

Collaboration and Innovation in Food Industry

Study on collaboration of packaging and process equipment industry with food manufacturing

Mustafa Ali Ashfaq Bombaywala

MASTER'S THESIS

Packaging Logistics
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This Master's thesis has been done within the Erasmus Mundus Master Course FIPDes, Food Innovation and Product Design.

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Abstract

Title **Collaboration and Innovation in Food Industry** - Study on collaboration of packaging and process equipment industry with food manufacturing.

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Issue of study In the dynamic economic environment where knowledge is vastly distributed companies can no longer rely on their own research and are pushed to utilize outside sources to sustain growth. At the same time food industry involves large number of horizontal and vertical relationships, the very dynamic nature of these relationships play role in innovation. In order to fully capitalize on supplier-customer collaboration it becomes vital to understand the dynamic relation between packaging and processing industry and need to operate closely, develop ways to identify good partners and create & maintain fruitful collaboration. However the research on collaboration with packaging and processing equipment industries as well as academia is rather limited.

Purpose The primary purpose of the research is to study interactions and relations between stakeholders in food industry, to gain an understanding of the driving forces for development in food processing and packaging technologies. Also gain insight into the innovation process at major Packaging solution provider (PSP) and Process equipment manufacturers (PEM), their interaction, collaboration and information sharing with food manufacturing companies (FMC). This understanding can then be utilized to identify the barriers for collaboration.

Method The research follows an inductive approach which starts with a premise and structure is built around the conceptual framework and the research objectives. Secondary data collected through literature survey was utilized to develop a conceptual model. Primary data was collected through interviews with experts from the industry and academia who have experience in working with innovation and collaboration. A non-probability sampling technique was adopted and

Semi-structured interview technique was followed. The interviews were transcribed to text and categorized under common themes which for analysis and comparison. To ascertain the credibility of the data it was triangulated and compared to literature.

Conclusion The views of industry experts strongly reflect that the role of suppliers of processing and packaging in food industry is “contractual” in nature, whereas ingredient suppliers tend to be more mature partners in the innovation process.

The innovation process at major food machinery and packaging companies corresponds well to the ‘food-machinery framework’ of open innovation (Bigliardi et al., 2010). It is apparent that food industry is taking steps to integrate external knowledge sources in the innovation process, still suppliers continues to play limited strategic role in innovation.

Some barriers to collaboration were identified and they can be grouped into two types: technical and perspective. Technical factors constitute lack of technical expertise amongst food manufacturer, requirement for legal framework and difficulty in predicting future needs. But the more imperative barriers are lack of trust, skepticism about new technologies and conflict of interest Trust continues to be the major barrier for collaboration and further research needs to be focused on this aspect.

Executive Summary

Introduction

In the dynamic economic environment where knowledge is vastly distributed companies can no longer rely on their own research and are pushed to utilize outside sources to sustain growth (Saguy, 2011), thus pushing the industry towards collaboration in R&D and innovation.

The food industry involves large number of horizontal and vertical relationships, the very dynamic nature of these relationships play role in innovation (Cannon T. 1994). The role of suppliers and their relation with manufacturers in improvement process has long been recognized (Petroni & Panciroli, 2002). Numerous studies recognize that supplier-customer collaboration in new product development (NPD) has a positive impact on product quality, cost and time to market (Clark, 1989). In order to fully capitalize on supplier-customer collaboration it becomes vital to understand the dynamic relation between packaging and processing industry and need to operate closely, develop ways to identify good partners and create & maintain fruitful collaboration (Birkinshaw et al, 2007).

Based on the understanding that the role of suppliers is crucial for technical innovation in food industry, the study is based around understanding of the interaction between food manufacturing companies (FMC) and their suppliers. There has been emphasis and prior research with focus on the role of retailers and ingredient suppliers in innovation, as they induce most visible innovations and a market push (Van der Valk & Wynstra, 2005; Traill & Meulenberg 2002). However the research on collaboration with actors on the other side of food system including packaging and processing equipment industries as well as academia is rather limited.

The primary purpose of the research is to study interactions and relations between stakeholders in food industry, to gain an understanding of the driving forces for development in food processing and packaging technologies. Also gain insight into the innovation process at major Packaging solution provider (PSP) and Process equipment manufacturers (PEM), their interaction, collaboration and information sharing with food manufacturing companies (FMC). This understanding can then be utilized to identify the barriers for collaboration.

The interactions can be defined in terms of involvement in NPD (new product development), research collaboration, sharing of production data. Previous research has focused on quantitative evaluation of food manufacturing industry and their suppliers (Ettlit, 1983; Petroni & Pancioroli, 2002). In this study a qualitative approach was adopted which relies on the nature of interaction, degree of interaction as well as at what level the interaction is carried out.

Methodology

The research follows an inductive approach which starts with a premise and structure is built around the conceptual framework and the research objectives. The research

design is in between tight pre-structured one and loose emergent one. Secondary data collected through literature survey was utilized to develop a conceptual model.

Primary data was collected through interviews with experts from the industry and academia who have experience in working with innovation and collaboration. A non-probability sampling technique was adopted selecting the experts based on three criteria purposive, strategic and convenience. Semi-structured interview technique was followed where respondents were asked for their opinion on specific open-ended questions. The responses are interpreted along the way and used to investigate further with a sub-question. The interviews were transcribed to text and categorized under common themes which for analysis and comparison. To ascertain the credibility of the data it was triangulated and compared to literature.

Results and Discussion

Idea generation is at the front end of innovation, in the majority of food companies these new product development processes are still based on internal innovation factor (Bigliardi et al, 2013). One expert from Tetra Pak Processing AB mention that traditionally the ideas came from academia or from the technical staff within the company and a research project started with a technical solution in mind. The success rate for such projects is very low and in the competitive market situations companies are forced to reconsider this approach to innovation. There has been realization that innovation is about problem solving and thus now the front end of innovation is based on need finding, market push, competitor products as well as advances in institutional research. This shift call for a better understanding of the customers as well as end users end consumers, collaboration with suppliers and research organization.

While the idea generation and collaboration process in larger companies is more complex, to understand the innovation idea generation process in a multi-national packaging company (> 10000 employees) an aspect of communication came to fore. There exist communication channels, a system to channelize requirements from customer, market and competitors, translating it into requirements, prioritizing it and using them to define research projects. The process is illustrated in **Figure 1** below.

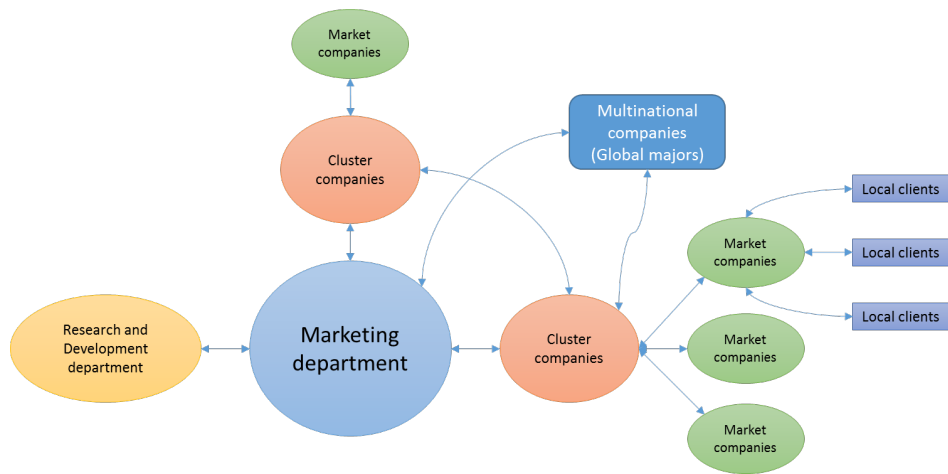


Figure 1: Communication channels for customer interaction in a multinational food packaging company

Communication is on a global scale, where ideas and needs from different markets are collected into a central marketing function, converted into requirements, prioritized and finally fed to the centralized R&D. In this system the requirement owners i.e. the research and development team seldom comes in contact with the need owners (customers). In that sense communication channels hamper personal relations and thus a hindrance for collaboration.

Based on the understanding of the communication channels in multinational food packaging companies, flow of innovation projects and inputs from literature, an understanding of the innovation process was built. The innovation process is illustrated in **Figure 2** below.

Most companies today operate on a global scale, supported by a trend of consolidation by merger and acquisitions in the food industry (Returners, 2014). Multinational companies having central R&D cater to customers in every corner of the world; this has let companies to develop innovation process to gather, filter and

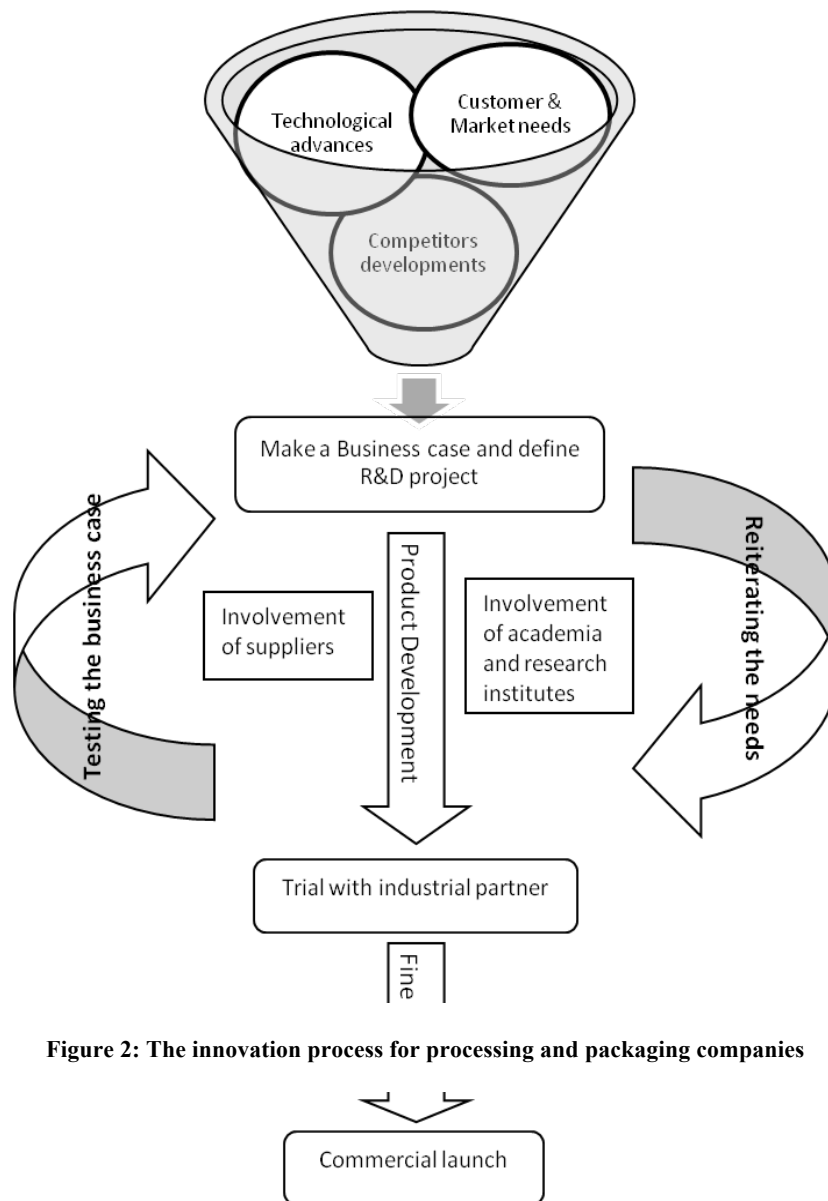


Figure 2: The innovation process for processing and packaging companies

prioritize the ideas to lead. Also create partnerships and collaborate with other stakeholders.

