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Functional Foods for Added Value

Developing and marketing a new product category

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Abstract

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In this study innovation involves the development of a new product category; i.e. new products, new processes and new business. The development process is conveyed in narratives where a radically new product group, functional foods, is developed. These high-tech food products are associated with added value for the food business as well as for individuals and society at large.

In the past decades Swedish food companies have faced an increasing competition. With increased competitive pressures, low prices and large volumes may not suffice as strategic advantage in a long-term perspective. One way of gaining competitive advantages requires finding new ways of creating added value based on technological development. It is a technological upgrading process that encompasses developing and making use of new knowledge. It may lead to the production of value added products, profits from licensing agreements and a boost for the company image.

Businesses that want to succeed in this market need to develop new managerial methods, in particular in identifying critical technologies. This refers to building internal skills, employing innovative external sourcing, developing new markets with strong brands, establishing alliances, developing packaging, and finding venture capital for new developments. The strategic options also include strategies of communication.

In the studied cases several factors have contributed to the successful innovation process. They are discussed in a creative management perspective, allowing for a creative perspective to be gradually complemented with a strategic planning perspective, as the innovation process proceeds. The early phases of the innovation process are characterized by an open-mindedness, flexibility and tolerance of ambiguity. The research procedures as well as the collaboration partners are changed several times during the innovation process. The later phases of the innovation process, however, are characterized by a more formal analysis seen through a strategic planning perspective. This part of the process appears more focused and communicable. In the cases this is conveyed as organizational arrangements, administrative routines for collaboration, and in different marketing strategies.

Key words: Functional foods, innovation, health, food, pharmaceuticals, NPD, new product development, technology, marketing, strategy, patent, medicine.

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1. Introduction

"*Fail to innovate and you can expect, at best, to see your rivals thrusting ahead while you languish in some backwater. Innovate, and do everything else well, and your business at least stands a chance of flourishing, though at times it may seem to companies that they are on the proverbial treadmill, on which they have to run faster and faster, just to stand still"* (Traill & Grunert, 1997, xv).

1.1 A practical problem

Most businesses face challenges in remaining competitive[1] and adhering to needs for change. This is especially the case for basic industries, such as the food industry, where a mature and stagnated market in itself is a challenge for growth and profit.

In Sweden, a major change occurred in 1995, when Sweden became a member of the EU. It is clear that the membership has had effects on the food industry. One effect is perceived in an increased rate of development in which the competitive pressures are strengthened (Mark-Herbert & Nyström, 2000 B, 23-24).

Developing new products, new processes and even new businesses thus seem to be ways of meeting these challenges. In reality, however, the food industry is rather low-tech, measured in terms of R&D[2] expenditure. A recent study of food businesses in Sweden reveals that on average 1.6% of the annual turnover is spent on R&D (Ibid, 22). Compared to the pharmaceutical industry, with 19% in R&D expenditure, this is relatively low (SOU, 1997)[3]. The major reason for making such comparison is that the pharmaceutical industry shows interest in the area 'between food and medicine', which is the area of interest in this study. R&D is an expensive undertaking associated with great risk. Even if costly R&D leads the way to a new product, studies of new product development indicate that up to 80% of consumer products fail in their first year (Doyle, 1998, 206).

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[1] Competitiveness is seen as when a company "… possesses the sustained ability to profitably gain and maintain market share in domestic and /or foreign markets" (Agriculture Canada, 1991).

[2] R&D, Research and Development

[3] A comparison of R&D expenditure of annual turnover in the agricultural area (1%), the food processing area (1%) and the pharmaceutical area (18%), in Sweden, further supports the perception that the food production and food processing areas are rather low-tech (Statistiska Centralbyrån, 2001, 18-19).

Assuming that the R&D-budget for most food businesses is limited, how can the scarce resources be used wisely? How can research and technology intensity be increased and markets be developed to achieve increased competitiveness? With these compelling questions in mind, it is time to ask who it is that gains from the innovation process, as it is demonstrated in the development of new food products.

1.2 Perspectives on the development of new food products

One might ask how great the need is for new food products. The food products in focus here are functional foods[4], foods with a positive health effect. Depending on who gives the answer, it will reflect one or more of a number of perspectives. Four perspectives are presented below: of society at large, individuals, food businesses and of academic people interested in innovation.

The first perspective is that of health and longevity for people on a societal scale. It is reflected in different cultures by the traditions, habits and guidelines by which entire groups of people live. In Western societies where resources are plentiful, starvation is in the twenty-first century no longer major causes of death. The problems in these cultures are rather that of overeating, eating an unbalanced diet and living a stressful life (Barnard, 1993). Treating the effects of these food and life-style related stress factors is seen in an escalating number of cases with cancer, coronary heart diseases and other signs of poor health management. As a result, the cost for medical care is escalating. From a societal point of view *preventing* a disease through certain food products, or even delaying the onset, appears financially sound.

The second perspective is that of the individual. Most individuals are very conservative in their food habits (Feurst, 1991), but still want the assurance of a long and healthy life. Most of us want to eat meat, sweet deserts and salty peanuts now and then. We eat more than we need and we have an unbalanced intake with regard to our limited daily activities. Foods that promote health are needed. This need is reflected in a consumer interest for products that provide some kind of guarantee of a health benefit, without any call for major changes in habits. Some might argue that a long, healthy life has always been prioritized, but it is very clear that a new market is rapidly expanding, one where many consumers are well informed (Eklöf, 2001; Kollberg, 2000), aware of their choices and willing to pay for health.

The third perspective is that of the Swedish food industry. It produces mainly bulk products for the local market. The value of imported food products is approximately twice that of exported food products in Sweden (1997: 22 077 M SEK vs. 13 266 M SEK, in Statistiska Centralbyrån & Livsmedelsekonomiska

[4] A closer presentation of *functional foods* is provided in ‘1.3 Definitions of terms’.

samarbetsnämnden, 1997, 64). Traditionally, the food industry at large has been regarded as a low-tech industry with production targeted for a local or national market (Nyström, 1990, 197). Food businesses are relatively positional in their activities, which means they are market searchers rather than market developers. (Ibid, 20). Most new food products are minor modifications of previous products.

Functional foods, however, are different. They are the result of strong R&D efforts and of the development of new technologies as well as new markets. These products and processes provide the basis for patents, 'know-how', licenses and sales of high value added products, sold with health-related marketing arguments (Mark-Herbert, 1993,4-8). Studies of attitudes towards the development of functional foods among CEOs[5] in the food industry indicate that there is a large interest in functional foods in the Swedish food industry (Mark-Herbert & Nyström, 1993; 2000 A & B).

Lastly, the fourth perspective, is the researcher's with an interest in the innovation process. Independent of their field and view, innovation for these people has a positive connotation. This is illustrated in a citation: "Innovation plays a role in nurturing the economy, in enhancing and sustaining the high performance of firms, in building industrial competitiveness, in improving the standards of living and in creating a better quality of life" (Goplakrishnan & Damanpour, 1997, 17).

Innovation, seen as a high-risk endeavor, is often viewed as constructive, profitable and a way to solve a problem. New ideas that are *not* useful are usually called mistakes. The usefulness can, of course, be objectively determined once the innovation process has been completed and implemented. This positive bias, however, is found in studies of innovation, regardless of the research perspective.

Hence, these four perspectives all seem to reflect a positive bias toward innovation and in this study, the development of new food products.

1.3 Definitions of terms

A few recurring terms are going to be used frequently throughout this thesis. Some of these terms are clarified below- *functional foods*, *technology* and *innovation*. Other terms are further explained in the text and in footnotes as they appear in the writing.

[5] CEO Chief Executive Officer

Physiologically functional food - PFF[6]

In most parts of the world, except in Japan, a legal recognition of a term for this food group is lacking. In Europe, as in the US, the lack of a legal definition leads to some confusion among people at large regarding PFF's. This has not, however, prevented a growing interest in the development of such products among food businesses.

PFF is a diverse group of foods, with little in common except what could be labeled as a medical effect. The medical effect is a physiological influence of certain chemical components in the PFF on different organ systems in the body. One might argue that all foods have such an effect, and to a certain degree that is true. All consumed foods affect the body in some way. Functional foods, however, are scientifically shown to have a preventive effect, which somehow delays or impedes the development of the onset of a disease or even in some cases, can be used for treatment of a disease.

It is the scientific evidence of a health-related effect, which distinguishes PFF from any other food. The scientific evidence of a health effect is the key to the profit arising from the development of such products for the food industry. One way of dividing functional foods is based on how the product is developed; in nature or in a development process by man (Figure1.1)

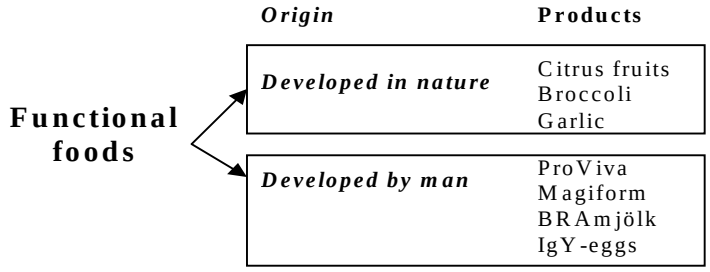

Figure 1.1 Functional foods can be divided in two groups based on the origin, developed in nature and developed by man.

The *naturally occurring* functional foods, for example, garlic and citrus fruits are most interesting for health-conscientious consumers (Berhow et al., 2000; Edgson & Marber, 2000; Parliament et al., 2000; Sandberg, 2001; Shibamoto, et al 1997 A; Shibamoto et al., 1997 B). *Developed* functional food products, on the other hand, are of a particular interest for the food industry as well as for consumers. If protected by proprietary rights, these products can be sold with a health-related argument, providing grounds for a high margin pricing, licensing arrangements and

[6] A review of the development of functional food is provided in chapter 4.

a strengthened business image due to proprietary knowledge in a strategic area (Mark-Herbert, 1993). This thesis focuses on functional foods that are developed by man. A closer presentation of these products is provided in Chapter 4.1, “Foods, medicines or what?”

Technology and technological strategies

The term technology is widely used in the literature with different meanings, but has mainly a narrow definition with associations to technical applications. The term for that kind of technology would be techniques, in this study.

Technology, on the other hand, has a wider definition in this approach. “Technology means knowledge that is potentially useful for product and company development, even though the immediate implications may not be clear” (Nyström, 1990, 43).

Knowledge is perhaps the best way to describe the term technology. Technological strategies refer to how companies extend their knowledge base. R&D is an important part of technological strategies, but it is not the only source of new knowledge. With reference to time, strategies may be divided into *intended technological strategies* and *realized technological strategies*. Intended strategies are concerned with conditions for change, expressed as policies, visions or goals. Realized strategies, on the other hand, are concerned with the outcome, the actual evolution of patterns of decisions and activities. Realized strategies have been implemented. It is what has been done (Ibid, 43, 77). This is further discussed in Chapter 2.

Innovation

Innovation is the process of “bringing new ideas to use” (Nyström, 1990, 30). Sometimes the term refers to the process and at other times to the results of a change. The context will determine which meaning is implied. In the marketing literature, the innovation process is commonly referred to as the development of new products and processes. In the organizational management literature, on the other hand, the change process is in focus.

In this dissertation, the innovation process refers to “the creation of the future” (Ibid. 75), which essentially means managing technological change and the outcome of it. This perspective includes marketing and organization management aspects of the process while focusing on technological and marketing strategies. In short, the innovation process encompasses all fundamental changes, which may affect product, process and company development.

1.4 A theoretical problem

The innovation process can be seen as new technologies that bring changes. These changes require resources and acceptance among participants in the process. The innovation process is often seen in technological development as a way to solve problems. New or established – all businesses face innovative changes.

