations that promote healthy diets are critical to creating awareness among consumers about these innovative food products (Menrad, 2003). Therefore commercialization of functional foods may be done more effectively through the establishment of collaborative networks across various stakeholders. This will require a more comprehensive IP protection policy to protect the company's proprietary position and ensure an equitable return on investment among collaborating partners. Intellectual property rights are also crucial in creating barriers to imitations by competitors in attaining sustained competitive advantage (T. John et al., 2007). This approach again deviates from traditional food NPD launch strategies (Matthyssens et al., 2006; Traill & Mueulenberg, 2002). Thus it is hypothesized:

H3: there is a difference in commercialization techniques between companies manufacturing functional foods and other food companies.

3.4 Research Design

There are only a few studies that have investigated food businesses for functional food product development (Broring, 2008; Broring et al., 2006; Mark-Herbert, 2002; Matthyssens et al., 2008). These studies have used mainly a single methods approach i.e., qualitative or quantitative with more studies focussing on qualitative research (focus group discussions & case studies). It is fair to say that this research area is yet to be explored in depth; therefore the newness of this study has led this project to adopt quantitative and qualitative approaches in combination. This *mixed-methods* approach is now more popular in the social and health sciences to increase the validity of research findings (Bryman, 2006). Various studies have discussed the effectiveness of *mixed-method* research design in exploring complicated phenomena in social sciences (Greene, Caracelli, & Graham, 1989; Onwuegbuzie & Collins, 2007; Sinkovics, Penz, & Ghauri, 2005; Tashakkori & Teddlie, 2010). Further they have suggested that the use of mixed-method design can improve the validity of research (Ivankova, Creswell, & Stick, 2006) and also increase the statistical power of the data collected. Therefore this research has been based on the principles of *mixed method* design.

3.4.1 Principles of mixed-method design

There have been reported five approaches to *mixed-method* research i.e., *triangulation, complementarity, development, initiation* and *expansion* (Greene et al., 1989; Sandelowski, 2000). *Triangulation* deals with convergence, corroboration and correspondence of the results across methods (Greene et al., 1989). *Complementarity* aims at supporting or complementing the results of two methods where the overlapping but distinctive facets of a phenomenon are investigated. *Development* is the technique of mixing two methods in a way that is supportive and developmental. The methods are arranged in a sequential way leading to a progression of understanding as the study progresses. *Initiation* recasts questions in a provocative way to discover paradox and contradiction in the results of the study under investigation. *Expansion* deals with widening the breadth and scope of the inquiry in evaluating different components of the investigation. Quantitative methods are used as the main tool to understand the structural features while qualitative methods assess the process features of the program (Greene et al., 1989) (Figure 3. 3).

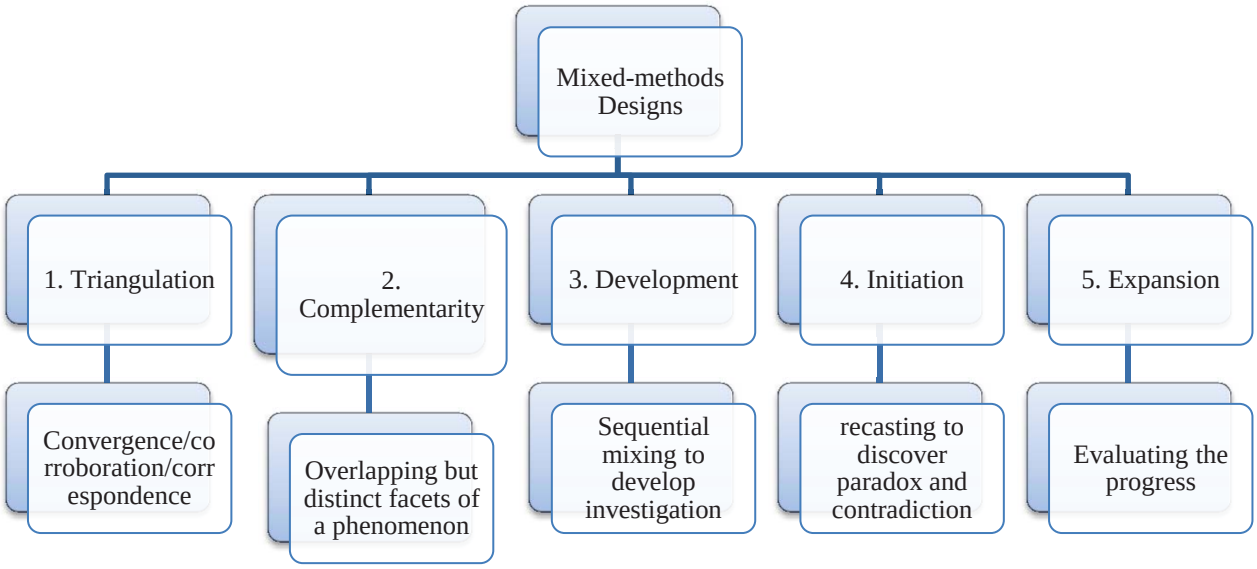


Figure 3. 3. Approaches to mixed-method research design (Greene et al., 1989).

3.4.2 Sequential Explanatory Design (SED)

In the literature almost forty *mixed-methods* research designs have been reported (Teddlie & Tashakkori, 2003) while six of them have found to be more frequently used (Creswell, Clark, Gutmann, & Hanson, 2003). Out of these six, three are *concurrent* designs while the remaining are *sequential*. Among the *sequential mixed-methods* designs, the collection of quantitative followed by the qualitative data seems to be the most popular sequence. This approach facilitates the understanding of numeric data when complemented with qualitative data in the form of expert opinions (Creswell et al., 2003; Ivankova et al., 2006). The quantitative study sometimes can produce unexpected results which are hard to describe on their own. Quantitative data may lack information on innovation-related activities which are not directly linked to numeric data e.g. all the patents are not necessarily a new product innovation and all the innovations are not patented. Therefore, subsequent qualitative exploration can address these issues in a more precise way by conducting interviews/ case studies to explain the quantitative results (Moghaddam, Walker, & Harre, 2003).

3.5 Data collection

3.5.1 Instruments for data collection

In the literature most of the studies around product innovation have used survey questionnaires to generate quantitative data (Beckeman & Skjoldebrand, 2007; OECD, 2005; Ok, 2009; Petersen, Handfield, & Ragatz, 2003, 2005; Ragatz, Handfield, & Scannell, 1997; Suwannaporn & Speece, 2003; Valk & Wynstra, 2005; Ziggers, 2005). This approach is

objective in nature and collects data on innovation activities such as new products, R&D activities, patents, bibliometirc directories. Therefore a quantitative questionnaire was used in the first part of the research with an objective to identify the main factors of food product innovation with particular reference to functional food product development.

Questionnaires are generally of two types i.e., structured and semi-structured. Similarly questions can also be open ended or closed. In general, structured questionnaires contain formally framed questions. Questionnaires can also be classified into four categories based upon the approach taken i.e., structured-non-disguised, structured-disguised, non-structured-disguised, non-structured-non-disguised (Table 3. 1) (Beri, 2008). A structured non-disguised questionnaire for the quantitative part of this research was chosen for this thesis.

Table 3. 1. Types of questionnaire and their salient features (Beri, 2008)

Questionnaire type	Salient features and purpose
Structured non-disguised	Objectives are clearly stated Pre-arranged list of questions Useful for descriptive research and large sample
Structured disguised	Investigative in nature Research objectives are not disclosed Useful in sensitive issues
Non-structured disguised	Contains a list of unstructured questions Flexible and appropriate for exploratory research
Non-structured non-disguised	Suitable for exploratory research Researcher ask questions as per situation

3.5.1.1 Data collection methods

Data can be collected by conducting face-face interviews, telephonic interviews and email/mail. Face-face interviews are the most effective method of data collection. They provide an opportunity to interact with the participant during data collection so that any confusion about any question can be explained directly. This approach helps in accurate and authentic data collection. However this method may not be feasible if the population or sample size is too big, as it will require more time and cost to arrange face-face interviews.

An alternative to face-face interview is telephonic interviews. This approach is cost-effective and can still ensure the authenticity of data, due to being able to still converse with the

participants. However, this method may run into difficulties in terms of finding contact numbers of relevant participants and issues with time and cost if the population size is too big.

A third approach is online data collection i.e. using e-mail, Web-based and personal digital assistants (PDAs) (Gordon & McNew, 2008), each having its own merits and demerits (Table 3. 2)**.** Web-based surveys can be very effective in saving time and cost of data collection from a large and diverse population but have disadvantages in terms of authenticity and clarification.

Table 3. 2. Comparison of online data collection tools (Gordon & McNew, 2008).

Method	Advantage	Disadvantage
E-mail	- easy -less cost -no software needed	- not anonymous -authenticity of the response - get blocked i.e., Spam - transcription of data expensive
Web-based	-anonymous -automatic data stored -no typographical error -skip and context logic based on previous response	-programming cost -internet-server if down can cause low response -weak or non-existent network connectivity of respondent -multiple completion attempts by same person
Personal digital Assistants (PDAs)	-portable and field data collection -time saving	-screen geography -operating system limitations -data transfer error due to limited synchronization -PDAs may be lost or stolen

This research project applied a combination of face-face and telephonic interviews for the New Zealand quantitative survey, while for the Singapore quantitative survey an online survey tool was used. The different approaches were used to adapt to the different cultural settings. After serious consultation with collaborating organisations in Singapore (SPRING

Singapore, Food Innovation Resource Centre and Health Promotion Board of Singapore), on-line surveys were considered the most appropriate approach. However to ensure the authenticity of data, SPRING Singapore, Food Innovation Resource Centre and Health Promotion Board of Singapore were requested to collaborate in ensuring the appropriate respondents were targeted for completing the online survey. Moreover, the questionnaire included an email ID, Job responsibilities and title to ensure the right person had completed the questionnaire.

3.5.1.2 Response rate of surveys

Generally it is considered hard to get a response in survey research that is directed to industries (Jie, Peiji, & Jiaming, 2008). In the literature, the reported response rate varies from as low as 17% (Bailetti, Callahan, & McCluskey, 1998; Suwannaporn & Speece, 2003) to as high as 60% (Nijssen & Frambach, 2000) . There could be various reasons for this low response rate. One of them, which is reported by Sinkovics, et al., (2005), is that, too many surveys make it hard for the managers to respond. Therefore various strategies were employed to increase the response rate such, as providing incentives to the participants (Jie et al., 2008), conducting one-one interviews and sending reminders through email/mail. All these strategies were applied in this research project. However, the main tool that had the most influence was the incentive of a benchmark report sent after completion of the study, mapping the participant's company against the average total response. This was an innovative approach to data collection not previously mentioned in the literature although the time commitment in preparing the benchmark reports is significant.

3.5.1.3 Handling missing data

It has been reported that there are three main sources of missing data in surveys viz. non-coverage, non-response (refusal), non-response to certain items/partial non-response (Barriball & While, 1999; Brick & Kalton, 1996). Weighting adjustment is generally applied to missing data originating from non-coverage and refusal to participate. Imputations are used to compensate for the item non-response. In this study, refusal to participate was enquired about, by asking the reason for not participating while item non-response was compensated by using imputation methods wherever applicable.

3.5.1.4 Common method variance (CMV)

Common method variance is "attributable to the measurement method rather than to the constructs the measure represents" (Podsakoff, Mackenzie, Lee, & Podsakoff, 2003). It is

rendered by the propensity of respondents to provide consistent answers to survey questions about two different parameters.

The most serious problem in data is considered when data on predictor and criterion variables are collected from same respondent in the same measurement context (Podsakoff et al., 2003). The basic solution to avoid common method variance is to construct dependent variables using different sources of information rather than indented variables, and. secondly, to design the questionnaire in a way to present questions in different layouts and scale types. Therefore the questionnaire was designed with separate sections, subheadings and different scale types (ranking options) to avoid common method variance.

3.5.1.5 Reliability and Validity

Data collection through questionnaires is often challenged on issues of reliability and validity of the survey instrument. Reliability is referred to as the consistency of responses in a measure about a particular concept in that survey. It can be checked by applying certain statistical tests. The most common method for verifying the reliability is by calculating the Cronbach's Alpha value. Generally Cronbach's Alpha should be ≥ 0.7 for accepting the reliability of the instrument (G. John & Reve, 1982; Pervaiz, 2013). Reliability can also be assessed by performing factor analysis. It measures the construct reliability of the measures without presuming that all items are equally weighted. It should have a value of ≥ 0.7 to be considered acceptable. Another parameter to assess the reliability is to measure the amount of variation extracted from a construct by its items. It measures the variance to measurement error in the construct. The recommended value for AVE is ≥ 0.5 (G. John & Reve, 1982).

Validity refers to the ability of an instrument to measure what it is aimed to measure. It is important to ensure validity of the construct for measuring a particular concept or parameters in an instrument. There are two types of validity commonly referred in literature i.e., content validity and construct validity (Chung-Yean et al., 2012; G. John & Reve, 1982).

Content validity is subjective in nature and explains the contents of the scale. It is related to clarifying the concepts in an instrument. Construct validity is related to the ability of items to measure accurately what they are designed to measure. It has further two components i.e., convergent validity and discriminant validity. Construct validity is ensured by determining the loading factor of each item on a construct. Each item should have a value ≥ 0.5 for being considered as a valid item for that particular construct (Chung-Yean et al., 2012; Pervaiz,

2013). In addition to loading factors value, AVE can also be used to explain the variance contributed by each factor.

Discriminant validity measures how strongly the constructs are correlated. There should not be a correlation ≥ 0.85 between two constructs, otherwise these correlated constructs may be measuring the same concept (Chung-Yean et al., 2012). Thus it may loosely discriminate the constructs for each concept in an instrument.

3.5.2 Data analysis techniques

3.5.2.1 Checking quality of data

An initial step towards data analysis is to explore the characteristics of the data and look for any abnormality in the data which may affect the subsequent analysis. Certain charts can be used to examine normality such as box plots, histograms and bar charts (Pervaiz, 2013). Descriptive statistics, e.g. mean, median, mode, range, average, standard deviation and standard error, are useful in different circumstances and help define the next stages of statistical analysis (Aaker, Kumar, & Day, 1995; Podsakoff et al., 2003).

A more in-depth analysis depends upon the nature of data collected e.g., ordinal, scale or nominal data. Ordinal data is mostly analysed using various choice models and presented in terms of frequency for each preference to predict dominant practices/choices. Scale type data is normally analysed by using various factor analyses such as exploratory factor analysis to identify principal factors. Nominal data is generally analysed using contingency tables and Chi square test to see the difference in categories generated in data collection (Aaker et al., 1995; Beri, 2008).

B. Methodologies used in the thesis

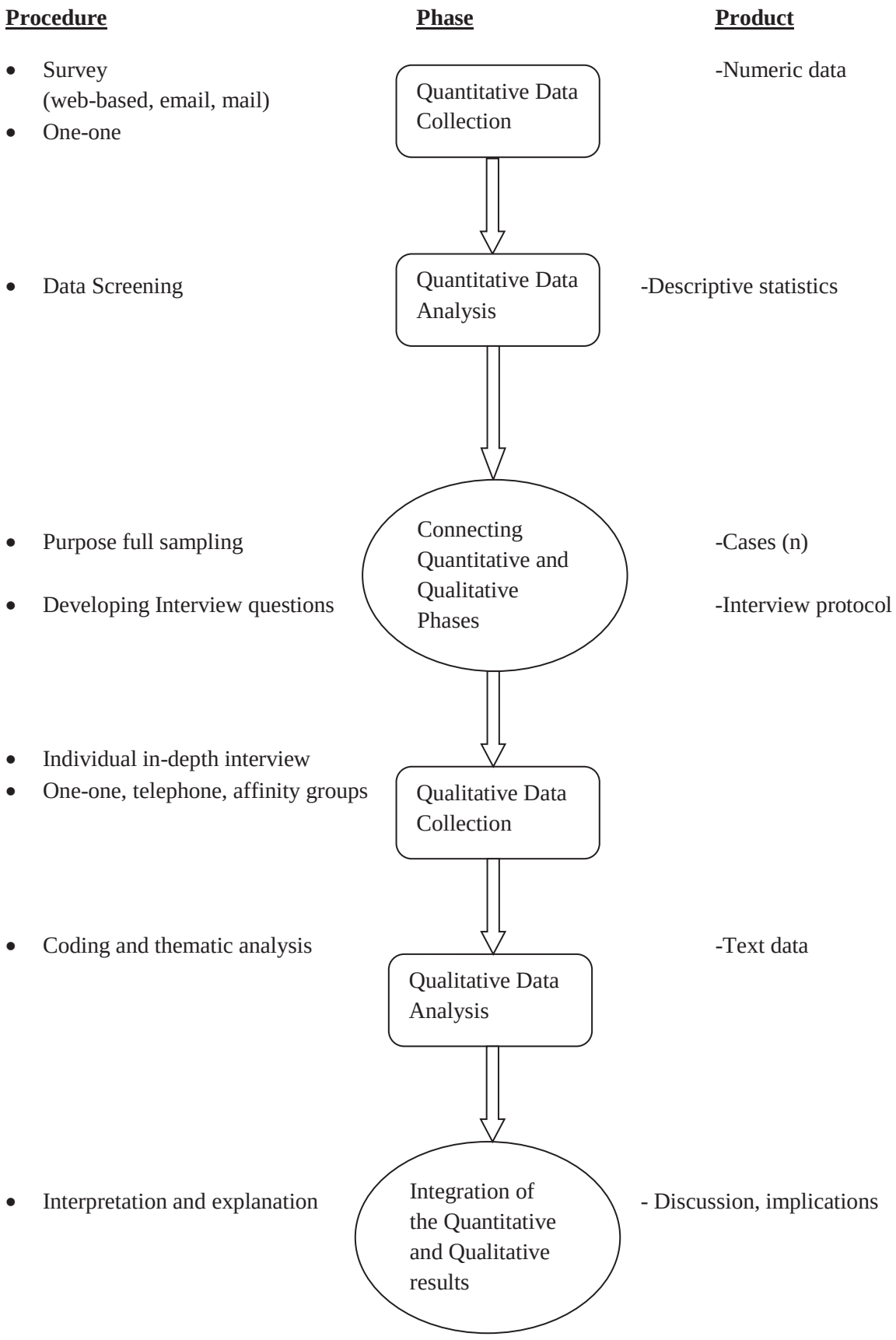
3.6 Thesis methodology

The primary research of this thesis has been carried out in two countries – New Zealand and Singapore. For New Zealand a mixed-method design was used. It was divided into two phases i.e. a quantitative phase followed by a qualitative phase (Caracelli & Greene, 1993; Onwuegbuzie & Collins, 2007; Sandelowski, 2000). In the first phase of data collection, an exploratory quantitative approach (Hillebrand & Biemans, 2004; Leech & Onwuegbuzie, 2007; Murphy, Dingwall, Greatbatch, Parker, & Watson, 1998) was adopted. The second phase of data collection was designed to further explore reasons behind certain attitudes and behaviours towards NPD activities of food manufacturers. It was accomplished by

conducting qualitative interviews with the New Product Development (NPD) managers of food companies (Hillebrand & Biemans, 2004) in New Zealand. The overall research design is presented in Table 3. 3.

The definition of functional foods adopted by this research is "***food products that contain compounds from natural sources that have added health benefits for the human body***". This definition was provided in the questionnaires used in collecting data from all the respondents (Please see appendix VIII and X).

Table 3. 3. A presentation of sequential mixed method design (Ivankova et al., 2006)



For Singapore only a quantitative survey was carried out

3.7 Data collection and analysis techniques

The overall data collection and data analysis techniques have been presented in Table 3. 4.

Table 3. 4. Summary of data collection techniques and analysis

Phase I- Quantitative study	
Target population	Food manufacturing companies in New Zealand and Singapore.
Quantitative data Collection	Quantitative questionnaire survey- Questionnaire design, piloting, field data collection (Gordon & McNew, 2008)
Data analysis	Non parametric statistics, frequency testing, Chi square test using Minitab® 15 (http://www.minitab.com; Minitab Inc.) (Ivankova et al., 2006; Nijssen & Frambach, 2000; Siriwongwilaichat, 2001).
Comparative analysis	Within sample (New Zealand) and between countries (New Zealand and Singapore)
Phase II- Qualitative study	
Target population	Participants of quantitative survey in New Zealand.
Data collection	Qualitative questionnaire design
	One-to one interviews with the NPD team managers of food manufacturing companies (Ivankova et al., 2006; Mark-Herbert, 2002).
Data analysis	Coding and thematic analysis using Nvivo 10 software Interpretative phenomenological analysis (Bryman, 2006; Ivankova et al., 2006; Onwuegbuzie & Collins, 2007)

3.8 Quantitative study (New Zealand)

3.8.1 Design of the quantitative questionnaire

A quantitative survey was designed based upon the ideas generated from previous surveys on innovations in New Zealand (Geoff 2010), UK (BIS 2005), OECD guidelines provided in the *Oslo Manual* for developing innovation related surveys (OECD, 2005) and a survey on new

functional food product development in Canada (Canada 2003). Thus 32 semi-closed questions were compiled under four themes viz. ***NPD orientation,*** measured as a cumulative response as to the aim of NPD (Li, Liu, and Zhao 2006), mode of NPD (Nystrom 1990) and orientation of organization towards innovations (OECD and Eurostat. 2005)***; cooperative network,*** measured as accumulative response to type of external partners and purpose of external collaborations (Emden, Calantone, and Droge 2006; Mishra and Shah 2009); ***commercialization techniques,*** measured as a response to tools for protection of innovation, marketing tools and marketing channels used (Mark-Herbert 2003; Ray 2004; Mark-Herbert 2004); and, ***drivers of and barriers to functional food product development*** was also explored (Appendix IV). Respondents were asked to choose the factors which best describe their company practices. They could also add factors if their choice was not listed among the answer options.

3.8.1.1 Piloting the questionnaire

The questionnaire was pre-tested with colleagues and the research team to ensure that survey was not too lengthy and complicated to impart unit non-response. All the terms used in this survey were defined and the duration of interview was kept to 10-15 minutes.

Further the questionnaire was piloted with ex-graduates of Massey University working in the food industry and personal contacts to determine the suitability of the questionnaire. A response of 8 participants in the pilot study, suggested some changes to the terms used in the survey and questions related to demographics.

3.8.2 Ethics approval

A minor risk ethics approval for the quantitative study was obtained from Massey University Human Ethic Committee (MUHEC, 2013).

3.8.3 Overall data collection plan

A summary of the data collection plan is presented in Figure 3. 4 and described in subsequent sections;

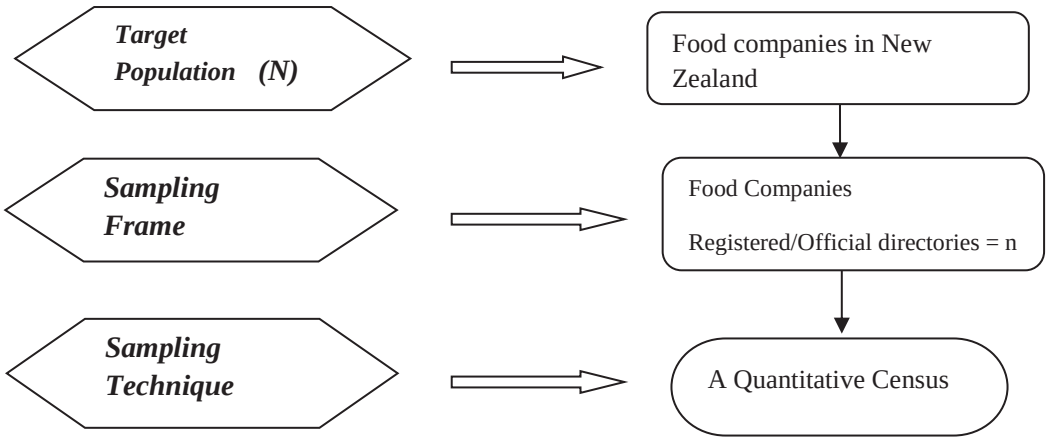


Figure 3. 4. Overview of the data collection plan for quantitative survey

3.8.4 Target population

The target population for this study was all the registered packaged food manufacturing companies that operate in New Zealand.

3.8.5 Sampling Frame

The official directories such as national directories, national statistics and business directories were used (OECD, 2005). A comprehensive list of 610 food manufacturing companies as listed in the online business directory (Finda, 2007, 2011) indexnz (IndexNZ, 2010) and kompass New Zealand (Kompass, 2011) was prepared. Duplicate entries were removed. Water companies and alcohol manufacturing companies were also removed from the list as these companies do not fit the criteria of packaged food companies. Thus a final list of 310 food and beverage companies comprised the sampling frame.

3.8.6 Sampling technique

Total population size was small enough for all 310 companies in the sampling frame to be contacted (OECD, 2005).

3.8.7 Data collection

3.8.7.1 Contacting the sample

The top-level manager of each company (i.e., Chief Executive Officer, Managing Director etc.) was written a letter of invitation asking them to participate in this study (Appendix II). An initial response form and return stamped envelope were attached with an invitation letter (Appendix III). A period of three weeks was allowed for a response (Traill and Mueulenberg

2002). From this, 112 companies responded positively to participate in the study, however, 45 of them subsequently declined to participate due to their busy schedule. Sixty seven (~22 % of the total) face-face and telephone interviews were completed. For telephone interviews, the survey questionnaire was first emailed or mailed to the respective respondent ahead of the interview so they could go through the questionnaire before answering questions and also giving them the chance to raise any concerns.

3.8.7.2 Non-response bias

Non-response due to non-coverage was managed by adopting a census approach to data collection. Unit non-response was managed by contacting all those companies (240) who did not respond through a follow up letter to ask their reason for not participating in the study (Barriball & While, 1999) (Appendix V & VI). Thus a total of 31 companies provided the reasons for their non-response. The main reasons given were *limited time and resources* to commit to these activities. Item non-responses were reduced by conducting face-face and telephonic interviews.

3.9 Quantitative study (Singapore)

The Singapore study was conducted in collaboration with Singapore Polytechnic, Spring Singapore, Food Innovation Resource Centre (FIRC), Health Promotion Board (HPB) of Singapore.

3.9.1 Design of the quantitative questionnaire

The same questionnaire was used but with some modifications to suit the Singapore audience (Appendix XI). Colleagues in Singapore Polytechnic were consulted in modifying the questionnaire. Input from the colleagues and ex-graduates of Massey University (Singapore), Spring Singapore, Food Innovation Resource Centre (FIRC), Singapore and Health Promotion Board (HPB) of Singapore suggested a few changes to make the questionnaire simpler for a Singapore business audience.

3.9.2 Ethics approval

A full scale Human Ethics approval from MUHEC (MUHEC, 2013) was obtained for overseas data collection in advance of commencement of data collection in Singapore.

3.9.3 Data Collection Plan

An online survey was developed using SurveyGizmo (SurveyGizmo, 2013) tool for collecting data in Singapore.

3.9.4 Sampling Frame

A data base of Spring Singapore and FIRC was used to access the food manufacturing companies operating in Singapore (450 companies). The same inclusion and exclusion criteria were used as the New Zealand study.

3.9.5 Data collection

An email message (Appendix X) from FIRC platform was sent to all the registered food manufacturing companies in Singapore where a link to complete the survey was embedded. Thus a total of 450 companies were contacted. These companies were given three weeks time to respond. After that a reminder was sent to encourage further response. Finally a telephonic and email follow up was carried out with those participants who partially completed the survey to increase the completed responses. Thus a total of 54 companies (12%) completed the survey.

3.10 Quantitative data analysis

3.10.1 Reliability and validity of data

The reliability of instrument measures was checked using IBM SPSS statistics 20 (IBM, 2013) and Cronbach's alpha was calculated for all factors. The cut-off value from Cronbach's alpha was ~0.7 or more (Pervaiz, 2013; Siriwongwilaichat, 2001).

3.10.2 Descriptive statistics

Frequency score for each ranked variable was calculated using IBM SPSS Statistics 20 (IBM, 2013). The results are presented and discussed in chapter 4.

3.10.3 Comparative analysis

A comparative analysis of food companies based upon their involvement in functional foods or not was conducted within New Zealand and Singapore food companies. The main objectives of this analysis were to compare the innovation process of food manufacturing companies with regard to functional food product development. Therefore the questionnaire was designed to create two categories of responses: ***Group 1***: those who claimed to have functional food development activity in their company. ***Group 2***: those food companies who did not claim to have any functional food development activity in their company. This enabled a comparative analysis of NPD approach and attitudes of food companies between the two groups. For this purpose accumulative frequency scores of all the variables were counted and the chi square test was applied to measure significant differences in NPD practices of Group 1 and Group 2 companies (Jolly and Therin 2007; Salavou and Lioukes

2003). Minitab® 15 (http://www.minitab.com; Minitab Inc.) and (GraphPad Software, 2013) were used for calculating chi Square test using a 2X2 contingency table.

A similar data analysis technique was applied to compare the innovation process features between New Zealand and Singapore food manufacturing industries.

3.11 Qualitative Study

This phase was built upon the findings of the quantitative study completed in New Zealand and aimed at understanding the reasons behind certain perceptions and attitudes towards new functional food product development. It was accomplished by conducting qualitative interviews with the NPD managers who had already completed the quantitative survey. This study was restricted to New Zealand as it was not feasible to conduct the qualitative study in Singapore owing to time and cost restrictions. The detail of the procedure for this study is explained below;

3.11.1 Data collection plan

The main aim here is to develop an expert opinion on the principal factors of bioactive functional food innovations from the group of New Product Development (NPD) managers.

3.11.2 Sampling frame

The sampling frame was the participants who completed the quantitative survey in New Zealand.

3.11.3 Sampling technique

All the participants (67 food manufacturing companies) were sent a benchmark analysis report of quantitative results and were requested to participate in next phase of the study (Appendix VII). Thus eleven one-one interviews were completed.

3.11.4 Data collection tools

One-one interviews were conducted with NPD managers of food manufacturing companies. These interviews were audio recorded for transcription of the dialogue later.

3.11.5 Qualitative questionnaire design

Five open ended questions were formulated on the topic of firm orientation towards NPD, nature of cooperative network and its activities, commercialization strategies and challenges, and finally the main barriers and drivers of functional food innovations (Appendix IX).

3.12 Qualitative data analysis

This phase of data collection was an extension to the quantitative data collection. Therefore it aimed at generating common views and opinions of NPD experts about the innovation process of food manufacturing. Thematic analysis was conducted using NVivo 10 software. All interviews were transcribed into word document files and were uploaded in Nvivo10 to conduct thematic analysis.

4. Characterisation of innovation process

4.1. Introduction

This chapter is aimed at characterizing the innovation process of food companies in New Zealand. For this purpose the quantitative survey is first analysed to observe any general trends across the response data. The frequencies of responses for each item are presented in tables and charts. Then an exploratory factor analysis is conducted to categorise these responses into smaller groups: differentiated by approaches towards NPD/innovation such as market oriented; product oriented or process oriented NPD (see section 3.3.1.1. *Orientation towards NPD/innovation*). Finally the innovation process of food companies based upon their orientation towards NPD is defined and discussed.

4.2. Methods

A quantitative survey of food manufacturing companies across New Zealand was completed by conducting one-one face-face interviews and telephonic interviews. Details of the methodology are described in chapter 3 under section 3.8.

4.3. Results

Descriptive statistics

4.3.1. Demographics of food manufacturing companies

More than 40 % of total food manufacturing companies are located in the Auckland region followed by Canterbury and Waikato/Wellington (Table 4. 1).

Table 4. 1. Region-wide distribution of food companies across New Zealand

Regions	No. of Companies	%
Auckland	132	42.58
Marlborough	12	3.87
Canterbury	49	15.81
Otago	11	3.55
East Coast	3	0.97
Waikato	18	5.81
Hawkes Bay	16	5.16
Southland	12	3.87
Manawatu-Wanganui	14	4.52
Nelson	10	3.23
Taranaki	3	0.97
Bay of Plenty	14	4.52
Wellington	16	5.16
Total	**310**	**100.00**

4.3.2. Distribution of respondent companies

The distribution of respondent companies across the total population based upon employee size is presented in Table 4. 2. This table shows that the sample distribution over population is closely matched. This is important to authenticate the representativeness of the sample. A large number of companies fall in the range of 1-50 employee size groups both in population and sample. This is in line with the overall outlook of the New Zealand manufacturing industry; comprising many small to medium enterprises (SME's) (MED, 2011).