In the above model ideas are collected from customers, market demands, competitor development, suppliers, consultants and technological advances in the industry and fed into an innovation funnel. Usually the marketing department filters these ideas, checks for feasibility and builds a business case around them. Ideas with a strong business case are prioritized and passed on to the research and development department. They work on the technical developments in collaboration with suppliers. The nature of this collaboration is mostly 'contractual'. Academic or research institutes are engaged if any fundamental or basic research needs to be conducted. As the developments usually take several years to commercialize and owing to the dynamic market situation there is a need to check and reiterate the market needs as well as the business rationale being the project. After the product is developed it is tested with an industrial partner or a trusted customer, fine-tuned and launched in the market. The actors are involved in the early stages of product development especially customers and academia (technology scouting). Their role in strategic development is limited and under-developed.

Further factors that limit the role of suppliers in collaboration and hinder collaboration were identified. Some common barriers to collaboration identified are legal hassles, documentation, and ownership of the research, agreements and setting up a legal framework (Sagay, 2011). Food manufacturers, especially SME see their suppliers as important collaborator for innovation, in their relationship there is exchange of market knowledge and ideas. The reasons cited by food manufacturing companies for limited collaboration with packaging are high cost of capital intensive and trial cost is also more, time consuming. It is much faster and cheaper to work with ingredients for new product development and develop new products new for the market. Another reason that prevents manufacturers to experiment with new processing and packaging technologies is skepticism about safety and the perception amongst consumers.

Conclusion

The views of industry experts strongly reflect the role of suppliers of processing and packaging in food industry is "contractual" in nature, whereas ingredient suppliers tend to be more mature partners in the innovation process. Petroni and Panciroli (2002) in their research on innovation as a determinant of suppliers' roles and performance found a need for food machinery suppliers to make it their goal to move up from a "contractual" to "mature" or even a "strategic" partner in NPD and innovation.

Documenting the innovation process from industry perspective and role of suppliers in innovation, it can be noted that, the innovation process at major food machinery and packaging company corresponds well to the 'food-machinery framework of open innovation' (Bigliardi et al., 2010). It is apparent that food industry is taking steps to integrate external knowledge sources in the innovation process, still suppliers continue to play limited strategic role in innovation.

Gain insight into barriers to collaboration; some of the barriers to collaboration were identified and they can be grouped into two types: technical and perspective. Technical factors constitute lack of technical expertise amongst food manufacturer, requirement for legal framework and difficulty in predicting future needs. But the more imperative barriers are lack of trust, skepticism about new technologies and conflict of interest. Trust continues to be the major barrier for collaboration. Especially with process equipment manufacturer and packaging solution provider where the technological edge accounts for their market advantage. The development for framework for engaging actors should be aimed at fostering trust and build a transparent as well as symbiotic relations. This is a major challenge that needs attention for further research.

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Date: 15/08/2014

Sincere Regards

Mustafa Ali Ashfaq Bombaywala

List of Acronyms

NPD	-	New product development
FMC	-	Food Manufacturing company
PSP	-	Packaging solution provider
PEM	-	Process equipment manufacturers

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1. Introduction

This chapter introduces the general context of the research and the purpose of the research as well as the specific research objectives. Based on the purpose and the objectives the scope and delimitation of this research are also elaborated in this chapter.

1.1 Background

Innovations in food industry are a combination of technological and socio-cultural innovation. The most visible outcome of innovation being new product and/or service for the consumer, but the innovation process occurs throughout the food value chain. The more radical innovations in food industry are often a consolidation of product and service innovation (Earle, 1997). It has long been recognized that uncertainty in business environment has a positive impact on initiation, adoption and implementation of innovation (Pierce & Delbecq, 1977; Ettlie, 1983; Russel & Russel, 1992) and it becomes more so relevant with the shifting consumer trends and competition on global scale. In the dynamic economic environment where knowledge is vastly distributed companies can no longer rely on their own research and are pushed to utilize outside sources to sustain growth (Saguy, 2011), thus pushing the industry towards collaboration in R&D and innovation.

Food industry has shown tremendous growth since the twentieth century. Packaging form an integral aspect of food processing as it ensures long shelf life. Food industry has become the largest customer of packaging (Brody, 2008). The fundamental changes in food industry can be attributed to innovative technologies in food industry (Earle, 1997), and packaging industry has set many examples towards that. Packaging technology started developing in early 20th century, before which food industry was limited to sugar, chocolate and confectionary industry amongst a few others. And food retail was restricted to small shops with self-service stores practically inexistent (Beckeman& Olsson, 2012). Thus with the development in packaging technology it was possible to have more processed food products that could be preserved for longer and in turn could be sold off the shelves in stores. Advances in packaging (particularly PET and carton packs) are also credited with creating a market for packaged beverages juices and other drinks. Vast expansion of dairy industry also relies on progress in packaging from sale of loose milk - in glass bottles - PE bags - carton packs, the progress is noteworthy. For the past few decades the trend of replacing traditional materials such as glass, metals and paper by polymeric materials has been growing continually within the various process industries, including the food industry (Pankaj et al, 2014).

Introduction of novel food processing technologies, such as high pressure processing, ultrasound and irradiation put additional demands on food packaging. The trends for processing inside packaging is catching up and calls for closer collaboration between packaging and processing industry for holistic development. Moreover food science and

packaging technologies are linked to both engineering developments and consumer studies. Consumers tend to seek out new materials with new functions, and new food packaging systems are being developed that reflect current food processing technologies, lifestyle changes, and political decision-making processes, as well as scientific research (Jung H. Han, 2013).

1.2 Problem Discussion

In the recent years, the focuses for development in food processing technologies has been on preserving the natural attributes (color, flavor and nutrients) of the food product and improve sustainability of processes (Langelaan et al, 2013). This has led to the development of minimal and novel food processing technologies. At the same time development in packaging technologies has evolved beyond just preventing deterioration in the quality of food/beverage due to environmental influence. Recent trends in packaging include active and intelligent packaging, cooking in packaging and green packaging (Rungismarket, 2014).

There seems to be a wide gap between research in the field and its practical implementations, food industry tends to be highly scattered with many stakeholders which makes it difficult for the companies to implement their far-reaching innovations (Mahalik and Nambiar, 2010). The various actors in food industry include processed food producers, process equipment manufacturers, packaging equipment producers, packaging material producers, government policies, academic and laboratory research. These actors need to operate closely develop ways to identify good partner and create & maintain fruitful collaboration (Birkinshaw et al, 2007).

The role of suppliers and their relation with food manufacturers has long been recognized as an important factor in improvement process (Petroni & Panciroli, 2002). Numerous studies recognize that supplier-customer collaboration in new product development (NPD) has a positive impact on product quality, cost and time to market (Clark, 1989). The food industry involves large number of horizontal and vertical relationships, the very dynamic nature of these relationships play role in innovation (Cannon T. 1994). Vertical cooperation is of particular interest as it stimulates integration of knowledge and brings a wider range of abilities into the innovation process.

In order to fully capitalize on supplier-customer collaboration it becomes vital to understand the dynamic relation between packaging and processing industry and their interaction with other actors and stakeholders in the food industry. Thus this study tries to understand the interaction between food packaging and processing industry and understand the barriers to collaboration between these stakeholders in food industry.

Based on the understanding that the role of suppliers is crucial for technical innovation in food industry, the study is based around understanding of the interaction and relation sharing between food manufacturing companies (FMC) and their suppliers. There has been emphasis and prior research with focus on the role of retailers and ingredient

suppliers in innovation, as they induce most visible innovations and market push (Van der Valk & Wynstra, 2005; Traill & Meulenberg 2002). The research on collaboration with actors on the other side of food system including packaging and processing equipment industries as well as academia is rather limited.

1.3 Purpose and Objective

The purpose of the research is to study interactions and relations between stakeholders in food industry, to gain an understanding of the driving forces for development in food processing and packaging technologies. Also gain insight into the innovation process at major Packaging solution provider (PSP) and Process equipment manufacturers (PEM), their interaction, collaboration and information sharing with food manufacturing companies (FMC). This understanding can then be utilized to identify the barriers for collaboration and suggest ways to streamline this interaction for development of the industry as a whole. The research objectives were inspired by previous research on role of food manufacturers in innovation in Sweden, Beckerman and Olsson (2013); it concludes that there is an increased interest amongst food manufacturers to collaborate with suppliers, specially packaging suppliers. Previous literature cited lack of trust and transparency as factors limiting this interaction (Vangen & Huxham, 2003; Barratt, 2004), which was explored further in this master's thesis research. Thus the objectives are:

- Understand the interaction and collaboration between FMC, PSP and PEM: collaboration in product development stage and Innovation.
- Understand and document development/innovation process from industry perspective and role of suppliers in innovation.
- Gain insight into importance of geographical proximity and barriers to collaboration.

The interactions can be defined in terms of involvement in NPD (new product development), research collaboration, sharing of production data. Previous research has focused on quantitative evaluation of food manufacturing industry and their suppliers (Ettlit, 1983; Petroni & Pancioroli, 2002). In this study a qualitative approach was adopted which rely on the nature of interaction, degree of interaction as well as at what level the interaction is carried out.

1.4 Scope and Delimitations

The scope of the thesis includes literature survey, study of collaboration between PSP, PEM and FMC for new product development. This also includes identification of core areas of collaboration and development in packaging material/technology. The study will focus on development in food industry on a global level but for industry interaction focus only on food companies located in or having their production/R&D facility in Sweden.

The research focuses mainly on the interaction and collaboration between three stakeholders: Packaging solution provider (PSP), Process equipment manufacturers (PEM) and food manufacturing companies (FMC). The companies were selected based on their current and perceived innovativeness, market leadership and growth record. To judge the perceived innovativeness inputs from academia experts (interviews) was considered. Due to practical reasons the selection of companies was limited by their location and only companies located in Sweden were interviewed.

1.5 Target group

It is an exploratory research that is intended to highlight a window of opportunity for companies to have a holistic perspective on collaboration with other stakeholders and direct company policies towards collaboration in research and innovation. It is targeted at early stage researchers to build further on researching this field. Also for Industry professionals working with innovation, new product development and project managers in food packaging and processing industry.

2. Methodology

A general methodology followed in due course of this research is explained in this chapter. For the research to attain rigor it is imperative to have a structured methodology. And for the research to be credible it is crucial to understand the empirical setup. This chapter also motivated the premise for selection of research methodology that will assist the reader to assess the findings.

2.1 Overview

The purpose of research is to understand the interactions and collaboration in innovation, between actors in food industry and role of suppliers in innovation. These interactions are complex in nature and have large variation induced due to nature of organization and nature of individual. Owing to these variations and to gain a deeper understanding of motivations behind interaction and the process of innovation, qualitative techniques were adopted for this research (Zikmund & Babin, 2010).