"Strategy innovation is the only way for newcomers to succeed in the face of enormous resource disadvantages, and the only way for incumbents to renew their lease on success" (Hamel, 1998, 8).

Although considerable attention has been paid to the outcome of innovation activities, little work has been concerned with describing the innovation process itself in the business. The need for understanding innovation, as it occurs over time, is discussed by Saren (1984, 11). But how can the innovation process be seen as a possible strategic advantage? How do innovative forces flow? Can a new market be developed? Understanding the conditions for the creative process from the early idea phase to a later phase of product and market development is a theoretical objective in this dissertation. A theoretical understanding of the process is further discussed in chapter 2.

1.5 Objectives and demarcations

The main objective is to address the question: *How do Swedish food businesses develop radically new products?* Radically new refers to products requiring R&D efforts that give rise to new technologies (new knowledge). These technologies serve as a base for know-how in production, patents and as strategic resources.

The empirical field of the development of functional foods is chosen for several reasons. Firstly, my choice is based on the fact that functional foods are *radically new* products, in terms of *technologies* (development of knowledge) as well as *markets* (the consumer's perception of the newness of a product)[7]. From a theoretical point of view this makes the innovation process readily identifiable with regard to the outcome as well as the progression of development. Secondly, the area of functional foods is seen as an expanding part of a new market and thus a strategic area for the food business. And lastly, my personal interest and understanding of health-related issues have certainly contributed to the choice as well.

It is important to keep in mind that the development of functional foods by no means represents a development of typical food products. Consequently, the

[7] The concept of a *new product* is further discussed in Chapter 2.

technological and marketing strategies differ from those used in developing most other food products.

The products in this study are developed functional foods, based on natural raw material. Natural, in this case, refers to the fact that the raw material or product is *not* genetically modified (GM). GM products that qualify as functional foods are labeled *novel foods*. These products are, just like functional foods, associated with major R&D efforts. At the time of writing this thesis I am not aware of any functional novel foods, but their existence is certainly only a matter of time[8]. They are *not*, however, studied here since problems in developing these products, in particular in marketing and ethics, differ from those of developing functional foods.

Ethical problems in the production of functional foods, as a part of agricultural production and processing (Jordbruksverket, 1997), and ethics concerning the pricing and distribution of functional foods are not discussed in this thesis. It would require more of a consumer-oriented perspective.

The discussion is limited in the area of financing the R&D process. In most cases I have had access to contracts and other unofficial empirical material but I have been asked not to refer to these documents or to use specific figures. Consequently, accessing resources will be discussed in terms of strategies and organizational arrangements.

Although the organizational aspects of innovation management are of great importance (Adler, 1999; Lindell, 1988; Lundgren, 1991; Lundqvist, 1996) they are not the only or primary focus of this study. The organizational arrangements are described in the cases and discussed as a part of factors that affect strategies and the innovation process as such.

The process of innovation can be stimulated or impeded by lack of certain factors in the setting and environment. A number of these factors have institutional character, such as the need for a legal framework and a structure within which growing business and ideas at universities can find financial support. Counterproductive factors are largely seen as deficiencies. They are not discussed in depth in spite of their influence on the process, since the object of this study is to study how technological an marketing strategies are realized – not why they are not realized.

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[8] "In a few years, we will not be able to distinguish what has been produced using GM technique and what has not!" (Sylwan, 2000, 3). The book "*The Earth and the Genes*" (*Jorden och generna*) provides a background for further discussion on possibilities and risks associated with genetic modification.

1.6 Approach

Studying the innovation process in a new empirical field has offered many interesting insights. What started in the early 1990s as a pilot study (Mark-Herbert & Nyström, 1993) and a literature review (Mark-Herbert, 1993) grew to become a doctoral thesis. Many choices were made along the way and it would be impossible to explain the rationale behind every road taken. A few significant choices, however, deserve to be further explained.

The research question, *How do Swedish food businesses develop radically new products?*, offers interpretation from several possible theoretical perspectives (Appendix 1). One part of the Ph.D. learning process is finding a perspective that offers a vocabulary and a focus that would provide grounds for analysis. My theoretical choice is further presented in Chapter 2. This is not to say that the research question alone has guided the process. Rather, the interplay between studied theory and empirical findings has guided the analytical process[9]. My theoretical background has influenced the research process as such, mainly in what questions are raised and how the answers are interpreted. This is reflected in the interview guide (Appendix 2), for example, where themes in the guide are rendered from studies of the innovation process in other industries. Some themes prove useful others less so. My ambition has been to conduct critical management research (Alvesson & Deetz, 2000), where an awareness of existing theories is balanced with an empirical sensitivity for discovering new trains of thought.

Generating empirically grounded comparisons in a holistic analysis, applicable to the innovation process in the food industry, is therefore an objective. Another objective is to use the existing theories and concepts when possible, and modify them when needed. The approach used in this study is explorative and for the most part descriptive, which is fruitful when the problem is new and complex. A holistic analysis on several levels of aggregation puts information in a context, which increases the understanding of the problem (Yin, 1991). This approach is illustrated in the dotted ring in Figure 1.2.

[9] The process of *reflexive research* is when theoretical and empirical understanding interplay throughout the research process, referred to as ' abduktion' in Swedish (Alvesson & Sköldberg, 1994, 45).

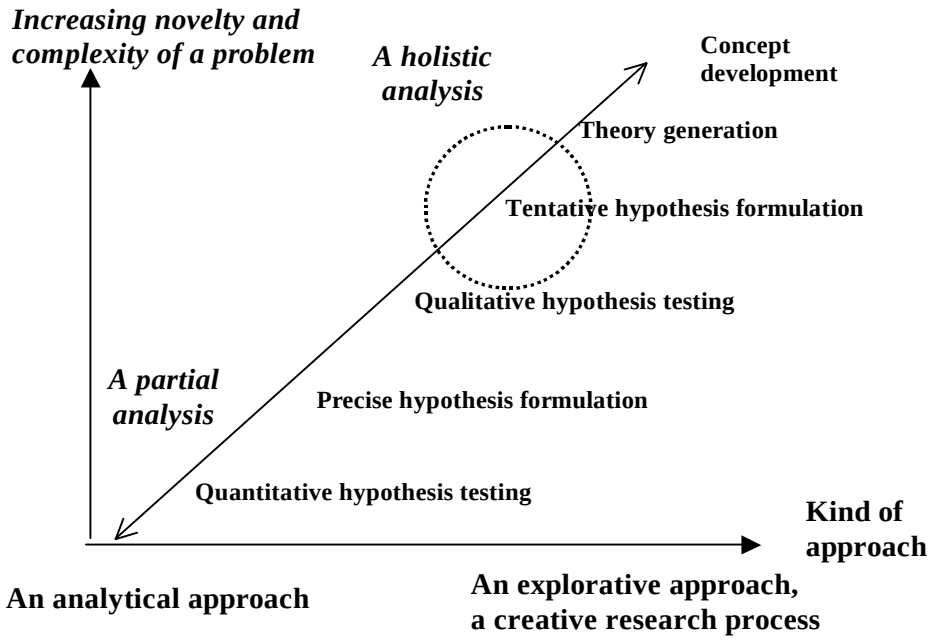

Figure 1.2 How increasing novelty and complexity of a problem affects the research approach and desired research contribution (personal communication, Nyström, 1998).

The choice of case studies and interviews to illustrate the phenomenon in a context is thus connected to the complexity and novelty of the problem. In terms of an academic contribution, this dissertation provides a framework describing and interpreting the innovation process. Fruitful concepts and hypotheses are possible to theoretically generalize (Yin, 1991) in applicable areas. It is also possible to test hypothesis in, for instance, a survey analysis (Mark-Herbert & Nyström, 2000 b).

1.7 Work phases and structure

Within this project several studies have contributed with insights (Figure 1.2). A pilot study and a literature review (1993) provided grounds for communicating the project proposal to SJFR (Skogs- och Jordbrukets forskningsråd nowadays a part of FORMAS). Grants were given in 1997 and the research continued mainly as case studies (Figure 1.3).

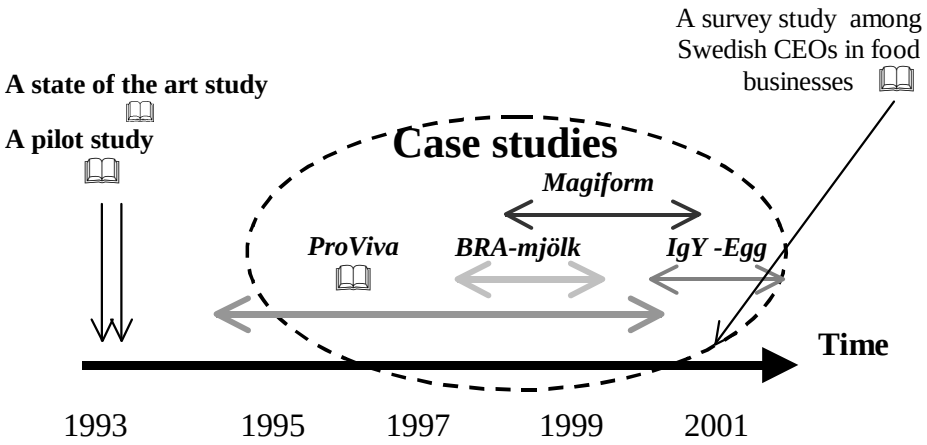

Figure 1.3 Studies within the project. The basis for this dissertation is the circled case studies. (The 🕮 symbolizes a publication).

In this thesis four case studies are presented and compared. The previously carried out studies, the state of the art and pilot studies, have provided insights and further understanding which has been useful for a contextual understanding of the cases.

In the next chapter, a perspective, a theoretical understanding of the innovation process is further explained. Chapter three offers some explanations as to how the longitudinal case studies have been carried out. A short historical background and a functional food market analysis are presented in Chapter four. This chapter provides further contextual insight that will enhance the understanding of further analysis of the cases in chapter five. Finally, Chapter six, offers a discussion of the empirical material, which is summarized in Chapter 7 along with suggestions for further research.

2 A theoretical perspective

Researchers in many disciplines have been preoccupied with research that focuses on the innovation process. They represent a vast number of disciplines: economy, business management, political sciences, technical areas, sociology and psychology, and they all offer different sets of research questions (Gopalakrishnan & Damanpour, 1997). Between these disciplines and even within each discipline the views on the meaning, focus and the impact of innovation vary. The basic question pertains to the nature of the innovation activity, whether the focus is on the new outcome (a product, a method or a device) or on the process of developing something new.

Assuming the innovation activity is regarded as a process, it is rarely disputed that innovation is a collective achievement (McCosh et al., 1998; Goldman 1985). Some even go as far as to say that corporate skills, correlated to business variables, rather than project-related skills or personal achievements, are accountable for innovative abilities (Schewe, 1994). While invention or the conception of innovative ideas may be an individual activity, "innovation is a collective achievement of pushing and riding those ideas into good currency" (Van den Ven, 1986, 591). In most research projects, the level of study is therefore aggregated, at a project, business or industry level, where the interplay between a number of individuals, functions and resources are studied.

The innovation process is a series of steps that basically link an invention to a market in a multi-step process. It involves managing ideas into good currency so that innovative ideas are implemented and institutionalized.

2.1 A creative management perspective

The management literature is rich in interpretations of how to manage the innovation process[10]. The traditional perspective has been that of *strategic planning* (Cooper, 1979; Crawford, 1983; Urban & Hauser, 1980). The basic assumption on which this theory is built is that it is possible to allocate resources and reduce uncertainty by rigorous planning before execution. In this approach, planning precedes action. The plan guides the process in stepwise progression. It also serves as a tool for evaluation of the innovation process. The success of the innovation

[10] A brief overview of management perspectives is presented in a time-table in Appendix 1 (Perspectives of the innovation process in different management schools).

process is related to finding the optimal way to meet the strategic goal, outlined in the plan.