Table 4. 2. Distribution of respondent companies across population based upon employee size

No. of employees	Total no. of food manufacturing companies	Sample
1-10	94 (30%)	21 (31%)
11-20	63 (20%)	17 (25%)
21-50	54 (17%)	8 (12%)
51-100	37 (12%)	7 (10%)
101-200	26 (8%)	5 (7%)
201-500	21 (7%)	5 (7%)
>500	15 (5%)	4 (6%)
Total	**310**	**67**

Source: (Kompass 2011b; Finda 2011)

The non-responding companies (240) were sent a letter to investigate the reasons for not participating. A non-response form and stamped returned envelope was dispatched and 3 weeks were given to reply (Appendix 2). A total of 31 companies informed the reasons for their non-response with the main reasons being limited time and resources to complete the questionnaire.

4.3.3. Demographics of interviewees

Participants were from various top management positions, namely CEOs or owners, managing directors, new product development managers, general managers, sales and marketing managers and operations managers. NPD managers (mostly in larger companies) and CEOs or managing directors (mostly in SMEs) dominated the pool of interviewees in this study.

The experience of respondents in functional food product development (FFPD) is presented in Figure 4.1. Some of the respondents have very high experience in functional food development i.e. 40, 35 & 30 years. These were omitted from the data as being outliers Figure 4.1.

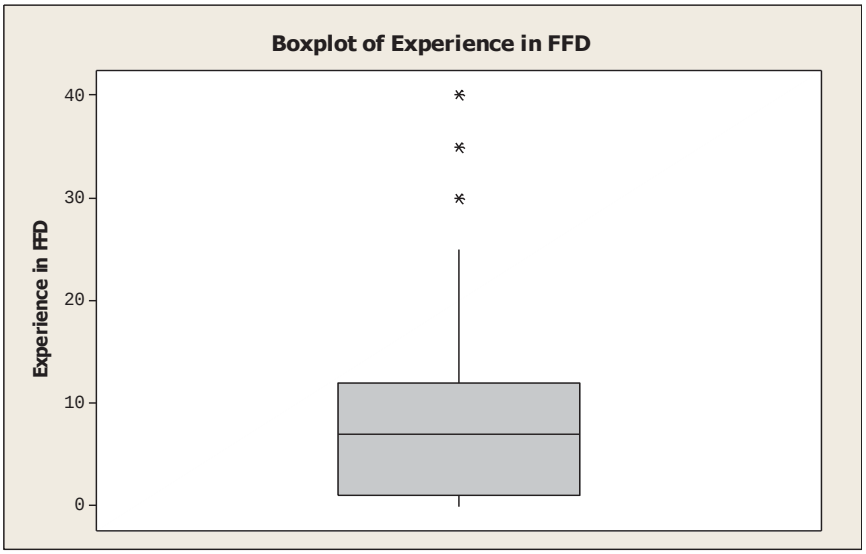


Figure 4.1. Participants experience (years) in functional food product development

Similarly experience in terms of number of new products development projects (NPDP) completed by respondents has been presented in Figure 4. 2. However, there were a few respondents who reported extremely large numbers of NPDP completed i.e., 540, 500 projects. These were also omitted from the data as being outliers Figure 4. 2.

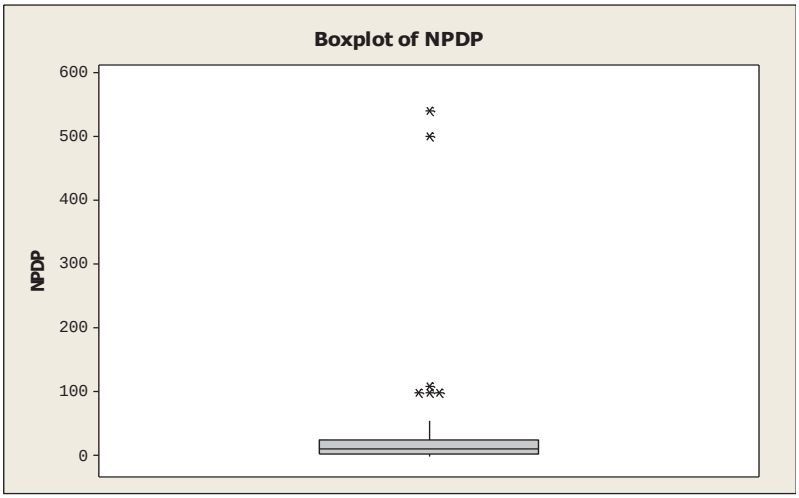


Figure 4. 2. Experience in New Product Development based upon number of NPs Developed.

The average NPD of a company and functional food product development (FFPD) experience of participants was calculated to be 17.6 ~18 new products and 8.8 years respectively (**Table 4. 3**). Further the sample was made up of 58 national companies and 9 multinational companies with an average number of new products launched in 2008-11 of 23.

Table 4. 3. Salient features of sampled companies and respective participants

Age Group (Years)	**No. of Participants**
Below 30	4
30-39	12
40-50	21
Above 50	30
1. NPD statistics	**Number of new products**
Average number of new products launched by each company (2008-11)	23
Average number of NPD projects completed by each respondent	17.6~ 18
Average FF experience (years) of each respondent	8.8 ~9 (Years)
2. Type of Ownership	**Number of companies**
National Companies	58 (85.5%)
Multinational Companies	9 (14.55%)

4.4. Orientation towards new product development (NPD)

4.4.1. Innovation characteristics of food companies

Frequency analysis showed that market oriented NPD is the most dominant NPD approach. Seventy six percent of the total responses ranked market oriented NPD as their most dominant approach (Table 4.4). The second most dominant orientation was found to be product oriented NPD with 68% of total responses ranking this orientation as their moderately dominant approach towards NPD (Table 4.4). The third ranked approach is process oriented NPD where 76% of respondents reported that this approach was slightly dominant (Table 4.4). Finally the least dominant orientation was considered to be organisational oriented NPD where 89.6% of respondents reported this approach to be less dominant (Table 4.4). It can be concluded from these results that market oriented NPD is the most dominant reported NPD approach followed by product and process orientation respectively. These findings are in line with literature citing observed practices in the food industry (Anahita, Jennifer, Sally, & Daffyd, 2012; Broring et al., 2006; Gehlhar et al., 2009).

Table 4. 4. Frequency score of ranking order for Orientation towards NPD/Innovation

Ranking Scale	Orientation towards NPD/Innovation			
	"Market-Oriented NPD" (MO)	"Product-oriented NPD" (PDO)	"Process oriented NPD" (PRO)	"Organisational-oriented NPD" (ORO)
Most dominant	51	12	5	0
Moderately dominant	13	46	4	1
Slightly dominant	2	7	51	6
Less dominant	1	2	7	60
Least dominant	-	-	-	-
Total	**67**	67	67	67

4.4.2. Major aims of NPD

The data collected on the number of new products developed under various aims of new product development (NPD) are presented in Table 4. 5. It shows that the most dominant aim of NPD is *to increase the range of goods/services* (IRGS) followed by *to increase market share* (IMS), *exploiting new marketing opportunities* (ENMO) and *increasing the responsiveness to the consumers* (IRC).

Table 4. 5. Main aims of NPD (2008-11)

Main aim of NPD	Total no. NPD	%
To increase range of goods/services (IRGS)	**525**	**32**
To increase market share (IMS)	**381**	**23**
To exploit new market opportunities (ENMO)	**352**	**21**
To increase responsiveness to consumers (IRC)	**278**	**17**
To reduce cost (RC)	**87**	**5**
To increase knowledge sharing with consumers (IKSC)	**34**	**2**
Total	**1657**	**100**

4.4.3. Mode of product development

The mode of product development (i.e., developed alone or in collaboration with others or developed by another company) has been presented in Table 4. 6 and shows that most of the new products are developed alone by the food manufacturing companies (83% of total new products). This approach has been described as a closed NPD approach where a food company controls its innovation activities through isolation. This approach has been reported to yield incremental innovations as the firm restricts itself to internal sources which are likely to be scarce or fall short of what is needed for radical innovations (Bougrain & Haudeville, 2002; Nieto & Santamaria, 2007). Bourgain and Haudeville (2002) argued that collaborations are essential in developing the resources of SME's for innovations. Similarly Nieto and Santamaria (2007) reported that the diverse collaborations are essential in developing the innovation capabilities of SME's.

There were a few new products (14.65%) which were developed in some sort of collaboration with external partners (Table 4. 6).

Table 4. 6 Overall mode of NPD (2008-11)

Mode of NPD	Total no. of NPD	%
Developed alone	1285	83.28
In partnership with other company	226	14.65
By other company	32	2.07
Total	1543	100

A very negligible percentage of NPD (2.07%) was reported to be done by another company. This may happen in situations where new products are just minor extensions of non-competing product ranges or to compensate for limited production capacity.

4.4.4. Sources of idea generation for NPD

New product idea generation was found to be heavily reliant on suppliers of ingredients, scientific research publications and ingredient exhibitions (Figure 4. 3). The least effective sources of idea generation were Crown Research Institutes, government health regulations, and universities.

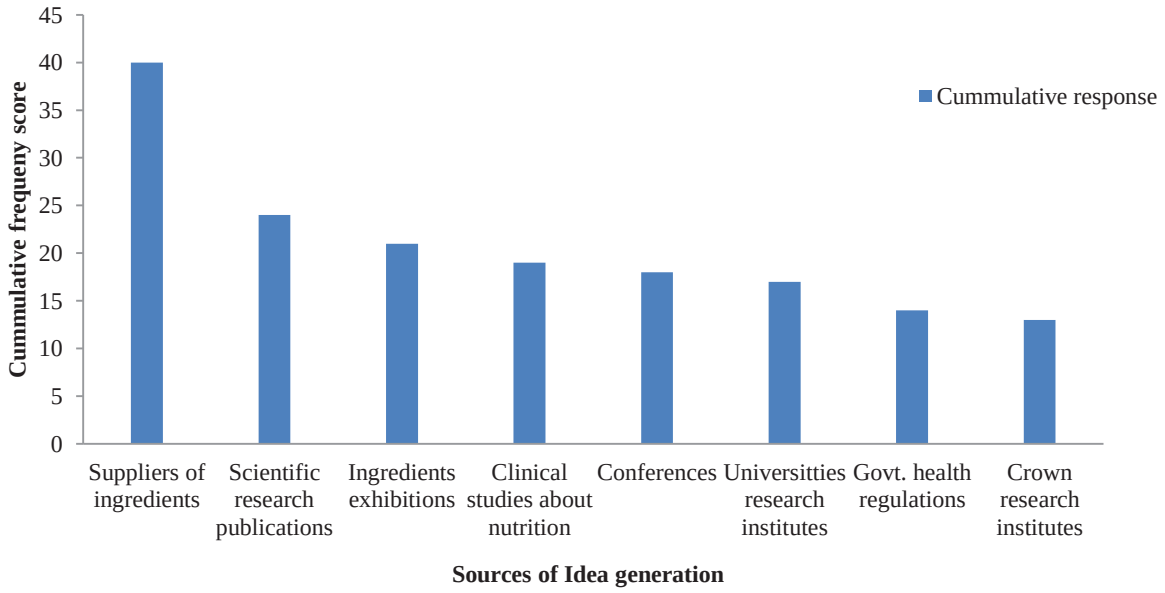


Figure 4. 3. Various sources of idea of generation in new functional foods development

4.5. Collaborative arrangements

Functional food product development is considered to be comparatively more efficient and successful when conducted in collaboration with relevant external partners (Mark-Herbert 2003; Broring, Cloutier, and Leker 2006). Therefore external cooperative links for NPD in the food industry were explored.

4.5.1. Cooperative links

Out of total 67 respondent companies, 54% companies were reported to have no external links (Figure 4. 4).

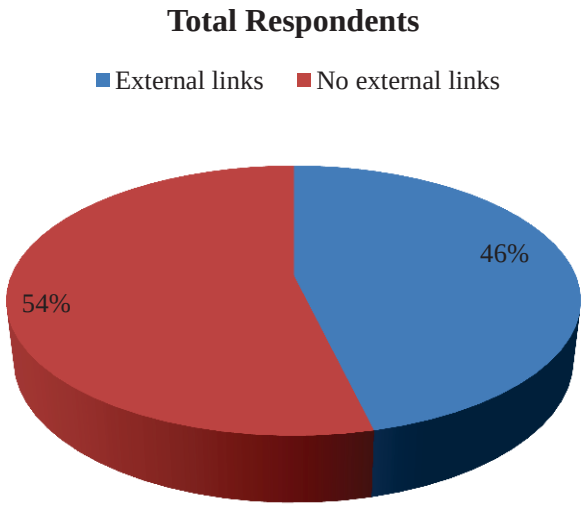


Figure 4. 4. Proportion of cooperative links for NPD

4.5.2. Dominant external partners

The preferred external links were mostly with customers and ingredient suppliers (Figure 4. 5). The least preferred choices for external collaborations were Crown Research Institutes and universities respectively.

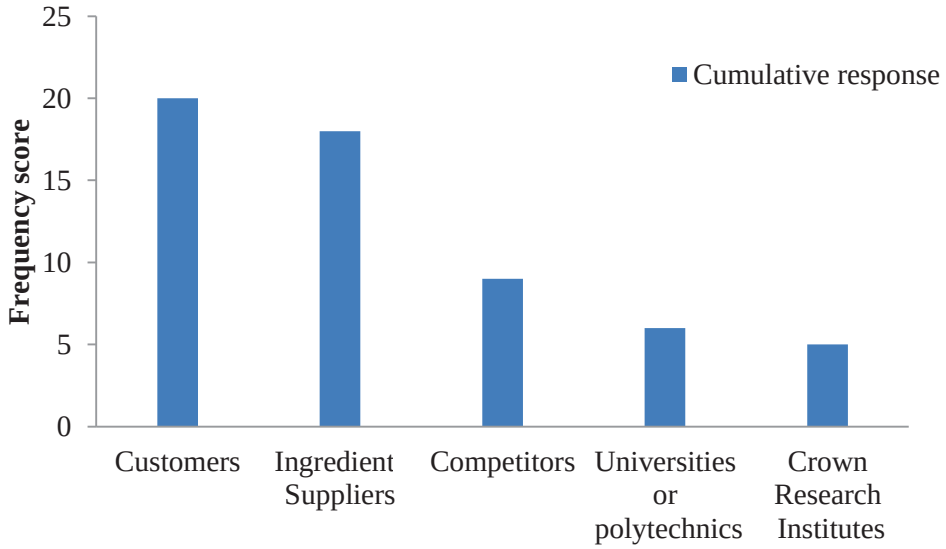


Figure 4. 5. Types of external partners in the food manufacturing industry

4.5.3. Purpose of external collaborations

Among the various purposes of cooperative arrangements (Figure 4. 6), it was observed that risk sharing was marked as the least dominant purpose for the existing cooperative arrangement among the food manufacturing companies.

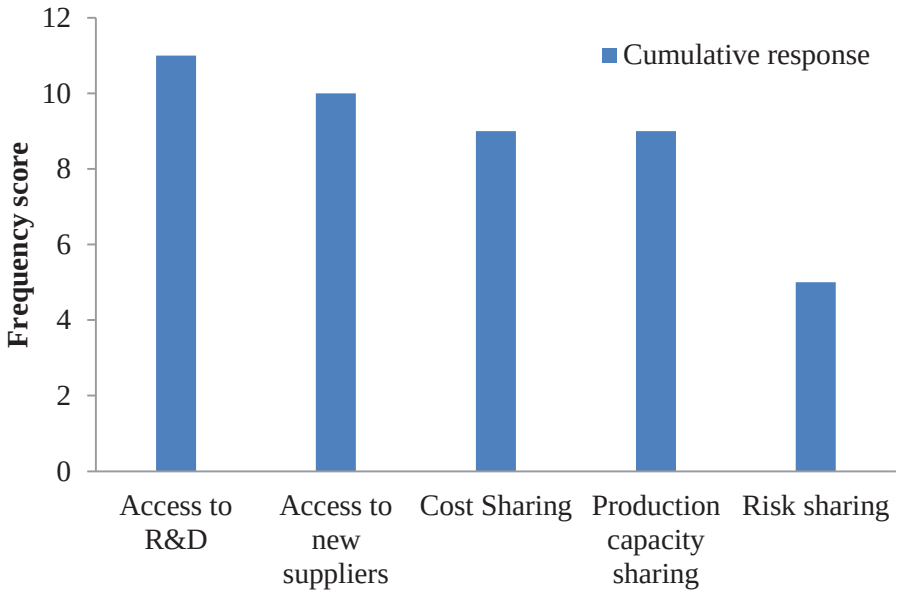


Figure 4. 6. Purposes of cooperative arrangements among the food manufacturing companies

The most preferred purpose of external collaborations was access to R&D and to new suppliers.

4.6. Commercialization Techniques

4.6.1. Protection of innovations

It was found that trademarks dominate the food manufacturing companies in New Zealand followed by confidentiality agreements and IP contracts which were considered equally important (Figure 4. 7). Respondents placed lesser importance to copyrights and patents as tools for protecting innovation.

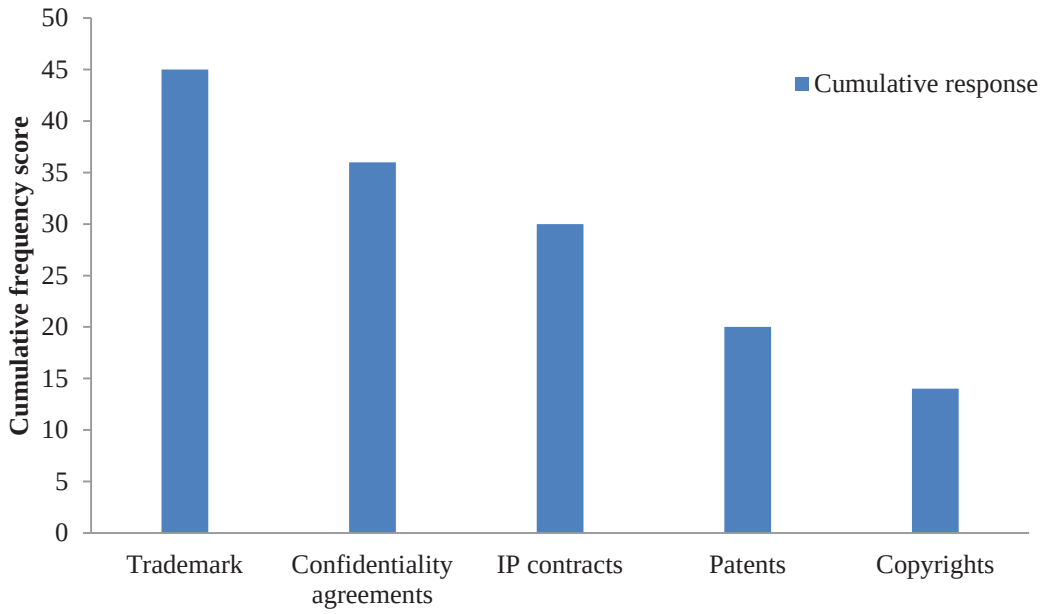


Figure 4. 7. Commercialization tools for protecting the innovations

Further ranking scores for these parameters showed that trademark (36.1%) and IP contracts (36.7%) were the most important tools for protecting innovations followed by confidentiality agreements having 28.9% of the responses as the most important tool (Table 4. 7).

Patents was considered by 20 participants to be relevant with 40% marked as the most important while 30% of total responses considered it the least important tools for protecting innovations (Table 4. 7). Copyright was only marked by 14 people as relevant out of which 42% of responses considered it the least important (Table 4. 7). Therefore it can be concluded that three major tools for protecting innovations were IP contracts, Trademark and Confidentiality agreements.

Table 4. 7. Frequency score of ranking order for “Protection of Innovations”.

Ranking Scale	Protection innovation tools				
	Trademark	Confidentiality Agreement	IP contracts	Patents	Copyrights
Most important	**13**	**13**	**11**	**8**	1
Very Important	**9**	**14**	**8**	2	3
Moderately important	5	9	3	2	2
Less important	5	4	4	2	2
Lesser important	4	5	4	**6**	**6**
Least important	-	-	-	-	-
Total	**36**	**45**	**30**	**20**	**14**

4.6.2. Main marketing tools

The leading effective marketing tools for commercializing new food products were found to be companies’ own marketing staff, followed by brand ownership and electronic media (Figure 4. 8).

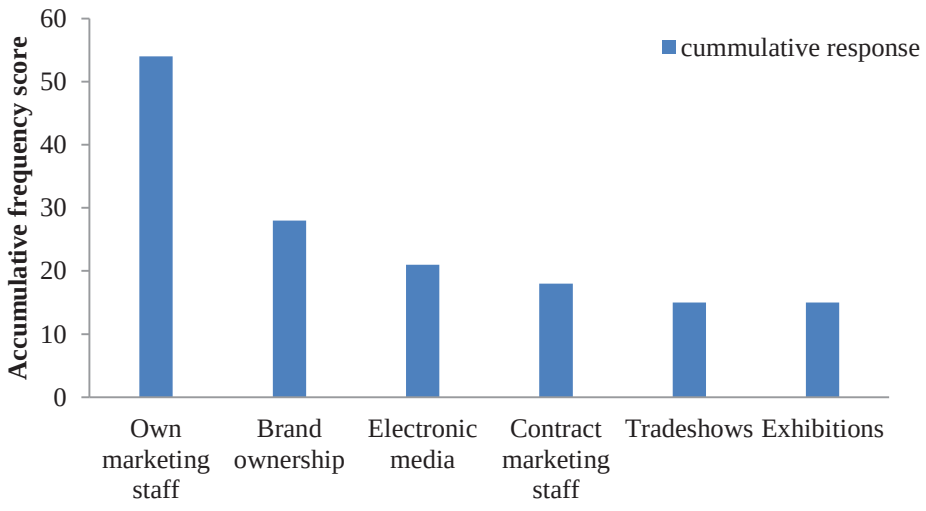


Figure 4. 8. Major marketing tool for NPD/innovations

Descriptive statistics revealed that “Own Marketing Staff” was ranked as the most important tool for marketing (61.1 % responses, N=54) followed by “Brand Ownership” (51.4% response=37) (Table 4.8.) The third most important marketing tool was Electronic media and Contract marketing staff both being ranked equally (13~% response). However 36% of responses considered Contract marketing staff to be the least important tool for marketing. Exhibitions were not considered by any of the respondents to be the most important tools. This factor was ranked as moderately important by 32% of responses. Trade shows were ranked slightly to least important by the majority of respondents (>50% respondents) (Table 4. 8).

Table 4. 8. Frequency score of ranking order for “Main marketing tools”.

Ranking Scale	**Marketing tools**			
	Own Marketing Staff	Brand Ownership	Electronic Media	Contract Marketing Staff
Most important	33	19	4	3
Very Important	12	6	7	3
Moderately important	6	9	7	5
Less important	2	1	6	1
Lesser important	1	1	3	2
Least important	-	1	3	8
Total	54	37	30	22

4.6.3. Major barriers to commercialization

The ranking order frequency score for various barriers to commercialization, revealed that Consumer confidence was ranked as the most important factor by 37.5% of total responses, N=32 followed by Access to market with N=33; 30.3% and Legislation with N=32; 28.1% (Table 4. 9).

Table 4. 9. Frequency score of ranking order for "Major barriers to commercialization".

Ranking Scale	Major barriers to commercialization				
	Access to Market	Health Awareness	Consumers' Confidence	Legislation	Government Support
Most important	10	5	12	9	2
Very Important	11	13	4	4	3
Moderately important	5	4	5	8	5
Less important	3	4	7	9	1
Lesser important	4	4	4	2	9
Least important	-	-	-	-	-
Total	33	30	32	32	20

In contrast, creating health awareness was found to be ranked as the most important by 16.7% of total responses followed by Government support (10% out of total 20 responses) (Table 4. 9).

4.7. Reliability and Validity of instrument

All the factors have acceptable Cronbach's alpha values (~0.7 or more) except for barriers to commercialization with a value of 0.45, due to a lower number of observations for this item (N=15) (Table 4. 10).

Table 4. 10. Measures of the instrument and their Cronbach's Alpha values

Variable	Factors	Indicators	Cronbach's Alpha
1. Orientation towards innovation	-Major aims of these new products	-To increase range of goods and services,- to increase market share, -to exploit new market opportunities, -to increase responsiveness, -to consumers, -to reduce cost, -to increase knowledge sharing with consumers	0.80
	-Innovation characteristics of organization	-Market oriented, -product oriented, -process oriented, -organizational oriented	0.65
	-Sources of idea generation for NPD	-Ingredient suppliers, scientific research publications, clinical studies about nutrition, ingredient exhibitions, university research institutes, conferences, Govt. health regulations, Crown research institutes	0.77
2. Cooperative network**	-Major external partners	Customers, ingredient suppliers, research institutes, universities, competitors	NA
3. Commercialization techniques/tool	-Protection of innovation tools -Commercialization tools -Barriers to commercialization	Trademark, IP contracts, Copyrights, Patents, confidentiality agreements	0.74
		Own marketing staff, contract marketing staff, brand ownership, exhibitions, tradeshows, electronic media	0.73
		Access to market, Creating health awareness, consumer confidence, legislation, level of government support	0.45

**** Frequency data**

Validity of data was checked by completing a factor analysis in IBM SPSS Statistics 20 (IBM, 2013). Exploratory factor analysis (Table 4. 11) was performed with varimax rotations and principal component analysis for relevant sets of items. Factors were extracted by using eigenvalues (>1) and scree plots (Ziggers, 2005). The factor analysis may reveal certain groups of responses which can be attributed to various approaches towards NPD adopted by food companies. This will help us in categorising the food companies' characteristics into a particular set of responses to a particular factor of innovation. Therefore three components were extracted for each measure which may correspond to three different orientations towards NPD i.e., market oriented (MO), process oriented (PRO) and product oriented (PO) approaches. The loading factors for items were selected with values more than 0.5. A step wise factor analysis is therefore presented in subsequent sections.

Table 4. 11. Factor analysis for construct measures

Construct measures	Components (Eigenvalues)	Factors loading
Aims of NPD	First component= 2.43 (MO)	-Increase range of goods/services (0.76) -Exploit new market opportunities (0.78) -Increase responsiveness to consumers (0.76)
	Second component=1.14 (PRO)	-Reduce cost (0.91) -Increase market share (0.79)
	Third component=0.83 (PDO)	-Increase knowledge sharing with consumers (0.9)
Protection of innovation	First component=1.27 (MO)	-Trademark (0.89) -Copyrights (0.59)
	Second component=1.85 (PRO)	-IP contracts (0.87) -Confidentiality agreement (0.79)
	Third component=0.8 (PDO)	-Patents (0.87)
Commercialization tools	First component= 2.19 (MO)	-Own marketing staff (0.74) -Exhibitions (0.74) -Tradeshows (0.76)
	Second component=1.13 (PDO)	-Brand ownership (0.87) -Electronic media (0.64)
	Third component=0.97 (PRO)	-Contract marketing staff (0.93)
Barriers to commercialization	First component=1.47 (MO)	-Legislation (0.85) -Government support (0.82)
	Second component=1.4 (PDO)	-Health awareness among consumers (0.74) -Consumer confidence (0.84)
	Third component=1.29 (PRO)	-Cost of Launch (0.83)

4.8. Discussion

4.8.1. Dominant features of NPD/Innovation process

Relationship between employee size distribution and innovation

It has been argued that the New Zealand food manufacturing industry faces serious challenges owing to its small domestic market and its geographic location (Geoff, 2010; Government, 2012). Therefore it was unsurprising that the majority of food businesses are SMEs (Table 4. 2). New Zealand has a strong preponderance of small food companies. However a comparison of size distribution of food and beverage manufacturing enterprises in various significant food-producing countries (OECD, 2007) reveals that New Zealand does not greatly differ from some of its peer countries (Table 4. 12), which suggests that issues about company size and ability to engage in functional food development may be applicable in other food-producing countries.

Table 4. 12. Comparative size distribution of food and beverage manufacturing enterprises (2007)

Countries	Fewer than 20 persons engaged	20 or more persons engaged	Total number of enterprises
NZ	1,470 (79%)	396 (21%)	1,866
USA	38,982 (81%)	9,275 (19%)	48,257
UK	5,021 (71%)	2,014 (29%)	7,035
Netherland	3,395 (81%)	810 (19%)	4,205
Denmark	1,305 (76%)	408 (24%)	1,713
Sweden	2,890 (88%)	385 (12%)	3,275

Source: (OECD and Eurostat.) SDBS structural business statistics (ISIC Rev.3): Manufacturing (by size class)

This study thus shows that size distribution does not matter as such, it may be the access to market that would matter in doing radical product innovations or truly new product innovations for that matter.

Approach towards NPD

The aims of new product development reflect an image of predominantly market oriented NPD where the focus is to meet consumer needs through incremental innovations. While the purpose of NPD to *share knowledge with consumers* (IKSC) scored least in the survey, which may be related to lower level of radical product innovation. Incorporation of novel knowledge into products to educate the society and create new markets has been related to

radical product innovations such as those of functional food product innovations (Todtling et al., 2009). However there were a few new products directed towards *knowledge sharing with consumers* which is a reflection of product oriented NPD. Further, food companies reported a sole reliance on their internal resources and capabilities for doing NPD which is described as closed in terms of its NPD activities. This approach is more likely to yield incremental innovations because most of the food companies in New Zealand are SMEs with limited resources. In addition, it has been reported that New Zealand agri-food research R&D spending is of the order of 0.9% of turnover which is well below the overall R&D spending (~2%) in the food industry when compared globally (Kevin. et al., 2012). All these findings suggest that food companies are following a linear model of NPD compared to new emerging interactive non-linear NPD models (Jacqueline et al., 2007; Winger, 2009). The traditional linear closed NPD model does not promote external links for developing resources and thus capabilities of food companies to innovate radically. The closed NPD model is best suited to "me too" kinds of innovations where speed to market is the core of new products with slight modifications in formulations or packaging. Contrary to this approach is the open NPD model where interactions with external partners for conducting NPD are sought to incorporate novel knowledge and technology in product development. Moreover value-added food products such as functional food products/ health oriented food products have been suggested to favour collaborative a product development model (Khan et al., 2013; Mark-Herbert, 2004; Matthyssens et al., 2008). Therefore it can be deduced from these findings that radical functional food product development would require an interactive non-linear NPD model with an aim to shift the focus of NPD from market searcher to market developer. This would also mean a shift from dominantly market oriented NPD to product oriented NPD which has already been offered as a critical factor in creating unique value and improving the profitability of a business (Gehlhar et al., 2009; Helen, 2002; Matthyssens et al., 2008).

Approach towards collaboration in NPD

There were 54% companies in this study who indicated that they have some sort of external collaboration with external partners in NPD or for NPD. However, these collaborations were dominated by customers and ingredient suppliers. This approach was confirmed in the subsequent qualitative phase of the New Zealand study where interviewees commented on having customers as their major external partners. These customers initiated and dictated the NPD project in most cases (a detailed discussion is presented in Chapter 6). A customer-oriented external collaboration is in line with other international market trends found in

Europe and USA (Sadler, 2005). Moreover customer- and ingredient supplier-dominated collaborations have been reported to generate incremental innovations (Nieto & Santamaria, 2007). A customer-focused firm is bound to have a market-oriented organization and the same is also applicable to ingredient supplier-focused firms (T. John et al., 2007). These findings suggest a market-orientated NPD approach is being carried out in the food manufacturing industry of New Zealand. The purpose of innovation activities under these cooperative arrangements is focused on getting access to R&D facilities and to new suppliers, followed by cost sharing. Moreover, a lower response rate to risk sharing may explain the nature of innovation activities i.e. low risk incremental changes being pursued in these collaborations.

These type of collaborations, as described in the preceding paragraph, are frequently thought of as being effective in improving existing products i.e. line extensions and "me too" products, and hence effective in meeting and responding to current customer needs, but can be expected to fall short of forecasting or anticipating emerging needs of future markets (Bennett & Cooper, 1981; Gehlhar et al., 2009; Lukas & Ferrell, 2000). Hence it cannot be considered as true collaborative NPD, rather it is more akin to contract manufacturing where customers' needs are met.

This approach towards collaborations may be rendered by two factors i.e. company size and access to market. Company size may not matter much if local markets are big enough to ensure easy access to mass consumers through local retailers. However, New Zealand is a small domestic market with few big retailers (customers), presenting a difficult situation for food manufacturers to avoid dictation from customers in their NPD endeavour. This situation may change if access to foreign markets is made easier for these food companies.

As discussed in detail in chapter 2, collaborative NPD has been reported to have higher degrees of novelty in product innovations as the innovating firm tries to look for extended resources and skills which may not be present in one single firm. This approach can bring novelty to product innovations. Functional food product development has been reported to be a collaborative exercise accessing a wider sources of information and skills required in NPD (Mishra & Shah, 2009; Tether, 2002).