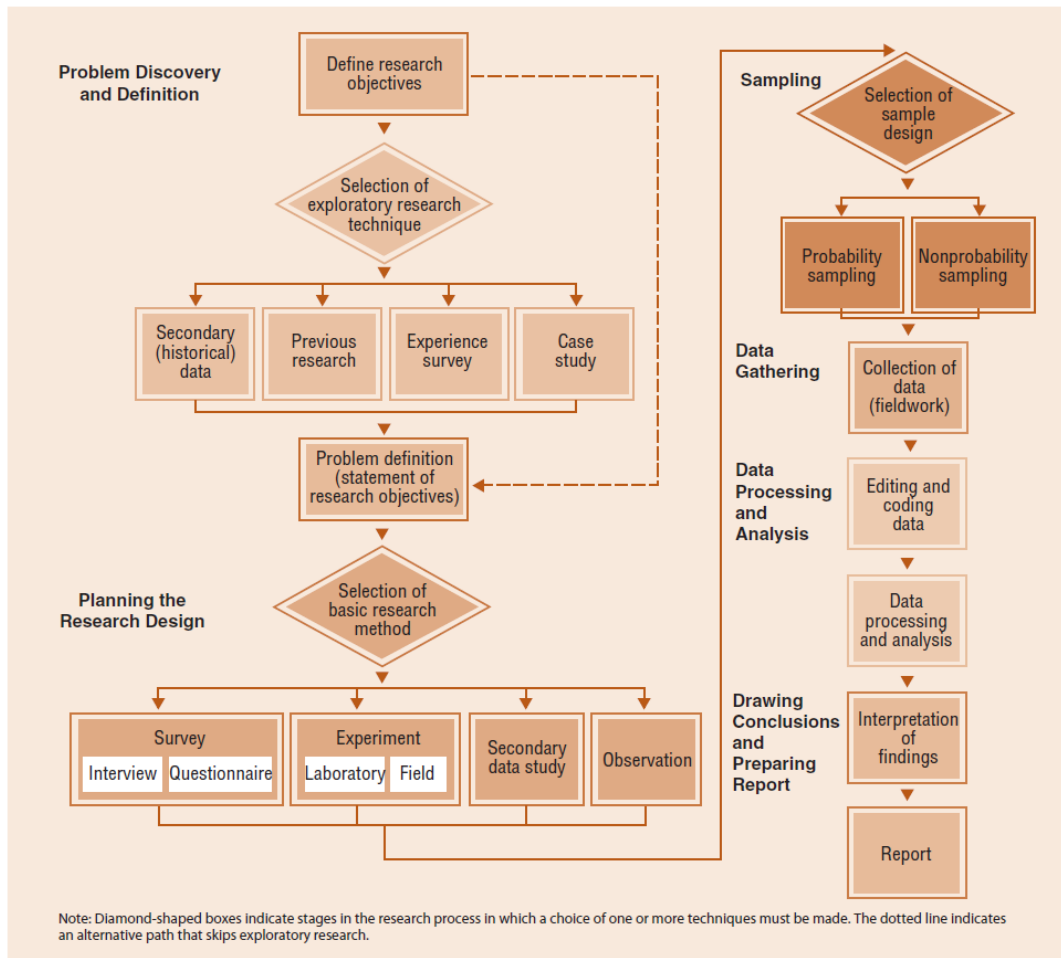
A step wise methodology was followed to build up understanding of role of stakeholders in innovation. The steps followed are as follows:

1. Identification of stakeholders. The stakeholders to be focused on were identified according to the purpose of the study and briefly discussed in the first chapter and further elaborated in the literature review.
2. Gain insight into the interaction between the stakeholders; this was focused more on the quality of interaction rather than the quantitative aspect. Here appropriate data collection tools were employed, the rationale behind it is discussed in this chapter.
3. The final step being to establish a relation between this interaction and innovation. The collected data was analyzed and presented in results and discussion chapter.

The framework for Qualitative research outlined by Zikmund & Babin (2010) in **Figure 1** was roughly followed and forms the base for the methodology.

Due to the ambiguity surrounding the objective, an exploratory research was conducted. At this stage a literature survey was carried out with focused on the previous research in this field collaboration and supplier-customer relation for innovation. Historical developments in food industries were also studied to understand interdependence of development in processing technologies and packaging. Literature survey was carried out using the Lund University library database. The key words used during initial literature survey were: innovation, collaboration, supplier-customer relation, trends & developments in food industry. Only peer review journal articles were considered to ensure quality of references.

EXHIBIT 4.6 Flowchart of the Business Research Process



Through literature survey close links between food manufacturer and supplier interaction and scope for innovation were observed. This literature survey was further built up and discussed in detail in the next chapter. These new inputs help in formulation of objectives for this thesis. Though it was evident that collaboration between actors was pivotal for radical innovation but the nature of interaction facilitating this behavior was vastly unknown.

Based on the initial research ideas (purpose) and findings from exploratory research/literature review clarity was reached on the research objectives. The further research design is discussed in the next section.

2.2 Research Design and Data collection

The research follows an inductive structure which starts with a premise and structure is built around the conceptual framework and the research objectives. Miles, Huberman and Saldana (2010) in the book on qualitative data analysis suggest following a research design in between tight pre-structured one and loose emergent one. This helps the researcher to have a structure and the same time to be reiterative and flexible. Secondary data collected through literature survey was utilized to developing conceptual model. This structure build on initial ideas and literature survey was flexible and developed further along with primary data collection.

After having a preliminary conceptual framework a sample for the research needs to be identified. Sampling involves selection of people that need to be interviewed or observed. Qualitative research works with a small¹ sample of people which integrate with the research purpose and their in-depth study (Miles *et al*, 2014). A non-probability sampling technique was adopted selecting the experts based on inputs from thesis supervisor. Sampling was based on three basic criteria **purposive**, **strategic** and **convenience**. Purposive relates to the selecting experts that represent the stakeholders identified i.e. food manufacturers, processing equipment suppliers, packaging solutions suppliers and academia. For the study to hold relevance it is essential to include experts from all the identified actors. Then it was of strategic importance to include experts with vast and diverse experience in their field. Also important is the relevance on the experience; therefore experts with experience in R&D, innovation and external collaboration were identified. Convenience corresponds to the practical aspects of sampling, where in the geographical constrains were considered. The selection of experts was restricted to southern Sweden. It is important to mention that geographical consideration is a convenience issue and not a limitation for research as all the stakeholders are well represented in the selected region. South Sweden is the base for major multinational and national processing, packaging and food producers. To avoid any sampling frame error it was ensures that all the sample elements are included and the sample size represents all the stakeholders important for the study.

Having a clear initial idea about **what** to find out and from **who** brings us to the next important question of **how** to get relevant information. In the research process Zikmund & Babin (2010) suggest to have sample selection after selection of data collection technique, in authors opinion data collection technique needs to be customized according to the sample and thus the change in the sequence of steps. Qualitative research uses a variety of 'Instrumentation' comprise specific methods/techniques for data collection as defined by Miles, Huberman and Saldana (2010). Even though interactions for collaboration in the industry are subjective but they follow guidelines and company policies. All the organizations follow a larger framework for collaboration; still

¹ Small compared to quantitative research.

interactions more than often are a function of individuals and the decision makers. Thus to gain a considerable insights and to address specifics of collaboration and innovation interview was thought to be the most appropriate data collection technique.

The experts were initially contacted via e-mail. A total of 20 experts were contacted through personal email introducing them to the thesis purpose and requesting for an interview. Most experts responded to the first email and agreed on sharing their knowledge and experience with collaboration and innovation. In case of no response a follow up e-mail was sent and then a phone call. Few experts declined the request sitting company policy and confidentiality issues. A summary about the experts interviewed is presented in **Table 1** below.

Sr. no.	Company/ Organization	Type of company	Sector of operation or Feature	Respondent's other relevant experience	
1.	Tetra Pak processing AB	Processing equipment manufacturer	Recognized for being innovative	Research & Technology Manager	Research experience in academic and industrial context
2.	Tetra Pak Packaging Solutions AB	Packaging material and equipment	Pioneer and market leadership	R&D manager	Industry advisor for academia
				Innovation manager	
				Mechanical design engineer	
				Innovation manager	Was associated with Tetra Recart project
3.	Oatly AB	Food Production	Innovation based company	Innovation director	
4.	Ecolean AB	Packaging material and equipment	Flexible and light weight packaging	Marketing Director	Innovation based (new packaging material and concept)

5.	Lund University	Academia	Division of Packaging logistics	Ph.D.	More than 30 yrs industrial experience in food industry
			Department of Food Engineering	Senior teacher and researcher	More than 30 yrs research experience in food industry

Table 1: List of interviewees

Interview is one-on-one interaction between the researcher and respondent conducted about relevant business topic where researcher asks a series of questions and follows up answers with additional examination for further amplification (Zikmund & Babin, 2010). It is a conversation built around a set of assumptions and an understanding about the situation, this technique of data collection applies to exploration of complex and subtle phenomenon (Denscombe, 2010). A semi-structured interview technique was followed where respondents were asked for their opinion on specific open-ended questions. The responses are interpreted along the way and used to investigate further with a sub-question. Thus the interviews are conducted with guidelines but the course of interview is determined by interest of the respondent. It helps interviewee to elaborate their ideas and speak more widely on the questions raised by the researcher; this also helps to get more specific and detailed information.

Interview started with the interviewees' idea about innovation followed by the specifics of innovation and their experience with R&D and NPD. Then go into the details of organizational aspects and importance of collaboration in innovation. The guidelines followed for interview can be found in Annexure I.

All the interviews were conducted in person (with an exception of telephonic interview) during the period of April and May 2014. Average duration of the interview was 70 minutes. The interviews were recorded in digital format for documentation as well as later play back and interpretation. They were transcribed into word format following first cycle of coding as described by Miles *et al*, 2014. Here the transcribed text was categorized under common themes which make it easier for analysis and comparison.

Apart from interview and literature review, case study and online survey was also used as a mode of data collection to a small extent. These cases help building understanding about hurdles and factors contributing towards successful product/system innovation. A case study on development of Tetra Recart™ and Oatly was conducted bases on literature and expert review and is resented in the results section.

Online survey was employed to get information from experts who could not be interviewed in person. A questioner was created based on the format of the interview and involved subjective answers. Whereas the case studies were built around examples of successful innovation, that came up during expert interviews. Interviews with experts and literature review were used for the case study.

2.3 Data Processing and Analysis

The *American heritage dictionary* defines analysis as “The process of breaking down something into its parts to learn what they do and how they relate to one another”. The purpose of analysis is to gain understanding of data collected through field work. According to Denscombe (2010) data analysis can be divided into five stages, these stages are summarized in **Figure 2** below.

The first step towards analysis is data preparation in case of this study primary data comprises of audio recordings of expert interviews. Miles *et al* (2014) describe processing/preparations listening to recordings, making notes, selecting excerpts and typically transcribing into text. Zikmund & Babin (2010) use the term ‘Editing’ for initial data processing, where editing involves checking the data for completeness, consistency and making the data ready for further analysis.

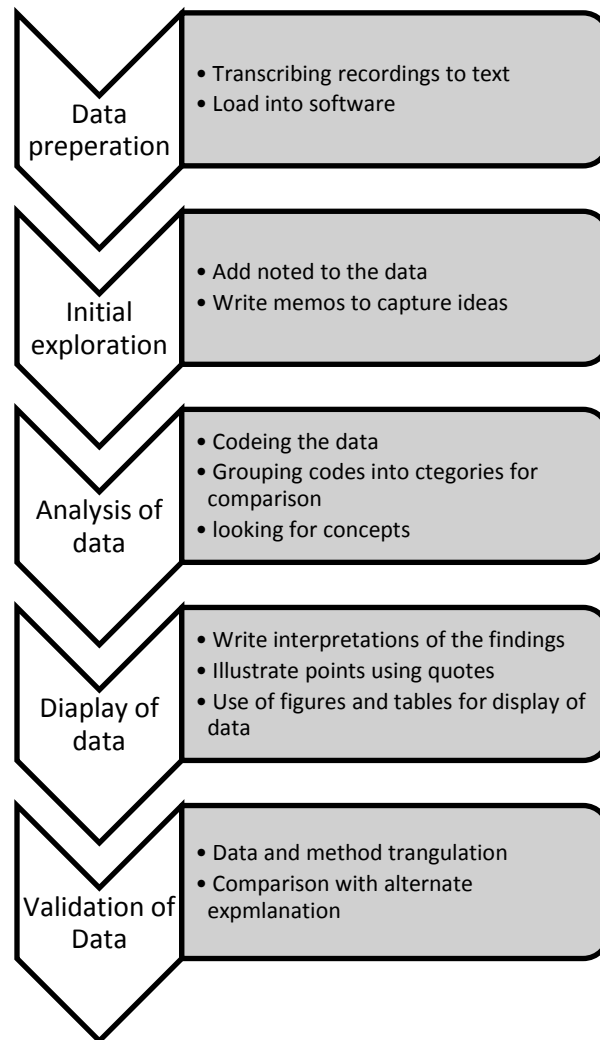


Figure 2: Stages of data analysis (Denscombe, 2010)

As this study employed semi-structured interview technique with open-ended and

descriptive answers for data collection, the interviews were transcribed into text format. The text was loaded into software (Microsoft Excel). The raw data was then processed by making notes and selecting excerpts. After data processing the main focus of analysis are the **words**, these words have been extracted and refined from the recordings into a lucid text for further analysis. In case of the thesis interviews were aimed at obtaining an understanding into the experts' perception of innovation, sources of innovation and importance of other actors in innovation process.