An alternative interpretation is an *entrepreneurial perspective*, which involves innovation management and entrepreneurship (Albernathy & Utterback, 1988; Hamel & Heene, 1994; Loverridge & Pitt, 1992). The plan is replaced by a direction for development; a vision in which an intended strategy gradually finds its way towards a realized strategy. Realized strategies constitute visualization and realization of ideas.

In this thesis the perspective is that of ***creative management*** (Henry, 1991; Nyström, 1990). Aspects of this perspective are described by authors, such as Crawford (1991), Mintzberg (1994) and Skat-Rørdam (1999). The term refers to a combination of the entrepreneurial perspective and a strategic planning perspective. In developing radically new products and processes, new opportunities are discovered. The early part of the innovation process is not possible to plan in great detail and thus is best viewed in an entrepreneurial, innovative perspective. Gradually, the innovation process becomes more focused and thereby possible to plan, allowing for a strategic intent to be expressed. In the later stages of development and in the marketing of a product, a strategic planning perspective is more useful.

2.1.1 The creative process

Creative management offers a perspective in which the innovation process itself, the creation of new technologies and new markets, is studied. The time perspective includes a context-bound history, a present and an unfolding future.

The innovation process is seen as the visualization and realization of new ideas. It refers to the creative process in which information is transformed into useful products, processes and skills. This process is often carried out by insightful individuals, labeled as entrepreneurs, change agents (Schumpeter, 1934) or product champions (Weryzer, 1998, 318). Their capacity to make use of information and mobilize resources for the implementation of their visions is well recognized (Gaddefors, 1996; Johannissson, 1992; Nyström, 1990).

The creative process is described by Nyström (1990, 55) as: "the balanced intellectual unfolding and converging of experience which is necessary to achieve technological and market innovation" in Figure 2.1. The terms divergent and convergent thinking are also used by Van de Ven et al. (1999, 16, 203-204) to describe cycles of a learning process. In their terminology the divergent process refers to a nonlinear chaotic process that facilitates learning by discovery. The converging part of the process signifies testing the trail and error outcome of the diverging part of the process in a context.

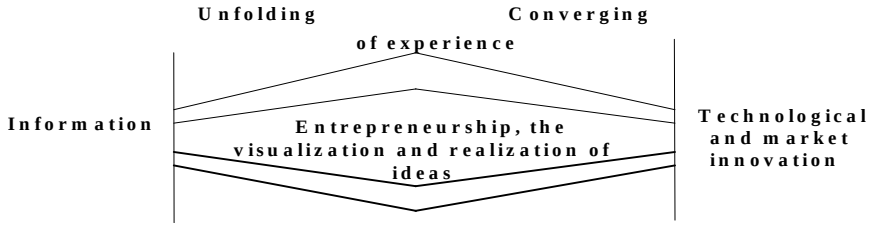

Figure 2.1 Entrepreneurship as the creative transformation of information into innovation (Nyström, 1990, 56).

The creative process is regarded as an ongoing interaction with the environment. The early phase is characterized by open-mindedness, intuition, visions, and withhold of judgment. It requires flexibility, tolerance of ambiguity and a holistic perspective. The later stages of the creative process, however, are distinguished by convergent thinking and reasoning in more formalized analysis. This in turn greatly improves the possibility to communicate results, which is crucial in later stages of the innovation process.

2.1.2 A choice of model for the innovation process

The complexity of the innovation process not only makes it difficult to explain and study but also presents problems in developing a general model. Two major types of models are presented below, a linear phase model and a simultaneous phase model.

When the innovation process is illustrated in a linear interactive model one phase is placed prior to another, for example in phases of generating an idea, development, production of a prototype, manufacturing, marketing & sales, and expanding to a broader market (Figure 2.2).

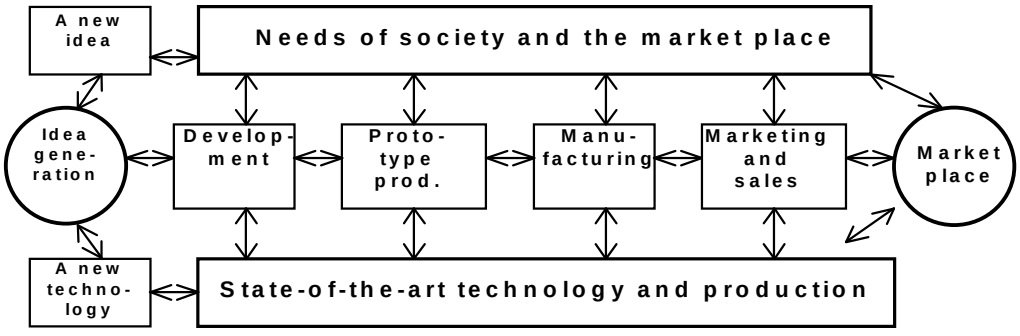

Figure 2.2 A linear interactive model for innovation (Clark and Guy, 1998, 369).

A *linear* model[11] for the innovation process may have parallel sub-processes, interconnected by feedback, but one phase precedes another (Cooper, 1990; Kotler, 1976; Nyström, 1972; Robertson, 1974; Twiss, 1992; Zaltman et al., 1973). Each of these phases is influenced by needs in the society and the development of technologies. Clark and Guy (1998) label such a model an interactive model.

The second type of model for the innovation process is one where a multitude of factors are affecting several interconnected phases that occur simultaneously (Gopalakrishnan & Damanpour, 1997). This is the *multiple simultaneous phase model* of innovation (Chiesa et al., 1996), Figure 2.3.

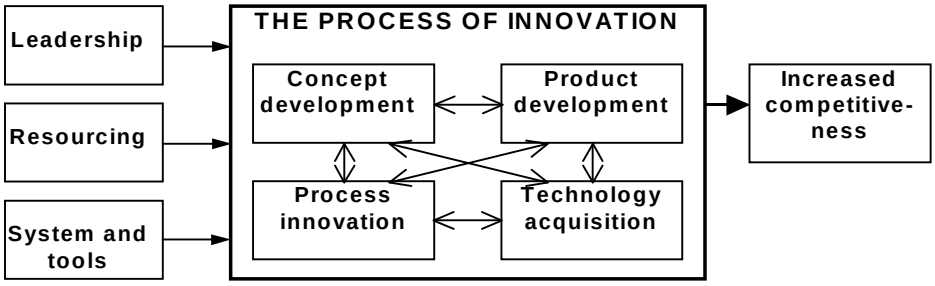

Figure 2.3 A multiple simultaneous phase model of innovation where the phases, technology acquisition, concept development, product development and process innovation take place simultaneously. Leadership, resourcing and systems and tools are enabling factors for the innovation process (after Chiesa et al., 1996, 108).

Before justifying my choice in model, it should be said that a number of arguments can be made for using either model. The theoretical, methodological and empirical arguments that follow are simply the arguments that I find fruitful.

At first glance the second, multiple simultaneous model appears to provide a creative freedom and lack of rigidity that would be conducive to the innovation process. It is deceiving. It is my understanding that the creative process continuously requires flexibility. This flexibility refers to altered leadership, different resources and different systems in the different phases of the process, which is not included in the model (Fig. 2.3). With the multiple simultaneous model, the various phases (concept development, process innovation, product development and technology acquisition) are supported by a set of enabling factors that do not change throughout the process.

[11] Another term for a linear model is a unitary phase model.

In the linear interactive model (Fig 2.2), however, the consecutive phases, each affected by needs in society and technological development, mark the different needs throughout the innovation process. My interpretation of the model is that it is a model where conditions for the different phases are created. This process is not possible to plan with a set of enabling factors but is rather a process of creating conditions for continual learning.

Depending on the theoretical perspective of innovation, the choice of methods may vary considerably. In a linear process model, such as the one presented in Figure 2.2, one can test if R&D expenditure, for example, correlates with the success rate of the innovation process. A statistical analysis could determine if any such uni-dimensional correlation exists on a particular level of analysis. In a multiple simultaneous phase model of innovation, on the other hand, interaction between different factors makes such an analysis difficult.

In this study, a linear model is better suited for understanding the innovation process. The main reason for choosing a *linear model* is, however, not associated with the difficulty of pursuing an analysis. It is attributable to the choice of studying the development of radically new products. In this development process, each step is dependent on the previous step, which makes the developmental path rather unpredictable and thus less suitable for planning and for the development of multiple parallel processes. It is an entrepreneurial process where continual learning leads the way for development of new technologies.

A second reason for choosing this linear model is the fact that the interplay between technological and market strategies is readily discerned. These strategies are a major part of the analysis in chapter six. This model also shows the interplay between the innovation process, market needs and technology development. In discussions about organizational aspects of the innovation process, however, the use of more complex models is fruitful (see 2.3.6 Fourth and Fifth generation industrial innovation models).

The third reason, and perhaps the most important reason for choosing a linear model, is associated with the conception of the process from the narrated empirical material. The innovation process is described in the interviews as a story. That in turn may be compared with narrative arts, where a process is often depicted in a sequential and chronological order.

Assuming the innovation process is perceived in a linear model, the process can be divided in two main stages: the generation and the adoption of innovation. These can in turn be further divided into phases as shown below in Table 6.1. Some researchers focus on one stage or phase (Table 6.1). Others take interest in the innovation process as a whole (Cooper, 1990; Henry, 1991; Nyström, 1990).

Table 6.1 Innovation seen as a linear process divided into stages and phases.

Stages of the innovation process / Phases	*Generation of innovation* (Utterback, 1971; Saren, 1984; Ford, 1988)	*Adoption of innovation* (Ettlie, 1980; Zaltman et al, 1973)
	-Idea generation	-Initiation
	-Project definition	-Implementation
	-Problem solving	
	-Design and development	
	-Marketing or commercialization	

In attaining my research objective, the entire innovation process is of interest. In the cases (chapter 5), however, it is clear that all the phases of the process do not get equal attention. One explanation is, as we will see, that the innovation process was in different phases at the time of the completion of each case study.

2.1.3 What's "new"?

Innovation is seen as the development of something new or, rather, we should say the development of something that someone perceives as new. In this study the products are not only new but radically new. Ideally, we would like to have a universal map of what is "radically new", "fairly new" and "established". This is epistemologically infeasible and any kind of classification would soon be outdated, if it ever gained general recognition. We will have to accept that the perception of "newness" lies in the eyes of the beholder (Rasmussen, 1968, 47 -49).

Crawford (1983, 35) elaborates further on the concept of consumers' perception of new products. He identifies nine types of new products:

1 A product performing an entirely new function such as television, which for the first time permitted the transmission of audiovisual signals.
2 A product that offers improved performance of an existing function, such as a wristwatch whose balance wheel has been replaced by a 'tuning fork'.
3 A product that is a new application of an existing one. For example, the aerosol bomb, which was first developed for insecticides, was later applied in paints, etc.
4 A product that offers additional functions. The hands-free telephone, for example does what the earlier telephone did, plus more.
5 An existing product offered to a new market. This may be done, for example, by repositioning or by taking a regional brand into other regions.
6 A product that through lower cost is able to reach more buyers. The hand calculator is an example.
7 An upgraded product defined as an existing product integrated into another existing product that had previously been purchased.

8 A downgraded product. For example, a manufacturer markets a component that had previously been purchased.
9 A restyled product. Annual auto and clothing changes are examples.

An alternative term to "new" would be using degree of *perceived uniqueness*. In the model below (Figure 2.4) the "newness" is expressed as technological uniqueness and market uniqueness (Nyström & Liljedahl, 1994). The technological uniqueness refers to the technological challenges the business confronts in the development of a new product or process. These challenges are seen in needs to develop new technologies in, for example, processing techniques. The market uniqueness, on the other hand, is what the customer perceives. This does not imply that the customer's need in itself is new; it is rather the product that fills these needs that is perceived as new.