Approach towards commercialization in NPD

It was found that overall conventional techniques (confidentiality agreements and trademarks) of protecting innovations are applied. This approach towards commercialization

again is reflective of incremental innovative activity. In this approach speed to market is considered the most powerful tool to exploit market opportunities. It enables a relatively quick return in investment, but for a limited time. Revenue soon tails off as new competitors come into the market with an improved product. This cycle keeps repeating and products come and go with ever decreasing life cycles (Hardy, 2010). It was also observed that the nature of food products such as recipe-based food products do not allow much room for IP rights as these can be changed easily. This indicates that if the product is unique and has a novel ingredient then copyrights may be applicable. Patents require a lengthy process and higher cost for securing IP rights which is difficult to be adopted by the food manufacturing industry functioning under current traditional NPD processes.

It was observed that food companies do not do much of their own marketing for their new products, rather key accounts (supermarket) are the main marketing activity, which is accomplished by the activities of key accounts managers. The main goal of marketing thus revolves around getting the product listed by supermarkets. Access to consumers has been reported as one of the main challenges in the rapidly changing Fast Moving Consumer Goods business (FMCG). Access to consumers is controlled to a great extent by supermarkets (Menrad, 2003), which have dictated selling price through their significant buying power, squeezing the profit margins of food businesses (Beverland et al., 2006; Menrad, 2003; Playne et al., 2003). Therefore to break out from the profit-margin cycle, new product offerings should be unique and differentiated. It will give some much needed power to the manufacturers to negotiate profit margins with customers. Hence differentiated functional food products may provide a panacea from the malaise of profit margin negotiations which non–differentiated food products cannot escape (Mark-Herbert, 2003).

4.9. Conclusion

The data analysis showed that overall a market-oriented NPD approach seems to dominate the innovation process in the food manufacturing sector in New Zealand. Major aims and mode of product development indicated a closed NPD approach, where increasing the range of goods and service to increase the responsiveness to customers and consumers persisted. Similarly, cooperative networks seem to reside in a narrow spectrum of ingredient suppliers and customers. These kinds of approaches are an indication of a traditional NPD approach. This fact was further reinforced in approaches towards commercialization of NPD which was reflective of a lower preference for protecting intellectual property rights.

5. Functional food development motivations and challenges

5.1 Introduction

This chapter now shifts focus from characterizing the innovation processes of food companies in New Zealand to investigating specifically how functional food product development (FFPD) is carried out in food businesses who report such practices. It also aims at investigating and explaining the differences and commonalities between food companies who may be involved in some sort of functional food development in comparison to those who may not be doing functional food development. The basic hypothesis is that there is a difference in the innovation processes of companies who are involved in functional foods development and compared to those that are not. Certain hypotheses for investigating these differences and commonalities are:

H1: There is a difference in NPD orientation between companies manufacturing functional foods and other food companies.

H2: There is a difference in external collaborative links between companies manufacturing functional foods and other food companies.

H3: there is a difference in commercialization techniques between companies manufacturing functional foods and other food companies.

These hypotheses have been described fully in Chapter 3 and will be tested in this chapter. Findings have been discussed in light of the Resource Based View (RBV) of management theory which supports the creation of unique resources for attaining sustained competitive advantage. In this thesis functional food product development is proposed as an opportunity for developing those unique resources.

The chapter is structured with firstly an investigation into the interests of food companies in various food categories for functional food development and target functions of human physiology (as presented from the data). Then major differences and commonalties of the innovation activities of food companies that are involved in functional foods and those that are not will be presented. To the author's knowledge this is a new approach to investigating functional food new product development with no similar studies being reported in the literature. This investigation will provide a deeper insight into this matter and thus will help in designing better innovation practices for successful functional food new product development programs.

5.2 Methodology

The data was collected as part of the quantitative survey run in New Zealand as described in chapter 3 under section 3.8. A comparative analysis was conducted to see the differences and commonalities in the innovation processes of food companies based upon their involvement in functional food development in New Zealand. Collected data was split into two groups i.e., Group 1: companies claiming to be involved in functional food development; Group 2: food companies that are not involved in functional food development. A full description of the methods and analysis for this comparative analysis is presented in Chapter 3; section 3.10.3.

5.3 Results

5.3.1 Descriptive statistics

5.3.1.1 Major food categories for FFNPD

Dairy products dominate functional food NPD followed by herbs, fruits and then vegetables (Figure 5. 1).

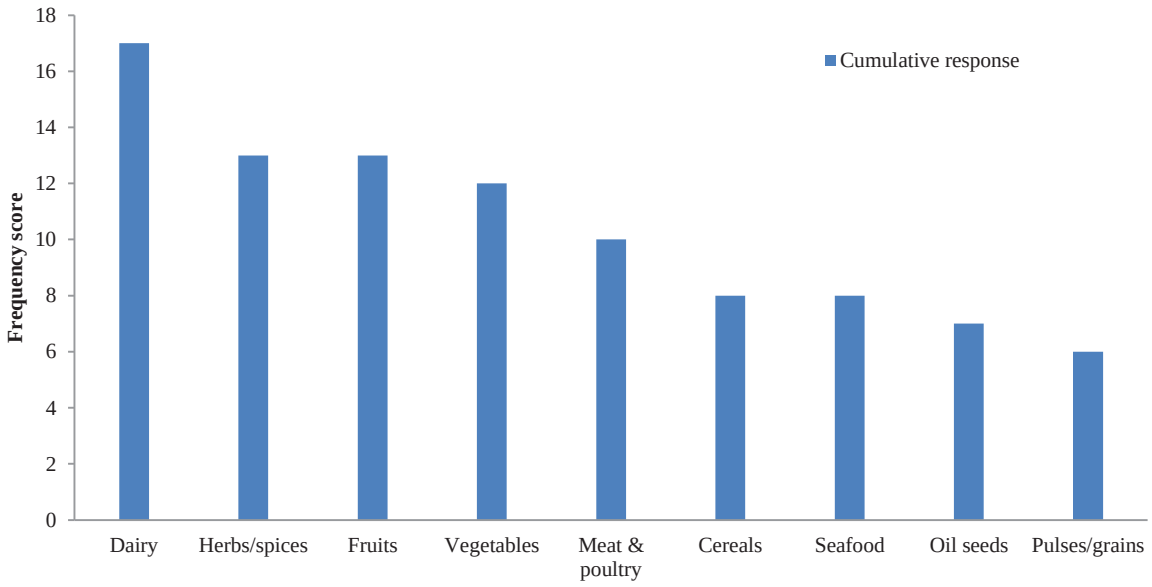


Figure 5. 1. Future FFNPD interest of food manufacturing companies in various food categories

PepsiCo, DANONE in collaboration with Chiquita, and Nestle have reported a shift in their Health and Wellness NPD portfolio towards developing fruit and vegetables (Mellentin,

2013). Herbs are also historically thought of as good source of bioactives imparting various beneficial health effects e.g. antibacterial, anti-carcinogenic etc.

5.3.1.2 Target functions/benefits

The leading target function of human physiology improvement was found to be general well-being followed by heart health and then the immune system (Figure 5. 2). General well-being is a common focus of food manufacturers in global markets as it broadens the scope of the target market (Hardy, 2010) whilst avoiding legislation difficulties that specified target functions are likely to present.

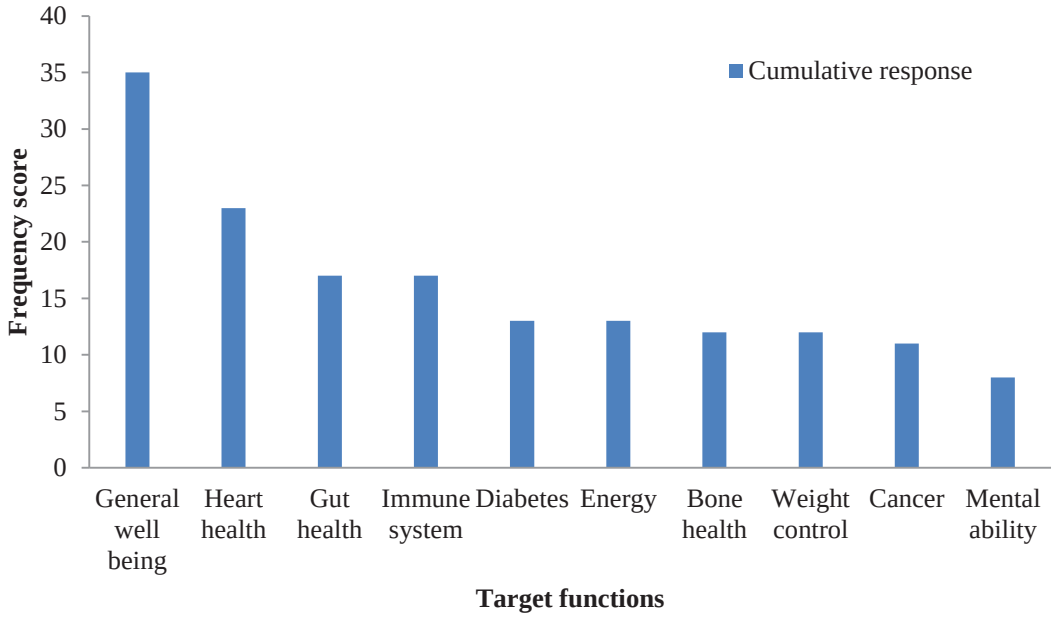


Figure 5. 2. Future NPD interest of food companies in target function of human physiology

5.3.1.3 Drivers of functional food product development (FFPD)

Main drivers of FFPD were attaining competitive edge (46% response) followed by market opportunity (35.7% response) and building trust with consumers (34.6% response) (Table 5. 1) .

Table 5. 1. Frequency score of ranking order for “Major drivers of FFPD”

Ranking Scale	**Major drivers of FFPD**				
	Market Opportunity	Attaining Competitive Edge	High Profit Margin	International Market Trends	Buildi With C
Most important	15	15	8	4	
Very Important	17	17	6	4	
Moderately important	6	6	7	7	
Less important	3	3	6	6	
Lesser important	1	1	5	3	
Least important	-	-	-	4	
Total	42	42	32	28	

Social responsibility was considered to be the least important driver for developing functional foods (26% response) (Table 5.1). These findings suggest that food manufacturers perceive these food products as a way of attaining some form of differentiation in terms of competitor products which is in line with the findings of literature (Mark-Herbert, 2004), (Matthyssens et al., 2008) and (Heasman & Mellentin, 2001).

5.3.1.4 Barriers to functional foods product development (FFPD)

Cost of innovation (50% of total responses) followed by regulatory structure (23.1% of total responses) are considered the major barriers to FFPD (Table 5. 2). These findings are in line with earlier studies that reported FFPD to be associated with higher cost and risk (Broring et al., 2006; Mark-Herbert, 2002, 2003). Regulatory structure has been argued as one of the main challenges facing food companies carrying out FFPD (B. B. Butchko & Petersen, 2006; EU, 2000; Frewer et al., 2003). Recently the New Zealand government has introduced new regulations for food manufacturers wanting to make health claims on packaging (FSANZ, 2013). The impact that these new regulations will have on FFPD in New Zealand is yet to be seen.

Technical skills (17.6% of total valid response) followed closely by lack of medical skills (16% of total response) were also considered barriers to FFPD (Table 5. 2). It has already been reported in Chapter 4 that it is hard to find a company which has all the technical skills to indulge in innovative functional food product development ventures (Bougrain & Haudeville, 2002; Laforet, 2008).

Protection of innovation and health efficacy were ranked as the least important barriers to FFPD respectively (Table 5. 2). As discussed in Chapter 4 the food industry relies upon first entry to market as a way of generating return on IP. This approach focuses on strong marketing campaigns rather than creating barriers to imitations by competitors. Hence developing comprehensive IP strategies are not common in food manufacturing companies. This could be the reason why it is not considered as a major barrier to FFPD, as the benefits of such a strategy are not realised as radical innovation is not part of NPD thinking.

Table 5. 2. Frequency score of ranking order for “Major barriers to FFPD”

Ranking Scale	**Major barriers to FFPD**				
	Cost of Innovation	Regulatory Structure	Health Efficacy	Lack of Technical Skills	Lack
Most important	19	6	3	6	
Very Important	10	10	6	8	
Moderately important	8	2	3	9	
Less important	1	5	2	4	
Lesser important	-	3	1	1	
Least important	-	-	6	5	
Total	38	26	21	33	

5.3.1.5 Desired characteristics of a successful bioactive ingredient

"Health Efficacy" with 34.9% of total response to this factor was considered the most desired characteristic of a successful bioactive ingredient (Table 5. 3). The second most important factors was found to be "Legal status" with 37.8% response followed by "Product Trends in the Market" (26.7% of total response) (Table 5. 3). "Purchasing cost" (22.5% response), "Technical Ease of Use" (17.5% response) and Ensured Supply from the Suppliers (6.3% response) were of comparatively lower importance (Table 5. 3).

Table 5. 3. Frequency score of ranking order for “Desired characteristics of a new bioactive

Ranking Scale	**Desired characteristics of a new bioactive food ingredi**				
	Efficacy	Purchasing cost	Product Trends in the market	Legal Status	Techni
Most important	15	9	12	14	
Very Important	8	13	10	5	
Moderately important	10	3	8	6	
Less important	5	8	5	8	
Lesser important	3	3	7	3	
Least important	2	4	3	1	
Total	43	40	45	37	

5.3.2 Comparative analysis of innovation process

A comparative analysis was conducted to see the differences and commonalities in the innovation processes of food companies based upon their involvement in functional food development in New Zealand. The collected data was split into two groups Group 1: companies claiming to be involved in functional food development; Group 2: food companies that are not involved in functional foods development.

5.3.2.1 Comparative demographics of food companies and participants

The NPD-related demographics of the two groups are presented in Table 5. 4. The employee size distribution of each of these two groups was more or less similar except for employee size >100 where a higher number of food companies were from Group 1 (companies manufacturing functional foods). Further, a comparison of the type of ownership between these two groups revealed that a comparatively higher number of multinational companies fall into Group 1 (7 compared to 2 in Group 2). In Group 2, there were 4 limited liability companies and 2 were public companies. Hence it can be said from the data that multinational companies (larger companies) are more likely to engage in functional food development activities in New Zealand. This may be attributed to their size and resources that can accommodate these innovative ventures in their NPD program.

Table 5. 4. Salient features of sampled companies and respective participants

Characteristics	Group 1 (companies manufacturing functional foods) *n=33*	Group 2 (other food companies) *n=34*	Overall *n=67*
1. Employee size distribution			
1-10	9	12	21
11-20	8	9	17
21-50	4	4	8
51-100	3	4	7
100>	9	5	14
2. NPD statistics	**Number of new products**		
Average number of new products launched by each company (2008-11)	25	20	23
Average number of NPD projects completed by each respondent	18	19	16
Average FF experience (years) of each respondent	11 years	7 years	9 years
3. Type of Ownership	**Number of Food companies**		
National Companies	27	31	58
Multinational Companies	7	2	9

Average NPD and functional foods (FF) development experience of participants in both categories was similar (Table 5. 4). It showed that those companies who are not involved in functional food product development also have NPD personnel with previous experience in some sort of functional food product development activity.

5.3.3 Orientation towards NPD/innovations

5.3.3.1 Major aims of NPD

There was a significant difference ($P<0.05$) in major aims of NPD between companies manufacturing functional foods and other food companies (Table 5. 5). It was observed that other food companies focus more on increasing their range of goods and services while

companies manufacturing functional foods prefer to focus more on exploiting new market opportunities. These findings are in line with other studies reporting that functional food product development creates opportunities for food business to exploit new market opportunities (Broring et al., 2006; Mark-Herbert, 2004; Matthyssens et al., 2008). Further a significantly ($P<0.05$) higher portion of NPD launch was dedicated to reduce cost by companies manufacturing functional foods.

5.3.3.2 Mode of NPD activities

There was a significant ($P<0.05$) difference between Group 1 and Group 2 in their mode of NPD (Table 5. 5). Group 1 companies were reported to have a higher level of collaborative NPD than those in Group 2. Functional food product development has been proposed to be more effective if conducted in close collaboration with external research partners (Broring et al., 2006; Mark-Herbert, 2004). These findings suggest that the difference in NPD focus of food companies may affect the way NPD is done. Creating new market opportunities through NPD requires identification of critical technologies to create unique value in product innovations, which may require collaborative development activities with specialised research groups (such as research institutes, universities and complementary industries such as pharmaceuticals) (Aarikka-Stenroos & Sandberg, 2012; Emden et al., 2006).

5.3.3.3 NPD/innovation characteristics

A lack of significant difference ($P>0.05$) in NPD/innovation characteristics (Table 5. 5) indicates that there is no single orientation favoured for NPD of functional foods. These findings are in line with those of Gehlhar et al. (2009). They found that food companies are generally not clear on their NPD orientation; rather a combination of various NPD orientations seems to govern the NPD process and innovation policies. They also reported that there are a number of factors that could influence NPD orientation, such as company ownership, size and target market.

Table 5. 5. Firm orientation towards innovation/NPD

Measures of the construct	Group 1 (companies manufacturing functional foods) *n=33*	Group 2 (other food companies) *n=34*	Chi Square Test
1. Major aims of NPD	***(No of NPD 2008-11)***	***(No of NPD 2008-11)***	
To increase range of goods and services	243 (27%)	295 (34%)	51.9, P<0.001*
To increase market share	254 (28%)	176 (21%)	13.16, P=0.0002*
To exploit new market opportunities	150 (17%)	218 (25%)	19.86, P<0.001*
To increase responsiveness to consumers	146 (16%)	132 (15%)	0.16, P=0.068
To reduce cost	91 (10%)	18 (2%)	47.046, P<0.001*
To increase knowledge sharing with consumers	16 (2%)	18 (2%)	0.1, P=0.75
Total	**900**	**857**	
2. Mode of NPD activities	***(No of NPD 2008-11)***	***(No of NPD 2008-11)***	
Independent NPD	688 (82%)	597 (86%)	60.65, P<0.001*
Collaborative NPD	163 (17%)	70 (10%)	23.66, P<0.001*
Contract out NPD	7 (1%)	25 (4%)	14.82, P<0.001*
Total	**858**	**692**	
3. NPD/Innovation characteristics	***Frequency scores***		
Market Oriented	28 (31%)	31 (41%)	1.6, P=0.19
Product Oriented	26 (29%)	24 (32%)	0.1, P=0.70
Process Oriented	21 (23%)	12 (16%)	1.4, P=0.22
Organisational Oriented	15 (17%)	9 (12%)	0.7, P=0.37
Total	**90**	**76**	

*Significant at P<0.01

A business with a clear understanding of its NPD orientation will be able to clearly identify and prioritise its core competencies, allowing more effective identification of what skills are available in-house and what supplementary skills need to be out-sourced (Barbara & Francesco, 2012).

5.3.4 Cooperative network

Functional food product development is considered to be comparatively more efficient and successful when conducted in collaboration with relevant external partners (Broring et al., 2006; Mark-Herbert, 2003). Therefore external cooperative links for NPD in the food industry were explored.

5.3.4.1 Types of external partners

Customers and ingredient suppliers seem to be prevalent in the food industry as external collaborating partners. However, there was a significant ($P<0.05$) difference between Group 1 and Group 2 in their external collaborations with customers. Group 2 food companies have a higher portion of collaborations with customers (Table 5. 6). It has been argued that the customer-dominated NPD collaboration often results in incremental innovations, "me too" products (Bryan & Ferrell, 2000). In contrast, Group 1 companies have a broader range of external collaborations with universities, research institutes and beside competitors, customers and ingredient suppliers (Table 5. 6). These findings support *H2*; *there is a difference in selecting collaborating partners*. These findings are also in line with reported literature and practices for successful novel product innovations (Beckeman & Skjoldebrand, 2007; Ritter & Gemunden, 2003; Sarkar & Costa, 2008; Siedlok et al., 2010) where diverse external collaborations are favoured in radical product innovations.

Table 5. 6. Comparative collaborative NPD external partners for various related activities

Measures of the construct	Group 1 (companies manufacturing functional foods) *n=34*	Group 2 (other food companies) *n=33*	Chi Square Test
1. External collaborative NPD links			
Yes	19 (56%)	11 (33%)	NA
No	15 (44%)	22 (67%)	NA
2. Major external collaborating partners			
Customers	11 (26%)	10 (59%)	25.91, P=0.015*
Ingredient Suppliers	13 (30%)	5 (29%)	0.004, P=0.95
Competitors	7 (16%)	2 (12%)	0.19, P=0.65
Universities or polytechnics	7 (16%)	0	N/A
Crown Research Institute	5 (12%)	0	N/A
Total	**43**	**17**	

*significant at P<0.05, N/A: not applicable

5.3.5 Commercialization techniques

The commercialization of new products plays a critical role in the success of a NPD program for a manufacturing company (Cooper, 2003). There are three aspects of commercialization which are likely to be of critical importance: protection of innovation and NPD (Hardy, 2010); commercialization tools; and, perceived barriers to commercialization (Menrad, 2003; Siro et al., 2008). These three aspects were investigated.

5.3.5.1 Protection of innovation/NPD

There was no difference between Group 1 and Group 2 for the various tools of protection used in NPD launch, except for IP contracts which were found to be significantly different (P<0.05) (Table 5. 7). This partially supports *H3: there is a difference in commercialization techniques.* It can be inferred here that type of innovation activity, such as functional food product development, may influence the intellectual property rights policy of a company i.e. a more formalized IP policy may be adopted. This needs to be investigated further.

Overall, it was observed that trademarks are considered to be the most important tool for protecting innovations and NPD, followed by confidentiality agreements and IP contracts.

5.3.5.2 Commercialization tools for NPD

There was no significant difference ($P>0.05$) between Group 1 and Group 2 in their commercialization tools for NPD (Table 5. 7). These findings do not support *H3; there is a difference in commercialization techniques.* Overall the most important marketing tools were stated to be the firm's own marketing staff, followed by brand ownership and trade shows.

5.3.5.3 Barriers to commercialization of NPD

Commercialization of novel food products can be very challenging due to the conservative attitude of most consumers towards food choice and limited access to markets (Bech-Larsen et al., 1999; Moskowitz & Hartmann, 2008). Therefore, the perception of potential barriers during commercialization of NPD was investigated with special reference to functional foods.

There was a significant difference ($P<0.05$) between Group 1 and Group 2 in creating health awareness and consumer confidence among the various commercialization barriers proposed in this study (Table 5. 7). These findings partially support *H3: there is a difference in commercialization techniques* as different perceptions of barriers may lead to different commercialisation techniques.

Access to market, legislation and level of government support were considered equally important by both groups (Table 5. 7).

Table 5. 7. Comparative commercialization techniques of food companies

Measures of the construct	Group 1 (companies manufacturing functional foods) *n=33*	Group 2 (other food companies) *n=34*	Chi Square Test
1. Protection of innovation tools	*Frequency Scores*		
Trade marks	26 (31%)	19 (31%)	0.00, P=0.99
Confidentiality agreements	19 (23%)	17 (27%)	0.39, P=0.53
IP contracts	19 (23%)	11 (18%)	0.57, P=0.04*
Patents	11 (13%)	9 (24%)	0.04, P=0.82
Copyrights	8 (10%)	6 (16%)	0.00, P=0.99
Total	**83**	**62**	
2. Commercialization tools for NPD			
Own marketing staff	27 (27%)	27 (26%)	0.002, P=0.96
Brand ownership	18 (18%)	19 (18%)	-0.23, P=0.81
Electronic media	14(14%)	14 (13%)	0.01, P=0.91
Contract marketing staff	9 (9%)	13 (12%)	0.64, P=0.42
Exhibitions	13 (13%)	12 (11%)	0.10, P=0.77
Trade shows	19 (19%)	20 (19%)	-0.23, P=0.82
Total	**100**	**105**	
3. Barriers to commercialization of NPD			
Access to market	18 (19%)	15 (24%)	0.74, P=0.45
Health awareness	20 (21%)	10 (16%)	2.74, P=0.006*
Consumer confidence	20 (21%)	12 (19%)	2.07, P=0.039*
Legislation	19 (20%)	13 (21%)	1.53, P=0.12
Level of Govt. support	12 (13%)	8 (13%)	1.29, P=0.19
Cost of launch	5 (5%)	5 (8%)	0.00, P=1.00
Total	**94**	**63**	

*significant at P<0.05

5.4 Discussion

5.4.1 Functional foods development trends and challenges

The interest in dairy products for functional foods development is logical as the New Zealand food industry is dominated by the dairy industry. In addition to this factor, global prices and volume of functional dairy products are increasing on a year by year basis (Euromonitor, 2009a, 2010c) as these products serve as a good vehicle for incorporating bioactive ingredients. However, the new emerging functional food categories are fruits and vegetables. These foods are perceived to be more natural and healthy. These findings are in line with a functional food survey conducted in Canada (Canada, 2003). The target physiological function of these foods was general well-being. This approach has multiple benefits. It broadens the market appeal and avoids the legal complex issues of making a specific physiological health claim (Sadler, 2005). However the drawback of this approach may be the reduction in credibility of these products in terms of their differentiation. In contrast to this approach, specific health-oriented food products may allow targeting of a certain segment of the market that has yet not been targeted by any other food company (B. B. Butchko & Petersen, 2006; EU, 2000). The other important target health functions were the immune system, heart health (Euromonitor, 2010a) and bone health (Sadler, 2005). These findings are again in line with global health and well-being trends (Euromonitor, 2010d). Further, heart health, which has been a major concern in developed countries such as the USA, Germany, UK (Sadler, 2005), is a potentially lucrative market for manufacturers in New Zealand.

Food manufacturers would like to have a new bioactive ingredient in their product if it has proven legal status, proven health efficacy and it matches with recent product trends in the market. These findings suggest that food companies are following the pursuit of purchasing bioactive ingredients from the suppliers and then completing the NPD project through traditional NPD route. This can also explain why food companies have shown greater interest in developing external collaborations with ingredient suppliers. It can be thus expounded that major part of R&D work for developing these functional food products is done by these ingredient suppliers and food companies do not indulge in extensive and expensive R&D work (Matthyssens et al., 2006). Rather a traditional NPD characterised by limited R&D and resources is pursued for all product innovations.

With the increasing sophistication in regulating these food products, regulatory authorities are working actively in providing comprehensive framework and guidelines for regulating health

claims on these food products (Euromonitor, 2010d; Hardy, 2010). These developments are critical in boosting consumer confidence in buying these products (B. B. Butchko & Petersen, 2006). Therefore legal status and efficacy of a bioactive ingredient are interrelated but critically important for claiming the health claim on these products (FSANZ, 2013).

5.4.2 Drivers of functional foods development

The results showed that motivational drivers for developing new functional foods are in line with current literature (Euromonitor, 2010d; Hardy, 2010). The most important factor for developing these foods is the desire to attain a competitive edge (Euromonitor, 2010d; Heasman & Mellentin, 2001; Lagorce, 2009; Regmi & Gehlhar, 2005; Sadler, 2005; Siro et al., 2008). This desire to leverage competitive advantage from functional foods supports the theoretical view of this thesis that food companies need to expand beyond current traditional NPD practices to generate inimitable and heterogeneous resources to fully realise the motivational drivers for carrying out this type of NPD (Broring et al., 2006; Heasman & Mellentin, 2001).

5.4.3 Barriers to functional foods development

When companies were asked what were the barriers to FFPD, responses were that resources fell short (cost of innovation, lack of medical and technical skills) of what was required for successful FFPD. Chapter 4 reported that a closed NPD model dominates the food industry in New Zealand. This type of NPD model is bound to face the challenges of managing cost of innovation, regulatory complications and lack of technical skills. These challenges are related to the breadth and depth of resources a company has. The general size of food businesses and the closed NPD model is more prone to struggle in managing these challenges of radical functional food innovations. Cost and regulatory structure have already been reported to be the main barriers to functional food development in various studies and reports (Broring, 2008; EU, 2000; FDA, 1997; Mark-Herbert, 2003, 2004; Matthyssens et al., 2008). It has been proposed that these challenges can be dealt with by enhanced collaborations with external partners/stakeholders such as pharmaceutical companies, government agencies, research institutes etc. A close collaboration with government bodies that are responsible for monitoring and regulating these novel foods could be an effective step towards successful development of functional food products. It has already proved effective in Japan (Menrad, 2003) and Canada (Canada, 2003; Ray, 2004) where some progress has been made.

5.4.4 Comparative analysis of the innovation process

Those food manufacturing companies that claim to have involvement in some sort of functional food development (Group 1) do show comparatively more focus on exploiting new market opportunities and encouraging collaborative NPD activities in their innovation model. These Group 1 food companies on the whole also indicate a willingness to collaborate with research-oriented external partners such as research institutes and universities, which is in stark comparison with Group 2 companies that did not indicate any such collaboration. A collaborative approach could therefore be considered a positive step towards generating a true value creation model of food manufacturing where a network of research-oriented collaborations with multiple stakeholders is exploited to predict and accomplish future-oriented needs and trends of consumers by incorporating new discoveries and technological developments in human nutrition and food science (Broring, 2008; Matthyssens et al., 2006). In similar antecedents, leading multinational food manufacturing companies around the globe have recently started to bring about changes in their NPD/innovation model, moving from an internally closed independent innovation business model to more of an open innovation model, such as General Mills open innovation, Kraft, Cadbury and P&G connect and develop models (Hardy, 2010; Huston & Sakkab, 2006), all resulting in higher NPD success. Further recent literature suggests that radical food product innovations such as bioactive functional foods - requiring broader resources and skills (Nieto & Santamaria, 2007) - are achievable through collaborative product development activities to effectively incorporate new technological and marketing knowledge (Broring et al., 2006; Mark-Herbert, 2004). Therefore research-oriented collaborations would be better suited to functional food development, as these collaborations are perceived to focus on getting access to new technologies and discoveries through collaborative R&D (Tether, 2002). Hence the role of research institutes and universities should increasingly gain more attention from the functional food industry as being an essential factor in building innovation capabilities (Diez & Kiese, 2009; Ritter & Gemunden, 2003; Taran, 2007). Though Group 1 companies have shown some trend towards developing research-oriented collaborations (research institutes and universities) (Table 5. 6), the intent and content of these research-oriented collaborations still needs to be explored in depth to assess the effectiveness of these collaborations in building the innovation capability of the food manufacturing industry. These were thus explored in qualitative interviews and the findings are presented in the next chapter.

Companies manufacturing functional foods (Group 1) considered IP contracts to be vital for protection of innovations. Apart from this, there was no major difference between groups in commercialization techniques of food companies. This may be attributed to two interrelated factors: first, the food industry size distribution viz. mainly comprising SMEs that lack resources and skills to develop a sophisticated professional approach to commercialization; and second, there may be a greater emphasis on "me too" products not requiring much protection of innovation. Further an overall higher importance of trademarks and confidentiality agreements was observed in this study. These factors have generally been associated with incremental innovations while patents and IP contracts have been reported as more common in securing exclusivity rights for novel food product innovations (Lehenkari, 2003). Even if the route of functional food product development is incorporation of a bioactive ingredient and the R&D is pushed down the stream, there is a need for more sophisticated commercialization routes to ensure competitive advantage e.g., exclusivity deals, do-branding. This would require collaboration at the commercialization end even if collaboration is not carried out at the product development part of the NPD process.

It is worth mentioning that commercialization techniques of food companies, being one of the critical factors of NPD success (Cooper, 1992, 2003), still need to evolve in order to gain greater access to consumers and securing IP rights (Broring, 2008; Broring et al., 2006). The challenges of securing higher revenues and profit margins can be done by applying a well-coordinated collaborative commercialization approach; a possible extension of NPD collaboration into commercialization network (Aarikka-Stenroos & Sandberg, 2012). Brand ownership and intellectual property rights have been offered as serious challenges in collaborative NPD and thus commercialization (Mark-Herbert, 2003).An efficient mechanism of collaborative commercialization may reduce the cost and complexity of collaboration (Menrad, 2003; Ray, 2004). Therefore those companies that want to take the lead in this segment of the food market may opt to apply comprehensive intellectual property rights.