According to Miles, Huberman and Saldana (2014) coding is a method of discovery. It involves carefully reading the transcripts and resonating on its core content or essence to assign the data chunk a 'code'. Codes are the words or labels used to describe or a sum up a data chunk. On similar lines as coding, for these studies themes were developed. Some examples of themes used were innovation, examples of innovation, process of new product development, importance of collaboration, geographical proximity to name a few. Parts of the interview corresponding to each theme were categorized and segregated for further analysis and comparison.

The next step is display of data. The interview transcripts were categorized into themes and analyzed in the light of literature according to the research objectives. The data is mostly presented in form of inferences drawn from the interview, table/matrix and as excerpts.

For the research to achieve credibility it is very important to establish validity of data and the analysis. Credibility or validity is the measure to which it can be demonstrated that the data is accurate and the analysis appropriate (Denscombe, 2010). To ascertain the credibility of the data any analysis one basic technique were adopted. Triangulation: the data was contrasted and compared to literature and previous research.

The research follows a line of reasoning that has been explained in this chapter. In additional steps were taken to bolster confidence in the findings. At the same time it should be noted that it is not feasible to replicate the research in the same way as it has been conducted due to unavoidable changes in the social setup (Denscombe, 2010). Also qualitative research involve a factor of researcher's 'self' who is in control of research instruments and becomes an integral part of the process. An open minded approach was adopted to eliminate 'self' factor influencing the data collection and analysis. The delimitations and boundaries of this research have been explicitly stated in the above chapter and should be borne in mind while assimilating the research findings.

3. Frame of reference

This chapter is aimed at providing an overview to historical developments in food industry, highlighting innovations that revolutionized the industry. Develop an understanding of stakeholder and their interaction. And finally build upon the understanding of the role of collaboration amongst the actors in innovation in food industry. The results in next sections will draw upon findings from the literature.

3.1 Historical overview and current trends in innovation in food processing and packaging technologies.

In this section highlighted are the historical developments in food industry. The historical perspective helps to reflect upon how major developments in food industry were brought about and understand the factors that play part in bringing about radical innovation. As the focus of the study is innovation therefore only the inventions that were commercialized and had a major impact on food industry have been focused upon as summarized in figure 3 below.

Food processing technologies have developed steadily over the last century. Taking example of Aseptic processing, it is one of the major development in food processing can be defined as filling commercially sterile product in a sterile packaging under sterile condition followed by hermetical sealing (Encyclopedia Britannica, 2013). First commercial aseptic processing and packaging system was launched in 1927; using retort process in which food product in stationary container (glass or can) was heated to 240⁰ F, known as the HCF (heat, cool, fill) process. It leads to significant color and flavor loss in the food product especially milk thus later giving way to high temperature and low time processing methods. In the early stages (1927 to 1961) the growth in aseptic technology was restricted to glass/can packing and was rather limited. This was revolutionized by the advent of Tetra Pak aseptic filling and packaging machine in 1951 which marks a new era in aseptic processing. Since then packaging has been the catalyst that has launched aseptic packaging and aseptic processing and will continue to take lead position in pushing advances in aseptic processing technology (Mitchell 1988). Aseptic processing since then has evolved ahead of the conventional canning process, with better sensory qualities and nutrition retention (Jairus et al 1996). The military-industry complex has a major impact on innovation in food industry during the first half of 20th century. One the example is the use of irradiation technology for food processing and preservation. Negative commercial and public perception of irradiation and its hazardous effects on humans' even today undermine the potential of this technology (Monica, 2013ⁱ).

Having a closer look at development of aseptic processing technologies highlights the inter-dependence and mutual development of processing and packaging technologies. It also adds to our understanding of external factors affecting innovation (refer Figure 5).

These social external factors like consumer needs and wants, technological knowledge and competencies, urbanization and industrial growth are discussed further in section 3.3 below.

There has been progress in non-thermal and mild processing technologies, generally known as Novel food processing technologies. Development of combined technologies including bacteria microfiltration, low heat treatment pasteurization and novel food technologies high pressure processing and ohmic heating has led to a shift in food processing trends and focus from thermal processing technologies. These new technologies generally require new packaging materials and new package design parameters for the purpose of optimum processing efficiency; for example, packages that undergo an irradiation process are required to possess chemical resistance against high energy to prevent polymer degradation, those that undergo UV treatments require UV light transmittance, and retortable pouches should resist pressure changes and maintain seal strength at retort temperature. Because each of these new food processing technologies has unique characteristics, packaging materials needs to be selected to accommodate them. Effects of non-thermal processing on the packaging materials and effects of packaging materials on the quality of non-thermally processed foods during shelf-life need to be considered for the selection of optimal packaging materials and methods (Galić et al, 2011).

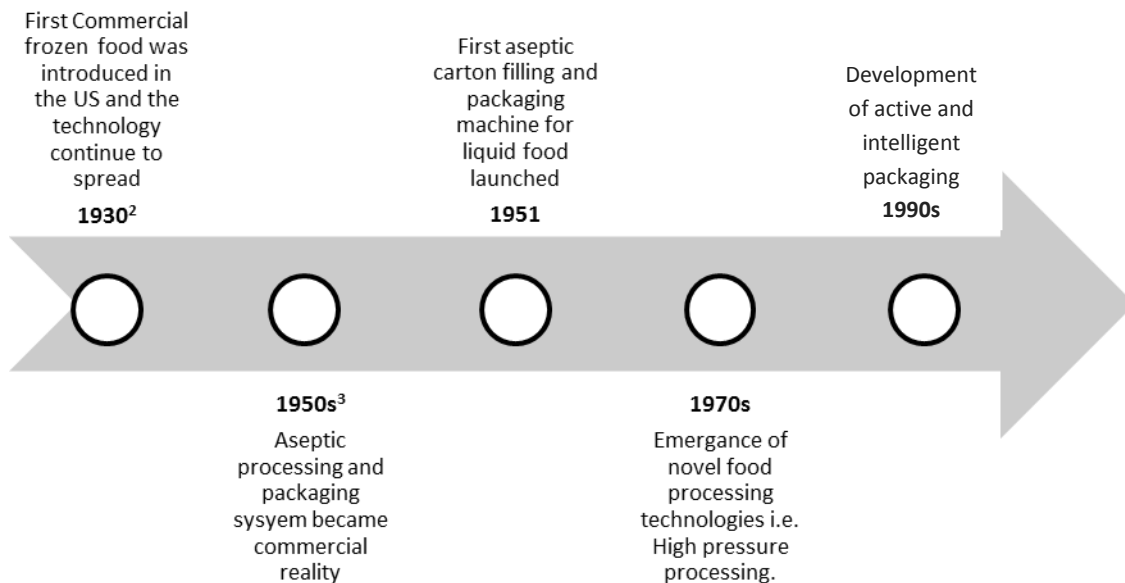


Figure 3: Timeline for major developments in food and packaging industry (FFF, 2014; Jairus R, 2013; Sonneveld, 2000)

The examples highlighted above are of particular interest because they radically changed the food industry in several ways and affected the way we process, pack, transport, store and even consume food. The more radical innovations in food industry were the ones combining product and service innovation as well as social and technological. Food manufacturer supplier relations play an important role in innovation and have been undermined during the recent years (Earle, 1997). After introduction in 1930 the growth of frozen food market was slow and assisted by advances in refrigeration technology, home freezers, cold supply chain and storage network, shortage of canned food during WW II and expansion of self-service stores (FFF, 2014). Years later the first commercial aseptic canner was installed in 1951 paving way for production of shelf-stable, nutritionally superior food products and ability to heat sensitive foods employing high temperature short time approach (Jairus R, 2013). Being able to store milk and juices at ambient temperature for longer duration was made possible with the launch of aseptic carton packaging technology in 1961. These developments were vital in shaping the food industry of today and indicate markets trends that have now matured but still continue to grow.

The food industry in 21st century has matured in terms of processing technologies. The latest trends in food industry are towards food safety, health and functional foods (Dixon, 2009; Monica, 2013). Food safety continues to be the major focus of food processing but in recent years it is shifting towards health and diet. The example of innovation cited above set example of innovation and innovative environment (discussed in next section). The leanings from these examples can be incorporated and used in designing the innovation process.

3.2 Interactions and Networks in food industry

“The overall innovation process can be thought of as a complex set of communication paths including internal and external linkages” in words of Trott (taken from Colurcio et al, 2010). In a world where knowledge is vastly distributed and fast pace of development companies can no longer afford to rely entirely on their own research. To remain competitive companies need to keep up to date with the trends and developments. This dynamic market condition makes it essential for companies to utilize outside sources and buy or license processes, technologies, inventions and solutions (Saguy 2011; Möller, 2010). This also highlights the importance of collaboration and innovation partnerships.

The food value chain is a network of stakeholders involved in growing, processing (primary and secondary producers), and selling (distribution and retail). This complex value chain involves a web of interactions. Clurcio et al (2010) in their research on relationships in networked food innovation process identify seven clusters of stakeholders which are relevant in innovation process in food sector, these players are: retailers,

business customers, suppliers, competitors, end-users/customers, marketing agencies/media universities/research institutes. The value chain for processed foods and interactions in the context of this thesis can be simplified and illustrated as in below **Figure 4**.

It is important to have holistic consideration of food system while considering innovation strategies. Innovation in one area may have a ripple effect in entire food system (Earle M. 1997). Example of which can be introduction of new strain of bacteria in pro-biotic yogurt production, this may alter the curdling process requirements thus putting new requirements on production equipment. On the other hand it might affect the supply chain and storage conditions of the finished product. Thus closer collaboration between various actors does not only facilitate innovation but also help reduce the turnaround time.

The importance of suppliers' especially packaging and processing equipment companies has long been assumed to account for much of the innovation in food industry. John Ettlie (1983) conducted an empirical study on the organizational policies and role of supplier in innovation. Based on a survey of 58 equipment and packaging suppliers Ettlie (1983) concluded that environmental uncertainty in the business environment leads to formation of more aggressive policies and thus leads to innovation amongst the suppliers. Their research supports the fact that suppliers play important role in innovation in food industry but completely ignore the dimension of collaboration.