It is possible that a business develops products that have a high degree of technological uniqueness (based on a technologically advanced process) and, yet, to the consumer they may appear as products of low uniqueness ("just cultured milk" so-called "filmjölk"). The contrary situation is also a possible outcome, when a product is seen as radically new on the market even though this product is based on established technologies. This may even be a desirable outcome in a business perspective as it promotes the discovery of new areas of application for a new technology (Strategy B in Figure 2.4). The relative impact of technological and market strategies on the innovation process is illustrated (Figure 2.4.1) and further described below.

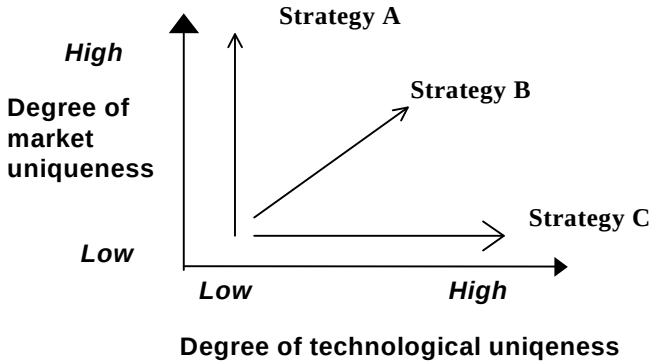

Figure 2.4 Technological and market strategies as parameters illustrating the innovation process (Nyström & Liljedahl, 1994, 7).

Strategy A- means finding a new market niche and creating new relationships with customers. The costs are related to market activities to promote a product on a market. There is no cost or risk for the development of new technologies.

Strategy B - involves finding a new market for a new technology. A condition for this strategy is that technological and marketing activities are well coordinated. Although the financial gain may be large, the risks associated with finding a new market and developing a new technology are considerable.

Strategy C- is less interesting in an immediate commercial perspective, as the market has not yet been defined. This strategy implies primarily basic research with no apparent market applications. In the long run, however, this strategy can lead to core competencies and thus competitive advantage.

The degree of technological uniqueness is defined as the degree of creativity that companies have to employ to solve critical technical problems in developing new products and processes. Therefore, achieving a high level of technological innovation is associated with the radical development of new knowledge, which may lead to patents or know-how protection.

Market uniqueness, on the other hand, refers to how interchangeable a product is perceived by a consumer. It is assumed that greater product uniqueness, the more a product differs in features and performance from competing products, signifies more of a market potential.

The innovation process is illustrated in this model (Figure 2.4) in terms of technological and market strategies. These strategies are not inherently good or bad. They are more or less conducive to the innovation process as such, and more or less

financially rewarding in different industries, in different markets and with different time perspectives.

2.2 Dichotomies to describe innovation

Competition at an industrial level is a reflection of changes in products and processes at the business level. It is assumed that businesses need to renew themselves, to innovate and change, in order to maintain their competitiveness. These changes at a business level can be described in terms of dichotomies.

Prevalent dichotomies for describing the innovation process and outcome are, for example, process vs. product, technical vs. administrative, incremental vs. radical, sustaining vs. disruptive, continuous vs. discontinuous, low-tech vs. high-tech, and technology-push vs. demand-pull. It could be argued that these dichotomies are not mutually exclusive and that is true. Furthermore, whether the innovation is considered as one type or another much depends on the time and level of analysis. These dichotomies are presented to provide a basis for a common understanding of the concepts in further discussions of the empirical material.

2.2.1 Product vs. process

Process innovations are defined as new tools, devices and technologies for an industry, business or subunit (Ettlie & Reza, 1992). Product innovations, by contrast, are new outputs or services that benefit a customer (Utterback & Abernathy, 1975). The difference between the two relates to the competitive advantage and activities that are born from these innovations.

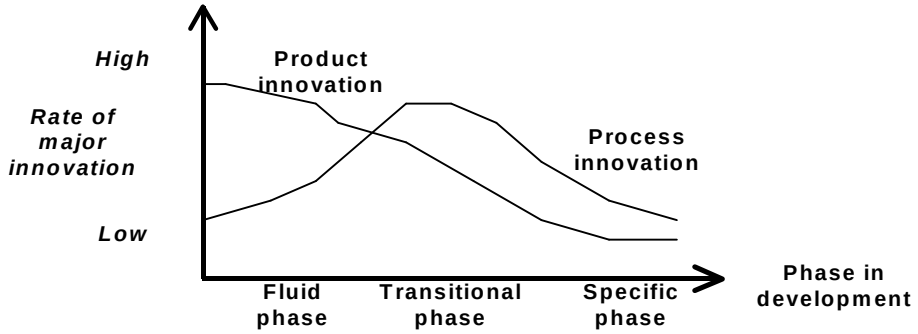

Figure 2.5 Product and process innovation in phases of development (adopted from Albernathy & Utterback, 1988, 27)

This model is further developed with descriptions of the changes that occur with regard to the product, the process, the organization and the market (Figure 2.5,

Table 2.2). It shows that the innovation rate is highest in the fluid phase. This is the time for radical technology development. Experimentation leads to product innovation and less attention is given to process development. During the transitional phase, product innovation slows down and the rate of major process innovation accelerates. Dominant designs of products and processes gradually appear as best satisfying users' needs.

The last phase, the specific phase, refers to a stable and mature market. On these markets businesses become extremely focused on cost, capacity and volume and the innovation process progresses in incremental steps. The first phase would include the introduction of a new technology that gives rise to productivity gains. This technology is refined, allowing for optimization and economies of scale. In the last phase the technology is mature and the only way to increase profitability is to once again introduce a new technology.

It is fairly clear that the food market is best described by the last step of this model. Most products are minor departures from existing products and the focus is on production efficiency.

Table 2.2 Competition on an industrial level as innovation and change processes (Utterback, 1995)

Level of analysis	**Change process**
Product	From high variety, to dominant design, to incremental innovation of standardized products.
Process	Manufacturing processes from heavy reliance on skilled labor and general purpose equipment to specialized equipment tended by low skilled labor.
Organization	From entrepreneurial, organic firms to hierarchical, mechanistic firms with defined tasks and procedures with few rewards for radical innovation.
Market	From fragmented and unstable markets with diverse products and rapid feedback, to a market for commodities with largely undifferentiated products.
Competition	From many small firms with unique products to an oligopoly of firms with similar products.

Utterback's model (Table 2.2) suggests that small companies have a tendency to focus initially on product innovation, grow larger, shift to emphasize on process innovation, and eventually reach a large-scale low-cost production as a mature business. This model has been criticized (Clark & Stauton, 1989; Pavitt, 1986) and studies of food businesses suggest that food businesses seldom evolve from small-

scale production to mass-market production (Christensen et al., 1996). The maturity of innovations, seen as temporal development patterns, is also described by Clark et al. (1989) as a phase of revolutionary technological developments followed by phases of evolutionary and incremental developments.

Traill and Grunnert (1997) have presented a model for the innovation process in which the studied food businesses were oriented towards either process innovation *or* product innovation. Other researchers would argue the contrary, that the development of products and processes cannot be separated (Albernathy & Utterback, 1978), let alone separated from the development of the business firm as such (Nyström 1990).

2.2.2 Technical vs. administrative

The distinction between technical and administrative is reflected in the difference in focus between a more structural vs. a human relations perspective on the organization (Bolman & Dale, 1995). Technical innovations pertain to the outcome: products, processes and services related to the innovations. Administrative innovations include organizational aspects of administrative processes and handling human resources.

Economists typically focus on technical innovations at a high level of abstraction and aggregation. A sociological perspective, on the other hand, tends to focus on administrative innovations and a business management perspective may include both technical and administrative aspects of innovation.

2.2.3 Radical vs. incremental

An innovation is regarded as radical or incremental depending on the degree of change it involves (Weryzer, 1998). A model for the change arena for discontinuous, continuous, sporadic change and status quo is presented by Stebel (1994, 32). Radical innovation refers to fundamental changes and a high level of technological novelty. The innovation represents a departure from existing practices often associated with a high degree of uncertainty. The product or process is referred to as a breakthrough, revolutionary, really new, game-changing or boundary-expanding. In developing a radically new product the innovation process is often found to be discontinuous. It involves the development and use of new technologies as well as challenges in commercialization. Weryzer (1998) declares that it is apparent from his empirical studies that discontinuous product development differs significantly from incremental product development in its orientation, progression and need of support. Examples of such products are airplanes, automobiles, televisions and personal computers when they were first introduced (Stebel, 1994).

An incremental or new generation innovation, by contrast, requires marginal departures from existing practices (Wheelwright & Clark, 1992). It refers to the development of an area, a product or a process that is already known. The degree of newness is minor and consequently it causes little uncertainty. Developing a second or third generation of products would be regarded as a continuous process, which can be made in incremental steps towards an improved version of a known product.

2.2.4 Sustaining vs. disruptive

Christensen (1997) offers two concepts to describe thedegree to which an innovation supports existing technologies or not, in the eyes of a consumer. He labels technologies as sustaining or disruptive. Sustaining technologies refer to logical progressions from previous product lines, using the demands of the existing customers to determine the need for an innovation. Disruptive technologies, on the other hand, are generally dismissed as "shoddy work" in the innovation evaluation. The outcome is regarded as functionally inferior and less desired by customers. As it turns out, sometimes these "shoddy" products may very well meet some customer' s needs. An example of such products could be an airplane trip. It can be viewed as an adventure, including a meal, a movie, a high degree of comfort etc., or it can be viewed simply as a transport from one place to another, such as the transport provided by Ryan Air (Capell et al, 2001). Customer preferences will ultimately determine the expansion potential for innovations that rely on the use of disruptive technologies.

Schon (1971) also uses the term disruptive in describing an innovation process, but he refers to an early phase of an institutionalization process in which a change is perceived as a disruptive event. The change has low currency in the early appreciative phase. As the institutionalization process progresses the change gradually becomes articulated and accepted and turns into good currency.

2.2.5 Low-tech vs. high-tech

The use of the terms high- and low-tech may refer to a product or a process or, in other cases, to a business or an industry. The terms are deceiving. Technologies, which are regarded as advanced by an outsider, may be seen as basic to that particular industry or business (Ford, 1988). The difficulty in declaring a perspective calls for caution when using these terms.

Nyström (1990, 20) uses the terms to differentiate business strategies from one another. The low-tech strategies are commonly found in businesses on mature and consolidated markets, whereas the high-tech strategies prevail in successful businesses on rapidly changing markets. Low-tech business are relative positional in their strategies, using product differentiation and market segmentation. The innovation process would be one of defending and exploiting achieved advantages, rather than developing new opportunities. A high-tech business, on the other hand,

is signified by open technological strategies aimed at creating and exploiting change. The innovation process concerns developing new technologies and new markets.

2.2.6 Technology-push vs. demand-pull

The terms market push and pull are widely used in the marketing literature. They usually refer to factors that enhance the process of marketing a product. In reference to new product development they are viewed as factors that support the progression of the innovation process (Clark & Guy, 1998).

Using Rothwell's terminology (1992; 1994) there have been five dominant models of industrial innovation in the time period 1950-1994. The first generation model was developed in the 1950s, which was a time of rapid economic growth through industrial expansion. The belief in science and technology was great, and it was assumed that more money put into R&D would automatically result in more new products. This first generation model is a simple linear *Technology-push model*. During the 1960s many new products were still introduced but they were based mainly on existing technologies.

A shift in emphasis towards market needs occured in the 1960-1970s. This is reflected in the second generation model, the *Need-pull model*. Customers needs and preferences are seen as driving forces for the innovation.

The third generation model was developed in the late 1970s and early 1980s. This was a time of two major oil crises, high rates of inflation and demand saturation. It became increasingly clear that the third generation model for successful innovation needed to take into account both technological development and market needs. It was labeled the *Coupling model* (see Figure 2.2) and it was assumed that "the innovation process was rarely associated with performing one or two tasks brilliantly, but with doing most tasks competently and in a balanced and well co-ordinated way" (Rothwell, 1992, 11).