As expected, Group 1 companies manufacturing functional foods differ significantly ($P<0.05$) from other food companies in their response to perception of health awareness and consumer confidence among various barriers to commercialization offered in this study. Otherwise perception of various commercialization challenges was similar between companies manufacturing functional foods and other food companies. This would again mean a similar NPD program and approach is being adopted by most food companies irrespective of type of innovation activities they pursue. Overall access to market being one

of the main challenges reflects the shortage of resources by most of these food companies in Group 1 and 2. This again indicates a need for a support system from various stakeholders of value-added food product innovations in New Zealand. The level of government support and cost of launch being equally important for both Group 1 and Group 2 may change with the introduction of new food standards related to nutrition, health and related claims (Standard 1.2.7) in New Zealand (FSANZ, 2013).

In this study, a higher proportion of larger companies (>100 employee size) were found in Group 1 "companies manufacturing functional foods" as compared to Group 2. Apart from this, employee size distribution of companies in both groups was similar. This means that functional foods are being developed by both large and small businesses by incorporating the bioactive ingredient and not really doing in innovative research. However, large scale production may be a daunting task for these SME's who lack resources and access to bigger markets (local and international markets). This fact was confirmed by marking access to market as one of the major barriers to commercialization of new food products by most of the food business. Thus these companies may play a critical role in transforming the New Zealand food manufacturing industry into a value-added processed food industry if facilitated with appropriate support systems to reach mass markets. In connection to this, the New Zealand government has already shown a deep interest by setting the agenda for next decade or so (2025) to double the value of exported food, in part by creating unique value in food product innovations (Government, 2012). This target can be achieved by transforming the food and beverage industry from a traditional food commodity manufacturing enterprise (volume and price mind set) to a value-added processed food industry (Government, 2012). However an initiative lead from entrepreneurs and industry through joint leadership may be required to facilitate these SMEs who do not have enough resources and skills to engage in these food innovation activities (Kevin. et al., 2012). Business to science links are crucial in succeeding effectively in functional (value added) food product innovations (Fritzsch, 2010; Taran, 2007).

Overall analysis of critically important factors of value creation in the food industry showed that all the food manufacturing companies are running their innovation activities on similar strategies. Hence from RBV, it can be argued that any one company is unlikely to obtain sustained competitive advantage under these circumstances and therefore the opportunities that the functional food business may present are not being fully realised.

5.5 Conclusion

These findings suggest that, among the food categories, dairy products, fruits and vegetables are going to be the main food targets for functional food development in New Zealand. This was quite obvious as the agri-food sector abundantly relies on dairy and fruit produce in generating revenues in domestic as well as international trade. The target physiological functions of these products were reported to be general well-being, heart health and immune system improvement. A focus towards general well-being is a common trend in global market as it broadens the scope of these innovative food products and also helps in making health claims on these products.

Attaining competitive edge and creating market opportunity are major drivers for functional food development. This is quite a rational reflection of food manufacturing challenges in domestic market as well as in the international market, where most of the manufacturers fell short of attaining and maintaining competitive edge due to fierce competition in a rapidly developing food market around the globe. New food businesses, being small in size and distant from other national markets, find it hard to invest in costly and risky innovations such as functional food development. Government may have to work in close collaboration with manufacturers of functional foods to evolve a regulatory framework that is compatible with domestic and international market regulations. The regulatory structure relevant to health-oriented food products has introduced new standards related to Nutrient, health and related claims; the impact of these new regulations are of yet not realised.

The findings presented here suggest that food manufacturers are aware of the fact that the legal status of an ingredient is critical and have also understood the importance of proven health efficacy of a bioactive food ingredient in functional foods.

Further the comparative analysis showed that food manufacturing companies are operating their NPD activities on similar lines irrespective of their involvement in functional foods development or not. There was a difference only in developing collaborative links with external partners between these two groups of food companies. The latter is a positive step toward developing an external resource base, which is essential in developing functional foods. This attitude should be encouraged in future innovation polices as being critical to value-added food product innovations in New Zealand. Commercialization strategies may also change in future if the collaboration activities are enhanced in product development.

Development of functional food products through incorporation of a bioactive ingredient purchased from a supplier may lead to incremental innovations. The absence of R&D activities to develop the functional food products and traditional approach towards commercialization may not prove effective in attaining competitive edge. Therefore commercialization needs to be done through more sophisticated means to secure exclusivity rights and revenues.

Food companies, being unable to operate different kinds of innovations through differentiated resources and approaches, have been led to have similar perceptions towards various challenges to functional food development. Similarly preference for various characteristics of a new bioactive ingredient was reflective of their perception towards various challenges of FFPD.

Overall it can be concluded that the type of innovation activity has not resulted in any effect on approach to innovation and challenges to innovation activities of food companies.

6. Qualitative exploration of NPD/innovation features

6.1. Introduction

This chapter is aimed at exploring the main findings from the qualitative survey run in New Zealand. Following the mixed method approach (described in chapter 3) 11 qualitative interviews with NPD experts were carried out. The main findings from the quantitative study revealed that a traditional, closed market oriented NPD approach still dominates the New Zealand food industry. Where external links did exist, they were mainly dominated by customers and ingredient suppliers. Similarly, commercialization was also driven through traditional marketing practices. There were, however, some encouraging results where food manufacturing companies, reporting that they were involved in functional food activity, seemed to have more diverse external collaborations. Therefore it was planned to gather a detailed description of these main findings (NPD process, nature of cooperative networks and major commercialization techniques) from the expert opinions of NPD personnel by a one-to-one interview approach.

Methodology

Eleven one-to-one qualitative interviews were conducted with NPD experts using an open ended question format (a detailed description of the methodology is presented in Chapter 3 under section 3.11).

6.2. Results

6.2.1. Salient features of participants and companies

The participants ranged from PD managers to company chief executive officer, depending upon the organisational size and structure. The salient features of the participants are presented in Table 6. 1. It was observed that a designated named person had responsibility for NPD in companies having a size of more than 100 employees. In smaller companies the Owner/CEO or General Manager having an age of >50 seemed to take responsibility for NPD.

Table 6. 1. Salient features participants and companies

Serial No.	Job Title	No of Employees	Experience in FFD (Years)	No of NPDP	Age group (Years)
1	NPD manager	500	0	2	40-50
2	Research and Development Manager (RDM)	350	2	11	30-39
3	Product Development Manager (PDM)	500	22	100	40-50
4	PDM	13	20	20	30-39
5	Operation Manager (OM)	6	2	1	>50
6	Managing Director (MD)	15	0	20	>50
7	GM	20	12	10	>50
8	CEO	50	7	6	>50
9	GM	26	9	4	>50
10	Director (D)	18	0	3	>50
11	CEO	7	0	15	>50

6.3. Main themes of qualitative data

The main themes of the qualitative research are presented in Table 6. 2.

.

Table 6. 2. Summary of main themes/codes

Research topic	Main themes/codes
NPD process	-Informal process, -informal/casual staff, -computer aided programs and -customer driven
Collaboration network for NPD	-Major partner-customers & suppliers, -need driven approach, -two way approach, -personal contacts, -customer oriented
Commercialization techniques	-Being first to market, -power of brand, -industrial secrets, -key accounts manager, -getting through to the customer
Challenges to functional foods development	-Regulations, -Technical complexity, -lack of resources
Drivers of functional foods development	-customers/suppliers, -New Zealand reputation, -Overseas market trends,

A stepwise discussion of these main themes with subthemes is presented as below;

6.3.1. Themes related to new product development process (NPD)

The main themes extracted from the transcripts were informal NPD process, informal NPD staff, computer aided and a customer-driven process (Figure 6. 1).

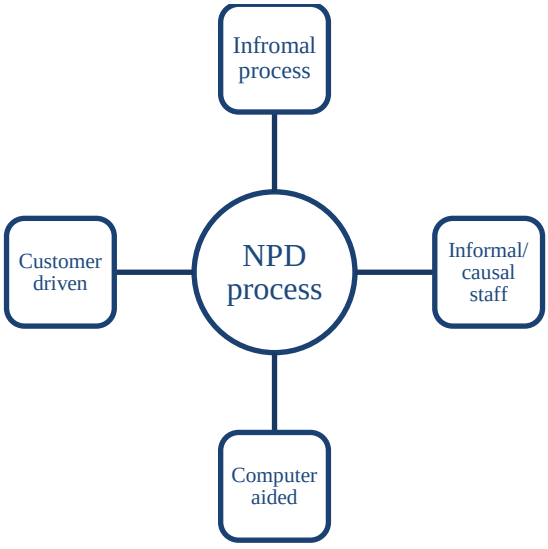


Figure 6. 1. The main themes of NPD process description

6.3.1.1. Informal process

New product development activities seem to be running through informally generated groups defined by informal processes.

"Typically informal, a very bold sort of six key people from our organization that met on a weekly basis, headed by myself. We have quite a formal procedure on the stages and areas that we have to scope out first. Then we go through the concept stage, the feasibility gate, market: so that's a consultation with the market, so do a lot of the homework ourselves, then take it to our key accounts for further discussion, and then of course project review: is it viable? - and let's proceed from there on". (NPD Manager; age group 40-50 years; employee size 500)

Similar sort of expressions were given by one CEO who described the NPD process to be informal but conducted through a simple stage gate process.

"Sales Managers around in England or Australia or New Zealand would request products and we would put them through a very simple stage gate process where we'd look at potential sales; potential GP. We'd look at it as a core business or non-core business; we'd look at our production capability; we'd look at cost of goods. So we'd run it through an informal process". (Company's CEO; age group >50 years; employee size 50)

It was observed that where there is a department specialising in NPD, the process is more structured. This approach was found to focus on understanding consumer attitudes and behaviour rather than developing new products in order to fill customer briefs.

"We use Stage-Gate process and then ideas and concepts come from consumer insights, and that's needs based. So rather than asking consumers, 'Do they want a berry fruit juice?' we're more trying to understand attitudes and behaviours about needs, and then we try and create a product to meet that need". (PD manager; age group 40-50 years; employee size 500)

6.3.1.2. Casual NPD staff

It was observed that each company has its own procedures for new product development. In small companies, the CEO/Owner may be running the NPD process with the help of some casual staff.

"We have a part-time contract chef, and a lot of our resources are contractors, but they're people that we have sort of on-going relationships with. So I've got a person that comes in, a

very experienced technical man, so he does both auditing; he's very experienced in product development as well". (Managing Director; age group >50 years; employee size 15)

It was also found that to reduce labour cost for NPD, certain computer programs are used to assist NPD activities.

"We have a computer system specifically for development if you like; it's called Millie's, for want of a term. That's the name of it. But the reason for that is, in our case we might look at, make it easy" (CEO; age group >50 years; employee size 20)

"We feed the ingredients, and maybe labour, into the computer system, and that'll give us percentages that we can make or break versus what we think we can sell it for, price-wise". (Operation Manager, OM; age group >50 years; employee size 6)

6.3.1.3. Customer oriented NPD

It was found that most of the NPD is driven by the market where customers give the basic input/concept to start a NPD project. These customers are mostly retail giants (supermarkets). *"It's more about customer need; it's more about trying to find that new product that's going to keep customers interested in buying..... So quite often... we've got two projects on the go now but both lines have been initiated from a key account, from a customer".* (NPD Manager; age group 40-50 years; employee size 500)

Customers' inquiries and general market trends together drive the NPD projects.

"I would say that we rely on our present and external trade fairs, customers' inquiries, and general market trends to give us some guidance to where our product development should go". (CEO; age group >50 years; employee size; 50)

It can be concluded that customers occupy the central position in driving NPD projects by their control over mass access to consumers. This reflects, certainly in the cases quoted here, a lack of direct relationship between consumers and product developers in order to understand consumer needs in a more comprehensive manner.

6.3.2. Themes related to external cooperative arrangements for NPD

The main themes are presented in Figure 6. 2.

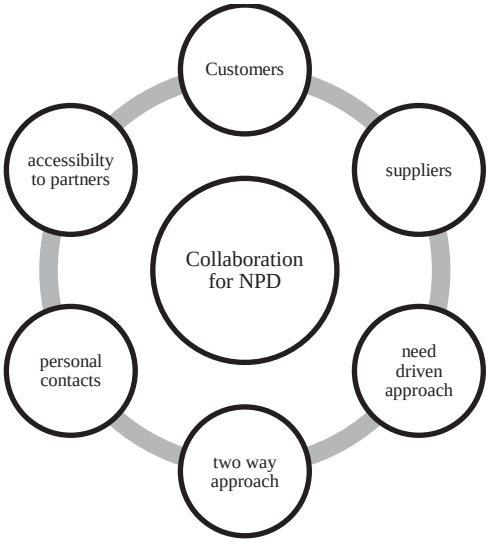


Figure 6. 2. Main themes of collaborations for NPD

6.3.2.1. Major external partners: customers & suppliers

Company structure may also influence the nature of an external collaboration. Small companies, which are mostly private businesses, may face financial issues in terms of developing/funding external collaborations. It was commented by the managing director (age group; >50 years; employee size; 20) of a company as;

"This company is a private company, so our funding structure is such that it's funded essentially by myself and my wife".

It was found that reported collaborations for new product development as a part of the NPD strategy were very few indeed. Food companies mostly run their NPD activities independent of external help. However in a few cases it was reported that customers and suppliers are the main external partners.

"To a certain extent our suppliers are as well are partners because they do provide us some technical assistance along with their ingredients and some part-time base recipes to promote it to our customers. So, yes, to a certain extent suppliers as well but most of the time, our customers". (R&D Manager; age group 30-39 years; employee size; 350)

Customers are the main players in initiating new product projects and thus become the central focus for all external collaborations and inputs into NPD.

"The major partner will be our customer 'cause they are the ones who come to us with their new product ideas. So normally we discuss what kind of product they want, what kind of

segment they want to target, and what kind of health benefits they want in their product". (R&D Manager; age group 30-39 years; employee size; 350)

"Our customers; I suppose they're partners in a way and if they want a product... Like for example, we're doing something for KFC at the moment, and they want a particular type of product, so yeah, we do it."(Operation Manager; age group >50 years; employee size; 6)

6.3.2.2. Approach towards Collaboration

6.3.2.2.1. A need driven approach

Those companies who responded to have some sort of external collaboration were observed to have an informal approach to their collaborations. A needs-driven approach towards external collaborations seems to dominate. This approach can be termed as reactive.

"We'll go where the expertise is. So if we were looking at fruit derivatives and compounds we'd go for Plant & Food, or they come to us - it's a two-way thing. I went to Riddet because they were doing some work on gut health. We've been to Otago for GI testing; we're going to Auckland University for nanotechnology". (PD Manager; age group 40-50 years; employee size; 500)

6.3.2.2.2. Two-way approach

Another approach was found to be the two-way approach where partners may decide to work in collaboration for some particular matter or issue.

"It works both ways. Sometimes our customers come to us with new product idea and sometimes we go out to our customer. We like to be proactive and we do some recipes and keep it in the file". (R&D Manager; age group 30-39 years; employee size; 350)

"It's a two-way thing. Sometimes we will go to the research institutes and say, 'We need to work out this problem,' other times the research institute will come to us and say, 'We can now do this; what does that mean to you?' and we have a discussion and…" (PD manager; age group 40-50 years; employee size; 500)

This approach is more encouraging where both parties feel comfortable enough to share ideas. This kind of collaboration can lead to permanent long term relationships and may increase the trust among collaborating partners, which is essential for knowledge exchange.

6.3.2.3. Universities are for basic research not for PD

Further it was found that companies would prefer to do basic research with external partners such as universities while keeping product development activities within their own control. It was reported that external assistance was generally sought when there was a problem.

"We'll do base research into certain issues or problems that we may be having, either through the new product development system or just our manufacturing in general. Or just in standard, in the course of our scientific work, if there's issues that we need to look at that we might not have the resource in-house, or we might not be able to afford the time here in the company, we get an external provider, like a university, or AgResearch, or someone like that to provide that for us". (PD manager; age group 40-50 years; employee size; 500)

These comments are in line with current literature as universities have been reported to be an important and cost-effective source of basic knowledge (Taran, 2007) in developing innovations.

6.3.2.4. Nature of external collaborations

6.3.2.4.1. Personal contacts

It was observed that external collaborations were based upon personal contacts rather than being structured on an organisational level.

"For example, right now I'm using Massey University, Doctor ----------, to develop Asian drinking yoghurt a bit like Yakult. And we've designed a product like Yakult, but I don't want to launch it just because my lab has designed it, I want to get it critiqued professionally. So I've given it to Massey and they are going to compare it to Yakult and give me some advice on how to improve it; how to make it better than Yakult. I know Doctor -----. Close, credible, capable, friendly, neighbours, they're not far". (CEO; age group >50 years; employee size; 50)

The conclusion can be drawn from these comments that external collaborations are based upon personal contacts and funding resources.

The overall comments about collaborations show that most food companies, especially smaller companies (>50 employees), do not have external collaborating partners beyond customers. However the bigger companies (>50 employees) did indicate some external collaborations beyond customers. These companies follow a needs-based approach rather than a business strategy to develop networks for future innovations. Further, these

collaborations were found to be based upon personal contacts rather than an institutionalised approach. The institutionalised approach has been argued as essential for building sustainable long term resources for a company (Bougrain & Haudeville, 2002; Bowonder, Dambal, Kumar, & Shirodkar, 2010; Emden et al., 2006).

6.3.3. Themes related to commercialization tools/techniques

The main themes related to commercialization tools and techniques are presented in Figure 6. 3.

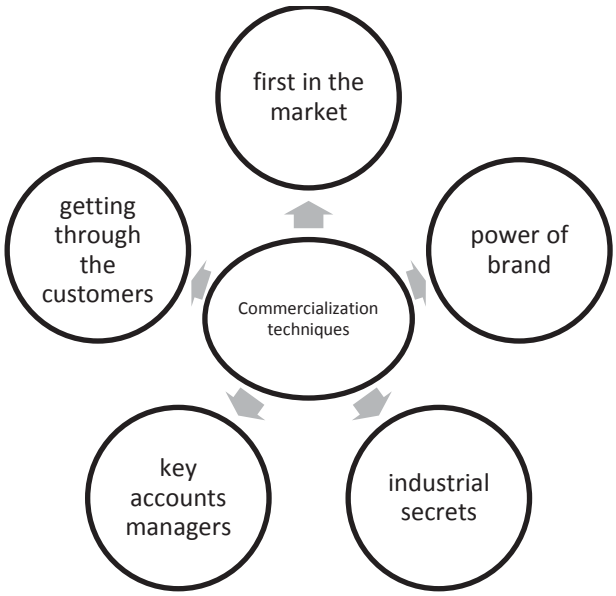


Figure 6. 3. Main themes related to commercialization techniques

6.3.3.1. Tools of protecting innovations

6.3.3.1.1. First to market/brand power

It was observed that food companies tend to rely upon conventional methods of protecting innovations, which include first entry to market and securing rapid sales.

"Sometimes you need to protect your IP but if we think it's going to be difficult to protect we won't bother, we'll rely on the power of the brand and just being first to market" (PD Manager; age group; 40-50 years; employee size; 500).

The second tool that came to the surface from these interviews was IP protection for a brand.

*"We have IP protection for brands that we can protect, but our main brand for example is not IP protected, because it could only be trademarked, because ****** is a word that is in common usage, and it's not patentable".* (Managing Director; age group >50 years; employee size; 15)

These findings are in line with quantitative data and previous literature which emphasise the importance of the brand in food manufacturing (Gehlhar et al., 2009).

6.3.3.1.2. Industrial secrets

Other tools that are used in protecting innovations include industrial secrets and copyrights.

"Well we don't patent, because patent requires public display of formulas, so we never patent. What we do is we use a word called 'industrial secret' so in other words we keep the milk formula secret, so no one; we just make it hard to copy". (CEO; age group >50 employee size; 50)

"We do have some patents but we generally try and keep the information in-house. So we keep just manufacturing knowledge and we just keep that knowledge within the company as much as we can. We don't go down the patent process for all of our products". (R&D Manager; age group 30-39 years; employee size 350)

"We rely for our own protection out here on secrecy. Because we're not big enough to be able to defend any infringement that might happen in terms of patent and so on. Our technology's developed within this company and it remains here". (General Manager; age group >50 years; employee size 20)

From the above comments, patents were considered not a feasible option because it is considered that:

a. Patents require a public display of the formula;
b. The patent process is lengthy and expensive;
c. Patents can be hard to defend.

Protecting the IP of a recipe was seen as problematic.

"Recipes are not protectable in any real sense, right. Because macaroni cheese... well hey, you can't claim exclusivity, and any small change in the recipe is really; you know would render any protection that you have as null and void". (MD; age group >50; employee size; 15).

Company size again came as one of the main issue in developing a proper IP protection policy especially when a company is exporting.

"We rely for our own protection out here on secrecy. Because we're not big enough to be able to defend any infringement that might happen in terms of patent and so on. Our technology's developed within this company and it remains here".

In light of these comments, it is evident that company size and resources are critical in developing IP protection. Overall results showed that food manufacturers are relying on conventional methods of marketing for their NPD which is reflective of NPD focussing on incremental innovations.

Food manufacturers seems to consider their products as basic common use items and hence cannot think of applying sophisticated IP protection tools for their innovations. This approach is a result of lower degrees of novelty being incorporated into most food products. Hence a traditional approach of being first to market and pushing sale through various promotion strategies seems to dominate.

6.3.3.2. Major marketing tools

6.3.3.2.1. Key accounts managers

Some food companies are focussed on customers rather than consumers. This approach does not require direct consumer marketing - rather in this case, key accounts management dominates.

"We have a customer base, because you see, in our case, we are not selling directly to public customers, users. We are selling to sellers" (GM; age group >50 years; employee size 26).

"We don't do an awful lot of marketing, again because we are directly selling to café operators. Although we do have a shop in Ponsonby Road, which is our public shop, because a lot of what we manufacture we provide to the shop, they sell to the public. They do a little bit more advertising and marketing because they are open to the public, whereas we're not". (GM; age group >50 years; employee size 26)

"When we make a new product, we're making it specifically for the customer, so we don't necessarily have to do marketing; we're already making it under contract for them". (R&D Manager; age group 30-39 years; employee size 350)

Larger companies with more structured NPD processes and greater resources present a broader approach to commercialization.

"Channels for us are two main channels so what we call the route channel and grocery. So grocery is supermarkets and then route channel is everything else apart from really night time bars and pubs and things like that, and cafés" (PD Manager: age group 40-50 years; employee size; 500).

Customers seem to play a critical role in promoting a product but restrict the manufacturers from establishing a direct link with mass consumers. This approach has been reported to be a major hurdle in understanding consumer needs.

6.3.4. Themes related to challenges to functional foods development

6.3.4.1. Regulations

6.3.4.1.1. New licence required

It was reported that a new licence is required for engaging in a new category of functional foods.

"The reason why we don't is that we need a new licence. We've got our RNP Dairy Licence. To do functional foods for example to put like an infant formula we'd need a different licence and we're not really ready for that. We don't want to do it."(CEO; employee size 50; age group >50 years)

6.3.4.1.2. Claims

It was also found that among regulations, claims (nutrient claims) are difficult to manage in multiple countries owing to variability in regulations.

"The biggest barrier is what claims are permitted in what country. For example, in Food Safety Authority in Europe, the EFSA won't allow probiotic from the 1st of December. All our boxes say probiotic. So we've had to take probiotic off there. In China you can make some claims and not others. And every country is slightly different."(CEO; employee size 50; age group >50 years)

"Labelling laws are very restrictive to what you can claim."(MD; employee size; 15; age group >50 years)

6.3.4.1.3. Nutritional requirements of a country

Nutritional requirements with recommended serving sizes in various countries vary as per their regulations. Hence it was considered difficult to produce packaging which can have nutritional requirements compatible with all countries.

"When we try and make a sachet, which is our global pack, we're finding it's harder and harder to have one pack that suits the world because of nutritional requirements. So what we're doing is moving from a sachet actually into boxes, because the sachet by itself won't fit the nutritional requirements of all countries."(CEO; employee size 50; age group >50 years)

6.3.4.1.4. Efficacy

Proof of efficacy was reported to be one of the most important aspects of functional foods development, and was considered complex and expensive for most of the food manufacturers.

"Efficacy, well that's what I mean, you've got to put it in there, it's got to do something; there's no point in putting it in not doing something. So and then that becomes potentially expensive because functional foods are leading edge; whosoever's come up with them, generally, they've got a margin. So it's quite difficult in beverage when beverages are generally cheap and there's real price sensitivity." (PD manager; employee size 350; age group 40-50 years)

It was found that generating evidence for even a well-known nutritional innovation is quite demanding for food companies. For example it was said about Omega three that;

"Even though for omega, for example, the science is very strong, I don't feel it, I don't measure it myself, I can't self-measure. It doesn't mean it's not worth doing, it just means if you're going to do it you need to spend a lot to support it, and that's the challenge for a lot of FMCG companies." (PD manager; employee size 500; age group 40-50 years)

"We'd like to research it first, 'cause even though we know it's been hugely popular in America and Australia we actually just need to get a feel for if it's right for New Zealand. So research first and then time, and of course money - we have no understand of the cost (yet) of the equipment that we need to be able to turn that product out I guess."(PD team head; employee size 500; age group 40-50 years)

6.3.4.2. Technical complexity

6.3.4.2.1. Handling flavours

It was also mentioned that in beverages a new bioactive ingredient added is most likely to impart some bad flavours to the final product. Masking undesirable flavours is considered very challenging.

"In beverage I suppose the technical one would be you put in your functional ingredient, whatever it is… unlikely that it doesn't have some sort of taste impact and if you're doing

beverages then you need to have great taste. So the technical challenge there is masking bad flavours because your functional ingredient is so compelling you've got to get it in and you've got to get it in at the right dosage - generally that's a challenge." (PD Manager; employee size 500; age group 40-50 years)

6.3.4.3. Lack of resources

Among the vital resources, access to facilities, finding the right people and labour charges were important factors.

"I guess, just access to facilities can be problematic at times. But it's not always an issue, but I'd say just access to facilities and you know enough resources, enough people in the country with enough qualifications to be able to do that for you."(R&D Manager; employee size 350; age group 30-39 years)

"And maybe if we rely on human input, the costs that we face here are significantly different to the costs in India, or in China, or in Korea, or in some other places. So we have got a high labour input. We find it very difficult to compete."(General Manager; employee size 20; age group >50 years)

6.3.5. Themes related to drivers of functional foods development

6.3.5.1. Customers and suppliers

The driver of functional food development seemed to be through responding to customer demands or suppliers pushing new ingredients.

"We're literally just following what the customer requires."(R&D Manager; employee size 350; age group 30-39 years)

"The supplier contacts us and tells us that they have this, this, and this kind of new ingredient if you want to use it somewhere". (PD Manager; employee size 13; age group 30-39 years)

6.3.5.2. New Zealand reputation

One of the interviewees commented that New Zealand has a good reputation for clean and pure resources in food production. This can be used in favour of functional food product development in combination with new technologies. For example

"Functional food products; one of our big benefits, that we've got a reputation that's probably second to none; and so we capitalize on that as best we can; the combination of that plus our technologies; that's where we go."(General Manager; employee size 20; age group >50 years)

6.3.5.3. Overseas market trends

Another driver for functional food development was reported to be overseas market trends. *"I think the key thing driver at the moment would probably be, initially anyway, what's happening overseas - so what are the market trends? Then, second to that, would be really looking closely what functional foods feel the benefit and what aren't… so where consumers can feel the benefit, whether it's energy or satiety or gut health (for example)"* (PD manager; employee size 500; age group 40-50 years).

6.4. Discussion

The *mixed methods* approach using qualitative research after the quantitative survey was successful. A number of themes were identified which confirmed trends in terms of the NPD process, collaborative partners and commercialisation strategies as identified in the preceding quantitative survey. In addition there was new information generated, which gave useful insights in terms of these key themes.

6.4.1. NPD process

The main findings from the quantitative study revealed that a traditional, closed market oriented NPD approach still dominates the New Zealand food industry. The qualitative data showed that for smaller companies interviewed, a proper structured NPD process is lacking. For example, some companies claimed to use casual staff, a consultants or chefs for particular issues NPD issues. This approach is adopted to avoid the cost of hiring skilled labour on a permanent basis and is not effective in expanding the capacities and capabilities of a company to increase its in-house knowledge and skills to develop innovative products. The majority of New Zealand food companies are SMEs and thus this research implies that in New Zealand an "ad hoc" based NPD process does exist in SMEs. This approach is more likely to serve the demands of local markets through incremental innovations but certainly fall short of future demands of the global market. Local markets are further promoted in New Zealand through franchise operations of one of New Zealand's two largest supermarket retailers, Food Stuffs, where individual owners have buying power beyond normal centralised operations.

To make any significant improvement in food product innovations, SME food companies need to adopt a more structured and formal approach towards NPD (Linnemann, Benner, Verkerk, & Van Boekel, 2006). In contrast, the larger companies interviewed are using a more structured and professional approach towards their NPD. A structured and formalized

NPD process has been argued to reduce the failure rate of NPD (Linnemann et al., 2006). As reviewed in Chapters 2 and 3 of this thesis, the shortage of resources may be overcome through joint ventures and collaborations beyond ingredient suppliers and customers (Van de Vrande et al., 2009).

This research supports the observation that company size and its resources are critically important in designing and adopting formal NPD processes. Most of the companies especially SMEs seemed to lack their own innovation strategies and policies to define their future goals and targets in their business plan (Cooper, 1984; Kim & Mauborgne, 1999; Salavou et al., 2004). Rather, customers are considered as the main driving factor for developing new products. This situation represents the case of contract manufacturing where companies are looking for customers to use their resources for developing new products..

6.4.2. External collaborations and commercialisation strategies

Quantitative research concluded that where external collaborations did exist, they were mainly dominated by customers and ingredient suppliers. What was further discovered through this qualitative study, is that those food companies who had some sort of external collaboration lacked a proper strategy to develop those external collaborations. Rather a needs-based approach was evident, i.e. if there is a need to find a solution to a problem which cannot be solved within the company, then outside resources are consulted to find a solution to that particular problem. This process was mostly done through personal contacts, which are more likely to end when the project is finished or as soon as the problem/challenge is solved (Khan et al., 2013). In addition there was no evidence of any collaborative relationships during commercialisation. Secrecy as a form of protecting IP and customer relationships dominated discussions. This approach towards commercialization again is reflective of incremental innovative activity as discussed in Chapter 4.9 .

From the quantitative survey there were some encouraging results, where food manufacturing companies reporting that they were involved in functional food activity, seemed to have more diverse external collaborations. In this qualitative survey more detail was provided. Larger companies described a more open approach towards collaborations - where partners offered ideas for NPD. This approach shows more encouraging signs of adopting an interactive nonlinear NPD model. This approach is indicative of a close working relationship between interacting partners. As argued in Chapter 2, this approach is critical to enhance the innovation capacities and capabilities of food companies especially for SMEs who lack

enough resources to do radical product innovations e.g. bioactive functional food development (Broring et al., 2006). However, formalised collaborative approaches that were displayed in Chapter 2would require a comprehensive strategy from top management to ensure effectiveness of these collaborations. This can be accomplished by putting in place a structured organisational setup for establishing and developing external collaborations (Bailetti et al., 1998; Humphreys, Huang, Cadden, & McIvor, 2007; Wynstra & Pierick, 2000).

6.4.3. Barriers and drivers to functional food development

Similar trends were observed in the qualitative research as first seen in the quantitative survey. Efficacy, regulations, technical complexity and low resource base were all discussed as serious barriers to innovation with following market trends as driving the interest in FFPD. Responding to customer demands and supplier advice were also discussed as driving FFPD.

Challenges to functional foods development are typical of a SME-dominated food industry where regulations and resources to manage a complex NPD process are lacking. To pursue international market trends in functional food development is important for food companies in New Zealand because of the small domestic market which will not generate large enough returns on the large investment required for such radical products. So food companies are aware they need to target international market trends whilst also being aware of the lack of resources following a traditional NPD model.

6.5. Conclusions

Qualitative research using the *mixed methods* approach confirmed the trends observed in the New Zealand Quantitative survey and elaborated on a number of themes. It highlighted the dominance of customers for generating NPD projects, external cooperation and commercialization activities. This kind of approach renders a food company to be preoccupied with incremental innovations i.e. line extensions and “me too” type innovations (Atuahene-Gima, 1996; Laforet, 2008). It gave some indication that formalization of the NPD process is affected by the size of the company and thus may be related to degree of novelty being pursued in product innovations (Laforet, 2008).

This chapter further establishes that the current features of the FFPD in New Zealand means that the industry has serious limitations in terms of its ability to develop diverse resources and skills in a company that are essential for novel food product innovations. These companies, in order to improve their innovation capabilities and capacities, would require taking a step back

and rethinking their innovation strategies. This may require a shift in NPD approach where direct contact with consumers and opening up the innovation process to diverse external partners for developing differentiated resources and skills. This can be expected lead to an enhanced degree of novelty in product innovations and can double the success rate (Huston & Sakkab, 2006).