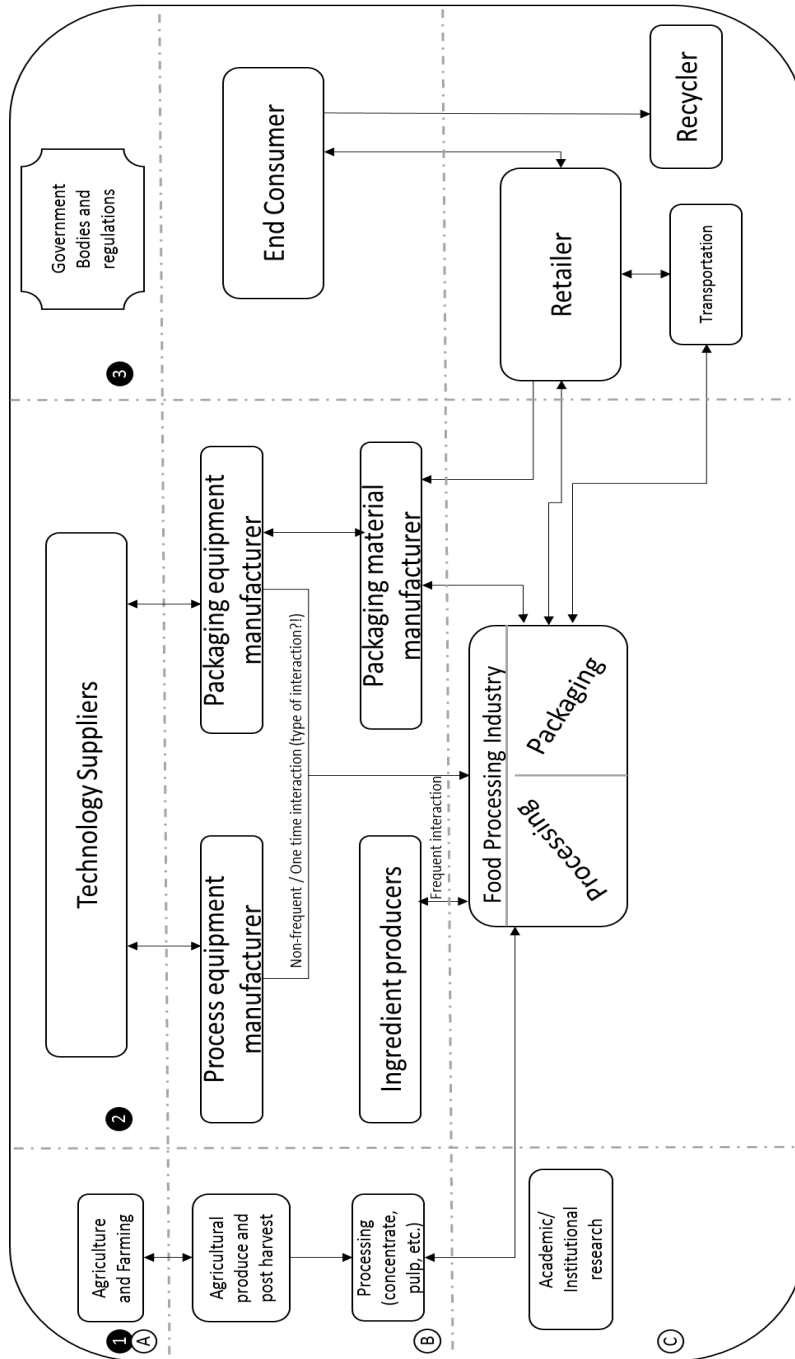


Figure 4: Interactions in food industry - Value chain

Base on their survey of more than 400 agri-food companies in Denmark, in their research on innovation and integration in agri-food industry Karantininis et al (2010) highlight importance of vertical integration. They conclude that both upstream and downstream integration have a positive impact on innovativeness. Contractual relations also have an impact on innovation outcome of the stakeholders involved. Also network linkage both upstream and downstream have positive impact on innovation. Trust and security amongst actors in the supply chain breeds stability and certainty which helps sustain an innovative environment (Karantininis et al, 2010). The importance of network innovation is increasing and due to tendencies of deregulation in the legal frame work and increasing global competitions. Most companies have a system to maintain relationships with other actors in the value chain but there is no strategy or plan to guide this (Colurcio, 2010).

3.3 Innovation process and Role of suppliers

Innovation can be defined in several ways, for practical purpose it can be stated as ‘the commercialization of an innovative idea’². Global survey on Innovation and commercialization (2010) conducted by McKinsey & Company underscore the importance of innovation as perceived by industry executives. As companies focus on growth, innovation has become a priority for any organization. Though the need for innovation is becoming more eminent, approach of industry towards innovation and commercialization has not improved or changed much over the years. The report indicates that organizational issues are a major barrier to commercialization of innovation. A large number of industry leaders believe that partnering successfully with suppliers and technology industry as well as including consumer insights into the innovation process need to be focused on. Realizing importance of networking in innovation, it can be seen as “*way through which knowledge is transferred and transformed across boundaries*” as defined by Charlie (2002). Supplier and network interactions play an important role in building a firm’s innovation capabilities and ability to exploit their knowledge base (Colurcio et al, 2012). However utilization of external resources relies on organizations’ interaction competence that is its ability to identify partners and create fruitful partnerships (Brikinshaw et al., 2008).

This brings us to the concept of open innovation. “*Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology*” as defined by Chesbrough (2013). Open innovation for practical purposes transcends into collaboration with suppliers, customers, research institutes and other actors directly or indirectly related to an industry. The concept of collaboration and knowledge sharing amongst actors in food industry evolves from the realization of difficulties in single

² Lars Rebieen Sørensen, CEO Novo Nordisk.

handedly meeting requirements of customers, end-users and legislators in this dynamic business environment. Sarkar and Costa (2008) in their research on dynamics of open innovation in food industry based on literature survey, conclude that open innovation does take place in food industry in spite of it being more traditional and mature industry. It supports the case for closer integration between marketing and R&D activities and calls for research into better understanding of open innovation and collaboration in food industry.

It is widely accepted by experts that small companies are more dependent on external knowledge for innovation. The ability to obtain information from outside and consequently collaboration with stakeholders is an important determinant of innovation in small companies. To support this hypothesis Avermaete *et al* (2004) in their research on determinants of product and process innovation in small food manufacturing firms conducted a survey of industries in EU to conclude that innovative small firms with more emphasis on R&D tend to have more intensive collaboration with customers and research institutes.

3.3.1 Types of innovation and innovative ecosystem

In his research innovation in food industry Earle (1997) talks about importance of conducive environment both inside and outside the company in order to foster innovation. The research also identifies some attributed that accounts for innovative environment; these factors are summarized in **Figure 5** below.



Figure 5: Factors for product service innovation (Earle, 1997)

The importance of these factors can be observed in the examples cited in the previous section. This highlights the role of extrinsic factors in innovation essential for radical innovation. Though we should bare these factors in mind while discussing barriers to innovation, only company organization and strategy will be focused on for further discussion (Earle, 1997).

The scope for innovation also depends on maturity of the process. Pisano & Shih (2012) in their research mention that, as processes mature the opportunity for improvement becomes more incremental. Based on maturity of the processes, relationship between processing/packaging technologies and innovation in food industry can be categorized into four basic types as shown in **Figure 6** below.

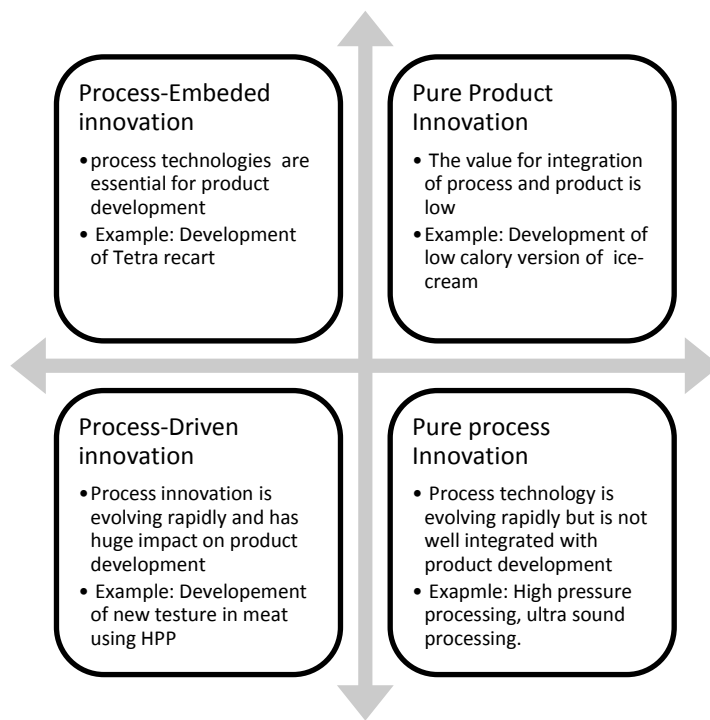


Figure6: Innovation matrix (Pisano& Shih, 2012)

Food industry is considered to be mature industry (Jönsson et al, 2012) it is characterized by a condition where processing technologies have not undergone only incremental changes over time (Pisano & Shih, 2012). Major discoveries and inventions in food processing face difficulties translating into innovation (Mahalik and Nambiar, 2010), stagnating innovation. Thus there still exists a vast potential for process-driven innovation and process-embedded innovation. One example of process-driven innovation is new texture development in food products using high pressure processing (Okamoto et al, 1990).

To highlight the importance of external factors (refer figure 5) and their role in successful innovations two examples of innovation have been discussed in next section.

3.3.2 The Innovation process – Integration and collaboration

The problem of intensive economic competition and uncertain economic situation faced by the companies is augmented by technological changes as well as short product lifecycles puts additional pressure on companies to innovate (Kodama (1985) taken from Rothwell, 1994). This has also led companies to reconsiders their approach towards innovation and innovation process. Roy Rothwell (1994) in his research on ‘Towards the Fifth-generation Innovation Process’ draws the journey of evolution of innovation process from technology push to market pull and further towards an integrated approach of innovation.

The first innovation process developed in the 1950s and 1960s was based on technology push. It was based on the belief that technology had potential to solve problems faced by the society and supported by the industrial revolution in the now developed world. The innovation process was perceived as linear, starting at technology development to the marketplace. In the mid-1960s as technology started to mature and competition between started to intensify this lead to more focus on consumers and lead to more consumer based innovation or market pull innovation. In the early 1970s it became clear that this approach towards innovation neglected long term research and radical innovation capabilities. As the technologies and market continued to mature and in the wake of economic uncertainty companies realized the need to understand the basis of successful innovations. During this time a more interactive model of innovation coupling the interaction between technological capabilities and market needs was developed. This model is illustrated in **Figure 9** below.

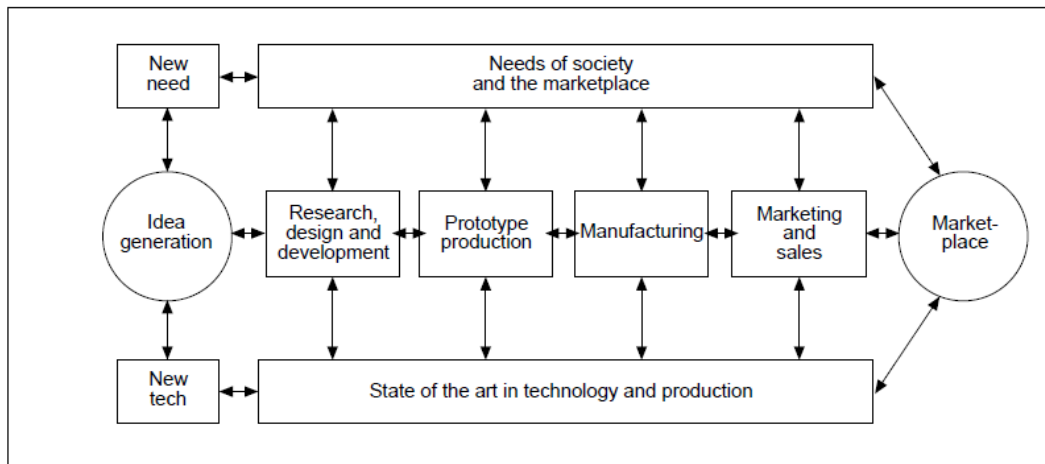


Figure 9: The third generation innovation process (source: Rothwell, 1994)

This approach stressed on the importance of communication within and outside the organization. It linked the functions in the company to scientific and technological community as well as to the market place. This structured approach towards innovation continued to be used and evolved on the lines of integration and parallel development. Integration involves bringing in external sources (suppliers, research organization) at the early stage of development and parallel development led to different departments within the organization working simultaneously on a development project. An example of this

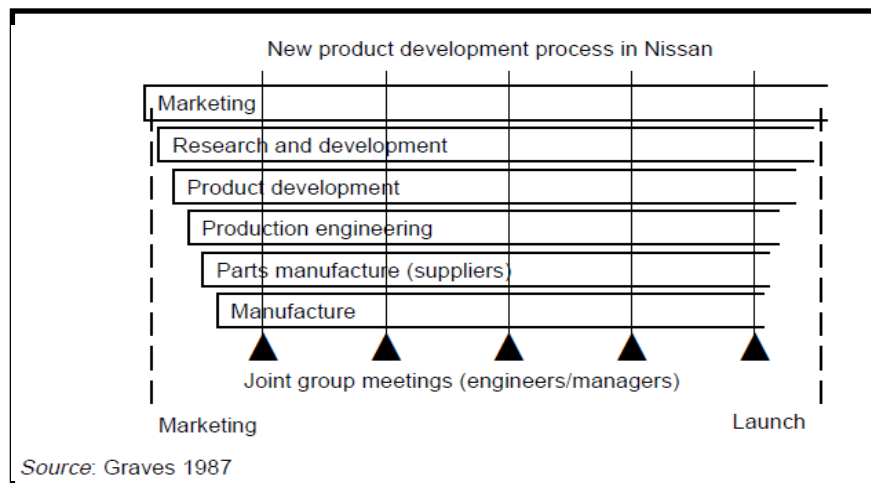


Figure 10: The fourth generation innovation process (source: Rothwell, 1994)

integrated approach is illustrated in **Figure 10** above.