The fourth model for industrial innovation was developed in the second half of the 1980s. In this model the emphasis lies on technology accumulation (technological strategy) where rapid growth is promoted in organizational arrangements such as joint ventures and increasing collaboration activities. These strategies led to shortened product life cycles with parallel development in an *Integrated innovation model*. When Rothwell wrote the article about the generations of innovation models in 1994, a fifth model was just budding. This model "involves inter-company networking and it employs a new electronic toolkit" (Rothwell, 1994, 221).

The fifth generation model is later described with an example, in a case study of a biotech company, as a network organization (Weisenfeld-Scenk et al., 1998). This

network is a virtual organization that provides flexibility, shared costs and effective use of relative competencies.

2.3 Innovation management

Strategic innovation management is concerned with innovation strategies and innovative performance, or in other words, the ability to perceive the need for and implement a change (Loveridge & Pitt, 1990). It is defined by Markides (1998, 32) as "a fundamental re-conceptualization of what the business is all about that, in turn, leads to a dramatically different way of playing the game in an existing business".

Hamel and Prahalad (1989, 63) describe the strategic intent as "a marathon run in 400-meter sprints". This implies clarity about the ends but flexibility as to the means, leaving room for improvisation along the way. As conceived by Mintzberg (1993, 37), it could also be described as a visionary approach to deal with uncertainty and changes: "Visions set a broad outline of a strategy, while leaving the specific details to be worked out ".

2.3.1 Innovation strategies

Strategies are "patterns of decisions which evolve over time in largely unpredictable ways" (Nyström, 1970, 50). The goal for these strategies is "the creation of order without careful crafting" (Hamel, 1998, 11), or, in other words, it is a direction but not a strict road description. Innovation strategies are closely related to an image of the desired path for a business. They provide guiding forces and enabling conditions for innovation to take place.

Nyström (1990) divides innovation strategies into *realized* and *intended* strategies. "Intended strategy is the overall, often indirect, guidance of company activities, with long run implications for product and company development" (Ibid., 23). In the management literature this is often called policy, and it is more concerned with conditions for change than with the actual outcome. These conditions include the development of new technologies, new markets and organizational conditions that will facilitate these changes. Realized strategy, on the other hand, "is the actual evolving of patterns of decisions and activities" (Ibid., 24). Here the outcome, what the business has done, rather than what it intends to do, is of main interest. In the management literature, realized strategies refer to different kinds of strategies, for instance marketing, technological and financial strategies, tactics and their outcome. Planned, intended and realized strategies are illustrated in Figure 2.6.

The strategic management of innovation is reflected not only in realized and intended strategies on a company level but also on an outcome level referring to

products, processes and marketable know-how. The interaction between the two levels of analysis is of main interest. Furthermore, Nyström (1990) and Crawford (1991) argue that the innovation process is a "dual-drive", where both technological and market strategies play important roles throughout the innovation process.

New intended strategies emerge, according to Hamel (1998), in contact with 'news'. New voices as in newcomers in a business, new conversations in dialogs which cut across the usual organizational boundaries, new passions felt in a creative process, new perspectives through new conceptual lenses, and new experiments in testing new ideas on the market. These new influences are regarded as preconditions for innovation. Strategic health (Markides, 1998) predicts a company's future financial health. Studies show that a company with sound finances may not be tendering its strategic health and consequently it shows poor finances a few years later.

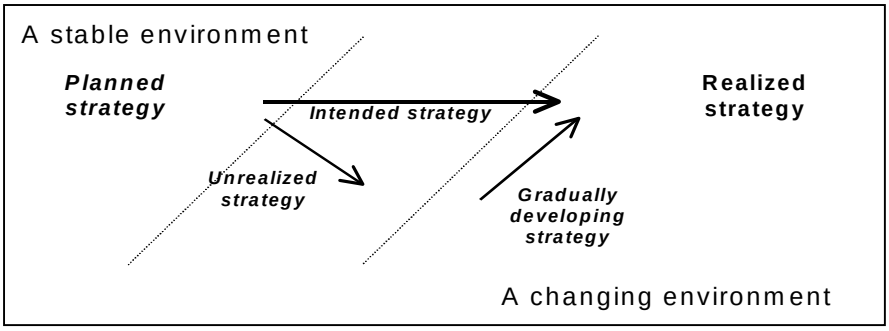

Figure 2.6 Strategies in different environments (with minor alterations from Mintzberg & McHugh, 1985).

Strategies are not to be confused with plans. Strategic planning is concerned with creating a plan (Mintzberg, 1993, 33), which would be conducive in a stable environment. Assuming the environment is changing, if not "turbulent", a plan could be seen as a need for control, paralyzing other ways of development that were not part of the plan. This could be seen as "crafting", leaving little room for creativity and innovation.

2.3.2 Time for change

Assuming the innovation process involves some kind of change, this change may be stimulated or hindered by factors within the organization as well as by factors in the environment. These, time related factors, can for example be structural, functional or related to customers' values and preferences. This supports the need for a contextual understanding of the innovation process as such.

The time dimension becomes essential when regarding the innovation process as including both the future, present and the past. Intended strategies set outer boundaries for realized strategies (Nyström, 1990, 24) and thus become important factors in explaining the outcome, in terms of realized strategies.

Much attention is given to the structural and functional differences between businesses with regards to strategic innovation. Businesses are studied in the organizational literature and divided into successful vs. less successful, hierarchies vs. 'adhocracies', small vs. large and established vs. new with special interest in organizational mode. The underlying question in most contributions in this area is whether or not it is possible to organize to facilitate the innovation process, for instance based on contextual differences.

Few, if any, authors provide a complete understanding of the complex organizational impacts on the innovation process. Conclusions from studies are not only non-uniform, but also in some cases contradictory. It is, however, widely accepted that the ability of an organization to continuously change in a "self-renewal" process is the ultimate goal of strategic innovation (Markides, 1998). It is also assumed that it is desirable to perpetuate continuous innovation, as opposed to occasional innovation (Dogherty & Corse, 1997). Several suggestions regarding the stimulation of this self-renewal process are given in, for example, a location of business (Ferugeson, 1998; McCosh et al 1998) and through allowing for co-existence of old and new (Markides, 1998). Others have suggested iterative organizing and non-hierarchical innovation teams to facilitate the innovation process (Dogherty & Corse, 1997). Studies of industrial innovation also suggest that comprehensive project evaluation systems play an important role (Granstrand & Sjölander, 1990).

Evidence suggests that small and new businesses, as opposed to those that are large and established, are more successful relative to their size (Dogherty & Corse, 1997). This is explained by a number of interdependent factors such as inertia of success, hierarchies and lack of support for change from different stakeholders (Markides, 1998). Goldman (1985) offers two additional obstacles accountable for this disparity, namely: bureaucracy drowning the innovation projects in organizations with large overheads, and the development time for a product to reach the market with regards to communication and coordination in large organizations.

It is also of organizational interest to discuss how technology is acquired (Ford, 1988) and where R&D may be carried out, if it is not located at the business site (Knox & Denison, 1990). Forming strategic alliances, working in joint ventures and using suppliers or 'leading customers' (von Hippel 1986,1988) as partners in development are all examples of strategies to access technologies.

A comparison of forms for R&D collaboration provides theoretical arguments for different organizational arrangements. Assuming that the innovation process requires access to resources and flexibility with regard to the organizational mode, these needs are often contrary to what is desired from an operative manager's perspective. This is in part an explanation for why it is hard to organize for innovation. Organizational and managerial aspects of different collaboration arrangements are illustrated in Figure 2.7.

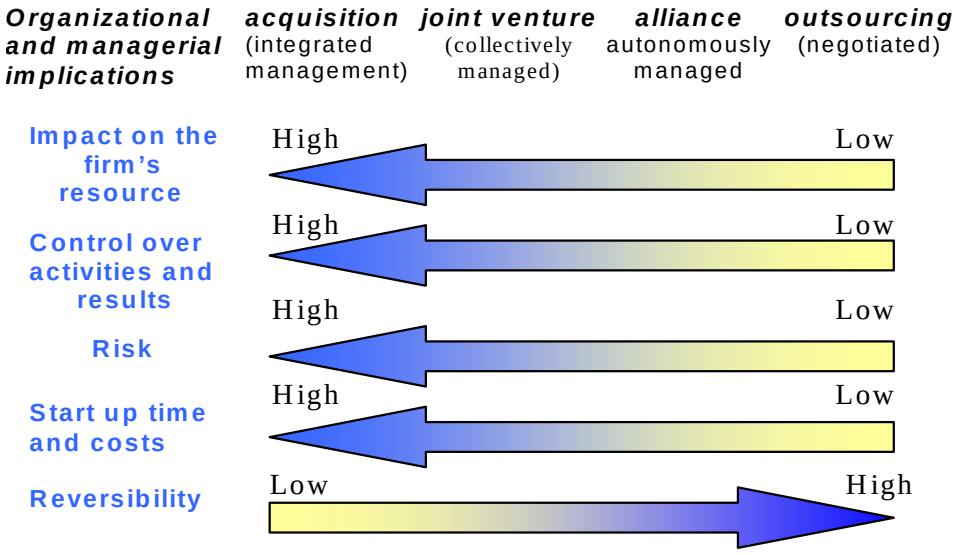

Figure 2.7 Organizational and managerial implications of different forms for R&D collaboration (minor alterations from Chiesa & Manzini, 1998, 80).

This simplified version of the model presented by Chiesa & Manzini (1998, 80) gives an overall impression that acquisition is associated with high commitments (impact on resources, control over activities, risk, and start up time and costs) but low reversibility. Simply put, it is hard to pull out of a commitment. Negotiated outsourcing, on the other hand, is associated with less commitment and high reversibility. It is theoretically easy to terminate such arrangements.

2.3.3 Managing the innovation process

It may be argued whether or not the innovation process can be managed at all. Schon (1971) rejects what he calls a 'rational view' of innovation. He argues that it is a non-plannable process. Most management researchers, however, seem to agree that the process can be managed. Van de Ven (1986) suggests that a leader can create an infrastructure that is conducive for the innovation process. This leadership "offers a vision of what could be and gives a sense of purpose and meaning to those who would share that vision. It builds commitment, enthusiasm and excitements"

(Ibid., 601). He views the leader's main responsibility as that of institutionalization (with references to Selznick, 1957), or in other words, providing organizational identity and a social integration.

At the product level, a leader may be called product champion (Weryzer, 1998, 318), or simply a person with a vision for the innovation project. This is especially important in a discontinuous innovation process, which tends to be less market-oriented. A product champion ensures that the innovation process advances.

2.4 The use of a theoretical perspective

The literature review provides a picture of a theoretical perspective for studying the innovation process. The purpose of this theoretical framework is to provide a guide for interpreting and structuring the empirical findings. An underlying assumption in this study is that of positive effects from innovation activities. It is assumed that innovations will result in a competitive advantage gain for the innovators. The gain can in turn be attributed in part to a number of short and long-term effects.

Following what could be described as a Scandinavian approach to management, this study is a cross-disciplinary analysis of empirically based management phenomena (Nyström, 1990, 7 note 12). The focus in this study is on innovation as a whole, including idea-generation, the R&D process, a new product, a new process, new skills and technologies, new markets, and the organizational development to facilitate the process. This indicates that no one factor or phase is emphasized as a major determinant of the innovation process. Rather, a multitude of context-bound factors are studied to gain a better understanding of the process. The time perspective includes a context-bound history, a present, and an unfolding future.

3 Method

Method is a mode and a framework for engaging in a research process. It is about empirical material, tools and techniques, vocabularies, ethical implications and who we are as researchers. It is a matter of making choices and being aware of research conduct.