7. Comparison of the food innovation process between Singapore & New Zealand

7.1. Introduction

This chapter is aimed at characterizing the various aspects of the innovation process of food companies operating in Singapore. Further, this chapter is also dedicated to describing the commonalities and differences between New Zealand and Singapore food manufacturing. Singapore is a country considered as an Asia-Pacific hub for export and trade. Singapore is considered to be a city without farms and limited primary production with imports of F&B (raw material i.e., ingredients) amounting to US$9.1 billion (2009/10). Beverage and primarily oils, fats and raw ingredients constitute a major portion (40% or more) of imports in this sector. New Zealand is one of the main exporting countries to Singapore for raw materials. The value of these exports is growing strongly at the rate of 16% CAGR which is above average compared to other countries exporting to Singapore (CORIOLIS, 2011).

Singapore has a well establish food manufacturing sector that requires substantial amounts of raw materials (e.g., milk powder) to be turned into food products that are consumed domestically or exported. Packaged food products are on the rise with a greater consumer focus on nutrition/staples e.g., high fibre bread, reduced fat milk, brown rice etc. Current statistics on nutrition/staples showed a growth of 4% (value growth) in 2012. Among nutrition/staples, baby food has the highest current value growth of 9% (Euromonitor, 2013b). These are mainly dominated by multinationals who have extensive distribution channels and marketing campaigns (Euromonitor, 2013b).

New Zealand F&B manufacturers can easily approach the Singapore market due to similar market size, which does not require much capital expenditure for food manufacturers to scale up (Table 7. 1). Similar population size and growth rate but higher GDP (US$223billion) of Singapore, makes it easy for New Zealand food manufacturers to export value-added food products to Singapore. Further, Singapore has a modern consolidated supermarket system which is similar to that of New Zealand with potentially higher capacity to spend on valued added products. Moreover Singapore is considered as an Asia-Pacific hub for F&B re-exports due to its central location and low tax rates, especially for processed foods (CORIOLIS, 2011).

Table 7. 1. Comparison of Singapore and New Zealand

Parameters	Singapore	New Zealand
Population	5.399m (2013)	4.4m (2011)
Age under 15	13.8%	20.4%
Age +65	9.2%	13.3%
Population growth rate	0.82%	0.88%
Area	697 Sq. Km	267710 Sq.Km
Population density	7,315/km2 3rd highest in world	16/km2 200th highest in world
GDP	US$223b (nominal)	US$140b (nominal)

Source: (CORIOLIS, 2011)

Therefore Singapore can serve as major market for New Zealand for exporting raw materials and finished goods in the F&B sector. However understanding the innovation process of food manufacturers in Singapore is critical to excelling in the export of value- added food products to Singapore. Recently a joint working of these two countries under the umbrella of international relationships fund-New Zealand Singapore food for health has been set up by the Ministry of Business, Innovation and Employment (MBIE, New Zealand). This will enable these two countries to complement the resources and skills required to boost health-oriented value-added food products.

This part of the study was designed to investigate the innovation process of food manufacturing in Singapore so that it can be compared with the food manufacturing innovation process in New Zealand. This will help in identifying the similarities and differences in perception of the various drivers of and barriers to innovative functional food product development. Further, a comparison of innovation processes between the food companies that claim to be involved in functional foods development and those that are not will provide a useful comparison for the findings of the New Zealand study. For this purpose, a quantitative online survey was conducted in Singapore and data collected and analysed to

observe general trends in innovation practices with special reference to value-added functional food products. Results are discussed in the light of current literature and finally conclusions are drawn at the end.

The main research question for this part of the study was;

Is there a difference between food companies' innovation processes based upon their involvement (or not) in functional foods development?

7.2. Methodology

An online quantitative survey was conducted using Survey Gizmo. Details of the procedure are explained in chapter 3 under section *3.9. Quantitative study (Singapore).*

7.3. Results

First, descriptive statistics are presented, followed by a comparative analysis between food companies that claimed to be involved in functional foods development and those that did not.

Descriptive Statistics

7.3.1. Salient features of the respondent companies and participants

The distribution of respondent companies across the total population, based upon employee size, is presented in Table 7. 2. It showed that 60% of the companies are from the <100 employee group. This indicated a dominance of SMEs in food manufacturing in Singapore, which is in line with general size distribution in New Zealand and elsewhere (MED, 2011). It has been observed that the food industry in most parts of the world is composed of SMEs (Anahita et al., 2012; Beckeman, Bourlakis, & Olsson, 2013; Government, 2012; Terziovski, 2010).

Average NPD and functional foods (FF) product development experience of participants were 9.88 and 3.26 years respectively (Table 7. 2). Food companies had an average of 16.8 new products launched over three years period (2009-2012).

Table 7. 2. Salient features of sampled companies and respective participants

1. Employee size distribution	**Number of companies**
< 20	16 (33.33%)
≥ 20	13 (27.08%)
1001-150	8 (16.67%)
151-200	3 (6.25%)
> 200	8 (16.67%)
2. NPD statistics	**Number of new products**
Average number of new products launched by each company (2009-12)	16.84
Average number of NPD projects completed by each respondent (2009-12)	9.88
Average FF experience (years) of each respondent	3.26 (Years)
3. Type of Ownership*	**Number of companies**
National Companies	36 (81.81%)
Multinational Companies	8 (18.19%)

*four companies did not respond to this question

Orientation towards new product development (NPD)

7.3.2. Innovation characteristics of food companies

Frequency analysis showed that "Market-oriented NPD" is the most dominant NPD approach, with 56.8% of the total respondents ranking it as the most dominant NPD approach (Table 7. 3). The second most dominant orientation was found to be "Product-oriented NPD" with 54% of total responses ranking it as their moderately dominant approach towards NPD (Table 7. 3). "Process oriented NPD" was ranked as moderately to slightly important (65.8% responses) (Table 7. 3), whereas "Organisational-oriented NPD" was ranked from slightly dominant to less dominant by a cumulative response of 64.1% respondents (Table 7. 3). It can be concluded from these results that market-oriented NPD is the most dominant NPD approach in food manufacturing in Singapore followed by product and process orientation respectively.

Table 7. 3. Frequency score of ranking order for Orientation towards NPD/Innovation

Ranking Scale	Orientation towards NPD/Innovation			
	"Market-Oriented NPD" (MO)	"Product-oriented NPD" (PDO)	"Process oriented NPD" (PRO)	"Organisational-oriented NPD" (ORO)
Most dominant	**25**	8	3	5
Moderately dominant	6	**24**	**13**	8
Slightly dominant	6	6	**12**	**13**
Less dominant	4	3	8	**12**
Least dominant	3	3	2	1
Total	**44**	**44**	**38**	**39**

7.3.3. Major aims of NPD

The data collected on number of new products developed under the various aims of new product development (NPD) are presented in Table 7. 4. These findings are similar to those from the New Zealand study, where the most dominant aim of NPD is *to increase the range of goods/services* (IRGS) followed by the urge *to increase market share* (IMS), *exploiting new marketing opportunities* (ENMO) and *increasing the responsiveness to the consumers* (IRC).While the purpose of NPD to *increase knowledge sharing with consumers* (IKSC) scored least important.

Table 7. 4. Main aims of NPD (2009-12)

Main aim of NPD	Total no. NPD	%
To increase range of goods/services (IRGS)	310	30
To increase market share (IMS)	258	25
To exploit new market opportunities (ENMO)	249	24
To increase responsiveness to consumers (IRC)	170	17
To reduce cost (RC)	43	4
To increase knowledge sharing with consumers (IKSC)	65	6
Total	1030	100

7.3.4. Mode of product development

The mode of product development (i.e., developed alone or in collaboration with others or developed by other company) has been presented in Table 7. 5. It shows that most of the new products are developed alone by the food manufacturing companies (75.89% of total new products).There were a few new products (8.43%) which were developed in some sort of collaborations with external partners (Table 7. 5).

Table 7. 5**.** Overall mode of NPD (2009-12)

Mode of NPD	Total no. of NPD	%
Developed alone	639	75.89
In partnership with other company	71	8.43
By other company for your company	124	14.73
Others (in partnership with research agencies)	8	0.95
Total	842	100

A small percentage of NPD (14.73%) was reported as having been done by another company. This may happen in situation where new products are just minor extensions of a non-competing product range or to compensate for limited production capacity of a company.

7.3.5. Sources of idea generation for NPD

New product idea generation was found to be heavily relying on "Ingredient suppliers", "Ingredient exhibitions" and "Government health regulations" respectively (Table 7. 6)**.** More than 60% respondents ranked "Ingredient suppliers" as the most/more important source for generating new product ideas (Table 7. 6).

Table 7. 6. Frequency score of ranking order for Ingredient suppliers", as sources of

Ranking Scale	Various sources of idea generation						
	Ingredient suppliers	Scientific Research Publications	Clinical studies about nutrition	Ingredient Exhibition	University Research Institutes	Conferences	
Most important	19	5	7	7	4	3	
More important	10	4	5	13	5	2	
Moderately important	5	5	10	10	7	12	
Slightly Important	3	7	6	2	3	7	
Important	2	6	1	4	6	3	
Less important	1	2	1	1	1	1	
Lesser important	2	1	2	2	5	2	
Least important		7	5	2	4	5	
Total	**42**	**37**	**37**	**41**	**35**	**35**	

"Government research agencies" were found to be lesser important source for new product idea generation (Table 7. 6).

Collaborative arrangements

7.3.6. Dominant external partners

Out of total 50 respondent companies, 48% companies reported having no external links (Figure 7. 1).

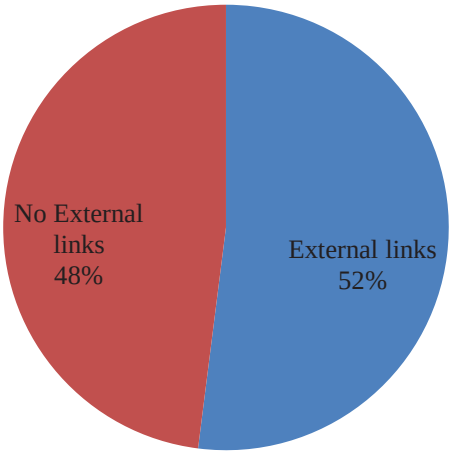


Figure 7. 1. Proportion of cooperative links for NPD

The frequency score of ranking order for various external partners from 52 food companies that indicated having some sort of external collaboration for NPD is presented below;

Table 7. 7. Frequency score of ranking order for "External cooperative links for conducting NPD"

Ranking Scale	External cooperative links				
	Customers	Ingredient Suppliers	Competitors	Universities	Government Research Agencies
Most important	7	4	2	10	4
More important	5	7	1	4	5
Moderately important	5	5	5	5	7
Less important	2	4	2	1	1
Lesser important	2	1	2	3	5
Least important		1	2		4
Total	21	22	14	23	**26**

The external links were preferred mostly with "Universities" and "Customers" (Table 7.7).

7.3.7. Purpose of external collaborations

In order to understand the nature of external collaboration, various purposes of establishing external collaborations were explored. It was found that the most dominant or most important purpose of any external collaboration was to get "Access to R&D" and cost sharing (Table 7. 8). "Production capacity sharing" and "Cost sharing" were other relatively less important purposes of external collaboration (Table 7. 8). A lower response rate to "Risk sharing" resembles results found for New Zealand food companies' responses, which is an indication of lower degree of risk in innovation activities i.e. incremental changes being pursued in these collaborations.

Table 7. 8. Frequency score of ranking order for “Purpose of external cooperative links”.

Ranking Scale	Purpose of external cooperative links				
	Access to R&D	Access to new suppliers	Cost Sharing	Production Capacity Sharing	Risk Sharing
Most important	15	3	6	4	1
Moderately important	5	6	4	5	3
Less important	2	4	4	2	5
Lesser important	1	2	3	2	2
Least important	2	1	-	1	2
Total	25	16	17	14	13

Commercialization Techniques

7.3.8. Protection of innovations

It was found that “Confidentiality agreements” and “Trademarks” are the main tool of food manufacturing companies in Singapore for protecting their innovations/NPD from being copied (Table 7. 9). It was followed by “Copyrights” and “IP contracts” respectively (Table 7. 9). The least important tool was found to be the “Patents”.

Table 7. 9. Frequency score of ranking order for “Protection of Innovations”.

Ranking Scale	Protection innovation tools				
	Trademark	Confidentiality Agreement	IP contracts	Patents	Copyrights
Most important	15	16	6	3	6
Very Important	8	9	7	7	4
Moderately important	4	7	9	5	8
Less important	3	1	2	3	3
Lesser important	2	2	5	4	4
Least important	3	3	4	7	5
Total	**35**	**38**	**33**	**29**	**30**

7.3.9. Main marketing tools

Descriptive statistics revealed that “Own Marketing Staff” was ranked as the most important tool for marketing (55.6 % responses, N=45) followed by “Brand ownership” (44.6% response, N=36) (Table 7. 10). These findings are similar to the New Zealand food manufacturing industry responses.

The third most important marketing tool was “Exhibitions” being ranked as most/very important by 57.9% of cumulative response percent (Table 7. 10). “Trade show” and “Electronic media” were ranked moderately important by 35~% respondents. However 31% of responses considered “Contract marketing staff” to be the least important tool for marketing (Table 7. 10).

Table 7. 10. Frequency score of ranking order for “Main marketing tools”

Ranking Scale	**Marketing tools**			
	Own Marketing Staff	Brand Ownership	Electronic Media	Contract Marketing Staff
Most important	25	16	4	3
Very Important	11	8	6	4
Moderately important	3	6	12	2
Less important	2	1	2	6
Lesser important	2	2	1	5
Least important	2	3	9	9
Total	**45**	**36**	**34**	**29**

7.3.10. Major barriers to commercialization

The frequency score of ranking order for various barriers to commercialization revealed that "Access to market" was ranked as the most important factor by 46.2 % of respondents followed by "Consumer confidence" 42.5 % of total responses and "Health awareness" 33.3 % respondents (Table 7. 11). These findings are not in line with New Zealand food industry response where "Legislation" is considered the third most important challenge to commercialization (28.1% compare to 16.7% responses) (Table 7. 11).

Table 7. 11. Frequency score of ranking order for "Major barriers to commercialization".

Ranking Scale	**Major barriers to commercialization**				
	Access to Market	Health Awareness	Consumers' Confidence	Legislation	Government Support
Most important	18	13	17	6	8
Very Important	11	12	9	14	12
Moderately important	4	3	8	7	11
Less important	1	4	2	4	1
Lesser important	4	6	3	3	4
Least important	1	1	1	2	1
Total	39	39	40	36	37

"Creating health awareness" was found to be ranked as most important by 16.7% of total responses followed by "Government support" (10% out of total 20 responses) (Table 7. 11).

Functional foods development (FFD) trends

7.3.11. Major food categories

The major food categories for functional food product development were ‘Dairy products” being on the top followed by “Cereals” and “Meat and poultry products” respectively (Figure 7. 2).

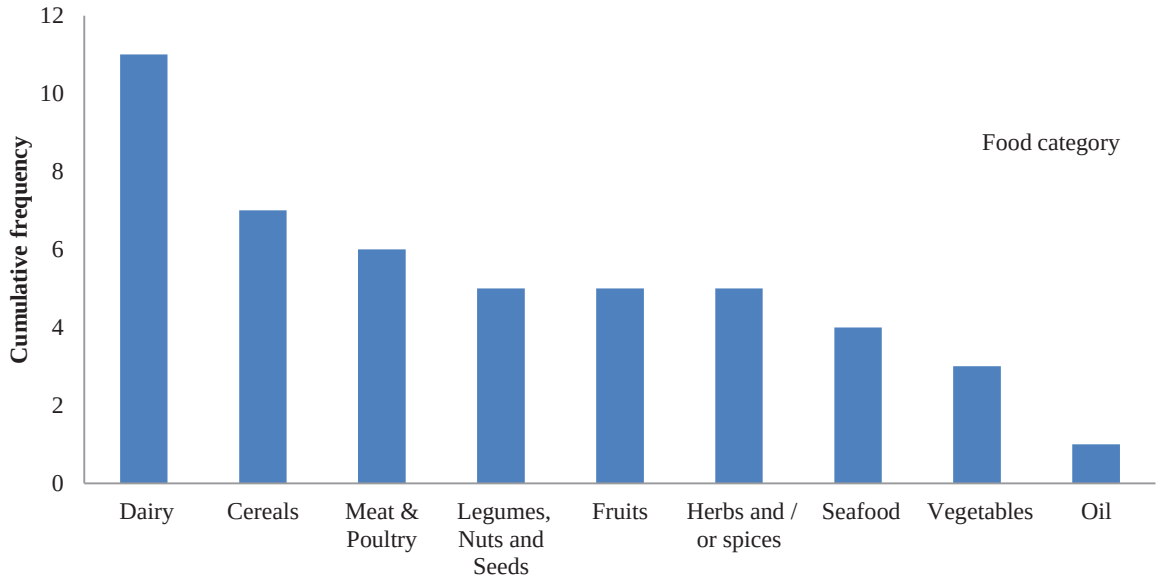


Figure 7. 2. Future NPD interest of food manufacturing companies in various food categories

7.3.12. Target functions/benefits

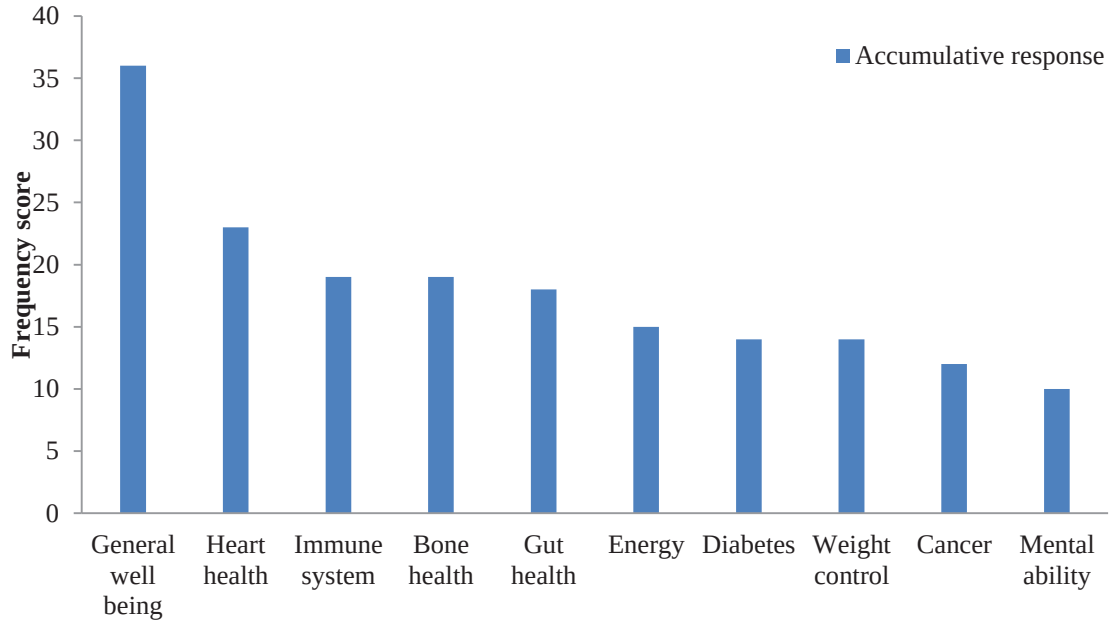


Figure 7. 3. Future NPD interest of food companies in target function of human physiology

The leading target function for human health and wellness improvement was found to be "General well-being" followed by "Heart health" and "Immune system" (Figure 7. 3).

7.3.13. Drivers of Functional Food Product Development (FFPD)

Drivers of functional foods development were ranked by only those companies who showed their involvement in functional foods development. The frequency scores of six factors for this construct are presented in Table 7. 12.

The frequency score of ranking order for various driving factors of functional foods development revealed that "Attaining competitive edge" was the most important factor (450% response) followed by "Market opportunity" (34.6% response) and "Building trust with consumers" (26.1% response) respectively. "Social responsibility" to develop functional foods was considered to be the least important driver for developing functional foods (20.0% response) (Table 7. 12).

Table 7. 12. Frequency score of ranking order for “Major drivers of FFPD

Ranking Scale	**Major drivers of FFPD**				
	Market Opportunity	Attaining Competitive Edge	High Profit Margin	International Market Trends	Buildi With C
Most important	9	13	3	7	
Very Important	8	7	6	7	
Moderately important	5	3	3	3	
Less important	1	2	4	5	
Lesser important	1	1	4	1	
Least important	2	-	1	2	
Total	26	26	21	25	

7.3.14. Barriers to Functional Foods Product Development (FFPD)

The frequency score for various barriers to functional foods development showed that 'Cost of innovation" is the most important factors with 39.5% of total responses followed by "Lack of Technical Skills" (34.9% of total responses) (Table 7.13).

Third most important factor found to be "Lack of medical skills" (32.5% of total response) (Table 7.13). "Protection of innovation" and "Health efficacy" were ranked as the least important barriers to FFPD respectively (Table 7.13).

Table 7. 13. Frequency score of ranking order for “Major barriers to FFPD

Ranking Scale	**Major barriers to FFPD**				
	Cost of Innovation	Regulatory Structure	Health Efficacy	Lack of Technical skills	Lack
Most important	17	3	8	15	
Very Important	7	10	14	8	
Moderately important	9	4	8	10	
Less important	5	10	5	5	
Lesser important	2	7	1	5	
Least important	3	3	1	-	
Total	43	37	37	43	

7.3.15. Desired characteristics of a successful bioactive ingredient

The most important characteristic of a potential bioactive food ingredient was ranked to be the “Purchasing cost” with 39.0% of total response to this factor (Table 7.14). The second most important factors was found to be “Ensured supply from the suppliers” and “Legal status ”with 34.3% and 34.2% response followed by “Product trends in the market” (30.0% of total response). “Technical ease of use” (28.2% response) and “Efficacy” (21.6% response) were comparatively lower important factors (Table 7.14).

Table 7. 14. Frequency score of ranking order for “Desired characteristics of a new bioactiv

Ranking Scale	**Desired characteristics of a new bioactive food ingr**				
	Efficacy	Purchasing cost	Legal Status	Product Trends in the market	Technic u
Most important	8	16	13	12	
Very Important	14	9	12	11	
Moderately important	8	10	6	12	
Less important	5	1	3	1	
Lesser important	1	1	3	1	
Least important	1	4	1	3	
Total	37	41	38	40	

Comparative analysis

7.3.16. Within Singapore food manufacturing

Within the sample a comparative analysis conducted to investigate the differences and commonalities in the innovation processes of food companies based upon their involvement in functional food development in Singapore. The collected data was split into two groups i.e. Group 1: companies having to claim functional foods development; Group 2: food companies that are not involved in functional foods development (as described in Chapter 3).

7.3.17. Comparative demographics of food companies and participants

The NPD-related demographics of Group 1: companies manufacturing functional foods and Group 2: other food companies are presented in Table 7. 15. The employee size distribution of each of these two groups was more or less similar. The majority of the companies (77%) were in the range of 100-150 or below employees. The average numbers of new products launched by each company during 2009-2012 in the two groups were 14 and 21 respectively. As expected, the functional foods (FF) development experience of participants in group 1 was higher (4 years) than group 2 (1 year).

One of the respondents in group 1 reported having launched more than 1000NPD in his career, which stands out to be an outlier in this small data set and this data point was thus omitted from the data set for calculating average NPD projects completed by each respondent. The average NPD value for this parameter was (3) lower in group 2 than group 1 (16) Table 7. 15.

Table 7. 15. Salient features of sampled companies and respective participants

Characteristics	Group 1 (companies manufacturing functional foods) *n=27*	Group 2 (other food companies) *n=21*	Overall *n=48*
1. Employee size distribution			
<20	10	6	16
20 or >20	6	7	13
101-150	4	4	8
151-200	2	1	3
>200	5	3	8
2. NPD statistics	**Number of new products**		
Average number of new products launched by each company (2008-11)	14	21	16.84
Average number of NPD projects completed by each respondent	16	3	9.88
Average FF experience (years) of each respondent	4 years	1 years	3.26 years
3. Type of Ownership*	**Number of Food companies**		
National Companies	22	14	36
Multinational Companies	3	5	8

*four of the respondents did not answer to this question.

Orientation towards NPD/innovations

7.3.18. Major aims of NPD

There was a significant difference (P<0.05) in the three aims of NPD (*to increase range of goods and services, to increase responsiveness to consumers and to increase the knowledge sharing with consumers*) between companies manufacturing functional foods and other food companies (Table 7. 16). Food companies in group 1 directed a comparatively higher proportion of their NPD (32.34%) towards increasing their range of goods and services. It was further noted that other food companies (group 2) focus comparatively more of their

NPD on increasing their responsiveness to consumers and increasing knowledge share with consumers.

7.3.19. Mode of NPD activities

There was a significant ($P<0.05$) difference between Group 1 and Group 2 in their mode of NPD (Table 7. 16). Group 2 companies were reported to have contracted out a higher number of NPD than those in Group 1, consequently resulting in a lower number of independent NPD done by food companies in group 2.

7.3.20. NPD/innovation characteristics

A lack of significant difference ($P>0.05$) in NPD/innovation characteristics (Table 7. 16) indicates that there is no single orientation favoured for NPD of functional foods. These findings are in line with the New Zealand food industry response.

Table 7. 16. Firm orientation towards innovation/NPD

Measures of the construct	Group 1 (companies manufacturing functional foods) *n=27*	Group 2 (other food companies) *n=21*	Chi Square Test
1. Major aims of NPD	***(No of NPD 2009-12)***	***(No of NPD 2009-12)***	
To increase range of goods and services	195 (32.34%)	115 (23.37%)	10.72, P<0.001*
To increase market share	138 (22.89%)	120 (24.39%)	0.34, P=0.55
To exploit new market opportunities	152 (25.21%)	97 (19.72%)	4.65, P<0.03
To increase responsiveness to consumers	15 (2.49%)	28 (5.69%)	7.37, P<0.006*
To reduce cost	88 (14.59%)	82 (16.67%)	0.88, P=0.006
To increase knowledge sharing with consumers	15 (2.49%)	50 (10.16%)	28.58, P<0.0001*
Total	**603**	**492**	
2. Mode of NPD activities	***(No of NPD 2009-11)***	***(No of NPD 2009-12)***	
Independent NPD	334 (87.66%)	305 (67.33%)	47.76, P<0.001*
Collaborative NPD	31 (8.14%)	40 (8.83%)	0.12, P=0.72
Contract out NPD	16 (4.20%)	108 (23.84%)	63.07, P<0.001*
Total	**381**	**453**	
3. NPD/Innovation characteristics	***Ranking scores***		
Market Oriented	53 (20.62%)	33 (22%)	0.10, P=0.74
Product Oriented	62 (24.12%)	39 (26%)	0.17, P=0.67
Process Oriented	70 (27.24%)	37 (24.67%)	0.32, P=0.56
Organisational Oriented	72 (28.02%)	41 (27.33%)	0.02, P=0.88
Total	**257**	**150**	

*Significant at P<0.01

Cooperative network

7.3.21. Types of external partners

The number of food companies with some sort of external collaboration was found to be higher in group 1 compared to group 2 companies. However there was no difference between the two groups in regard to their external partner preferences (Table 7. 17). These findings do not support that *H2*; *there is a difference in selecting collaborating partners*.

Table 7. 17. Comparative collaborative NPD external partners for various related activities

Measures of the construct	Group 1 (companies manufacturing functional foods) *n=27*	Group 2 (other food companies) *n=21*	Chi Square Test
1. External collaborative NPD links			
Yes	18 (66.67%)	8 (38.10%)	NA
No	9 (33.33%)	13 (61.90%)	NA
2. Major external collaborating partners			
Customers	19 (24.36%)	4 (6.15%)	0.09, P=0.76
Ingredient suppliers	17 (21.79%)	5 (7.69%)	0.17, P=0.67
Competitors	12 (15.38%)	2 (3.08%)	0.29, P=0.58
University or Polytechnic	17 (21.79%)	6 (9.23%)	0.89, P=0.36
Government research agencies	13 (16.67%)	2 (3.08%)	0.44, P=0.50
Total	**78**	**19**	

*significant at P<0.05, N/A: not applicable

Commercialization techniques

7.3.22. Protection of innovation/NPD

There was no difference between Group 1 and Group 2 for the various tools of protection used in NPD launch (Table 7. 18). Hence the data do not support *H3: there is a difference in commercialization techniques.*

7.3.23. Commercialization tools for NPD

There was no significant difference (P>0.05) between Group 1 and Group 2 in their commercialization tools for NPD (Table 7. 18). These findings do not support *H3; there is a difference in commercialization tools.*

7.3.24. Barriers to commercialization of NPD

There was no significant difference (P>0.05) between Group 1 and Group 2 in their perception of various barriers to commercialization of NPD (Table 7. 18). These findings do not support *H3; there is a difference in perception of barriers to commercialization.*

Table 7. 18. Comparative commercialization techniques of food companies

Measures of the construct	Group 1 (companies manufacturing functional foods) *n=28*	Group 2 (other food companies) *n=21*	Chi Square Test
1. Protection of innovation tools	*Frequency Scores*		
Trade marks	58 (21.25%)	46 (22.22%)	0.06, P=0.79
Confidentiality agreements	54 (19.78%)	33 (15.94%)	1.16, P=0.27
IP contracts	56 (20.51%)	50 (24.15%)	0.9, P=0.34
Patents	47 (17.22%)	36 (17.39%)	0.003, P=0.95
Copyrights	58 (21.25%)	42 (20.29%)	0.065, P=0.79
Total	**273**	**207**	
2. Commercialization tools for NPD			
Own marketing staff	51 (14.13%)	37 (12.98%)	0.17, P=0.67
Brand ownership	75 (20.78%)	51 (17.89%)	0.84, P=0.35
Electronic media	48 (13.30%)	36 (12.63%)	0.62, P=0.8
Contract marketing staff	61 (16.90%)	63 (22.11%)	2.78, P=0.09
Exhibitions	59 (16.34%)	48 (16.84%)	0.03, P=0.86
Trade shows	67 (18.56%)	50 (17.54%)	0.11 P=0.73
Total	**361**	**285**	
3. Barriers to commercialization of NPD			
Access to market	54 (19.85%)	41 (21.69%)	0.23, P=0.63
Health awareness	60 (22.06%)	38 (20.11%)	0.25, P=0.61
Consumer confidence	57 (20.96%)	41 (21.69%)	0.03, P=0.84
Legislation	52 (19.12%)	36 (19.05%)	0.00, P=0.98
Level of Govt. support	49 (18.01%)	33 (17.46%)	0.02, P=0.87
Total	**272**	**189**	

7.4. Comparative analysis of New Zealand and Singapore food manufacturers

Innovation-related characteristics

7.4.1. Major aims of NPD

There was a significant difference ($P<0.05$) in the three aims of NPD (*to increase responsiveness to consumers, to reduce cost and to increase the knowledge sharing with consumers*) between New Zealand and Singapore food companies (Table 7. 19). Singapore food companies focus more on reducing the cost of NPD than New Zealand businesses. Singapore food companies see knowledge sharing with consumers more of a priority for NPD, whereas New Zealand food businesses aim NPD more towards responsiveness to consumers.

7.4.2. Mode of NPD activities

There was a significant ($P<0.05$) difference between New Zealand and Singapore food companies in their mode of NPD (Table 7. 19). New Zealand food companies were found to have completed a higher proportion of their total NPD in isolation. However New Zealand food companies have done a comparatively higher percentage of collaborative NPD compared to Singapore. Conversely, Singapore food companies contracted out a higher proportion of their total NPD (Table 7. 19).

7.4.3. External links for NPD activities

There was no significant difference ($P>0.05$) between the data for the two countries in terms of external collaborative links for NPD activities (Table 7. 19).

Other parameters related to the innovation processes such as types of external collaborating partners, commercialization techniques and perception of drivers of and barriers to FFPD could not be analysed statistically, due to the nature of data collected in Singapore study. The Singapore study was done online and the questionnaire was presented in a slightly different manner (Appendix IX), which did not allow a sound statistical comparison of these parameters.