Many companies today are working towards effective implementation of fourth generation of innovation process. Unlike most ‘high tech’ industries, food industry has undergone a process of ‘chain reversal’. Where the consumers demand as to what they want to eat (Bigliardi et al, 2013). Bigliardi et al (2010) in their case study on open innovation in food machinery supply chain developed the ‘food-machinery framework’ for open innovation as illustrated in **Figure 11** below.

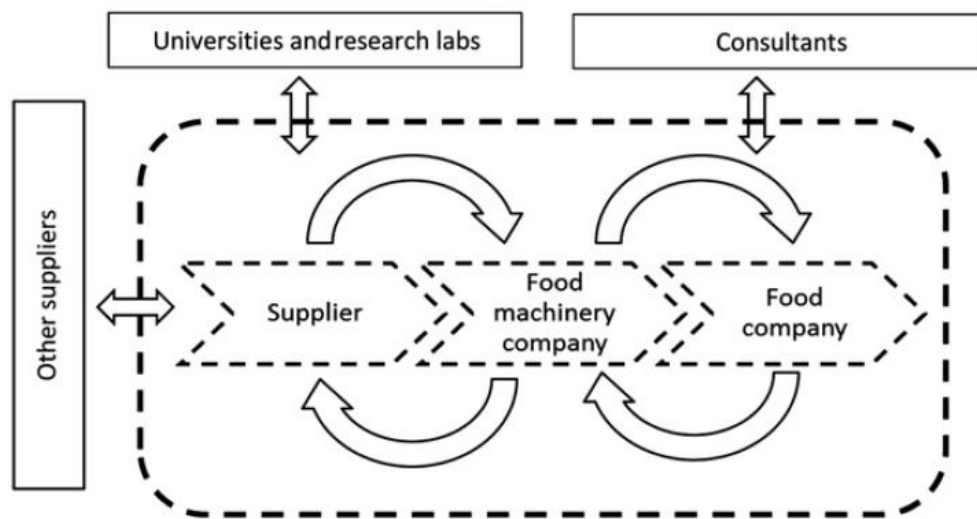


Figure 11: The food-machinery framework for open innovation (Bigliardi et al, 2010)

This study shows the importance of collaboration of food and food machinery companies to collaborate with suppliers and university. It highlights the strategic value of a mature partnership with both the actors for development of new technical solutions. The ‘food-machinery framework’ has been most adopted in the food industry with reciprocal interaction between the various actors. The success of this model is subject to the effectiveness of these interactions and the maturity if the relationship. Under the light of these processes we try to understand the role of target stakeholders and their integration in the innovation process.

3.3.3 Geographical proximity

Highlighting the importance of information and information sharing, Porter (1998) defines clusters as *“a multitude of linked industries important to competition including suppliers of specialized product or services and extends laterally to include industries related by skills, technology or common inputs”*. In his research Porter (1998) concludes that cluster not only inspire innovativeness but also lead to faster adoption of innovation and new technologies. Globalization trends and improvement in transportation and communication in the 21st century have led to a diminishing importance of geographical proximity. This on the other hand has given way for virtual clusters or networks as mentioned by Beckeman et al (2007) which play role in building innovative ecosystem. Underlining the generic importance of networks in industry extending it further this research tries to understand the importance of geographical proximity with suppliers and its implications in innovation for food industry.

One examples of cluster outlook in Sweden is Packbridge. Packbridge (<http://eng.packbridge.se/om-packbridge>) is a cluster for packaging and logistics that brings together the various stakeholders (consumers, innovators, researcher and suppliers), formed in 2010 in south of Sweden. Another example of companies integrating competencies is Tetra Pak which through acquisition and expansion brings under one roof expertise in packaging and processing in beverage industry, foraying in CSD (carbonated soft drinks) sector with its latest acquisition of Switzerland-based Miteco, a leading provider of production solutions for soft drinks with strengths in CSD.

To get an idea of importance of geographical proximity in collaboration, industry experts were asked for their opinion on this and the results are discussed in later section.

4. Results and Discussion

This chapter sums the insights gathered through interviews with the experts looking at it under the light of the research objectives. It also makes use of findings of literature survey to reinforce some results. The results help build an understanding of role of collaboration in innovation projects, nature of interaction, innovation process as well as role of academia in innovation. Discussion and author's views are also included in this chapter.

4.1 Interaction and Ideation

Idea generation is at the front end of innovation, this section presents a brief overview of interactions that lead to idea generation and feed ideas to the innovation funnel. In the majority of food companies these new product development processes are still based on internal innovation factor (Bigliardi et al, 2013). Expert from Tetra Pak Processing AB mention that traditionally the ideas came from academia or from the technical staff within the company and a research project started with a technical solution in mind. The success rate for such projects is very low and in the competitive market situations companies are forced to reconsider this approach to innovation, this finding is supported by literature (Rothwell, 1994) and discussed in the section 3.3.2. There has been realization that innovation is about problem solving and thus now the front end of innovation is based on need finding, market push, competitor products as well as advances in institutional research. With projects based on problem solving build on need finding which is then used to build a technical solution. From the interviews it can be deduced that there has been a shift from building innovation around a technical solution to building innovation around need. This shift call for a better understanding of the customers as well as end users end consumers, collaboration with suppliers and research organization.

When asked about the relative importance of academia, customers and suppliers in innovation experts tend to break the innovation process into ideation and implementation phase. All the experts express a consensus on the importance of customer in need finding followed by academia and then suppliers whereas for the implementation phase suppliers are the most important followed by academia and then customer. The customers do not always know what they want, therefore companies need to help them express their needs and translate them into requirements. Suppliers are usually involved on 'contract' basis where a problem is presented depending on their area of expertise. It is interesting to note that most companies interviewed do not have a defined process to involve the customers. There only exists' a process to involve academia through projects, competitions or PhD collaborations.

4.2 Innovation through collaboration

To get an insight into innovation and examples of what accounts for innovation the experts were asked to cite recent examples of what they consider being innovation. Examples of Innovation that came up during the interview are summarized in the **Table 2** below.

Innovation	Type of innovation	Description	Brand/research owner	Comments
Tetra Recart	Packaging innovation / alternative for conventional cans	Carton based packaging solution than could withstand retort process	Tetra Recart AB	See case study below for details (p 25)
Oatly	New product category/ product innovation	Oat based beverage and products developed as milk substitute for lactose intolerant and health conscious consumer	Oatly AB	See case study below for details (p 27)
Low temperature second pasteurization	Development in thermal processing of beverages	Lowering the second pasteurization temperature from 95°C to 80°C leading to better product quality and energy saving	Tetra Pak Processing AB	Innovation invisible to consumer, but a significant development in heat treatment of beverages
Tetra Brik Aseptic Edge	New packaging shape	Efficient design for better stackability and large cap space	Tetra Pack AB	-
Gooh – MicVac	New product, process and packaging	Microwave processed meals with special valve	Lantmännen AB	Example of NPD assisted by processing and packaging innovation
Lite weight pitcher shaped packaging	New packaging material and concept	Lite weight and ergonomic packaging for chilled and ambient distribution	Ecolean AB, Helsingborg	-

Table 2: Summary of examples of innovation cited by industry experts

These innovations are aimed at solving problems and add value further down the product value chain; they might or might not be recognized as innovation by the consumers but are beneficial for several stakeholders throughout the value chain. These examples were further investigating through literature review and interview with experts involved in these innovation projects was conducted. Below highlighted are the cases of Tetra Recart® and Oatly oat drinks.

4.2.1 The case of Tetra Recart™

Tetra recart³ is an example of collaboration between packaging – processing – food manufacturing companies for successful innovation. As described on Tetra Pak website Tetra Recart is a unique carton based retortable packaging for shelf stable products that are traditionally packed in cans, glass jars or pouches. Just like the conventional canning process here the food can be sterilized inside the packaging.



Developed as an alternative to conventional cans, it not only made use of new packaging material also new filling and packing equipment. Thus the development took place at several levels, which makes it interesting to study the success case of Tetra Recart.

Base on interview with expert from Tetra Pak associated with

Figure 7: Picture of Tetra Recart®

the Recart for several years and literature review, it was attempted to understand and identify the

hurdles and success factors for this project and thus understand the role of collaboration in new product development. It is a unique example organizational innovation as well as collaboration with suppliers & customer. The concept demonstrated advantages for all stakeholders gaining their confidence by involving since early stages of product development.

The origin of idea behind this project is not clear, but based on interview with experts from industry and academia it is speculated that it came from the industry and supported by the trends of environmental concern. It was a radical step for Tetra Pak to foray into a market segment different from its expertise in liquid foods and beverages. Recognizing a need for organic and flexible organization Tetra Recart was incorporated in a different

³Tetra Recart is a registered trademark of Tetra Pak International S.A. and hence forth referred to as Recart in this text.

company. Tetra Recart AB was established within Tetra Pak in Lund, Sweden with the sole and independent responsibility to develop carton based reportable packaging. The new company incorporated expertise from both packaging and processing and had access to resources within the organization.

The customers were involved in the project at a very early stage of development. They were partnered to understand their product, process and operations including supply chain consideration getting a holistic perspective. There was more direct contact with the customers promoted by the flexibility of a smaller organization. More than one customer was involved in the project. Even though they were not competitors, their association with the project kept reassuring about the business interest of the project. This close collaboration with the customer help in developing high quality product requirements based on the product, process and operations.

The project started around 1994 and the first commercial retortable carton based packaging system was installed in 2004, a turnaround time of 10 years. The successful development of Tetra Recart stress on importance of collaboration and involving stakeholders at early stage of product development and these leanings can help develop a model for running successful collaborative innovation projects.

4.2.2 Oatly: The innovative oats

Oatly⁴ AB is an innovation based start-up based in Landskrona, Sweden. It is based around the concept of oat based beverages and other milk substitutes. The idea came about from a perceived need for healthy substitute for milk and dairy products due to growing prevalence of lactose intolerance as well as interest from the farmers for utilization of locally produced cereals. The original research was conducted and developed at the university and later commercialized.

⁴Oatly is the registered trademark of Oatly AB, Box 224, 261 23 Landskrona (Sweden).