3.1 Research is about making choices

Many factors have affected my choice of method. First and foremost, the research objective calls for a contextual understanding of a problem. In order to develop this understanding closeness to the empirical material has been essential. Previous studies of the theoretical problem (Nyström, 1990) as well as the empirical area, through literature (Mark-Herbert, 1993) and a survey study (Mark-Herbert & Nyström, 1993), provided a broad picture of the research area. The choice of theoretical problem, as well as study objects, are derived from these experiences. The choice may be regarded as one of interest with the expectancy of intriguing results.

In the Scandinavian management school, a methodological tradition offers acceptance of qualitative approaches. From my previous training in what could be labeled as a quantitative approach, but the Ph.D. program has offered many opportunities to enhance the skills of qualitative methods.

Depending on epistemological beliefs, the use of qualitative studies may vary. I believe that an example or a case may very well provide a theoretical understanding that can be applied in a wider area, assuming it is written with "**a**n instrumental interest" (Stake, 1994, 237). The 'generalizability' is determined by reflexive reasoning and rhetoric skills to recognize the 'domain', i.e. adequate areas, for further applications (Alvesson & Sköldberg, 1994, 32).

A significant choice is that of making a proper selection of cases (Yin 1989; Miles & Huberman, 1984). Understanding a phenomenon may very well depend on an illustrative choice and portrayal of a small number of cases (Stake, 1994, 243). Working with cases is thus quite time consuming, which explains the limitations on the number of cases that can be studied.

3.1.1 Choosing case as a method

This thesis is built upon the empirical material from three solid case studies ProViva, Magiform and IgY Egg. In each case, the innovation process has resulted in the development of a radically new functional food product. Initially, a fourth case was planned and started but it did not get permission for further investigations. This fourth study is therefore presented as a short case (5.3), and it will be used in the analysis since it provides interesting contrasts to the remaining empirical material. In my analysis I draw conclusions from comparisons of all four cases. My understanding of the process, however, is greater in the case studies where my investigations were not limited. Problems with trust are further discussed in ethical considerations (2.3.2). The total process is studied over time in the chosen context (Miles & Huberman, 1994).

A case study method is chosen for a number of reasons, but most importantly it is chosen to match the research question (Wigblad, 1997, 56). The object of this study is to make a detailed analysis, a comparison between the innovation process in the three cases. According to Saunders (1997), a case can generate new concepts and provide an understanding of how these concepts relate to one another. These concepts are put in relation to one another as hypotheses and empirically grounded theories. According to Strauss & Corbin (1990, 23): "A grounded theory is one that is inductively derived from the study of the phenomenon it represents. That is, it is discovered, developed and provisionally verified through systematic data collection and analysis of data pertaining to that phenomenon. Therefore, data collection, analysis, and theory stand in reciprocal relationship with each other. One does not begin with a theory, and then prove it. Rather, one begins with an area of study and what is relevant to that is allowed to emerge".

Looking closely at the empirical material in the attempt to define concepts and uncover structures does *not* mean, however, to disregard the prior works carried out by other researchers. It merely means making those experiences and theories a part of the perspective from which the empirical material is analyzed (Merriam, 1994, 31, Strauss & Corbin, 1990, 49).

A case can be regarded as a unit of analysis. Yin (1998) calls such a case a holistic case study. He also states the possibility of more than one level of analysis within a single case study, so called embedded case studies. In embedded case studies, one level of analysis will reflect other levels, such as product, product group and company, in terms of marketing (Nyström, 1990, 140). The cases in this dissertation have two levels of analysis: the product/process level and the company level. They would thus qualify as embedded case studies.

3.1.2 Selection of case studies

A selection of case studies has been made to provide credible description of differences in factors that have an effect on the innovation process. The aim was to find case studies that illustrated different strategies in development, marketing and organization. The end result in each case, however, was required to be a radically new functional food product.

The search for products in different food groups, for example meats and vegetables, did not succeed in identifying the development of radically new product. This is not to say that meat-based functional foods do not exist. They do, in Finland, as hot dogs containing crushed flaxseeds[12] (Anonymous, Kemivärlden, 2001). The development of chewing gum that lowers the cholesterol is also an example of a new Finnish functional food product (Jacobsson, 2001). Benecol is yet another well know product, but the development of these products took place in Finland; and thus in a different context. In delimiting the empirical scope and thus simplifying a contextual understanding, I decided early in the process to study the development of Swedish functional food products.

The case study selection was based on empirical findings in the pilot study (Mark-Herbert, 1993[13]), contacts in the food industry[14] and a careful screening of articles about research novelties[15] in the area of functional foods. Other than looking for differences in strategies, a major factor in case selection was the expectation of access to interesting material. It may sound trivial but the willingness to share "the story" in an interview makes all the difference for a case writer.

3.2 Using interviews to build cases

The process of constructing a case can be compared to the process of creating a piece of art (Birgerstam, 2000). The artist, or in this case the researcher, chooses to take interest in a certain phenomenon, from a particular angle. A rough sketch receives more nuances with more colors and artistic efforts. That is much the way a case takes shape as well.

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12 Crushed flaxseeds have multiple health effects. The main effects are a decreased risk of coronary heart disease and hormone related forms of cancer (Anonymous, Kemivärlden, 2001).

13 The *ProViva* study was presented in Appendix IV of the-state-of-the-art study (Mark-Herbert, 1993).

14 The cases about the development of *Magiform* and *L. reuteri* were chosen based on personal contacts and previous knowledge of the development of functional foods (personal communication Lindgren (1986) and Börjesson (1999)).

15 Two articles and a personal meeting at a health conference opened the door for the last case about the development of *IgY-egg* products (personal communication, Andersson, 2000).

In practical terms the process of letting a case take shape can be translated into a number of work phases in an iterative model (Wigblad, 1997, 22) of abduction. This refers to making use of theoretical knowledge and empirical insight while remaining open for new explanatory factors. One interview creates the basis for understanding the next and so forth. Interviews are carried out until saturation appears, during which the interviewees no longer add information to what appears to be the case. Prior to each personal interview the respondent receives a letter and an interview guide, (Appendix 2) if requested, to prepare the interview.

Themes in the interview guide are based on what has been reported in scholarly journals as factors that affect the innovation process. The guide serves as a support during the interview but the interviewees are free to talk about anything that they feel might affect the innovation process as such (i.e. the development of their products and processes). This would thus qualify as semi-structured interviews.

As the main method for gathering empirical material, the research interview exhibits a number of characteristics. It is an interaction between two people with reciprocal influence on the outcome (Kvale, 1997). What may appear as a relaxed conversation aims to describe a specific situation in the world of the respondent. The respondent's story is built on his or her logic and structure, thereby determining what is of importance and what is not.

During the interview a continuous validation process ensures the researcher of an approximate understanding of the interviewee (Kvale, 1997). Typically such validation would be a question such as "Do I understand you right if I say that …?" or, in some instances, it is a questioning statement that summarizes what the interviewee just said.

Multiple interviews in each case are used to create narratives of a development process. Usually the respondent starts with some personal and general background, providing a retrospective understanding of the story that follows. In most interviews the story follows a chronological development. Towards the end of an interview most respondents are willing to share strategies for future developments, assuming that this information is handled with discretion.

After the interview, tapes are transcribed and translated. The transcriptions are sent to the respondent for corrections, additions and in some cases to delete a paragraph or two. Once the transcriptions are returned they are corrected in accordance with the interviewees' comments. Each interview renders a part of the base that is used for writing the case.

A second step in validation occurs when the interviewees, experts and other representatives for the food industry read the cases. Cases are sent to each respondent once a case is finalized. In the ProViva case a 'post-case interview' created grounds for an epilogue. The present CEO felt that the changes that had

occurred in the last two years were of major importance for understanding the present situation. So far the cases have fortunately been met with supportive comments and acknowledgements during presentations (Örnewall, 2000). Even the survey studies (Mark-Herbert & Nyström, a pilot study, 1993, and a follow up study in 2000) have been greeted with recognition among representatives from the food industry (personal communication, Nobelie 1999; Rosenström 1999; Wennström, 2000).

3.2.1 Ethical considerations

Most qualitative research working with interviews to build cases requires taking interest in another person' s views and experiences. Those who have been interviewed risk exposure and embarrassment. To counteract possible undesired effects, the ethical implications of the interview procedures are discussed prior to each and every interview. This trust allows for the interviewee to talk at liberty about what he or she feels is of value with regard to the main questions in the interview guide. Sometimes the conversations went far beyond the scope of the guide, but at the time it was impossible to judge what would be of explanatory value to the study and what would not.

The research procedures were, at all times, carried out in accordance with the agreement that was made prior to the interview. A few interviewees felt uncomfortable with the tape recorder during our first encounter. It was turned off and in most cases the tape recorder was not a problem during a second meeting. A draft of the interview was sent to the interviewee - and for the most part it was returned with minor corrections, clarifications and suggestions.

Examples of correction and clarification are seen in many of drafts for each case. Respondents were asked for comments and in some cases these comments were contradictory to each other, which lead to numerous mails and phone calls. In the ProViva case, the new CEO did not feel that the case left the reader up to date with the development. This was resolved by a brief interview that gave rise to an epilogue.

In one case, however, ethics posed a major problem. After two completed interviews with persons in key positions in the business and major investigations, the CEO withdrew his promise to engage in the research process. The reason being that a business on the stock market cannot reveal such sensitive information regarding technological and market strategies. My personal disappointment did not undermine my ethical guidelines established for the interview and I respected their choice. This case is, therefore not presented as a full case, since much of the story remains to be told, but it is presented as a short case and, as such, provides interesting information.

3.2.2 Level of analysis

The level of analysis refers to what is regarded as an analytical unit. Assuming the innovation activity is a process in which several actors and resources are involved, the analytical unit has to be aggregated. Four possible levels of analysis are identified: the innovation itself where a number of individuals are engaged (referred to as product/process level), an organizational sub-unit (departments), the organization (company) and the industry.

One level of analysis may be sufficient to provide an answer to a proposed question. It is also possible to use different levels of analysis, thereby enhancing the understanding of a problem. Here, an institutional analysis of the industry (Chapter 4) provides a contextual understanding for case studies on a company and product/process level (Chapter 5). The interest is in this study is on factors that that enables businesses to generate and develop viable new products on a regular, not occasional, basis.

An innovation project

Studying the process at the level of innovation tends to focus on the outcome. It makes it possible to study certain characteristics of a project in detail such as: complexity, "radicalness", relative advantage, the need of resources and use within the organization.

A subunit activity

On a subunit level the process is commonly in focus. Studying the R&D process in organizational subunits include communication, decision making within a department (Farris, 1988), tenure of R&D groups and the diversity of R&D teams (Gordon et al, 1991). This level of analysis may also include studies of interaction between different subunits (departments and functions within a business). Typically these studies tend to identify critical factors within the company that either hinder or facilitate the innovation process.

An organizational process

The organizational level of analysis offers two approaches, firstly with focus on the outcome and secondly with focus on the process. Studies of the outcome largely describe structural, behavioral and contextual characteristics, which differentiate innovative companies from non-innovative (Markides, 1998). Studies where the process is of interest mainly describe events, sequences and factors that are critical for the innovation process (King, 1992). The organization as a unit of analysis offers a management perspective for studying how the company adapts to changes, allocates resources and strives for overall effectiveness.

An industrial development
Studying innovation at an aggregated industry level provides an understanding for the institutional setting. This includes, for example, legal aspects and general financial aspects of innovation, production and trade. The focus may be on the industry in a context or within the industry itself. Studies of the industry in a context identify differences in innovation patterns between different industries (Clark & Guy, 1998; Von Hippel, 1983).