Table 7. 19. Comparison of innovation process characteristics of New Zealand and Singapore

Measures of the construct	**New Zealand**	**Singapore**	**Chi Square**
1. Major aims of NPD	***n=67*** ***Last 3 years NPD***	***n=48*** ***Last 3 years NPD***	**Test**
To increase range of goods and services	538 (30.71%)	310 (28.31%)	1.85, P=0.17
To increase market share	430 (24.54%)	258 (23.56%)	0.35, P=0.55
To exploit new market opportunities	368 (21.00%)	249 (22.74%)	1.19, P=0.27
To increase responsiveness to consumers	278 (15.87%)	43 (3.93%)	96.04, P<0.0001*
To reduce cost	104 (5.94%)	170 (15.53%)	71.23, P<0.0001*
To increase knowledge sharing with consumers	34 (1.94%)	65 (5.94%)	32.04, P<0.0001*
Total	**1752**	**1095**	
2. Mode of NPD activities	***(No of NPD)***	***(No of NPD)***	
Independent NPD	1285 (83.28%)	639 (76.62%)	15.75, P<0.001*
Collaborative NPD	226 (14.65%)	71 (8.51%)	18.62, P<0.0001*
Contract out NPD	32 (2.07%)	124 (14.87%)	144.51, P<0.001*
Total	**1543**	**834**	
3. External collaborative NPD links			
Yes	30 (44.78%)	26 (54.17%)	0.98, P=0.32
No	37 (55.22%)	22 (45.83%)	
Total	67	48	

*significant at P<0.05

7.5. Discussion

Orientation towards NPD

Within the sample taken, food NPD in Singapore is carried out mainly in isolation (i.e. >75% NPD). Food companies rely upon their own in-house resources, external collaborations are not widespread, and a market-oriented approach toward innovations/NPD was reported by participants as most important. This approach is in line with the New Zealand food manufacturing quantitative survey (Chapters 4 and 5). These findings suggest that concerted efforts are directed towards incremental innovations in the Singapore food manufacturing industry. Hence it may be inferred that Singapore food manufacturing is also focussed on incremental innovations, with major emphasis on meeting consumer demands and increasing product range. As discussed throughout this thesis this approach is contrary to radically innovative functional food product development.

Collaborative external links for NPD

The extent of reporting external NPD collaborations was roughly half the respondents, similar to results for New Zealand (44% in New Zealand, 54% in Singapore). In Chapter 5 there was a trend reported in the quantitative data set that food companies reporting functional food NPD activities in New Zealand had more collaborative links (56% of group 1 food companies compared to 33% group 2). These collaborative links were more diverse in group 1 as compared to group 2. Although customer and ingredient suppliers still dominated, there was an increase in collaborations with universities and government research agencies in Singapore compare to New Zealand. This is seen as a first positive step towards a more open innovation model. This trend is partially followed in the Singapore study where 66% from group 1 as compared to 38% from group 2 report working with external collaborators. However, no greater diversification in selection of external partners is seen in group 1. Both groups report working with tertiary institutions and government research agencies. Universities and government research agencies are reported as the most important external partners in Singapore, which is in contrast to results for New Zealand food companies where customer and ingredient suppliers were considered most important. The importance of customers and ingredient suppliers is the expected trend in international markets found in Europe and the USA (Sadler, 2005). Why Singapore presents more diverse collaborations with the tertiary sector and government research agencies may be for two reasons. Firstly geographic: a city state may present more localised access to universities and government research centres. Secondly political/strategic: there is one government-funded food research

centre (Food Innovation Research Centre), situated on the Singapore Polytechnic campus. This is a well-known facility which focuses on near to market solutions and is heavily subsidised by government. In contrast, the New Zealand science system is based on a full cost recovery model, including recovery of all overheads and depreciation. This somewhat unusual system (compared to most other countries) means that the cost of doing science with government agencies and universities is relatively expensive.

Food companies that are seeking a leading edge in radically innovative food products have realised the importance of diverse external collaborations and thus have adopted a more diverse approach towards collaborations beyond ingredient suppliers and customers (Broring, 2008; Emden et al., 2006; Fritzsch, 2010). The new innovation models (e.g., General Mills, Unilever and P&G connect and develop model etc.) have suggested collaborations beyond collaborative NPD where the focus is on developing resource and assets of an organisation by reaching outward while not losing the core competencies of its business. These models have been shown to reduce the cost and time of innovation significantly (Barbara & Francesco, 2012; Huston & Sakkab, 2006). Therefore, it is essential to expand the scope of collaborations beyond customers and ingredient suppliers to succeed in value-added food product innovations. Singapore, with easy access to a number of collaborating partners, may be better positioned than most countries to radically innovate.

Commercialization of NPD

The approach towards commercialization tools and techniques also gave no indication of radical innovative activity. Results were found to be similar to the New Zealand food manufacturing industry response. However, one notable difference was the greater emphasis on *Exhibitions* for commercialization. This is not surprising considering the density of population in this city island state and the effectiveness of exhibitions to access this population (CORIOLIS, 2011). On the other hand, New Zealand food manufacturers consider *Electronic media* to be their third most important tool for marketing. This may be related to thinner population density and thus access to a remote audience enabled by electronic media.

Drivers of and barriers to functional food development

The findings for major drivers to develop functional foods suggest that food manufacturers perceive these food products as helping in attaining competitive edge, which is in line with the findings of Mark-Herbert (2004), Matthyssens et al. (2008) and Heasman and Mellentin (2001) and the New Zealand study. Regulatory structure has been argued as one of the main

challenging factors for food companies wanting to make health claim on food products, and in the New Zealand study this factor was ranked highly, after cost of innovation (B. B. Butchko & Petersen, 2006; EU, 2000; Frewer et al., 2003). In the Singapore trial, although regulatory structure was considered important, technical and clinical challenges were more highly ranked by most respondents, after cost. This is in line with earlier studies that reported functional food product development to be associated with higher cost due to the technical and clinical challenges (Broring et al., 2006; Mark-Herbert, 2002, 2003).

Functional foods development trends and challenges

Interest in major functional food categories in Singapore follows closely reported global trends (Euromonitor, 2010d, 2013a). *General Well-being* was found to be the main focus of these food products, which has been already reported as a common global market focus (Hardy, 2010). A comparative analysis with the New Zealand food industry response showed that there was a difference in ranking, with *Cereals* as the second most important food category in Singapore, compared to the New Zealand food industry response, where *fruits and vegetables* were considered to be the second most important food category. This difference may be due to the strong agricultural base of New Zealand allowing relatively easy access to fresh fruit and vegetables as compared to Singapore (CORIOLIS, 2011).

Comparative analysis

Overall comparison of New Zealand and Singapore food companies revealed that Singapore food manufacturers are more focused on reducing their cost of NPD. This attitude may be attributed to the limited primary production (F&B (primary products) import 11.9 billion US$) (CORIOLIS, 2011), higher cost of importing the raw materials. Another difference among the aims of NPD was increasing responsiveness to consumers in the New Zealand food market whereas Singapore food manufacturers comparatively attributed a larger proportion of their NPD towards increasing knowledge sharing with consumers (Table 7. 19). These observations suggest that New Zealand is a customer-oriented market where responsiveness to customers is higher compared to knowledge sharing with consumers. Further, New Zealand food companies have conducted a comparatively higher proportion of their total NPD in collaboration with external partners whereas Singapore food companies have contracted out a higher portion of their NPD. However, this collaborative NPD in New Zealand food manufacturing may be attributed to the input of customers, who are the major external partners of NPD (35% of total external partners) (Table 7. 19).

7.6. Conclusion

The overall pattern of NPD attitudes in food manufacturing in Singapore is in line with that found for New Zealand, which is characterised by a dominantly market-oriented NPD with a closed NPD model where most of the NPD is done alone. However, external collaboration in Singapore, unlike in New Zealand, is not restricted to customers only, rather it is distributed evenly across various external partners. Similarly, commercialization techniques in terms of protection of innovation are more sophisticated. Further, functional food development challenges reside around cost of innovation and creating health efficacy, which are crucial to the marketing of these food products. Overall, it can be concluded that the innovation process characteristics are reflective of a traditional NPD approach, where an internally closed NPD model is preferred to introduce new food products. This approach may not be suited well to radical food product innovations especially in the case of bioactive functional food innovations.

8. Overall Discussion and Conclusions

8.1. Introduction

This chapter is aimed at concluding the findings and outcomes of this research in the light of the stated aims, objectives and hypothesis as described in section 1.2 of Chapter 1. First, a better functional food product development (FFPD) model is proposed after a comprehensive review on current radical product innovation practices reported in the literature. Then, overall innovation characteristics of food companies operating in New Zealand are summarized and compared with international practices recommended for innovative food product development. Further, a comparison of the food innovation process in New Zealand and in Singapore is discussed. In addition the implications and limitations of this research are presented. Finally, future directions for continuing research in this discipline are proposed.

8.2. Practices that would improve the development of successful functional foods

The first aim was to *provide insight into practices that would improve the development of functional foods.*

A comprehensive review of traditional NPD practices and changing requirements of radical product innovation in the food industry led to a proposed better FFPD model, which has been published in *Trends in Food Science and Technology* (Chapter 2). The main differentiating factors identified in this FFPD model are: orientation towards innovation, knowledge generation (analytical), development of resource base of a company (open innovation), collaborative networks and arrangements, and commercialization strategies.

A change from a dominantly market oriented NPD to a product oriented NPD (although market oriented NPD should not be completely ignored), and a balance of product and market orientation is favoured for successful functional food NPD (Khan et al., 2013). Historically, the NPD process in the food industry has been a closed model, where all the NPD activities are conducted using company resources, and this has resulted in mostly incremental innovations. Among several reported drawbacks of this closed NPD, limited resources and spending on R&D are considered the most critical in the current scenario of competing on price and quality offering in supermarkets. Also, easy access to technical innovations has made it critically important for food companies to rethink their NPD model from being an internally closed NPD model to a flexible interactive model. The other relevant changes required for FFPD is a focus on generating analytical knowledge instead of relying heavily on

synthetic knowledge. This can be accomplished by developing the resource (technical know-how) base of the company by creating collaborative networks with diversified external partners. This network approach is not only essential for product development but also for commercializing these innovative functional food products. The main focus of these commercialization strategies should be to develop intellectual assets for a company which are essential in securing the premium returns on investment. Overall it can be said a more comprehensive and interactive nonlinear NPD model will suit the successful functional foods NPD.

Innovation Practices by the food manufacturing companies of New Zealand

The second aim of the research was to *understand the innovation processes and practices currently used by the food manufacturing industry (in New Zealand and Singapore).*

Three main objectives were constructed to focus the empirical investigations. These objectives encompass previous findings in support of answering the first aim. This research therefore, empirically investigates the innovation processes of food manufacturing with special emphasis on orientation towards innovation, collaborative networks and commercialisation techniques, as described in chapters 2 and 3.

To investigate the new product development practices, major aims of NPD, mode of NPD and organizational orientation towards NPD.

The findings related to NPD characteristics of food companies such as NPD aim, Mode and orientation (as discussed in Chapter 4,5 & 6), suggest that food companies are following a linear model of predominantly market oriented NPD, as compared to new interactive non-linear NPD models (Jacqueline et al., 2007; Winger, 2009). This kind of closed NPD model is in contrast to value-added food products such as functional food products/ health oriented food products NPD model where external collaborations are the main focus of innovating truly new functional food products (Khan et al., 2013; Mark-Herbert, 2004; Matthyssens et al., 2008). The closed NPD model is best suited to *"me too"* kinds of innovations, where speed to market is at the core of new products with slight modifications in formulation or packaging. This traditional NPD model has a serious deficiency of developing external links for developing resources and thus capabilities of food companies to innovate radically. Further the qualitative data analysis (Chapter 6) showed that smaller companies lack a proper structured NPD process whereas bigger companies have more structured processes. An informal NPD process with informal NPD staff in small companies would most likely fall

short of the mark for developing research based food products. Further, predominantly market-oriented NPD characteristics govern the whole NPD process. Contrary to this approach, a combination of product- and market-oriented NPD has been suggested to lead to successful functional food product development.

To investigate the cooperative network of food companies i.e., who are the major external partners and what kind of activities are done with them.

It was observed in this study (Chapter 4) that current reported NPD collaboration, which was centred on customers and ingredient suppliers, may not be considered as effective NPD collaboration for developing truly differentiated FFPD. Rather, it presented a situation where food companies are seen as contract manufacturers where customers' needs are met in new product development activities. This approach towards collaborations may be rendered by factors such as company size and access to market. Company size would not matter much if the local market was big enough to ensure easy access to mass consumers through local retailers. However, New Zealand is a small domestic market with few big retailers (customers); presenting a difficult situation for food manufacturers to avoid dictation from customers in their NPD endeavour. This situation may change if access to foreign markets is made easier for these food companies. Further exploration of current collaboration activities through qualitative data analysis (Chapter 6) revealed that food companies do not have a proper strategy to develop external collaborations; rather their approach is needs-based. Collaboration is mostly done through personal contacts, which are more likely to end when the project is finished or there is no need to collaborate. Some companies have only *ad hoc*-based approaches to their collaborations where some consultants or chefs are contacted when required. This approach may again be related to the size of the company and its resources. There is a need for developing a support system, by the public and private sector, to enhance the collaboration among various relevant stakeholders of food manufacturing, to increase the innovation capabilities and capacities of food companies. This will be essential in developing truly innovative functional food products that can be exported in competitive global market.

To investigate the commercialization tools of NPD such as protection of innovation, marketing tools and major challenges.

It was found (Chapter 4) that most of the food manufacturing companies rely upon conventional methods of protecting and marketing their new products. This is reflective of their NPD approach described in chapter 4, section 4.6. It was observed that food companies'

marketing activities are limited for their new products, rather being focussed on winning and sustaining key accounts (supermarket). The main goal of marketing thus revolves around getting SKUs listed by supermarkets. Access to consumers has been reported as one of the main challenges in the rapidly changing field of Fast Moving Consumer Goods (FMCG), an area mainly controlled by supermarkets (Menrad, 2003), which have dictated selling price through their significant buying power, squeezing the profit margins of food businesses (Beverland et al., 2006; Menrad, 2003; Playne et al., 2003). In this scenario, food manufacturers are faced with fierce pressure and competition from private brands that are offering quality products at lower price. Branded food manufacturers have to reconsider their resources and marketing skills to effectively introduce radically innovative products still at competitive price. Food manufacturers are usually short of technical knowledge and knowhow to develop technologically advanced product innovations, due to their limited resources and R&D spending (Bougrain & Haudeville, 2002). Nevertheless, differentiated functional food products may provide a rescue from the trap of profit margin negotiation that non–differentiated food products cannot provide (Mark-Herbert, 2003). Furthermore, food companies have to secure their innovations by developing a more sophisticated approach towards IP protection.

The third aim of the research was to *understand the current perceptions of personnel managing functional food development*. The fourth objective of the study focussed on this aim.

The objective was:

To investigate the perception towards various drivers of and barriers to functional foods development

The results (Chapter 5) showed that the drivers for developing new functional foods are in line with internationally reported drivers of functional food development (Euromonitor, 2010d; Hardy, 2010). The most important reported factor for developing these foods is the desire to attain competitive edge and avoid traditional competitive behaviour. These food products also create a market opportunity for food manufacturers and this helps in building trust with consumers about a company. These findings are in line with reported motivational drivers of functional food product development in the literature and global market surveys (Euromonitor, 2010d; Heasman & Mellentin, 2001; Lagorce, 2009; Regmi & Gehlhar, 2005; Sadler, 2005; Siro et al., 2008). Generally, creating a new market is challenging due to the

historical perspective of the food industry being characterized as market searcher rather than a market developer. Therefore these food products can be effective in creating new market opportunities if developed on innovative parameters of product innovation (Broring et al., 2006; Heasman & Mellentin, 2001).

Reported barriers to functional food product development were from a closed NPD perspective. This type of NPD model is bound to face the challenges of managing cost of innovation, regulatory complications and lack of technical skills. These challenges are related to the breadth and depth of resources a company has. The general small size of food businesses in New Zealand (Chapter 5) and Singapore (Chapter 7) coupled with the closed NPD model mean that a company is more prone to struggle in managing these challenges of radical functional food innovations. Cost and regulatory structure has already been reported to be the main barriers to functional food development in various studies and reports (Broring, 2008; EU, 2000; FDA, 1997; Mark-Herbert, 2003, 2004; Matthyssens et al., 2008). It has been suggested that the provision of comprehensive guidelines can facilitate the process of nutrient and health claim on these foods which then will help in bringing these innovations to market (Verhagen et al., 2010). The challenges of cost (resources) have been proposed to be dealt with through enhanced collaborations with external partners/stakeholders, such as pharmaceutical companies, government agencies and research institutes. A close collaboration of government bodies that are responsible for monitoring and regulating these novel foods could be an effective step towards successful development of functional food products. This approach has already proved effective in Japan (Menrad, 2003) and Canada (Canada, 2003; Ray, 2004) where a significant progress has been made in this segment of the food industry. In this connection, European Union has published its Regulation1924/2006 on nutrition and health claims on foods. This will help in defining the process of attaining health and nutrient claims on functional foods. In this regard, European Food Safety Authority provides scientific advice to the European Commission on issues related to health claims under regulation 1924/2006. It has provided several opinions on health claims (Verhagen et al., 2010). These developments may help in boosting functional food product development in coming years.

Food manufacturers would like to have a new bioactive ingredient in their product if it has proven legal status, proven health efficacy and it matches with recent product trends in the market (Chapter 5). As discussed earlier, this is a reflection of traditional NPD process where a bioactive ingredient is purchased from a supplier who has already established its efficacy.

This approach has been reported to yield incremental innovations. This model is best suited to those companies that lack resources and capacities to do extensive R&D activities. This approach will not allow food manufacturers to learn and develop those skills that are crucial for developing efficacy of bioactive functional foods. This can be seen from the fact that food companies ranked "lack of technical skills "as the third most challenging barrier in functional food development, indicating a typical problem of SMEs that are unable to cope with complex technological issues and thus cannot grow substantially in the functional food market (Broring, 2008; Broring et al., 2006; B. B. Butchko & Petersen, 2006; Hardy, 2010; Siro et al., 2008). This again indicates the importance of collaborative links with various stakeholders in order to build innovation capacities and capabilities.

8.2.1. Perceived desired characteristics of a new bioactive food ingredient

8.3. Inter and Intra Industry Comparison

A further investigation of the second aim (*understand the innovation processes and practices currently used by the food manufacturing industry (in New Zealand and Singapore)* was achieved by differentiating companies based on their reported involvement in functional foods (Chapter 5) or not. Two groups were formed which facilitated a hypothesis driven approach comparing activities between these groups. The main hypotheses investigated were

1. *H1: There is a difference in NPD orientation between companies manufacturing functional foods and other food companies.*
2. *H2: There is a difference in external collaborative links between companies manufacturing functional foods and other food companies.*
3. *H3: there is a difference in commercialization techniques between companies manufacturing functional foods and other food companies.*

The comparative analysis of data showed that the food industry in general operates on similar resources and capabilities irrespective of type of innovation activity. From a resource-based view (RBV) of competitive advantage, it is unlikely that any of the food companies surveyed will gain a significant competitive edge in this environment (Barney, 1991). A traditional approach to NPD collaboration dominates the New Zealand food manufacturing industry regardless of reported functional food new product launches or not. However, a promising trend with those businesses self-reporting functional food new product launches was an increased external collaborative activity, particularly with government funded research organisations and Universities. Food businesses in New Zealand, keen to engage in functional food NPD, need to strengthen these research linkages and generate protectable IP

to build brands that can combat the supermarket-driven price wars. This can lead to the creation of heterogeneity in resources of these firms and hence they may develop capabilities to exploit these resources to implement differentiated innovation strategies. These external collaborations need to be further investigated in relation to innovation activities in the food industry. Also there is a need to identify resources for development of functional foods and capabilities that are valuable, rare and costly to imitate. These resources and capabilities are critical for attaining competitive advantage in the food manufacturing industry.

A comparison of Singapore and New Zealand food manufacturing companies (Chapter 7) overall exhibited similar response patterns to various innovation processes, suggesting that both countries need to move away from a traditional NPD approach and adopt new interactive NPD models in order to succeed in value-added functional food development. Though some differences were observed in their approach towards innovation, collaborative network and commercialization techniques, the perception of various drivers of and barriers to functional food development was similar. There are certain complementary areas of opportunity for both countries to collaborate in order to boost the progress of value added food production i.e., Singapore lacks primary production, a key strength of New Zealand; New Zealand is isolated geographically whereas Singapore is the export hub for the Asia-Pacific region (CORIOLIS, 2011).

8.4. Conclusions and implications for research and practice

This research has indicated that food manufacturing companies heavily rely upon internally closed NPD model with a major external input from customers and ingredient suppliers. This kind of NPD model is suited to incremental innovations, thus may face serious challenges of bringing truly differentiated functional food products. Also it was observed that functional food product development may be done by purchasing a bioactive ingredient that have proven efficacy (purchased from ingredient suppliers). Thus avoiding major R&D activities that are required to develop efficacy and hence a traditional NPD route is adopted. This approach will not generate functional food products that are unique and differentiated. A competitive edge through this approach is highly unlikely unless exclusivity of the bioactive ingredient is sought through more sophisticated commercialization route; currently no evidence of sophisticated commercialization routes was found in this research.

A customer dominated NPD approach is prone to fall short of the mark in the wake of emerging health and wellness market segment which requires a change in NPD attitude

where future needs and demands of consumers are to be met through understanding consumer attitudes towards foods and their life-style. However, this is a challenging task for food companies that are too small, to employ NPD professionals and resources to develop an interactive NPD model where internal capabilities are leveraged with external resources to enhance the innovative capability of food companies.

In connection to innovation of truly differentiated FFPD, current collaborations are bound to have serious limitations as being restricted to customers, suppliers and key accounts that are, in fact, controlling the NPD direction. This approach is not suited to radical product innovations. In order to supplement with extended resources for enhancing innovative capabilities of these food companies, external NPD collaborations with diverse external partners, such as research institutes/universities and commercial/public research facilities are essential. Further these collaborations should be embedded into the broader business strategy for developing a long-term relationships rather than a needs-based approach. This approach will enable these collaborations to be institutionalized instead of being personalized. However this approach towards collaborations will again ask for a change in NPD model to be more flexible and open in order to absorb external knowledge and skills through formalized collaborative structures within a company. Industry-university relationship needs serious attention from Government to enhance the innovative capabilities of SMEs for developing truly differentiated FFPD.

The current findings observed a traditional approach towards NPD commercialization which is reflective of incremental innovations. Further the perception towards various barriers of (cost, regulatory structure and efficacy) and drivers to FFP (competitive edge & market opportunity) are of a typical conventional NPD approach. This research also suggest that all type of new food products (traditional foods/functional foods) are developed through same traditional NPD process and resources which is in contrast to reported literature and practices of successful FFPD.

Overall it can be concluded that current NPD model is a typical incremental NPD process operating through informal structure and NPD personnel that lack the ability to recognise different needs and resources for innovating truly differentiated FFPD. Therefore New Zealand food manufacturing must adopt a NPD process which can cater the needs for discontinuous product innovations that will ensure higher return on investment while providing leading edge in global food market.

8.5. Limitations and future research

This study was exploratory in nature and the results presented are from a small industry size (New Zealand). The responses were collected from a NPD personnel or similar persons responsible for product development activities in each food company. A single response was collected against each item of the construct in this survey. Therefore propositions made in this thesis are cautiously offered. It is hoped that further studies will broaden the scope of these propositions. Also, multiple responses from a single company about commercialization techniques can be sought in future studies, to ensure a comprehensive response from a multidisciplinary area.

This research was a first step towards understanding the characteristics of the innovation process of the food manufacturing industry in relation to value creation for FFPD. Further investigations on variable factors of value creation should be explored in more depth by academia, government institutes and relevant industry experts to provide guidelines for the food industry to develop differentiated policies of innovations and to assist government in framing appropriate policy to support development in this important emerging area.

References

Aaker, D. A., Kumar, V., & Day, G. S. (1995). *Market Research* (Fifth ed.). New York: John Wiley & Sons, Inc.

Aarikka-Stenroos, L., & Sandberg, B. (2012). From new-product development to commercialization through networks. *journal of Business Research, 65*(2), 198-206. doi: http://dx.doi.org/10.1016/j.jbusres.2011.05.023

Anahita, B., Jennifer, R., Sally, S., & Daffyd, D. (2012). Innovation in food sector SMEs. *Journal of Small Business and Enterprise Development, 19*(2), 300 - 321.

Asheim, B., T., & Coenen, L. (2005). Knowledge bases and regional innovation systems: Comparing Nordic clusters. *Research Policy, 34*, 1173-1190.

Ashley-Jones, C. (2010). Economic Survey of Manufacturing: March 2010 quarter *Hot Off the Press*. Wellington: Statistics New Zealand.

Atuahene-Gima, K. (1996). Market orientation and innovation. *Journal of Business Research, 35*(2), 93-103. doi: http://dx.doi.org/10.1016/0148-2963(95)00051-8

Bailetti, J. A., Callahan, R. J., & McCluskey, S. (1998). Coordination at different stages of the product design process. *R & D Management, 28*(4), 237-247.

Baker, V., Brady, B., & Mary., V. (2012). Regulatory environment for nutraceuticals and functional foods (pp. 28). Canada: Canada Institute for Scientific and Technical Information.

Barbara, B., & Francesco, G. (2012). Models of adoption of Open Innovation within the Food Industry. *Trends in Food Science & Technology, 10.1016/j.tifs.2012.11.001*. doi: 10.1016/j.tifs.2012.11.001

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management, 17*(1), 99-20.

Barriball, K. L., & While, A. E. (1999). Non-response in survey research: a methodological discussion and development of an explanatory model. *Journal of Advanced Nursing, 30*(3), 677-686.

Bech-Larsen, T., Poulsen, J., & Grunert, K. G. (1999). Acceptance of functional foods in Denmark, Finland and the US- A cross-cultural study of consumer values and preferences. http://ideas.repec.org/p/hhb/aarmap/0073.html#provider

Bech-Larsen, T., & Scholderer, J. (2007). Functional foods in Europe: Consumer research, market experiences and regulatory aspects. *Trends in Food Science and Technology, 18*, 231-234.

Beckeman, M., Bourlakis, M., & Olsson, A. (2013). The role of manufacturers in food innovations in Sweden. *British Food Journal, 115*(7), 953-974.

Beckeman, M., & Skjoldebrand, C. (2007). Clusters/networks promote food innovations. *Journal of Food Engineering, 79*(4), 1418-1425.

Benkouider, C. (2003). Euromonitor archive. *Functional food- fad or future?* Retrieved 05-05-2010, 2010, from www.euromonitor.com/articles.aspx?folder=Functional_food_fad_or_future

Benkouider, C. (2004). Euromonitor archive. *Functional food: strong performance, but barriers remain.* Retrieved 05/05/2010, 2010, from www.euromonitor.com/articles.aspx?folder=Functional_food_strong_performance_but_barriers_remain

Benner, M., Geerts, R. F. R., Linnemann, A. R., Jongen, W. M. F., Folstar, P., & Cnossen, H. J. (2003). A chain information model for structured knowledge management: towards effective and efficient food product improvement. *Trends in Food Science & Technology, 14*(11), 469-477.

Bennett, R. C., & Cooper, R. G. (1981). The misuse of marketing: An American tragedy. *Business Horizons, 24*(6), 51-61. doi: http://dx.doi.org/10.1016/0007-6813(81)90026-4

Beri, G. (2008). *Marketing Research*. New Delhi, India: The McGraw-Hill

Beverland, M. B., Ewing, M. T., & Matanda, M. J. (2006). Driving-market or market-driven? A case study analysis of the new product development practices of chinese business-to-business firms. *Industrial Marketing Management, 35*, 383-393.

Bhaskaran, S. (2006). Incremental innovation and business performance: Small and medium-size food enterprises in a concentrated industry environment. *Journal of small Business Management, 44*(1), 64-80.

Bougrain, F., & Haudeville, B. (2002). Innovation, collaboration and SMEs internal research capacities. *Research Policy, 31*, 735-747.

Bowonder, B., Dambal, A., Kumar, S., & Shirodkar, A. (2010). Innovation Strategies for Creating Competitive Advantage. *Research-Technology Management, 53*(3), 19-32.

Brick, J. M., & Kalton, G. (1996). Handling missing data in survey research. *Statistical Methods in Medical Research, 5*, 215-238.

Broring, S. (2008). How systematic innovations require alterations along the entire supply chain: the case of animal-derived functional foods. *Journal on Chain and Network Science, 8*(2), 107-119.

Broring, S., Cloutier, L. M., & Leker, J. (2006). The front end of innovation in an era of industry convergence: evidence from nutraceuticals and functional foods. *R & D Management, 36*(5), 487-498.

Bryan, A. L., & Ferrell, O. C. (2000). Effect of market orientation on product innovation. *Journal of the Academy of Marketing Science, 28*(2), 239-247.

Bryman, A. (2006). Integrating quantitative and qualitative research: how is it done? *Qualitative Research, 6*(1), 97-113. doi: 10.1177/1468794106058877

Butchko, B. B., & Petersen, B. J. (2006). Functional foods/regulatory aspects. In C. Benjamin (Ed.), *Encyclopedia of human nutrition* (Second ed.): Elsevier Ltd.

Butchko, H. H., & Petersen, B. J. (2005). FUNCTIONAL FOODS | Regulatory Aspects. In C. Editor-in-Chief: Benjamin (Ed.), *Encyclopedia of Human Nutrition (Second Edition)* (pp. 366-375). Oxford: Elsevier.

Butchko, H. H., Petersen, B. J., & Benjamin, C. (2005). FUNCTIONAL FOODS | Regulatory Aspects *Encyclopedia of Human Nutrition* (pp. 366-375). Oxford: Elsevier.

Cagliano, R., Chiesa, V., & Manzini, R. (2000). Differences and similarities in managing technological collaborations in research, development and manufacturing: a case study. *Journal of Engineering and Technology Management, 17*, 193-224.

Canada, S. (2003). The Functional Foods and Nutraceuticals Survey. 2011, from http://www.statcan.gc.ca/imdb-bmdi/instrument/5038_Q1_V1-eng.pdf

Cantwell, J., & Molero, J. (Eds.). (2003). *New Horizons in International Business*. Cheltenham, UK.

Northhampton, MA, USA: Edward Elgar Publishing, Inc.

Caracelli, V. J., & Greene, J. C. (1993). Data analysis strategies for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis, 15*, 195-207.

Chiaroni, D., Chiesa, V., & Federico., F. (2011). The open innovation journey: How firms dynamically implement the merging innovation management paradigm. *Technovation, 31*, 34-43.

Christensen, C. M., Johnson, M. W., & Rigby, D. K. (2002). Foundations for growth: How to identify and build disruptive new businesses. *MIT Sloan Management Review*, 22-31.

Chung-Yean, C., Canan, K.-H., & Nallan, S. (2012). An empirical investigation of the impact of strategic sourcing and flexibility on firm's supply chain agility. *International Journal of Operations & Production Management, 32*(1), 49-78.

Cooper, R. G. (1984). The impact of new product strategies. *Industrial Marketing Management, 12*, 235-256.

Cooper, R. G. (1992). New product success in industrial firms. *Industrial Marketing Management, 20*, 215-223.

Cooper, R. G. (Ed.). (2003). *Profitable product innovation: the critical success factors*. Canada: Elsevier science ltd.

Coppens, P., Fernandes da Silva, M., & Pettman, S. (2006). European regulations on nutraceuticals, dietary supplements and functional foods: A framework based on safety. *Toxicology*(221), 59-74.

CORIOLIS. (2011). Food & Beverage information project In Coriolis (Ed.), *Market Stream* (Vol. 1.3, pp. 24). online.

Costa, A. I. A., & Jongen, W. M. F. (2006). New insights into consumer-led food product development. *Trends in Food Science & Technology, 17*(8), 457-465.

Creswell, J. W., Clark, V. L. P., Gutmann, M., & Hanson, W. E. (2003). Advanced mixed-methods research designs. In A. Tashakkori & C. Teddlie (Eds.), *Handbook on mixed methods in the behavioral and social sciences.* (pp. 40-209). Thousands Oaks, CA: Sage.

Dahlander, L., & Gann, D. M. (2010). How open is innovation? *Research Policy, 39*, 699-709.

Dess, G. G., Lumpkin, G. T., & McKee, J. E. (1999). Linking Corporate Entrepreneurship to Strategy, Structure, and Process: Suggested Research Directions. *Entrepreneurship: Theory and Practice, 23*(3), 85-102.

Diestre, L., & Rajagopalan, N. (2012). Are all 'SHARKS' dangerous? New biotechnology ventures and partner selection in R&D alliances. *Strategic Management Journal*. doi: 10.1002/smj.1978

Diez, J. R., & Kiese, M. (2009). Regional innovation systems. *International Encyclopedia of Human Geography*, 246-251.