Figure 8: Oatly oat based cream substitute and beverage products (<http://www.oatly.co.uk/products>)

As a company grown out of an innovation developed at university, collaboration has been an integral part of their growth story. One expert at Oatly having vast experience with innovation and development was interviewed to gain more insights into these collaborations.

For SME the use of external resources is a necessity more than a choice (Colurcio et al, 2012). This was also the opinion of the expert who can be quoted as *"We could never be what we are if we did not have cooperation with people outside the company. Cooperation in research, product development, process development, production, sales and marketing are undertaken. Smaller the company the more dependent it is on external force. It is very natural for us to collaborate with knowledge outside"*.

All the basic research for Oatly is outsourced to research institutes that is, the end research from the research forms front end of innovation for the company. Most of the basic research is done in collaboration with research institutted and only the product development is completely in house. University students are engaged in product development through internships and thesis.

Development of Oatly can be seen as technological push innovation. The need was recognized by the industry and the researcher. To experimenting with beverages based on cereals and invention of oat based beverage and ingredients. The invention stage was accomplished at university. Next step was to develop the product on an industrial and commercial scale. This required working together with milling equipment suppliers, ingredient and enzyme suppliers. Implementation phase involving collaboration with retailers. Finally the diffusion phase, it involves working together with various stakeholders (retailers, packaging companies, ingredient companies and so on).

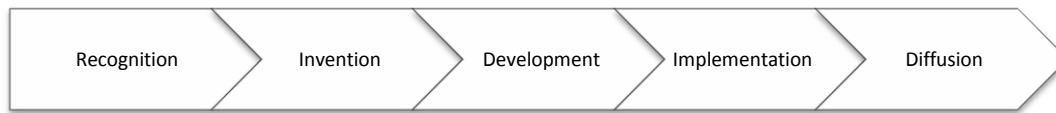


Figure12: Technologies push innovation process

The process is not completely linear as illustrated in **Figure12** above, for understanding the dynamic need of collaboration and external partnership it can be simplified as a linear process. Most of the collaboration is ‘contractual’ in nature, but the expert express openness to collaboration on a more strategic level.

4.3 Interaction and the Innovation process

A lot of research has been done on company organization and its innovation capabilities and it has long been recognized that organizational structure plays an important role in innovation (Damanpour & Gopalakrishnan, 1998; Gosselin, 1997). In this research we try to understand the effect of organization size on collaboration and innovation.

Academic experts who have vast experience of conducting research in collaboration with the industry believe that ‘family owned’ companies in Sweden tend to be more innovative and open to adoption to innovation. This can be attributed to easy accessibility of the decision makers and their direct involvement in the development process. As well as indicated in the literature SME (small and medium enterprise) are more open to adoption of innovation and their ability to obtain information and inputs from outside are a key determinant of their innovativeness (Avermaete et al, 2004). Smaller companies are thought to be innovative because product innovation is an opportunity for them to establish themselves in the competitive market (Ettlie, 1983).

While the idea generation and collaboration process in larger companies is more complex, to understand the innovation idea generation process in a multi-national packaging company (> 10000 employees) an aspect of communication came to fore. There exist communication channels, a system to channelize requirements from customer, market and competitors, translating it into requirements, prioritizing it and using them to define research projects. The process is illustrated in below **Figure 13**.

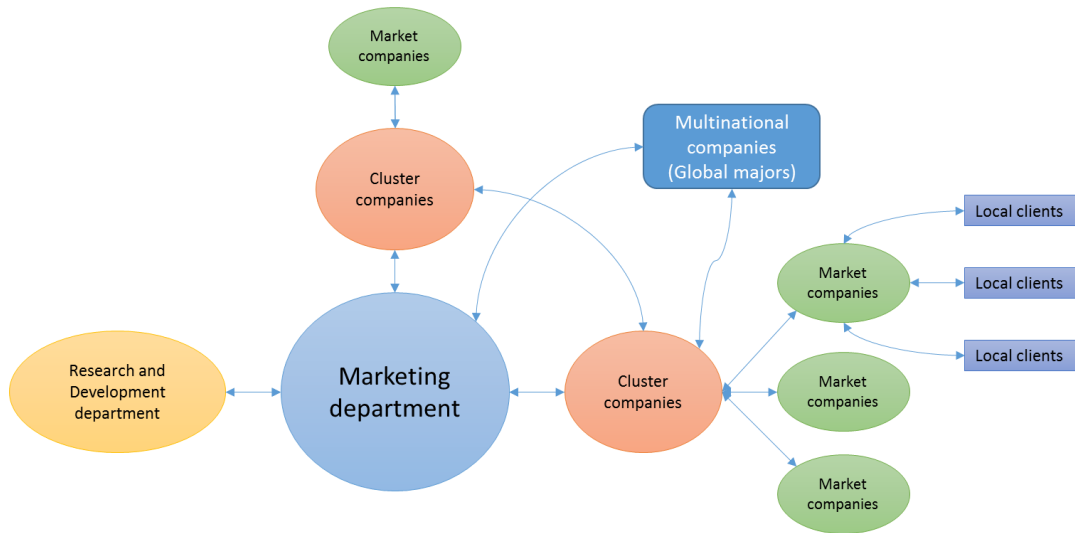


Figure 13: Communication channels for customer interaction in a multinational food packaging company

Communication is on a global scale, where ideas and needs from different markets are collected into a central marketing function, converted into requirements, prioritized and finally fed to the centralized R&D. The market companies have limited R&D capabilities. Thus the market companies are able to conduct incremental innovation based on the customer feedback or requirements, whereas the central R&D function engaged into more radical and exploratory developments.

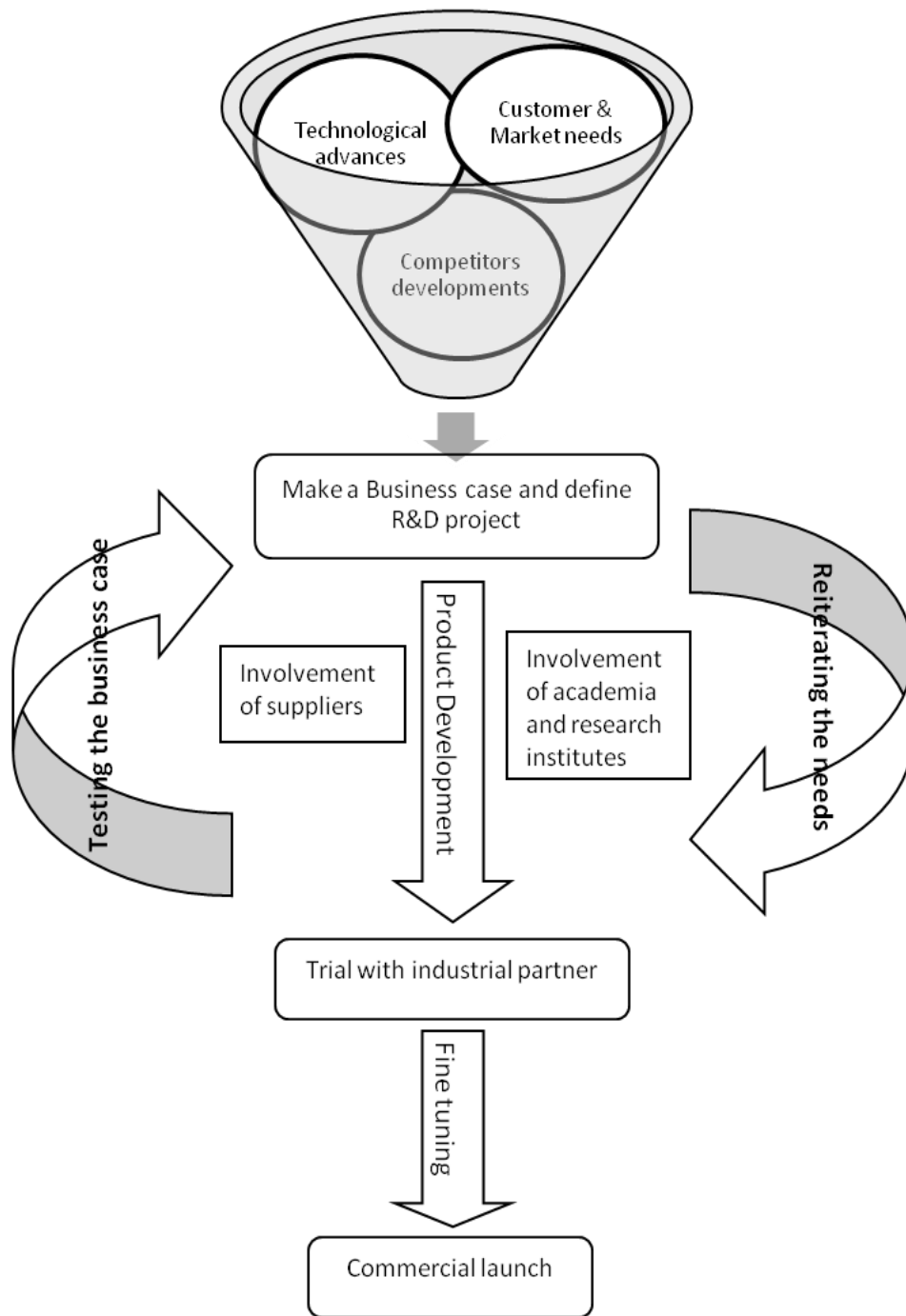
In this system the requirement owners i.e. the research and development team seldom comes in contact with the need owners (customers). Experts hold mixed views on the effect of communication channels. Experts from packaging and processing industry believe that not having to deal with the customers help research and development team to concentrate on their core activities and remain focused on the technical aspect. They also recognize that with customers located in unfamiliar geographies it is difficult for the research team to visualize details and get a complete picture of exact customer requirements. The expert from food producing company stresses on ‘human’ aspect of collaboration, and believes that collaboration is about people believing in an idea working towards its development. In that sense communication channels hamper personal relations and thus a hindrance for collaboration.

4.3.1 The Innovation Process

Based on the understanding of the communication channels in multinational food packaging companies, flow of innovation projects and inputs from literature, an

understanding of the innovation process was built. The innovation process is illustrated in **Figure 14** below.

Most companies today operate on a global scale, supported by a trend of consolidation by merger and acquisitions in the food industry (Returners, 2014). Multinational companies having central R&D cater to customers in every corner of the world; this has let companies to develop innovation process to gather, filter and priorities the ideas to lead. Also create partnerships and collaborate with other stakeholders.



Figur 14: The innovation process for processing and packaging companies

In the above model ideal are collected from customers, market demands, competitor development, suppliers, consultants and technological advances in the industry and fed into an innovation funnel. Usually the marketing department filters these ideas, checks for feasibility and builds a business case around them. Ideas with a strong business case are prioritized and passed on to the research and development department. They work on the technical developments in collaboration with suppliers. Industry expert in this regards can be quoted as *“Suppliers form the major part of collaboration, sub suppliers and module supplier. They are more involved in execution but not for idea generation or in design”*. The nature of this collaboration is mostly ‘contractual’. Academic or research institutes are engaged if any fundamental or basic research needs to be conducted. As the developments usually take several years to commercialize and owing to the dynamic market situation there is a need to check and reiterate the market needs as well as the business rationale being the project. As pointed out by industry expert *“during the development stage requirements are checked with them (customers) but they are still involved in the development process directly”*. After the product is developed it is tested with an industrial partner or a trusted customer, fine-tuned and launched in the market.

The specifics of the model developed refer to a particular case and not to a general one. This model in many aspects corresponds to the open innovation framework of ‘food-machinery model’ developed by Bigliardi et al. (2010) and discussed in previous chapter. The actors are involved in the early stages of product development especially customers and academia (technology scouting). Their role in strategic development is limited strategic and under-developed.