Studies of an industry usually seek explanations for relative differences in innovation performance between companies. Other studies of the industrial context include an understanding of broad cultural and resource endowments provided by society,
distribution of resources, and structure of the industry. Research by Ruttan and Hayami (1984) suggests that innovation can be seen as a reflection of the amount of support an organization can draw from the larger community.

3.3 A continuous analysis

Facts are theoretically laden (Alvesson & Sköldberg, 1994). What is seen and communicated has to be understood and that calls for a perspective. This is revealed in a theoretical understanding and the use of a subject-related vocabulary (McCloskey, 1986). As a researcher I have an understanding of the phenomena I take interest in, prior to carrying out interviews (Van Maanen, 1988, 41). During the interviews my themes are chosen with a theoretical bias, allowing for some empirical material to be interpreted - and other to remain further untold. It is thus more than my prior experiences and understanding that delimits the first analysis of the socially constructed empirical material (Kohler-Riessman, 1993).

Combining different methods of analysis is sometimes referred to as methodological triangulation (Janesick, 1994). In the project, a combination of methods are used in a number of analytical steps (Figure 1.2). In this thesis the case studies are presented as a base in a continuous analysis process. It is revealed as three analytical steps, but there are no fixed boundaries separating the early analysis, later analysis, or the final analysis. The first, within-case analysis, addresses the product that has been developed and how this development occurs. These developments are presented as narrative stories, “cæses” in Chapter 5. A second step is a comparative content analysis of the cases, which is revealed in Chapter 6. And lastly, in Chapter 7, a conclusion of the analysis, of the cases and a context, that may provide an understanding of the institutional factors for the development of radically new food products.

3.3.1 Narrative cases

A case is a piece of a created reality. When communicated in interviews, this reality is commonly shared as a story, a narrative. It provides a time, a social and a contextual dimension for a phenomenon (Mishler, 1986). Keeping these structures in a case provides a contextual understanding of the phenomenon for a reader (Kohler-Reissman, 1993).

Precisely because cases are "meaning making structures", narratives must be preserved, not fractured. The primary narratives appear in interviews when the interviewee shares an experience with the interviewer. A second level of narrative is created when these narratives are analyzed and combined to create a narrative case. Narrators thus create structure in a disordered experience. For the present study, it does not mean that the interviewee describes the innovation process in a logical sequence – the sentences in the narrative cases provide this logic for the reader (Czarniawska, 1999,8).

In sharing an experience, the interviewee chooses to reveal some things and others remain untold. Depending on the listener, the rhetoric and the content of the story may even vary. My interview guide has, no doubt, guided the interviewee in a specific direction and stimulated the use of a certain vocabulary (Barry& Elmes, 1997). In the figure below (3.1) Kohler Riessman (1993) shows how an experience is "reduced" in the narrative process (the lower trapezoid).

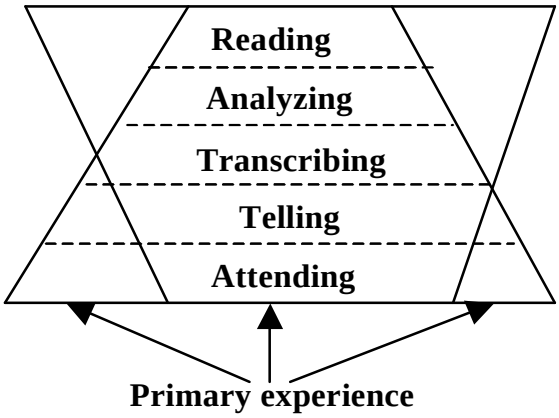

Figure 3.1 Levels of representation in the research process (Kohler-Riessman, 1993, 10).

In this model the primary experience, *attending* in the figure (3.1), refers to individually perceived sensations, such as olfactory sensations, visual input and

auditory impressions. Examples would be the scent of newly baked bread, and the sound of the oven door closing. The next level in the model, *telling*, requires a picture of how these impressions fit together. In the narrated story some impressions, the smell, for example, is difficult to convey. In the process of *transcribing*, more nuances are lost, such as facial expressions and articulation. In the *analytical* step the information is even further delimited with regard to what seems to provide insights to a research question, and what does not. In the last level of this model, a *reader* meets with what remains of the primary experience. Kohler-Riessman (1993) does not provide a distinct interpretation of what the trapezoid with the base upwards resembles.

My interpretation of the figure is that the lower trapezoid signifies only some aspects of a story can be told – and furthermore told again, in a second narrative, so as to be understood by a reader. In terms of this thesis, many hundred pages of interview -transcripts, brochures and articles are narrated to a fairly short part of my dissertation. I interpret the upper trapezoid as representing the perception of the narrative perceived by the reader. The broad base represents the total understanding for the reader (preconceived ideas[16] and the perception of the actual narrative).

Kohler-Riessman (1993) does not address the problem of translation that a person with English as his or her second language will face. Every translation implies risks of loosing contextual understanding and linguistic nuances. This problem could be illustrated as yet another level in the trapezoids in Figure 3.1 (perhaps a top of the trapezoids from both sides, creating two triangles in Kohler-Riessman's figure).

The interplay in the narrative between the interviewee, the author and the reader suggest that the interpretation of the text is both pluralistic and dynamic. It is reflecting the interviewee's intent, the narrator's perception and intent, and the reader's constructed meaning.

3.2.2 Comparative content analysis

Comparative content analysis refers to cross case analysis. This is where similarities and differences between cases are shown and discussed. These comparisons are often illustrated in matrices with explanatory reflexive thoughts to explain the comparison. Quotations from the interviews are also used to illustrate the comparative analysis.

Depending on the strategy for cross case analysis, different comparisons are performed. As pointed out by Ragin (1992) a distinction can be made between case-oriented and variable-oriented comparative studies. The latter focus on predetermined variables of particular interest. In this thesis, however, a cross comparison is carried out as a case-oriented replication comparison (Yin, 1984).

[16] Förförståelse

This refers to building a conceptual framework around one case, the *ProViva case*, and successive cases are examined to see whether the new patterns match the one found at first or not.

In principle, this approach can be compared to generating a ' grounded theory' (Strauss & Corbin, 1990) where a framework is built up inductively and refined by multiple comparisons (Huberman & Miles, 1994). The inductive process does not mean looking at empirical data alone. It refers to the interplay between the understanding of one case, with a theoretical preconception of the phenomena, and refining the understanding in repeated comparisons with other cases.

3.4 Ensuring rigor

There are numerous ways to ensure rigor in qualitative research, where some of these methods are more appropriate and usable than others (Denzin & Lincon, 1994). Traditionally, the terms validity and reliability are used in discussions about ensuring rigor. In qualitative research these terms are refined using, for example, the terms *criteria of adequacy* and *appropriateness of data*, *careful documentation*, and different forms of *validation*.

3.4.1 Criteria of adequacy and appropriateness of data

To attain adequacy, a number of persons are interviewed for each case. Each person tells their story, where parts of one interview confirm parts of another interview. Printed material and internal documents also provide information. This provides concurring and confirming data, and with sufficient number of interviews it ensures saturation. Seeking cases that are as different from each other as possible gives a rich empirical picture. Additional interviews with people representing, for example, legal authorities may also be a part of confirming data.

3.4.2 Careful documentation and validation

Careful documentation in ' thick descriptions' (Stake, 1994, 242) and explanations of the many research steps taken are two ways of aiming for research transparency. Organizing the data material and dating the documents are important factors in a careful documentation. These notebooks of transcripts and articles of empirical material are preserved for researchers to use in future studies.

A research log-book helped me keep track of versions of cases, of who to ask about what and the questions that each analytical step gave rise to. I have not been able to follow up on all the questions that emerged as the research process progressed.

Some of the questions are addressed in this dissertation. Others remain as allurements for future research.

Validation in different audiences is a prerequisite for research rigor. The first validating step is taken during the actual interview, in a conscious approach to the interview technique (Kvale, 1997). This means continuously validating the interpretations of what has been said. During the interview it is also possible to ask about interpretations of what has been told in previous interviews, thus allowing for help in rating as well as verifying data.

Validation is also given in reader responses to drafts, presentations and conclusions. Presenting the studies for different audiences has proven helpful in creating credible interpretations based on empirical data and theory.

3.4.3 Method in retrospect

Working with narrative cases has been rewarding and challenging. I realize that my linguistic sensitivity puts limits to the art of working with narratives. My role has, for the most part, been that of an author that excludes her self in the presentation of a singular external perspective. That may imply a false sense of objectivity and an unbiased view of my role. On the contrary, I see subjectivity in choices of what should be included and how it should be worded. In these subjective choices I rely on validation and the use of good judgment from my interviewees and critical readers.

Using interviews to build cases provides an understanding for the innovation process in these four case studies. These cases are stories that provides some answers to a few "what?" and "how?" questions. A continuous validation pr ocess provides high internal validity and reliability (Yin, 1984, 40-45). But, how about the external validity; are these findings possible to generalize? Reflexive reasoning and empirical insight might allow the reader to find other appropriate areas for generalization.

4 A review of functional foods

Phyto-foods (Hanman, 1993), *therapeutic foods* (Ruderus, 1992), *kinoseishokuhin* (Japanese for ”foods for specified health use”; PA Consulting, 1990), *designer foods* (Caragay, 1992), *neutraceuticals* (Foundation for Innovation in Medicine, 1989), "*funkismat*", *good-for-you-foods* and *”added value foods*”[17] – the designations for functional foods are numerous.

This chapter offers some clarification of the concept functional foods, a short historical background and a brief market analysis.

4.1 Food, medicine or what?

The term functional foods leads the thought to a food with a specific function or effect. The product may vary in shape as well as in specific function but the desired outcome is a scientifically proven medical effect. It may be a preventive effect, which delays or altogether impedes the onset or further development of a disease, or even a curing effect. It is especially with this last effect that the distinctions between food and medicine get blurred, in the communicated functions of this product (Figure 4.1).

Figure. 4.1 Differences between foods, functional foods and medicines (Mark-Herbert, 1993, 4).

Foods provide energy, nutrition, organoleptic[18] enjoyment and in many cases a mode of social interaction (Briggs & Calloway, 1984). Functional foods do all of the above *and* also have a preventive effect. If functional foods are seen as food products, they are also expected to appear food-like (Ruderus, 1992) and have a pleasant taste. If functional foods, on the other hand, are seen as proactive medicines, they may assume medicine-like shape and taste.

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[17] ’Added value foods’ is a direct translation of ” *mervärdesmat*” which in turn is a translation of functional foods in a text on novel Swedish words (Moberg, 2000).

[18] Organoleptic refers to taste and smell.

Consumer perceptions of functional foods thus seem to be one way to establish the categories of foods, functional foods and medicines. Other distinguishing grounds for division are, for example, the effects of these foods (Mark-Herbert, 1993, in Appendix 3 & 6), whether these products are developed by nature vs. developed in an industrial development process (Chapter 1), or how these products are marketed.

4.1.1 Strategies for marketing functional foods

Depending on the marketing strategy for functional foods, the conditions for sales and distribution will vary. If a functional food product is sold as an OTC (Over The Counter), for example, the distribution channel (in Sweden) would be a pharmacy. The marketing strategy would include information to medical professionals. If, on the other hand, a product is sold as a normal food or a health food the expected distribution channel would be the retail market where consumers would find the product in a food store, or possibly a health food store.