Diplock, A., Aggett, P. J., Ashwell, M., Bornet, F., Fern, E. B., & Roberfroid, M. B. (1999). Supplement-Scientific Concepts of Functional Foods in Europe: Consensus Document. *British Journal of Nutrition, 81*(4), 1.

Earle, M. D. (1997). Innovation in the food industry. *Trends in Food Science and Technology, 8*, 166-175.

Emden, Z., Calantone, R. J., & Droge, C. (2006). Collaborating for New Product Development: Selecting the Partner with Maximum Potential to Create Value.

Journal of Product Innovation Management, 23(4), 330-341. doi: 10.1111/j.1540-5885.2006.00205.x

EU. (2000). Scientific concepts of functional foods in Europe

Consensus document (C. Unit, Trans.). In C. research (Ed.), *Quality of Life and Management of Living Resources* (Vol. 3, pp. S1-S27). Brussels: Directorate-General for Research , European Commission.

Euromonitor, I. (2009a). Fortified/functional packaged food-UK *Euromonitor International: Country Sector Briefing*.

Euromonitor, I. (2009b). Rationalization and geographic expansion remain key to growth in packaged food In I. Euromonitor (Ed.), *Packaged food-Corp strategy* (pp. 65). London: Euromonitor International.

Euromonitor, I. (2010a). Cardiovascular Health: A Key Area of Functional Food and Drinks Development (pp. 52). London: Euromonitor International.

Euromonitor, I. (2010b). Fortified/functional Packaged Food-AUS *Euromonitor International: Country Sector Briefing*.

Euromonitor, I. (2010c). Fortified/functional Packaged Food-US *Euromonitor International: Country Sector Briefing*.

Euromonitor, I. (2010d). Navigating wellbeing: Today and tomorrow in functional food and drinks-world. 2011, from www.euromonitor.com

Euromonitor, I. (2013a). Health and Wellness: Euromonitor from trade sources/national statistics. Retrieved 30/04/2013 http://www.portal.euromonitor.com/Portal/Pages/Magazine/IndustryPage.aspx

Euromonitor, I. (2013b). Packaged food in Singapore *Industry overview* (pp. 41). online: Euromonitor International.

FDA Modernization Act of 1997 (FDAMA) (1997).

Finda, L. (2007). Online directory of New Zealand Businesses. Retrieved 16/02/2011, 2011, from www.ubd.co.nz

Finda, L. (2011). New Zealand business directory, listings and review. Retrieved March-2011 http://www.finda.co.nz/business/c/food-manufacturers/

Frewer, L., Scholderer, J., & Lambert, N. (2003). Consumer acceptance of functional foods: issues for the future. *British Food Journal, 105*(10), 714-730.

Fritzsch, L.-M. (2010). Functional Food Net (FFNet): Innovation in food industry. Retrieved 12/02/2013, from http://www.eu-research.com, http://www.eu-research.com/Themes/functional-food/

FSANZ. (2013). Nutrition, Health and Related Claims *Food Standards* (Vol. 1.2.7). Online: Food Standards Australia New Zealand.

Furman, J. L., Porter, M. E., & Stern, S. (2002). The determinants of national innovative capacity. *Research Policy, 31*(6), 899-933.

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. doi: 10.1111/1540-5885.1920110

Gehlhar, M. J., Regmi, A., Stefanou, S. E., & Zoumas, B. L. (2009). Brand leadership and product innovation as firm strategies in global food markets. *Journal of Product and Brand Management, 18*(2), 115-126. doi: 10.1108/10610420949013

Geoff, B. (2010). Business operation survey 2009. *Business growth and innovations.* 2011, from http://www.stats.govt.nz/browse_for_stats/businesses/business_growth_and_innovation/BusinessOperationsSurvey_HOTP2009.aspx

Gordon, J. S., & McNew, R. (2008). Developing the online survey. *Nurs Clin N Am, 43*, 605-619.

Government. (2012). Driving growth in the processed foods sector (F. a. Beverage, Trans.) (pp. 110). Auckland: Ministry of Business Innovation and Employment.

Graf, E., & Saugy, I. S. (Eds.). (1999). *Food product development process: from concept to the marketplace*. Gaithersburg, Maryland: Aspen Publisher Inc.

GraphPad Software, I. (2013). QuickCalcs. Retrieved from http://www.graphpad.com/quickcalcs/contingency1/

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis, 11*, 255-274.

Gupta, A., Pawar, K. S., & Smart, P. (2007). New product development in the pharmaceutical and telecommunication industries: A comparative study. *International Journal of Production Economics, 106*(1), 41-60. doi: http://dx.doi.org/10.1016/j.ijpe.2006.04.008

Hardy, N. (2010). Future innovations in food and drinks to 2015 *NPD, trend convergence and emerging growth opportunities* (pp. 152). London: Business Insights.

Heasman, M., & Mellentin, J. (2001). *The Functional Foods Revolution: Healthy people, healthy profits?* London: Earthscan Publications Ltd.

Helen, S. (2002). Profitability in market-oriented SMEs: does product innovation matters? *European Journal of Innovation MAnagement, 51*(3), 164-171.

Hillebrand, B., & Biemans, W. G. (2004). Links between internal and external cooperation in product development: An exploratory study. *The Journal of Product Innovation Management, 21*, 110-122.

Hoban, T. J. (1998). Improving the success of new product development. *Food Technology 52*(1), 46-49.

Hoecht, A., & Trott, P. (2006). Innovation risks of strategic outsourcing. *Technovation, 26*, 672-681.

Howe, P. R. C. (2000). What makes a functional food functional? *Asia Pacific J Clin Nutr, 9*(Suppl.), S108-S112.

Humphreys, P., Huang, G., Cadden, T., & McIvor, R. (2007). Integrating design metrics within the early supplier selection process. *Journal of Purchasing & Supply Management, 13*, 42-52.

Huston, L., & Sakkab, N. (2006). Connect and Develop: Inside Procter & Gamble's New Model for Innovation. *Harvard Business Review* 1-8.

IBM. (2013). IBM SPSS Statistics 20 (Version 20). New York: IBM. Retrieved from http://www-01.ibm.com/software/analytics/spss/

IndexNZ. (2010). Web Directory for New Zealand. Retrieved 11/11/2010, 2010, from http://www.indexnz.com/Top/Business-and-Economy/Industries/Food-and-Beverages/Food-Companies

Ivankova, N. V., Creswell, J. W., & Stick, S. L. (2006). Using mixed-methods sequential explanatory design: From thoery to practice. *Field Methods, 18*(1), 3-20.

Jacqueline, H., Beckley, M., Michele, F., Elizabeth, J., Topp, J. C., & Huang, W. P. (Eds.). (2007). *Accelerating new food product design and development* (1st ed.). Ames, Iowa: Blackwell Pub. : IFT Press.

Jie, S., Peiji, S., & Jiaming, F. (2008). Effect of incentives on web-based surveys. *TSINGHUA SCIENCE AND TECHNOLOGY, 13*(3), 344-347.

John, G., & Reve, T. (1982). The Reliability and Validity of Key Informant Data from Dyadic Relationships in Marketing Channels. *Journal of Marketing Research, 19*(4), 517-524. doi: 10.2307/3151724

John, T., Eric, H., Mark, G., & Jon, D. (2007). A resource-based view and market orientation theory examination of the role of "Familiness" in fmaily business success. *Family Business Review, XX*(1), 17-31.

Jones, P. J., & Jew, S. (2007). Functional food development: concept to reality. *Trends in Food Science and Technology, 18*, 387-390.

Kelly, D. (2009). Adaptation and organizational connectedness in corporate radical innovation programs. *Journal of Product Innovation Management, 26*, 487-501.

Kevin., M., Graeme., A., Russell., B., & Johns, D. (2012). A call to arms (pp. 72). Palmerston North: Riddet Institute.

Khan, R. S., Grigor, J., Winger, R. J., & Win, A. (2013). Functional food product development-opportunities and challenges for food manufacturers. *Trends in Food Science & Technology*(30), 27-37.

Kim, W. C., & Mauborgne, R. (1999). Strategy, value innovation, and the knowledge economy.(Special Issue: In Search of Strategy)(includes related article on profitable corporate growth). *Sloan Management Review, 40*(3), 41(41).

Kleef, E. V., Trijp, H. C. M. V., Luning, P., & Jongen, W. M. F. (2002). Consumer-oriented functional food development: how well do functional disciplines reflect the 'voice of the consumer'? *Trends in Food Science and Technology, 13*, 93-101.

Kohli, A. K., & Bernard, J. J. (1990). Market Orientation: the construct, research proposition, and managerial implications. *Journal of Marketing, 54*(2), 1-18.

Kompass, N. Z. (2011). Advanced Search. Retrieved March 2011, from Kompass New Zealand http://nz.kompass.com/en/advanced-search.html

Krystallis, A., Maglaras, G., & Mamalis, S. (2008). Motivations and cognitive structures of the consumers in their purchasing of functional foods. *Food Quality and Preference, 19*, 525-538.

Laforet, S. (2008). Size, strategic, and market orientation affects on innovation. *Journal of Business Research, 61*, 753-764.

Lagorce, A. (2009). Functional foods bring healthy returns. Retrieved 06-05, 2010, from http://www.marketwatch.com/story/functional-foods-bring-healthy-returns-2009-12-09

Leech, N. L., & Onwuegbuzie, A. J. (2007). An array of qualitative data analysis tools: A call for data analysis triangulation. *Schoold Psychology Quarterly, 22*(4), 557-584. doi: 10.103/1045-3830.22.4.557

Lehenkari, J. (2003). On The Borderline of foods and drug: Constructing Credibility and Markets for a Functional Food Product. *Science as Culture, 12*(4), 499-525. doi: 10.1080/0950543032000150337

Linnemann, A. R., Benner, M., Verkerk, R., & Van Boekel, M. A. J. S. (2006). Consumer-driven food product development. *Trends in Food Science & Technology, 17*, 184-190.

Lukas, B., A., & Ferrell, O. C. (2000). The effect of market orientation on product innovation. *Journal of the Academy of Marketing Science, 28*(2), 239-247. doi: 10.1177/0092070300282005

Lynch, R. (2006). International Acquisition and Other Growth Strategies: Some Lessons from the Food and Drink Industry. *Thunderbird International Business Review, 48*(5), 605–622

Mallard, H., Trevor. . (2007). *Food and beverage taskforce: Government response*. Wellingtone: Ministry of Economic Development Retrieved from http://www.med.govt.nz/templates/MultipageDocumentTOC____27840.aspx.

Margaret, A. P. (1993). The conerstones of competitive advantage: a resource-based view. *Strategic Management Journal, 14*, 179-191.

Mark-Herbert, C. (2002). *Functional food for added value. Developing and marketing a new product category.* (PhD), Swedish University of Agricultural Sciences, Uppsala.

Mark-Herbert, C. (2003). Development and marketing strategies for functional foods. *AgBioForum, 6*(1&2), 75-78.

Mark-Herbert, C. (2004). Innovation of a new product category - functional food. *Technovation, 24*, 713-719.

Marsh, D. (2003). Does New Zealand have an innovation system for biotechnology? *Technovation, 23*(2), 103-112.

Matthyssens, P., Vandenbempt, K., & Berghman, L. (2006). Value innovation in business markets: Breaking the industry recipe. *Industrial Marketing Management, 35*, 751-761.

Matthyssens, P., Vandenbempt, K., & Berghman, L. (2008). Value innovation in the functional food industry: Deviations from the industry recipe. *British Food Journal, 110*(1), 144-155.

McNaughton, R. B., & Green, M. B. (2002). *Global Competition and Local Networks*. Hampshire: Ashgate Publishing Limited.

MED. (2011). SMEs in New Zealand: Structure and dynamics. Wellington: Minsitry of Economic Development.

Mellentin, J. (2013). 10 key trends in food, nutrition and health 2013. http://www.new-nutrition.com/report/showReport/985: New Nutrition Business.

Menrad, K. (2003). Market and marketing of functional food in Europe. *Journal of Food Engineering, 56*, 181-188.

Ministry of Health, L. a. W. (2013). Food for specified health uses. Retrieved 14 November, 2013, from http://www.mhlw.go.jp/english/topics/foodsafety/fhc/02.html

Mishra, A. A., & Shah, R. (2009). In union lies strength: Collaborative competence in new product development and its performance effects. *Journal of Operations Management, 27*(4), 324-338. doi: http://dx.doi.org/10.1016/j.jom.2008.10.001

Moghaddam, F. M., Walker, B. R., & Harre, R. (2003). Cultural distance, level of abstraction, and the advantages of mixed methods. In A. Tashakkori & C. Teddlie (Eds.), *Handbook on mixed methods in the behavioral and social sciences.* (pp. 51-89). Thousands Oaks, CA: Sage.

Mortara, L., & Minshall, T. (2011). How do large multinational companies implement open innovation? *Technovation, 31*, 586-597. doi: 10.1016/j.technovation.2011.05.002

Moskowitz, H., & Hartmann, J. (2008). Consumer research: creating a solid base for innovation strategies. *Trends in Food Science and Technology, 19*, 581-589.

MUHEC. (2013). Research Ethics. 2013, from http://www.massey.ac.nz/massey/research/research-ethics/research-ethics_home.cfm

Murphy, E., Dingwall, R., Greatbatch, D., Parker, S., & Watson, P. (1998). Qualitative research methods in health technology assessment: a review of the literature. . *Health Technol Assessment, 2*(16), 294.

Nieto, M. J., & Santamaria, L. (2007). The importance of diverse collaborative networks for the novelty of product innovation. *Technovation, 27*, 367-377.

Nijssen, E. J., & Frambach, R. T. (2000). Determinants of the adoption of new product developemnt tools by industrial firms. *Idustrial Marketing Management, 29*, 121-131.

OECD. (2005). Oslo Manual: Guidelines for collecting and interpreting of innovation data (3rd ed., pp. 166). Oslo: Organisation for Economic Cooperation and Development.

OECD. (2007). SDBS Structural Business Statistics (ISIC Rev. 3): Manufacturing (By Size Class) (Statistical data). OECD Retrieved 5/03/2013, from OECD http://stats.oecd.org/#

Ok, J. (2009). *Food Information System.* (Master Research), The University of Rhode Island Rhode Island.

Onwuegbuzie, A. J., & Collins, J. K. (2007). A typology of mixed-methods sampling designs in social science research. *The Qualitative Report, 12*(2), 281-316.

Pervaiz, A. (2013). *Determinants of Coordination Effectiveness of Selected International Agri-food Supply Chains: A Structural Equation Modelling Approach.* (Doctor of Philosophy), Massey University, New Zealand.

Petersen, K. J., Handfield, R. B., & Ragatz, G. L. (2003). A model of supplier integration into new product development. *Journal of Product Innovation Management, 20*, 284-299.

Petersen, K. J., Handfield, R. B., & Ragatz, G. L. (2005). Supplier integration into new product development: coordinating product, process and supply chain design. *Journal of Operations Management, 23*, 371-388.

Playne, M. J., Bennett, L. E., & Smithers, G. W. (2003). Functional dairy foods and ingredients. *The Australian Journal of Dairy Technology, 58*(3), 242-264.

Podsakoff, P. M., Mackenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method baises in behavioral research: A critical review of the literature and recommedned remedies. *Journal of Applied Psychology, 88*(5), 879-903.

Porter, M. E. (2000). Location, competition and economic development: Local clusters in a global economy. *Economic Development Quarterly, 14*(1), 15-34.

Ragatz, G. L., Handfield, R. B., & Scannell, T. V. (1997). Success factors for integrating suppliers into new product development. *Journal of Product Innovation Management, 14*, 190-202.

Ray, K. (2004). *A strategic analysis of new product entry into the nutraceuticals, functional foods, and vitamins and supplements market.* (Master of buisness adminstration Masters), University of Victoria, 1992, Victoria.

Regmi, A., & Gehlhar, M. J. (2005). New directions in global food market (USDA, Trans.). In A. Regmi & M. J. Gehlhar (Eds.), *Agriculture Information Bulletin* (pp. 81): Economic Research Services USDA.

Regulation (EC) No. 1924/2006 of the European Parliament and of the Council of 20 December 2006 on nutrition and health claims made on foods (2007).

RELEASES, F. N. (2002). BEAUTY AND NUTRITION - L'ORÉAL AND NESTLÉ ANNOUNCE A JOINT-VENTURE PROJECT. Retrieved 11 November 2013, 2013, from http://www.loreal-finance.com/eng/news-release/beauty-and-nutrition-loreal-and-nestle-announce-a-joint-venture-project-38.htm

Ritter, T., & Gemunden, H. G. (2003). Network competence: Its impact on innovation success and its antecedents. *Journal of Business Research, 56*, 745-755.

Ronteltap, A., Van Trijp, J. C. M., Renes, R. J., & Frewer, L. J. (2007). Consumer acceptance of technology-based food innovations: Lessons for the future of nutrigenomics. *Appetite, 49*, 1-17.

Rudder, A., Ainsworth, P., & Holgate, D. (2001). New food product development: strategies for success? *British Food Journal, 103*(9), 657-671.

Rudolph, M. J. (1995). The food product development process. *British Food Journal, 97*(3), 3-11.

Sadler, J. (2005). Innovation in functional food and drinks. In J. Sedler (Ed.), *Growth opportunities from new nutraceutical ingredients*: Business Insights Ltd.

Salavou, H., Baltas, G., & Lioukes, S. (2004). Organizational innovation in SMEs: The importance of strategic orientation and competitive structure. *European Journal of Marketing, 38*(9/10), 1091-1112.

Sandelowski, M. (2000). Combining qualitative and quantitative sampling, data collection, and analysis techniques in mixed-methods studies. *Research in Nursing & Health, 23*, 246-255.

Sarkar, S., & Costa, A. I. A. (2008). Dynamics of open innovation in the food industry. *Trends in Food Science and Technology, 19*, 574-580.

Siedlok, F., Smart, P., & Gupta, A. (2010). Convergence and reorientation via open innovation: the emergence of nutraceuticals. *Technology Analysis and Strategic Management, 22*(5), 571-592.

Sinkovics, R. R., Penz, E., & Ghauri, P. N. (2005). Analysing textual data in international marketing research. *Qualitative Market Research: An International Journal, 8*(1), 9-38. doi: 10.1108/13522750510575426

Siriwongwilaichat, P. (2001). *Technical information capture for food product innovation in Thailand*. (PhD), Massey University, Palmerston North, New Zealand.

Siro, I., Kaplona, E., Kaplona, B., & Lugasi, A. (2008). Functional food. Product development, marketing and consumer acceptance-A review. *Appetite, 51*, 456-467.

Stanton, C., Ross, R. P., Fitzgerald, G. F., & Van Sinderen, D. (2005). Fermented functional foods based on probiotics and their biogenic metabolites. *Current Opinion in Biotechnology, 16*(2), 198-203. doi: 10.1016/j.copbio.2005.02.008

Stewart-Knox, B., & Mitchell, P. (2003). What separates the winners from the losers in new food product development? *Trends in Food Science and Technology, 14*, 58-64.

Stopford, J. M., Charles, W. F., & Baden-Fuller. (1994). Creating corporate entrepreneurship. *Strategic Management Journal, 15*(7), 521-536.

SurveyGizmo. (2013). PS_Build Mapping New Product. 2013, from https://appv3.sgizmo.com/projects/overview?id=1173536

Suwannaporn, P., & Speece, M. (2003). Marketing research and new product development success in Thai food processing. *Agribusiness, 19*(2), 169-188.

Taran, T. (2007). University-Industry collaboration: the network embeddedness approach. *Science and Public Policy, 34*(3), 158-168.

Tashakkori, A., & Teddlie, C. (Eds.). (2010). *Handbook of mixed methods in social and behavioral research* (2nd ed.). Los Angeles: Sage.

Teddlie, C., & Tashakkori, A. (2003). Major issues and controversies in the use of mixed-methods in the social and behavioral sciences. In C. Teddlie & A. Tashakkori (Eds.), *Handbook on mixed methods in the behavioral and social sciences.* (2nd ed., pp. 3-50). Thousand Oaks, CA: Sage.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18*(7), 509-533.

Terziovski, M. (2010). Innovation practice and its performance implications in small and medium enterprises (SMEs) in the manufacturing sector: a resource-based view. *Strategic Management Journal, 31*(8), 892-902. doi: 10.1002/smj.841

Tether, B. (2002). Who co-operates, and why. An empirical analysis. *Research Policy, 31*, 947-967.

Todtling, F., Lehner, P., & Kaufmann, A. (2009). Do different types of innovation rely on specific kinds of knowledge interactions? *Technovation, 29*, 59-71.

Traill, W. B., & Mueulenberg, M. (2002). Innovation in the food industry. *Agrbusiness, 8*(1), 1-21. doi: 10.1002/agr.10002

Valk, W. v. d., & Wynstra, F. (2005). Supplier involvement in new product development in the food industry. *Industrial Marketing Management, 34*, 681-694.

Van de Vrande, V., DeJong, J. P. J., Vanhaverbeke, W., & deRochemont, M. (2009). Open innovation in SMEs: Trends, motives and management challenges. *Technovation, 29*, 423-437.

Van der Meer, H. (2007). Open innovation-the Dutch treat: challenges in thinking in business models. *Creativity and Innovation Management, 16*(2), 192-202.

Van Kleef, E., Van Trijp, H. C. M., & Luning, P. (2005). Consumer research in the early stages of new product development: a critical review of methods and techniques. *Food Quality and Preference, 16*(3), 181-201.

Verhagen, H., Vos, E., Francl, S., Heinonen, M., & van Loveren, H. (2010). Status of nutrition and health claims in Europe. *Archives of Biochemistry and Biophysics, 501*(1), 6-15. doi: http://dx.doi.org/10.1016/j.abb.2010.04.012

Veryzer, R. W. (1998). Discontinuous Innovation and the New Product Development Process. *Journal of Product Innovation Management, 15*(4), 304-321. doi: 10.1111/1540-5885.1540304

Winger, R. (2009). Product Development. In G. Campbell-Pllat (Ed.), *Food Science and Technology*. West Sussex: John Wiley & sons Ltd.

Wynstra, F., & Pierick, E. (2000). Managing supplier involvement in new product development: a portfolio approach. *European Journal of Purchasing & Supply Management, 6*, 49-57.

Ziggers, G. W. (2005). Radical product innovation in the Dutch food industry. *Journal of Food Products Marketing, 11*(3), 43-65.

Appendix I: Examples of functional food products

Serial #	Functional food product	Functional ingredient	Health claim
1	Rice Dream Heart Wise:	Fortified with phytosterol from plants	may lower cholesterol and redu risk of cardiovascular disease
2	8th Continent Soy Milk	Soy protein	May reduce the risk of heart dis and high blood pressure and str
3	Tropicana	FruitCal (Calcium)	Improve heart health
4	Minute Maid Premium Heart Wise	Phytosterol from plants	may lower cholesterol and redu risk of cardiovascular disease
5	DanActive (Probiotic yogurt)	Probiotic	Contribute to healthy gut flora
6	Kashi heart to heart Instant Oatmeal	Soluble fibre from oats	Support health cholesterol
7	Vitality yogurt Drink	Fat free, probiotic	Fat free
8	Ensure Immune Health	fiber-containing liquid formula with fructooligosaccharides (FOS)	FOS helps maintain digestive tr health
9	Celestial Seasonings, Wellness Tea	Natural Antioxidants	Help reduce the cell-damaging of free radicals in your body.
10	Yunker Energy Supplement drink	Promotes general well-being	Traditional oriental herbs

Appendix II – Invitation letter to participate in survey (New Zealand)

Ref.No. …..

Date: ……..

Subject: **Succeeding in new value added food markets**

Mr. …….

I am currently carrying out research on the prospects of future value added foods (specifically products with added health benefits) for the New Zealand food industry, at Massey University. This project is part of a larger Government funded research programme titled ***'future foods'***. For this project we have developed a census to map the domestic and international prospects of value added new food product development in New Zealand. This will potentially highlight new directions for the NZ food industry to enhance its productivity and competitiveness.

This letter is to respectfully request your permission for <Company name> to be part of this research and that we may interview your New Product Development Manager (or equivalent senior manager with primary responsibility for overseeing NPD and introduction in your business). Initial completion of a quantitative survey by the NPD Manager is not expected to take more than approximately 15 minutes.

We assure you the confidentiality of data collected under the Massey University rules of ethics, where no individual or company will be identified in the results - only cumulative results will be presented.

Your company's participation will be highly appreciated and in compensation of your time, a full and comprehensive executive summary of the results will be provided. Further, a benchmarking analysis of your company against the cumulative industry prospects in the value added market with domestic and international potential will also be provided.

Please let us know of your response to this request by completing the attached survey form and returning in the enclosed freepost envelope attached with this letter.

Yours Sincerely,

Mr. Rao Khan (Principal researcher) **Email**: r.s.u.khan@massey.ac.nz

Appendix III- Initial Response Form

(Note: This form can be mailed or emailed back at r.s.u.khan@massey.ac.nz*)*

No.

On behalf of:

<company name>

Please contact the following person with respect to completion of the necessary survey:

Name: …….....

Designation/job title: ……...

a. Preferred mode of contact:

1. Telephone ☐ 2. Skype ☐ 3. Face-face ☐

b. Contact Detail:

……

……

Preferred Time to contact:

1. Morning ☐ 2. Afternoon ☐ 3. Evening ☐

Please return the filled forms latest by 6th May, 2011 in the freepost envelop provided!

Many *Thanks for Your Time!*

Appendix IV- Quantitative questionnaire for New Zealand

Te Kunenga ki Pürehuroa

Title of the Project: "**Characterisation of food product innovation with reference to bioactive functional food product development: an Asia-Pacific study**"

A brief account of the project

This research is designed to identify the major drivers of and barriers to effective [2]bioactive functional ingredient/food development in the food industry. A brief quantitative survey is designed here to collect expert opinions of NPD/technical or R&D managers on the topic. This will provide a base line for developing a new business model for food manufacturers in New Zealand to innovate bioactive functional foods successfully. Moreover, later on an international perspective on NPD practices in functional foods will be generated through case-studies and interviews in various multinational companies in Australia, UK and Asia (Singapore). The incorporation of international trend into domestic NPD approaches is critical to develop globally competitive functional foods by the food manufacturers in New Zealand.

For ethical conduct of this research, please read the Information Sheet attached here (Appendix 1.1) and sign the Consent Form (Appendix 1.2) if you are willing to participate.

Many thanks for your precious time!

[2]**Bioactive functional food**: The food products that contain compounds from natural sources such as whey proteins from milk, herbal extracts, omega-3 and probiotics etc and have added health benefits for the human body.

Bioactive Functional Food Innovations

No…….

This survey is aimed at collecting food manufacturing industry response on the drivers of and barriers to the development of new foods containing novel bioactive ingredients.

Important Information

1. This questionnaire is designed for New Product Development/ Technical Managers or R&D Managers.
2. The data collected here will be used to construct a model suggesting an effective approach for developing bioactive functional foods.
3. All data will be kept strictly confidential to the study team. All responses will be collated and no individual company data will be identified.
4. Contact details of the researchers as well as Ethics committee for this research are provided in the Information Sheet (Appendix 1).

Definitions of the terms

A. ***Bioactive functional food***: The food products that contain compounds from natural sources such as bioactive peptides from milk (whey), herbal extracts (ginseng), omega-3 fatty acids (fish) and Lycopene (tomatoes) etc. and have added health benefits for human body.

B. ***Company*** means: A legally defined voluntary association that is organized to carry on a food manufacturing business.

Structure of the Questionnaire

Section I: Demographic of the Respondent

Section II: Firm Orientation towards Innovations

Section III: Drivers/Barriers of Functional (Bioactive) Food Innovations

Section IV: Cooperative network

Section V: Commercialization Routes

Note: Instructions to complete the Questionnaire are provided in each section.

Section I: Demographic of the respondent

1. Company (OR attach a business card)

2. Job title/designation……

3. Main job responsibilities

I. ----------

II. ----------

III. ----------

4. Respondent's experience (years) in Functional Foods Development……

5. Number of new product development projects completed ……
(All NPD projects)

6. Age group:

a. Below 30years ◯

b. 30-39years ◯

c. 40-50years ◯

d. Above 50years ◯

Section II: Firm Orientation towards Innovations

7. Please tick the type of ownership which best describes your company.

Institution	Types of ownership	
1. Private Enterprise	National	Multinational a. Controlled affiliates b. Parent companies under foreign control c. Parent company not under foreign control
2. Public Enterprise	Controlled by Government units	
3. Others please specify		

8. How many new products were developed by your company during the last three years (2008-2010)?

- Please specify the number (e.g., 1, 2, 3 etc.) ----------

9. Please distribute these new products from *Q8* in the following table?

Serial No	Main aim of New Product development	No. of New Products developed
1	To increase range of goods/services	
2	To increase market share	
3	To exploit new market opportunities	
4	To reduce cost	
5	To increase responsiveness to consumers	
6	To increase knowledge sharing	
7	Others, please specify.	

10. Please allocate no. of new products from *Q8* to each mode of product development

Serial No.	Mode of Product Development	No. of New Products
1	By this company alone	
2	In partnership with other company	
3	By other company	
4	Others, please specify	

11. Which of these innovation characteristics relate significantly to your company?

I. Market oriented
II. Product oriented
III. Process oriented
IV. Organizational oriented
V. Others, please specify

12. Please rank these characteristics for your company.

Most Dominant **Least Dominant**

Section III: Cooperative Network

13. Does this organization have any external cooperative arrangement?

a. Yes b. No

If "NO" Then move on to Q No.17.

Please tick (✓) *the options which are relevant to your organization. You may tick more than one option.*

14. If yes, which of the following best describes your cooperative partners?

a. Customers
b. Ingredient suppliers
c. Competitors- other business from the same industry
d. Universities or polytechnics
e. Crown Research Institutes
f. Others, please specify

15. Which of the innovation related activity best matches your external partner *(from Q14)*?

Serial No	Innovation related activity	Relevant external partner
1	Joint R&D	
2	Joint product development	
3	Joint marketing	
4	Joint production	
5	Others please specify	
6		

16. Why do you undertake cooperative arrangements?

a. Cost sharing ◯
b. Risk sharing ◯
c. Production capacity sharing ◯
d. Access to R&D ◯
e. Access to new suppliers ◯
f. Others please specify

Section IV: Drivers of & Barriers to Functional (Bioactive) Foods Innovations

17. Is your company involved in functional food products development?

Yes ◯ **No** ◯

If 'No' go to question 21.

Please tick ◯ *all the options which are relevant to your organizations.*

18.* Please mark & rank all that matches with your company's interests?** *Whereas; **1= most important and 9= least important.

Food Categories	***Company's interests***	***Target function***	***Company's*** *interest.*
Dairy	◯	Heart Health	◯
Cereals	◯	Diabetes	◯
Oil seeds	◯	Cancer	◯
Meat & Poultry	◯	Energy	◯
Seafood	◯	Mental Ability	◯
Pulses/Grains	◯	Gut Health	◯
Fruits	◯	Immune system	◯
Vegetables	◯	General Well being	◯
Herbs and/or spices	◯	Bone Health	◯
Others, please specify below	◯	Weight Control	◯
		Others please specify …….	

19. What are the drivers of functional food innovation for your company?

a. Attain competitive edge ◯
b. Higher profit margins ◯
c. Building trust with consumers ◯
d. Market opportunity ◯
e. Social responsibility ◯
f. International market trend ◯
g. Others, please specify

20. Please rank the selected factors in *Q19*, according to their significance for your organization? *1=most important while 9= least important*

◯ **1** ◯ **2** ◯ **3** ◯ **4** ◯ **5** ◯ **6** ◯ **7** ◯ **8** ◯ **9**

21. What are the barriers to bioactive functional food innovations in your organization?

a. Cost of innovation
b. Lack of technical skills
c. Lack of medical/clinical skills
g. Others, please specify
d. Protection of innovation research
e. Regulatory structure
f. Health Efficacy

22. Please rank the above selected factors in terms of their potential to hamper these innovations? *1=most important while 9= least important*

1 **2** **3** **4** **5** **6** **7** **8** **9**

23. What sources of information do you use to discover a new potential bioactive ingredient?

a. Suppliers of ingredients
b. Universities research institutes
c. Crown Research Institutes
d. Scientific research publications
i. Others, please specify
e. Clinical studies about nutrition
f. Govt. health regulations
g. Conferences
h. Ingredient exhibitions

24. Which sources from the above choices are the most effective in selecting the new bioactive ingredient for you? *1=most important while 9= least important*

1 2 3 4 5 6 7 8 9

25. What are the important characteristics of a potentially successful bioactive ingredient?

a. Purchasing cost
b. Efficacy of the ingredient
c. Technical ease of use
g. Others please specify
d. Legal (regulatory & safety) status
e. Product trends in the market
f. Ensured supply from suppliers

26. Please rank your choices in descending order by using same ranking scale as used earlier? *1=most important while 9= least important*

1 2 3 4 5 6 7 8 9

Section V: Commercialization Routes

27. How do you secure the intellectual property?

a. IP contracts with customers
b. Confidentiality agreements
c. Patents
d. Trade marks
e. Copyrights
f. Others please specify.