4.3.2 Geographical proximity and Collaboration

As an effect of global operation, need for geographical proximity for collaboration is diminishing. Expert from Ecolean AB when asked about importance of geographical proximity for collaboration can be quoted as saying *“We are a global company with customers all over the world. The key to close collaborations is transparency and communication to build an open and flat-hierarchic environment where new ideas are welcome”* another expert can be quoted as saying *“Collaboration comes down to people that have similar ideas and are interested in working together”*. Industry experts believe that geographical distance is not a barrier for collaboration as long as there is trust, transparency and the interests are aligned together. The findings are supported by literature, as relations and collaboration are a function of trust and it does not require the actors to be geographically close together (Gordon and McCann, 2005).

4.4 Barriers to collaboration in innovation

Some common barriers to collaboration identified are legal hassles, documentation, and ownership of the research, agreements and setting up a legal frame work (Sagay,

2011). This not only had a cost implication but also result into higher turnaround time. Apart from that other barriers from stakeholder perspective are discussed as below.

4.4.1 Food Manufacturer perspective

Food manufacturers, especially SME see their suppliers as important collaborator for innovation, in their relationship there is exchange of market knowledge and ideas. But the intensity of the relation is often limited to contractual collaboration. As in when a company is faced with a technical difficulty in development process which is not their expertise they involve suppliers and draw upon their expertise to address the problem. The reasons cited for less collaboration with packaging and processing can be summed in two major factors high cost of capital intensive and trial cost is also more, time consuming. It is much faster and cheaper to work with ingredients for new product development and develop new products new for the market. This is also affected by asymmetrical relationship between processing SME-Supplier and the retailer that can block ideas and restricts the scope of innovation (Colurcio et al, 2010).

Another reason that prevents manufacturers to experiment with new processing and packaging technologies is skepticism about safety and the perception amongst consumers. A good example of this is public rejection of food irradiation. Even though food irradiation has been scientifically documented to be safe, the perception of risk and lack of public awareness limit the acceptance of this technology (Kamolprasert and Morehouse, 2004).

Expert here believe that food industry is not a technologically intensive industry. They seldom use completely new equipment in their production rather they use already existing equipment in a different way. If processing and packaging companies offer opportunity for food producers (especially SME) to run commercial trials to test market potential it would be a big leap for collaboration and process driven innovation.

4.4.2 Processing and packaging company perspective

Food producers more than often do not have expertise in food engineering but have expertise in food science. A report by food manufacturer daily, a UK based magazine talks about the factors limiting factory automation in food industry. Industry experts believe that capital is not always the factor limiting acceptance of automation but majorly it is the fear amongst food manufacturers about lack of qualified engineers who could install and maintain such an automation system (Addy, 2014). Drawing analogy from this example about reluctance for acceptance of innovations in automations it can be extrapolated to the acceptance of innovation in processing technologies.

Experts in food processing equipment companies interviewed also realize this limitation and can be quoted as, *“We need to develop a process to involve the customers. It is*

difficult as customers find it difficult to define the problem, but come up with a technical solution instead.” Processing equipment and packaging companies face a challenge as most customers do have a fair idea as to what they want in the near future but not what they would want in the future or 10 years down the line. Here industry experts identify with the famous quote *"If I'd asked people what they wanted, they would have asked for a faster horse"*⁵. The quote only goes forward to support this point, the research findings re-enforce the idea that customer not always know what they want mostly due to lack of technical expertise in field of packaging and processing. This also opens a debate about merits of merits of innovating vis-à-vis customer feedback v/s innovation arising from singularly gifted individuals or industry. Even though the customer may not be able to precisely verbalize the innovation they would want, it is important for innovator to have an understanding their customers and their problems via empirical, observational, anecdotal methods or even intuition (Vlaskovits, 2011).

Another aspect of acceptance and adoption of innovation in processing and packaging technologies is spreading awareness amongst consumers. Consumer perception and skepticism about new technologies is a major barrier for their development. Employing effective communication tool to spread awareness amongst consumers is thus essential for adoption of new technologies and in turn to encourage innovation activities.

4.5 Innovation and academia

Another aspect that came up during the interview with the experts is the industry-academia interaction. Experts from the academia believe that small and medium enterprise (SME) and mostly family owned food companies are more open to adoption of innovations that originate with the academia and are rooted in the academic research. Most companies are reluctant to adoption of academic research oriented innovation because it more than often does not correspond to the market pressures. The academic innovations are not in synchronization with cost and optimization objectives as their main focus is to increase and build on the knowledge and fundamental research.

Similarly views from industry experts resonate with the belief that innovations of academic origin even after being novel are not applicable in the competitive industrial environment. These innovations fail to capture the holistic perspective and therefore are difficult to commercialize. Industry is driven by the bottom line of maximizing profit, increase market share and consumer acceptance, and its pursuit to gain full IP rights, whereas academic research is mainly driven by quest of science, knowledge diffusion, student education and publication Sagay (2011) indicating an expectation mismatch it resonates the views expressed by industry experts. Experts from the academia interviewed at Lund University recognize the conflict over IP rights of academic research

⁵ Speculated to have been said by Henry Ford founder of Ford motors.

and it is worth mentioning that the researchers at Lund University are entitled to own their research which paves the way for industry-academia collaboration. There exists a strong interest from the industry to collaborate with industry during new product development phase and to outsource few technical aspects of new product development. The idea is to utilize the scientific expertise of the academia to resolve an issue rather than generate ideas. Academic research usually forms fuzzy front end of innovation for the industry.

Thus the role of academia is restricted to a facilitator innovator and not a partner in innovation. Sam Sagay (2011) in his article talks about innovation partnership and a mindset of information sharing / collaboration. He talks about paradigm shift in academia and food industry to meet innovation challenges and suggests some recommendations for paradigm shift in academia and the food industry required to meet the challenge of innovation. Most important of which is breaking down the wall between academia and industry, most of academic research do not produce innovation due to 'funding gap'. These research projects lack funds to take the project from basic research to new product/service development and finally to commercialization.

Partnering with Academic research

Experts believe there is a lot of scope and potential for partnering with academia for research & development and it will be beneficial to building innovative partnership between industry and academia. In the results some barriers for the partnership have been identified, it can be summarized as an expectation mismatch – academic research is based on criteria of novelty whereas industrial research is motivated by a business case. Though it is important for academia to carry out explorative research, it can only account for innovation if it makes business sense. Thus the need to add an economic element to the research projects in food technology and engineering, exploring long term business prospects and engaging industry from the beginning.

4.6 Model for inclusive collaboration in innovation

Most companies follow a stage gate process to guide the innovation process. Need to develop a model for innovation that focuses on external sources as much as the internal resources. Develop a process to involve stakeholders. Mainly three factors involving external resources essential for increasing development speed and efficiency need to be incorporated in the innovation process:

1. Involvement of customer to **develop high quality product specification**. Product specifications are requirements put on NPD process and help the development team to define the new product/process. This can be deduced from the case of Tetra Recart discussed in previous chapter. Involvement of customers from an early stage in Tetra

Recart from the helped develop better understanding of product requirements and thus was crucial for product development.

2. **Close links with primary suppliers.** Close and early collaboration with suppliers can reduce development cost and time as well as provide advantage for downstream product development (Rothwell, 1994). It was also highlighted by the experts interviewed.
3. **Accessing external knowhow.** It has long been know that use of external R&D can speed up new product development (Gold, 1987). Example of Oatly discussed in previous chapter is a good example, where most of the basic research is conducted in collaboration with research institutes.

Currently ingredients are developed to fit into existing food systems. But if processes and ingredients are developed in synchronization to deliver newer functionality it could promote food product development to a whole new level.

5. Conclusion and implications for future research

In this chapter the results, discussion and insights gained during the course of this research were reflected upon based on the research objectives and address the purpose of this research. Also scope for further research is developed at the end of this chapter.

Gaining understand the interaction and collaboration between FMC, PSP and PEM: collaboration in product development stage and Innovation; The views of industry experts strongly reflect the role of suppliers of processing and packaging in food industry is mostly “contractual” in nature, whereas ingredient suppliers tend to be more mature partners in the innovation process. Petroni and Panciroli (2002) in their research on innovation as a determinant of suppliers’ roles and performance found a need for food machinery suppliers to make it their goal to move up from a “contractual” to “mature” or even a “strategic” partner in NPD and innovation. This does not only require large investments but also a process of building specific capabilities and nurturing organizational values.

Documenting the innovation process from industry perspective and role of suppliers in innovation, it can be noted that: The innovation process at major food machinery and packaging company was identified as part of this study. This process corresponds well to the ‘food-machinery framework of open innovation (Bigliardi et al., 2010). It is apparent that food industry is taking steps to integrate external knowledge sources in the innovation process. With numerous chain and network ties in food industry there is a vast potential for opening up innovation process. At the same time the web of relations make it complex and challenging to manage the collaborations. The role of suppliers continues to play limited strategic role in innovation.

Gain insight into barriers to collaboration; some of the barriers to collaboration were identified and they can be grouped into two types: technical and perspective. Technical factors constitute of lack technical expertise amongst food manufacturer, requirement for legal framework and difficulty in predicting future needs. But the more imperative barriers are lack of trust, skepticism about new technologies and conflict of interest. Trust continues to be the major barrier for collaboration. Especially with the PEM and PSP where the technological edge accounts for their market advantage. One expert from Tetra Pak AB mentions that “*In an ideal world a company would have a single exclusive supplier for a certain item, but that is utopia*”. There exists a web of relationship with every company having multiple suppliers and vice versa thus a need to establish trust amongst stakeholders. The development for framework for engaging actors should be aimed at fostering trust and build a transparent as well as symbiotic relations. This is a major challenge that needs attention for further research.

Industry experts believe that **geographical distance** in not a barrier for collaboration as long as there is trust, transparency and the interests are aligned together. The findings are

supported by literature, as relations and collaboration are a function of trust and it does not require the actors to be geographically close together (Gordon and McCann, 2005).

To conduct further research in this field it is crucial to establish trust with and within the industry. Collaboration is considered strategic and to get experts to speak about it openly is a challenge that needs to be dealt with. The next logical steps to make this research more applicable for industry will be to conduct a wider study which is more quantifiable or conduct company specific case study to assess their position in the collaborative innovation landscape.

Industry experts and literature (Davenport et al, 1998; Vangen & Huxham, 2003) emphasize on building trust as important criteria for collaboration. Studies on trust have been carried out by behavioral scientists. There is a need to put available literature on literature in context for industry. Therefore further research can be focused on building inter-organizational trust for collaboration and incorporating trust in the open innovation process.

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Appendix

A. Interview guide

1. What is your background, education and work experience? Tell me about your experience with new product development and/or innovation?
2. What does innovation mean to you as an individual and for your company?
 - Could you cite some examples of innovation in packaging, product or process you came across in the food industry?
 - Examples of recent innovations from your company?
3. Where do you find innovation?
 - Where do new ideas come from i.e. who comes up with new ideas (marketing department, customers, employees)?
 - Who is the driver of innovation process (R&D department, marketing department, cross-functional teams)?
 - Does innovation in the organization follow fixed processes, path or decision points (stage gate) and what does it signify?
4. During the new product development process do you work together with your suppliers and specifically packaging solution providers or processing equipment manufacturers?
 - Procedure for involving suppliers?
 - At what stager are the suppliers involved?
 - What degree are the suppliers involved (contract, problem solving...)?
5. Do you involve your customer in the NPD process?
 - Customers influence in product development specifications?
 - Are customers involved in concept design or testing?
 - Do you engage in or see possibilities for R&D integration or information sharing with customers?
6. In your opinion, is involvement of academia in the innovation process beneficial?
 - Mean of engaging academia
 - Advantage and disadvantages

7. Do you think geographical distance between stakeholders is a barrier for collaboration?
 8. Which of the following stakeholders do you consider important during the innovation process: your customer, your suppliers or academia?
 - Relative importance?
 9. How do you see the future of collaboration with stakeholders with respect to innovation and innovation process?
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