***28.* Please rank above marked choices in terms of their effectiveness?** *1=most important while 9= least important.*

1 2 *3* *4* *5* *6* *7* 8 9

29. How do you commercialize these innovations?

a. Own marketing staff
b. Contract marketing staff
c. Brand ownership
d. Electronic media
e. Exhibitions
f. Trade shows
g. Specify others

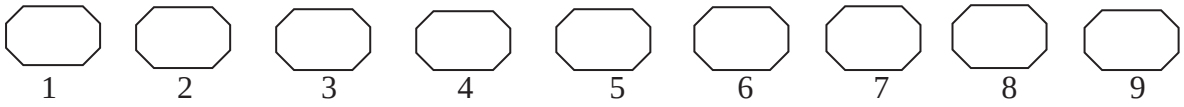
30. Please rank your choices in terms of their effectiveness? *1=most important while 9= least important*

1 2 3 4 5 6 7 8 9

31. What are the barriers to commercialization of these functional foods?

a. Level of Government support
b. Legislation
c. Health awareness
d. Consumer confidence
e. Access to market
f. Others, please specify

32. Please rank these barriers in order to show their significance? *1=most important while 9= least important*



Comments if any----------

Thank you very much for your valuable input!

APPENDIX 1.1: INFORMATION SHEET

Title of the Project: "**Characterisation of food product innovation with reference to bioactive functional food product development: an Asia-Pacific study**"

Researcher(s) Introduction

Researcher's Name:	Rao Sanaullah Khan (PhD Student)	Contact details:	IFNHH-Massey University, Albany Telephone +64 9 4140800 ext. 41566 Email:r.s.u.khan@massey.ac.nz
Supervisor's Name:	Dr. John Grigor (Senior Lecturer)	Contact details:	IFNHH- Massey University-Albany Private Bag 102904, North Shore City 0745, Auckland, New Zealand Tele:+ 64 9 4140800 ext. 41131 Fax:+ 64 9 4439640 Email: j.Grigor@massey.ac.nz
Co-supervisor's Name:	Prof. Ray Winger	Contact details:	Email: ray.winger@btconnect.com
Co-supervisor's Name:	Mr. Alan Win (Senior Lecturer)	Contact details:	IFNHH- Massey University-Albany-New Zealand Logistics &Supply Chain Management Tel: +64 9 414 0800 ext. 41105 Mob: +6421751479 Email: a.g.win@massey.ac.nz

Introduction

You are invited to take part in a *quantitative survey of collecting information on the topic of corporate food industry motivations for developing new bioactive functional foods (innovations).*

Your participation in this activity will take approximately 15-20 *minutes*.

Participating organisation/individual is welcome to receive a copy of the results at the end of this research. Please select the option on the next page.

Selection Criteria

We are selecting people for this exercise who meet the following criteria:

- FMCG companies who are involved in manufacturing packaged food products.
- New product development managers/technical managers or R&D managers of food manufacturing companies

Assurance of Confidentiality

All data will be kept strictly confidential to the study team. All responses will be collated and no individual company data will be identified.
The information collected in this study will be used to write a doctoral thesis and journal publications in the food technology department of Institute of Food Nutrition and Human Health (IFNHH) at Massey University-Albany, New Zealand.
The researcher where required is willing to sign company specific confidentiality agreements.

Data Management

Data will be saved and protected for maintaining confidentiality, by the researcher in electronic and printed form for 5 years at IFNHH-Massey University-Albany, New Zealand.

Exclusive Rights to Participants

You are under no obligation to accept this invitation. *If you decide to participate, you still have the right to:*

- *decline to answer any particular question;*
- *withdraw from the study any time you wish;*
- *ask any question about the study at any time during participation;*
- *provide information on the understanding that your name will not be used unless you give permission to the researcher;*
- *be given access to a summary of the project findings when it is concluded.*

Reward for participation

You are welcome to a summary of the results.

Please indicate if you wish to receive a summary of the results from this research.

YES NO

For Research Queries

If you have any questions about this work, please contact one of the people indicated above.

For Ethical Queries

"This project has been evaluated by peer reviewed 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 are 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 researcher (s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 350 5249, e-mail humanethics@massey.ac.nz."

APPENDIX 1.2: CONSENT FORM

Title of the Project: "**Characterisation of food product innovation with reference to bioactive functional food product development: an Asia-Pacific study**"

This consent form will be held for 5 years.

- I have read and understood the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

- I agree to voluntarily participate in this study under the conditions set out in the Information Sheet.

- I understand that I have the right to withdraw from the study at any time and to decline to answer any particular question.

Participants Signature: ..... **Date:** .....

Full Name - printed .....

Appendix V- Letter to non-responding companies

Ref.No. ….

Date: ……..

Subject: **Succeeding in new value added food markets**

Mr. …….

I am writing this letter in response to my initial letter regarding a research survey (letter attached here), on the prospects of future value added food products (specifically products with added health benefits) development in New Zealand food industry, at Massey University. This project is part of a larger Government funded research programme titled ***'future foods'***. We are in the process of completing a census to map the domestic and international prospects of value added new food product development in New Zealand. This letter is to respectfully request you to inform us the reasons for not participating in the study which is essential in completing this necessary survey.

We assure you the confidentiality of data collected under the Massey University rules of ethics, where no individual or company will be identified in the results - only cumulative results will be presented.

Your company's participation will be highly appreciated and in compensation of your time, a full and comprehensive executive summary of the results will be provided.

Please let us know of your response to this request by completing the attached form and returning in the enclosed freepost envelope attached with this letter.

Yours Sincerely,

Mr. Rao Khan (Principal researcher) **Email**: r.s.u.khan@massey.ac.nz

Dr. J. Grigor (Principal advisor) Mr. A. Win (Co-advisor)

Appendix VI- Reasons for Non-Response

(Note: This form can be mailed or emailed back at r.s.u.khan@massey.ac.nz*)*

No. ……..

On behalf of:

<Company name>

Please provide the reason for not participating in the study.

……

……

……

Designation/job title: ……...

Signature: _____

Please return the filled forms latest by 27th September, 2011 in the freepost envelop provided!

Many *Thanks for Your Time!*

Appendix VII- Invitation for participating in Qualitative study

Ref. No. …..

Name
Title
Company Name
Company postal address

Date: 15 October 2012

Dear name

Succeeding in new value added food markets

I am sharing here the benchmark analysis report of the quantitative survey conducted across food manufacturing companies of New Zealand (please see attachment). We (Riddet institute and Massey University) are most appreciative of your time and efforts to successfully complete the survey. The data have been incredibly important for providing some useful insights to the intended objectives of the project. Please do not hesitate to contact me for further exploration/discussion of the results.

In continuation of this study, we have designed a short qualitative interview to further explore reasons/factors behind the main themes which are concluded from the quantitative survey results. Therefore, I would politely request you to allow me to have one-on-one interview with you. The interview will not take more than 15 minutes.

We assure you the confidentiality of data collected under the Massey University rules of ethics, where no individual or company will be identified in the results - only cumulative results will be presented.

Your company's participation will be highly appreciated and in compensation of your time, a full and comprehensive executive summary of the results will be provided.

Please let us know of your response to this request by completing the availability form for interview and returning it in the enclosed freepost envelope attached by **9 November 2012**.

Yours sincerely

Mr. Rao Khan (Principal researcher)
Dr. J. Grigor (Principal advisor) Mr. A. Win (Co-advisor)
Riddet Institute and Institute of Food Nutrition and Human Health
Massey University, Auckland, New Zealand
Telephone +64 9 414 0800 (Ext) 41260 |Email: r.s.u.khan@massey.ac.nz
|Mobile: +64 211 204 332

Attachments: (a) Benchmark analysis report (b) Initial response form
(c) Return stamped addressed envelope

Appendix VIII- Availability Form for Qualitative study

(Note: This form can be mailed or emailed back at r.s.u.khan@massey.ac.nz)

No.

On behalf of:

Company name

Please contact the following person with respect to completion of the necessary survey:

Name: ……

Designation/job title: ……

Your availability for one-one interview:

Day of the Week	Time

Please return the filled forms latest by 21 November, 2012 in the freepost envelop provided!

Many *Thanks for Your Time!*

Appendix IX- Questionnaire for Qualitative interviews

Massey University
INSTITUTE OF FOOD, NUTRITION AND HUMAN HEALTH

Te Kunenga ki Pürehuroa

Title of the Project: "**Characterisation of food product innovation with reference to bioactive functional food product development: an Asia-Pacific study**"

A brief account of the project

This research project is designed to identify the major drivers of and barriers to effective [3]*new functional food product* development in the food industry. A quantitative survey completed in phase 1 of this project has guided us to design a qualitative exploration of some themes/factors marked as critically important for developing new functional food products. Therefore a qualitative interview has been designed to collect expert opinions of NPD/technical or R&D managers on these themes/factors. This will explain the main reasons behind certain attitudes and approaches adopted by the food manufacturers in developing new functional food products.

Important Information

5. This questionnaire is designed for New Product Development/ Technical Managers or R&D Managers.
6. The data collected here will be used to explain the factors identified as critical in already completed quantitative survey in this study.
7. All data will be kept strictly confidential to the study team. All responses will be collated and no individual company data will be identified.
8. Contact details of the researchers as well as Ethics committee for this research are provided in the Information Sheet (Appendix 1.1).

[3]The food products that contain compounds from natural sources such as whey proteins from milk, herbal extracts, omega-3 and probiotics etc., and have added health benefits for the human body.

Q. No. 1. How would you describe your new product development process for your company?

Q. No. 2. How would you describe cooperative NPD activities of your company?

Q. No. 3. How would you describe your commercialization of new products?

Q. No. 4. What are the drivers of new functional food product development?

Q. No. 5. What are the barriers to new functional food product development?

Many thanks for your time and valuable input in this project!

Appendix X- Invitation email message to food companies (Singapore)

Dear Sir/Madam,

We are conducting a research to understand the innovation process of Singapore-based food manufacturing companies with reference to the **development of functional (health oriented) foods**. This project is organised by Massey University (New Zealand) in collaboration with Riddet Institute, New Zealand. It is supported by SPRING, Singapore and Food Innovation Resource Centre (FIRC), Singapore.

An online survey has been designed for this purpose and this survey will take less than 10 minutes of your precious time. We highly appreciate your valuable input in providing us expert opinions on the topic presented in this survey. In return to your valuable input, we will send your company the results from this survey. This report canserve as a guidance for your company to understand your attitudes towards functional food product development vis-à-vis other companies primarily in Singapore. These results could provide your company with some useful insights in developing functional food to meet the growing need of the consumer.

The survey can be access through the following link from **16th May 2013 till 17th June 2013**.

http://www.surveygizmo.com/s3/1173536/PS-Build-Mapping-New-Product

This project has been approved by the Ethics Committee of Massey University, New Zealand. We assure you the confidentiality of data collected under the Massey University rules of ethics, where no individual or company will be identified in the results - only cumulative results will be presented.

Many thanks!

With Kind Regards,
Rao Sanaullah Khan
Institute of Food Nutrition and Human Health, Massey University
Private Bag 102904, North Shore 0745, Auckland, New Zealand.
Email:r.s.u.khan@massey.ac.nz

Appendix XI- Questionnaire for online Quantitative survey (Singapore)

MASSEY UNIVERSITY
COLLEGE OF HEALTH
TE KURA HAUORA TANGATA

Title of the project: "**Characterisation of food product innovation with reference to bioactive functional food product development: an Asia-Pacific study**"

A brief account of the project

This research is designed to identify the major trends in and associated challenges to new product development practices in the food manufacturing industry of the Asia Pacific region (New Zealand, Australia and Singapore). This quantitative survey has been designed to collect the opinions of NPD/technical or R&D managers on how they practice NPD in their respective companies. In particular, the survey will focus on collecting information pertaining to collaborative links, commercialization techniques and the perception of various drivers of and barriers to functional food NPD. The data will also be analysed to identify the main challenges facing businesses that wish to be involved in functional food product development.

For an explanation of the code of ethics under which this research is conducted, please read the *Information Sheet* attached to this document in Appendix 1.1, and, if you are willing to participate, please sign and return the *Consent Form* found in Appendix 1.2.

Many thanks for your time!

Bioactive Functional Food Innovations No…….

Important Information

9. This questionnaire is designed for New Product Development/ Technical Managers or R&D Managers.
10. The data collected here will be used to construct a model describing an effective approach for developing bioactive functional foods.
11. All data will be kept strictly confidential to the study team. All responses will be collated and no individual company data will be identified.
12. Contact details of the researchers and the approving Ethics committee for this research are provided in the *Information Sheet* found in Appendix 1.

Definitions of the terms

C. ***Functional food***: food products that contain compounds from natural sources that have added health benefits for the human body. Examples are bioactive peptides from milk (or whey), herbal extracts (such as ginseng), omega-3 fatty acids (from fish) and lycopene (from tomatoes).

D. ***Company***: a legally defined voluntary association that is organized to run a food manufacturing business.

Structure of the Questionnaire

Section I: Company orientation towards NPD and innovation

Section II: External Collaborations for NPD

Section III: Drivers/barriers of functional food innovation

Section IV: Commercialization routes

Section V: Demographic of the respondent

Instructions for completing the questionnaire:

1. Please select and rank your choices from the options given in each question.

2. You may add additional options if these option(s) are not already listed among the ones given in each question.

Section I: Company orientation towards NPD and innovation

1. **Please select the type of ownership which best describes your company.**

Institution	**Types of ownership**	
1. Private Enterprise	National ◯	Multinational ◯
2. Public Enterprise	Controlled by Government units ◯	
3. Government and statutory	◯	
4. Other (Please specify)		

2. **Number of employees in your company ……**
3. **Total sales turnover per year (US$)…….**
4. **How many new products were developed by your company during the last three years (2009-2012)?**
   - Please specify the number (e.g., 30, 240, 100 etc.) ----------
5. **Please allocate the number of new products from *Q4* to each mode of product development as listed below. Please include exact numbers and these should add up to the total you gave in *Q4*.**

Serial No.	**Mode of Product Development**	**No. of New Products**
1	By this company alone	
2	In partnership with another company	
3	For your company by another company	
4	Other (please specify)	

6. **Please distribute these new products from *Q4* into the following table. Certain new products may fall under multiple aims and thus the total in *Q6* may not add up to the total from *Q4*.**

Example: if you answered Q4 as 150 new products, you may have distributed them in a similar way to the example below.

Serial No	Main aim of New Product development	No. of New Products developed
1	To increase range of goods/services	50
2	To increase market share	30
3	To exploit new market opportunities	40
4	To reduce cost	
5	To increase responsiveness to consumers	50
6	To increase knowledge sharing with consumers	
7	Other (please specify)	20

Now please fill in the following table.

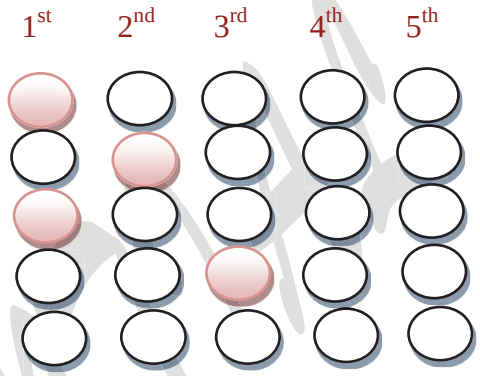
Serial No	Main aim of New Product development	No. of New Products developed
1	To increase range of goods/services	
2	To increase market share	
3	To exploit new market opportunities	
4	To reduce cost	
5	To increase responsiveness to consumers	
6	To increase knowledge sharing with consumers	

7	Other (please specify)	

7. **Which of these NPD characteristics describe your company?** Please select and rank the choices which best describe your company *(1= most important, 5= least important).* You may choose more than one option.

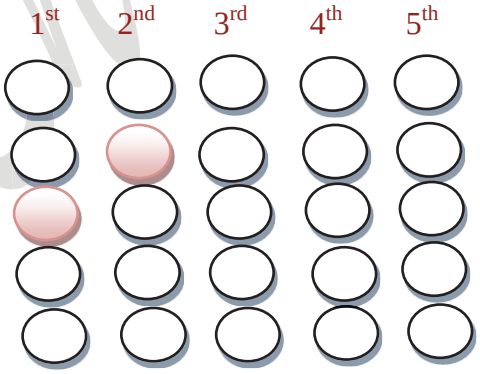
These are examples on how to answer the question.

VI. Market oriented
VII. Product oriented
VIII. Process oriented
IX. Organizational oriented
X. Others please specify…….



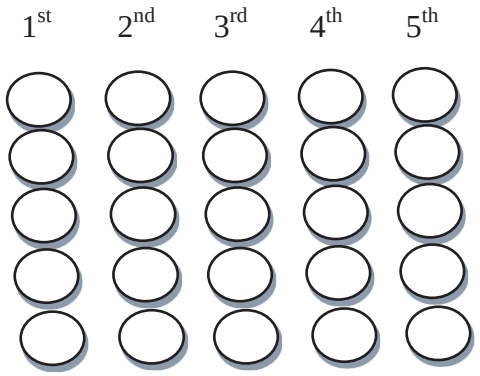
Example 2.

a. Market oriented
b. Product oriented
c. Process oriented
d. Organizational oriented
e. Others please specify…….



Q.7

a. Market oriented
b. Product oriented
c. Process oriented
d. Organizational oriented
e. Others please specify…….



Section II: External Collaborations for NPD

8. Does this organization have any external collaborative partners for doing NPD?

b. Yes ⬭ b. No ⬭

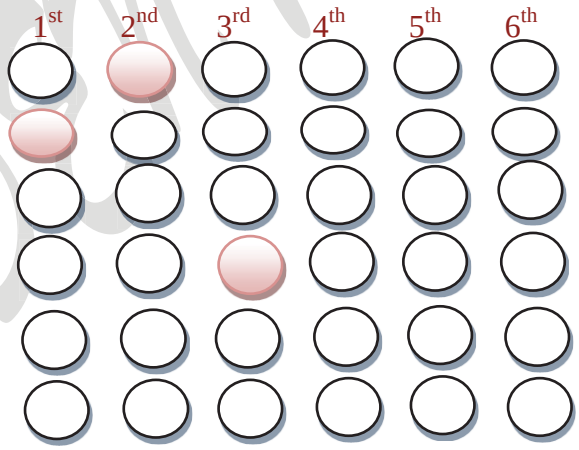
If "No" then move on to Q No.12

If "Yes" then move on to Q No.9

9. **Which of the following options best describe your collaborating partners?** Please select and rank the choices relevant to your company You may choose more than one option. *(1= most important, 6= least important).*

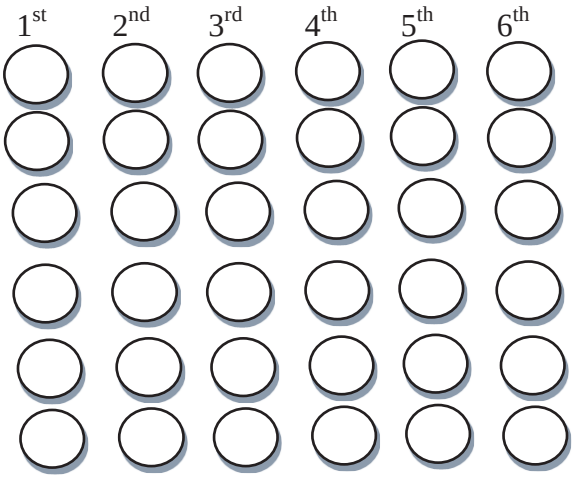
This is an example on how to answer the question.

f. Customers/retailers
g. Ingredient suppliers
h. Competitors; other businesses from the same industry
i. Universities or polytechnics
j. Government research agencies
k. Others (please specify)



Q.9

a. Customers/retailers
b. Ingredient suppliers
c. Competitors; other business from the same industry
d. Universities or polytechnics
e. Govt. Research Agencies
f. Others (please specify)



10. Which type of innovation related activities, have you done with your external partners *(from Q9)*?

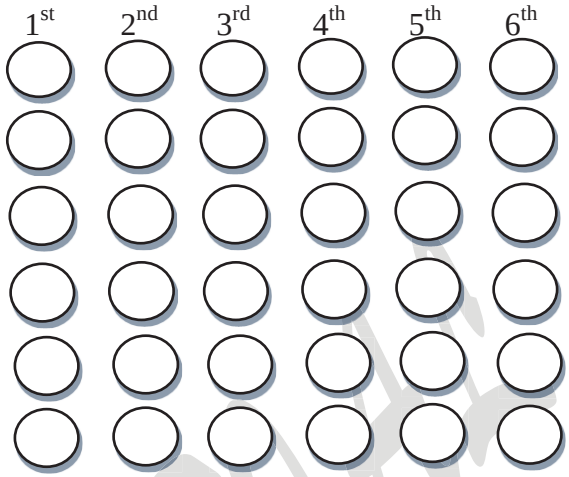
This is an example on how to answer the question.

Serial No	Innovation related activity	Relevant external partner (*From Q9*)
1	Joint R&D	*Ingredient suppliers & research institutes*
2	Joint product development	*Ingredient suppliers*
3	Joint marketing	*Customers/retailer or competitors*
4	Joint production	*none*
5	Others (please specify)	*NA*

Now please fill in the following table.

Serial No	Innovation related activity	Relevant external partner (*From Q9*)
1	Joint R&D	
2	Joint product development	
3	Joint marketing	
4	Joint production	
5	Others (please specify)	

11. **What is the purpose of these collaborative arrangements?** Please select and rank the choices relevant to your company. You may choose more than one option. *(1= most important, 6= least important).*



Section III: Drivers of & Barriers to Functional (Bioactive) Foods

12. Is your company involved in functional food product development?

Yes ◯ **No** ◯

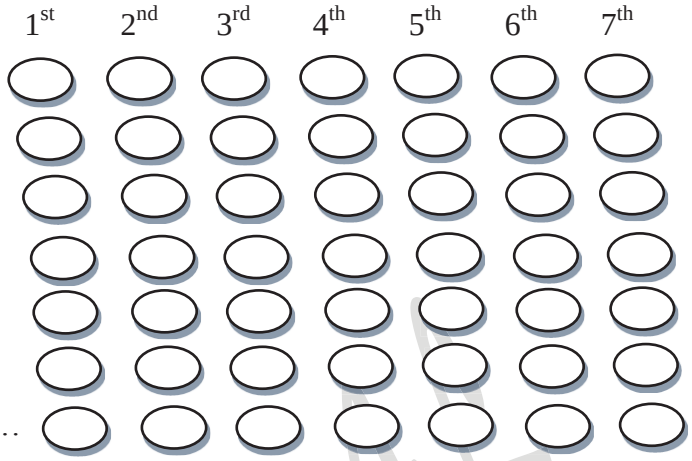
If 'No' please go to question 15

13. Please select from the options given below that matches with your company's interests?

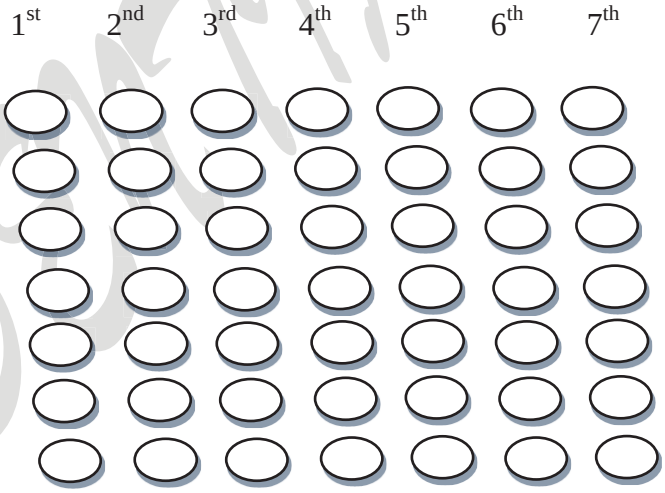
14. **What are the major drivers of functional food development for your company?**

Food Categories	*Company's interests*	*Target function*	*Company's Interest*
Dairy	◯	Heart Health	◯
Cereals	◯	Diabetes	◯
Oil seeds	◯	Cancer	◯
Meat & Poultry	◯	Energy	◯
Seafood	◯	Mental Ability	◯
Pulses/Grains	◯	Gut Health	◯
Fruits	◯	Immune system	◯
Vegetables	◯	General Well being	◯
Herbs and/or spices	◯	Bone Health	◯
Other (please specify below)	◯	Weight Control	◯
		Others (please specify)	

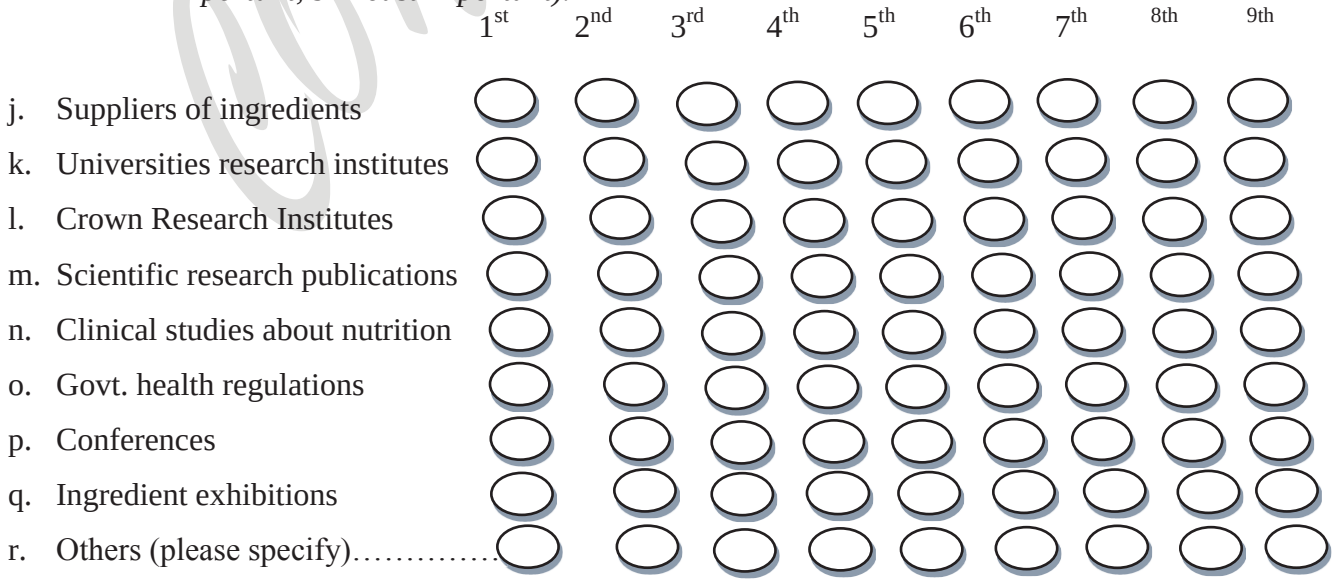
15. Please select and rank the choices relevant to your company. *(1= most important, 7= least important).*



16. What are the main barriers to functional food development in your company? Please select and rank the choices relevant to your company *(1= most important, 7= least important).*

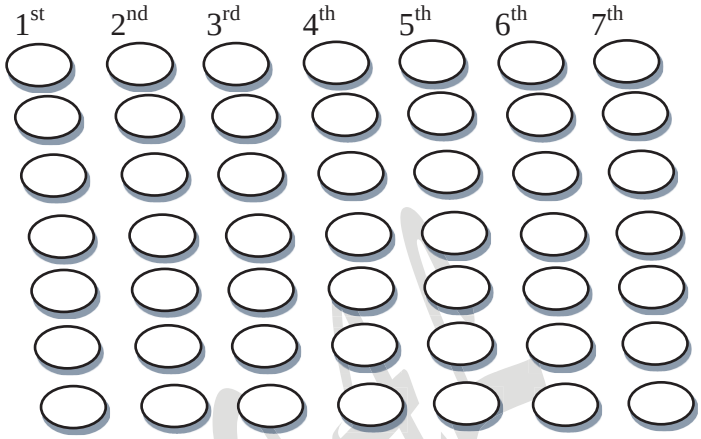


17. What sources of information do you use to discover new leads for functional food ingredients? Please select and rank the choices relevant to your company *(1= most important, 9= least important).*



18. What are the important characteristics of a potentially successful bioactive ingredient?
Please select and rank the choices which best describe your company. *(1= most important, 7=least important)*

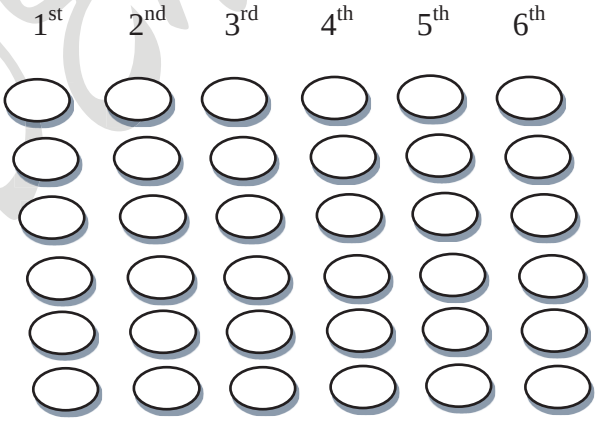
a. Purchasing cost
b. Efficacy of the ingredient
c. Technical ease of use
d. Legal (regulatory & safety) status
e. Product trends in the market
f. Ensured supply from suppliers
g. Others please specify……



Section IV: Commercialization Routes

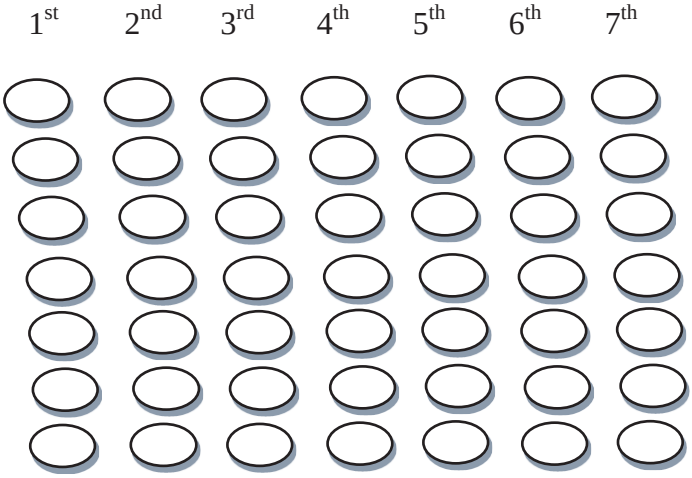
19. How do you secure intellectual property rights for your innovations? Please select and rank the choices which best describe your company *(1= most important, 6= least important).*

g. IP contracts with customers
h. Confidentiality agreements
i. Patents
j. Trade marks
k. Copyrights
l. Others please specify……..



20. How do you commercialize your new products? Please select and rank the choices which best describe your company (Whereas*; 1= most important, 7= least important).*

h. Own marketing staff
i. Contract marketing staff
j. Brand ownership
k. Electronic media
l. Exhibitions
m. Trade shows
n. Others please specify……..



21. What are the barriers to commercialization of functional foods for your company?
Please select and rate the choices which best describe your company (*Whereas; 1= most important, 6= least important).*

	1st	2nd	3rd	4th	5th	6th
g. Level of Government support	◯	◯	◯	◯	◯	◯
h. Legislation	◯	◯	◯	◯	◯	◯
i. Health awareness	◯	◯	◯	◯	◯	◯
j. Consumer confidence	◯	◯	◯	◯	◯	◯
k. Access to market	◯	◯	◯	◯	◯	◯
l. Others please specify…….	◯	◯	◯	◯	◯	◯

Section V: Demographic of the respondent

Your job title/designation……

22. Main job responsibilities

I. ----------

II. ----------

III. ----------

23. Number of new products developed by you in your career…….

24. Your experience (years) in functional food development so far in your career……

25. Your age group:

a. Below 30years ◯

b. 30-39years ◯

c. 40-50 years ◯

d. Above 50years ◯

Thank you for your valuable input!