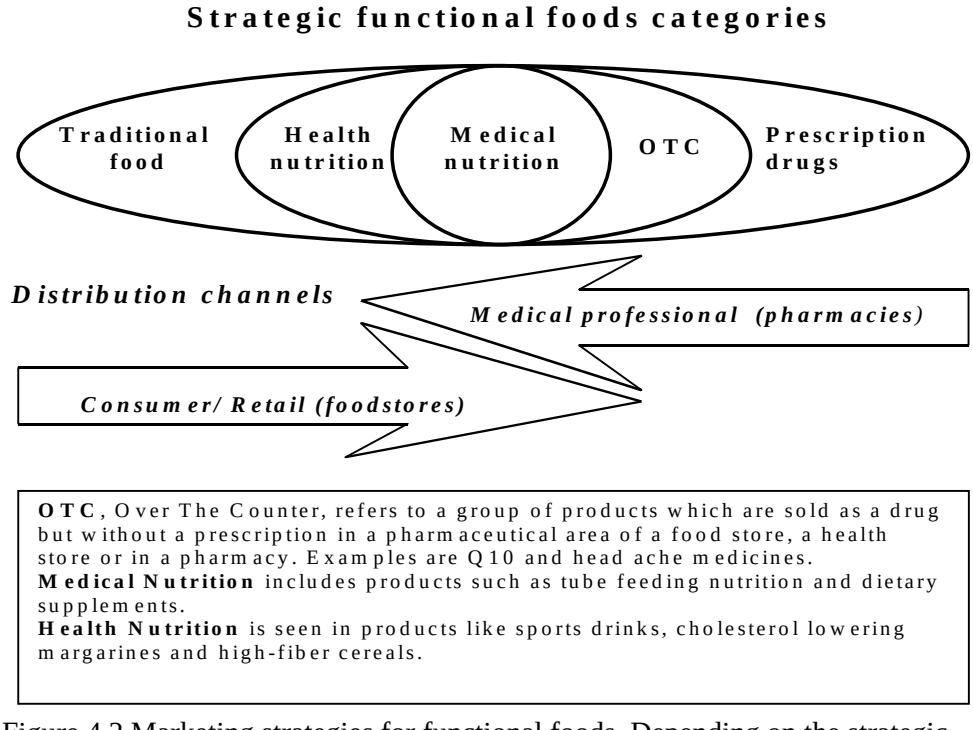

Figure 4.2 Marketing strategies for functional foods. Depending on the strategic position the business chooses to take, the marketing, sales and distribution channels will vary (Mark-Herbert & Nyström, 2000A, 42).

The marketing strategy will thus greatly affect the price of the product[19] and the sales volume. Figure 4.2 also illustrates that functional food is an arena where the food and the pharmaceutical industry may have mutual interests. This is further discussed in Chapter six.

It is mainly in the sales argument for the product that companies reveal their marketing strategy. History shows that the very same product can be sold as both a pharmaceutical and a food product. An example is *Wasa Fiber* (a hard bread) which was sold as a food product in the 1970s, with health arguments. The Medical Products Agency[20] did not accept these arguments - not because they did not hold scientifically, but because health arguments could not be made for food products. In Sweden the medical product legislation has precedence[21] over the legislation that concerns food products. Registering the product as a medical product, however, allowed for appropriate health-related arguments to be proclaimed in marketing the product.

4.1.2 Legal definitions

Marketing functional foods in Sweden in the 21st century is still an area of debate. It is guided by the National Code of Practice[22], which allows for eight well established relationships between diet and health to be made (Table 4.1) in marketing food products.

Table 4.1 Eight established relationships between diet and health (Asp, 1999)

Health problem	**Well-established relationship with...**
Obesity	Energy content
Cholesterol level	Fat
Blood pressure	Salt
Arteriosclerosis	Omega-3-fatty acids
Constipation	Dietary fiber
Osteoporosis	Calcium
Caries	Easily fermentable carbohydrates
Iron deficiency	Iron

The generic claims have to be presented in two steps, where step one is information regarding the diet-health connection, which is related to step two, information on

[19] The sales tax will also vary depending on if the product is marketed as a medical product, health or hygiene product (25% tax) or a food product (12% tax) in Sweden.

[20] Läkemedelsverket

[21] When one law takes precedence over a second law, this is referred to as a superceding law. (Läkemedelslagen har tolkningsföreträde).

[22] The National Code of Practice is an agreement between the food industry and legal authorities. It provides guidance to marketing health related foods.

the composition of the product. An example would be "Dietary fibre can help prevent constipation. Product X contains high amounts of dietary fibre." (internet, functionalfoods.nu, 2001).

A legal framework is being developed within the EU, where a European Food Authority is proposed to have a number of functions. One function is to harmonize the future food legislation "from farm to table" within the community (internet, functionalfoods.nu/file/dyn/0000m/619i/dyn, 2001).

4.2 Functional foods – where did it all start?

The question regarding the need for functional foods is often raised in debates. To understand this development, a brief historic review of influencing factors in the development of functional foods is presented below.

4.2.1 Cultural food habits

One might argue that people have always been interested in health and to a certain extent that is true. This is expressed as habits on an individual level as well as in cultural rituals.

Ancient cultures developed skills in, for example, the use of herbs to promote health. Living conditions and climate also promoted the development of processing skills to maintain food freshness and enhance nutrient availability. This is, for example, seen in cultured milk products and hard bread in Scandinavia (Swahn, 2000). In other parts of the world the use of garlic, olive oil, spices and numerous vegetables and fruits are other examples of cultural habits that promote health.

The discovery of vitamins can be seen as a precursor for the concept of functional foods. A well-known example is the proactive treatment of *scurvy*[23] by simply having, for example, citrus fruits on a regular basis as a part of a meal.

Nowadays, food related poor health is, in the rich parts of the world, mostly *not* associated with lack of nutrients. Rather the contrary, the problem is that of overeating (Peyron, 2001)[24] and having an unbalanced food intake. These problems cause individual suffering and costs for society. It should be pointed out that much attention is given to infectious diseases, such as BSE and Salmonella infections.

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[23] The term *scurvy* refers to a condition which is caused by lack of C-vitamin.

[24] In the article "*An industrial perspective on obesity and poor health. Obesity is one of the biggest threats to health in society*" (2001) Bitti Peyron discusses the effects of obesity. The increased risk of developing diseases like diabetes, high blood pressure, metabolic diseases and cardiovascular diseases is pointed out.

The major cause of disease and early death, however, is associated with poor food habits, which may result in hypertension, diabetes, cancer and coronary heart disease. Despite a great deal of knowledge gained on the impacts of diet on health and specific diseases, relatively little is known about how to influence dietary choices (Shepherd, 1989). It is assumed that possible explanations of dietary behavior are related to an optimistic health bias (sickness does not strike me) and a problem with comprehending complex health issues as well as factors that affect human behavior in general (for example, physiological needs, social and cultural factors).

4.2.2 A societal investment[25]

It was the threat of escalating medical care costs that stimulated a societal investment in functional foods in Japan. Demographical studies in the early 1980s revealed an increasing number of aging people. This group of 'old people' was getting larger and their expectations on their standard of living were increasing. In a societal perspective that implied increased costs for care in general, and medical care in particular.

One way to lessen the costs for medical care was to offer old people health-related products that allow for 'self-care' as long as possible. A major research fund was set up by the Japanese government in 1984, parallel to the development of a legal structure that would allow for these products to be sold with health arguments.

Japanese industrial interests were stimulated in part by the fund and in part by the shareholders interest in long-term pay back. The long-term pay back interests facilitate long-term R&D investments that are seen as a prerequisite for the development of functional foods.

4.2.3 A growing interest for functional foods among food companies

One way to show the growing interest for functional foods in the food industry is to look at available functional food products on the market. In 1993 some 16 products were mentioned in a survey study about functional foods (Mark-Herbert & Nyström, 1993 B, in Appendix 5). A quick review of available products today shows well over forty products with web sites (Appendix 3). A closer investigation in a food store will show vastly more products than those listed in the appendix (with a web site).

A growing interest in functional foods in the 1990s is also reflected in an increasing number of articles about these products. When I started my article collection in the early 1990s I was thrilled to find an article that remotely touched on functional

[25] Mark-Herbert, 1993 (a literature review).

foods. Ten years later I find myself with many notebooks full of articles, unable to keep up with the progress.

A database search[26] on *functional food** showed that the number of publications about functional foods has increased significantly in the last decade (Table 4.2, and 4.3).

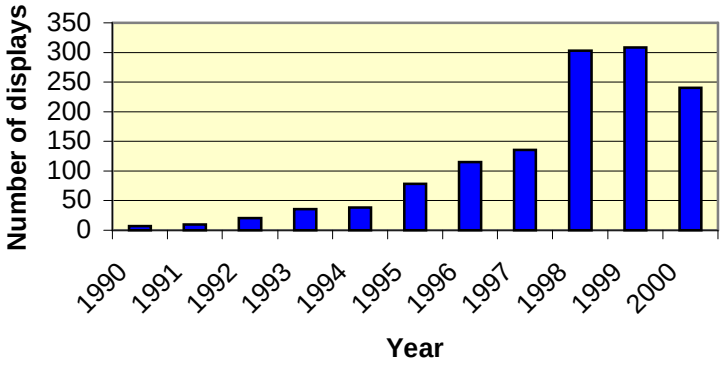
Table 4.2 Data base search for publications about functional food*

Data base	⇒ 1990	1991-2000
Libris	4	41
***Affärsdata* (Tidningsdatabas)**	0	18
BTJ Artikelsök	0	128
WebSPIRS*	1990: 7	2000: 240

* The search was carried out on functional food* (singular and plural).
** During this year alone.

The data-base WebSPIRS is large and a (non truncated) search for the years between 1990 and 2000 shows an increase in articles with time (Table 4.3). At a first glance, the number of displays for 2000 may seem low. Why the sudden decrease? The lower number, compared to the previous year, may be attributed to the fact that there may be a significant delay in coding articles in the data-base.

Table 4.3 A database search on "functional foods*"[27] in WebSPIRS



Source: The search was carried out by librarian Christina Brundin,
Dept. of Economics, SLU, Uppsala, Sweden (March 6, 2001).

[26] A data base search on *functional food/ s* was carried out in Libris, Affärsdata, BTJ Artikelsök and WebSPIRS by Christina Brundin, librarian at the Department of Economics at SLU, Uppsala, Sweden (March 1, 2001).

[27] The table shows the number of displays of Functional food/s (singular and plural) in the caption in articles in the database WebSPIRS.

These database searches show an increasing number of articles about functional foods in papers and journals. In reality, the number is much larger than these searches indicate. This is explained by the fact that only those with functional foods in the headline provided a display in the search. Nevertheless, this search shows a growing interest in functional foods. Looking in more detail the lists of publications show that an increase in articles in scientific and professional journals precede an increase in common papers and popular journals. This may indicate that the development process is driven as much by "technology push" as by "market pull".

In attending food conferences, I also find a growing awareness of the area of functional foods. All food companies are not pursuing this avenue but they all keep track of consumer needs - and health related products are certainly in vogue. Some would argue that health values are perpetual, as a growing awareness, others argue that it is a trend. It is clear, however, that food companies are attentive to consumers' needs.

A growing interest in functional foods is partly stimulated in Sweden by financial support from governmental and industrial research funds (Ingvarsson, 2000). Most of this research is, as we will see in the cases, carried out at established universities, for instance in Lund, Göteborg and Uppsala, in collaboration with food companies. This financial support in Sweden is rather moderate compared to the investments made in, e.g., Japan and Finland.[28] Investments in Finland and Sweden are, for the most part, motivated by forecasted industrial advantages. In Japan, on the other hand, the Health Ministry took the initiative and it appears as if the health effect among citizens was the primary driving force.

The number of functional food organizations is also steadily increasing (Appendix 4). The national center in Sweden is located in Göteborg (Swedish Centre of Excellence and Innovation in Functional Foods, www.functionalfoods.nu). It is seen as an arena for the development where business interests meet research interests and societal needs. This center provides information, advice and lobbying for further development of functional foods. One of the areas where this center fills an important role is in providing information about functional foods to the public and to representatives for food companies.

[28] In Finland a long-term research project in the area of functional foods (300 million FM) is put forward by TEKES (the equivalence of NUTEK in Sweden) for joint projects at universities in collaboration with food businesses such as Fazer AB, Valio OY and Raisio OY (Ingvarsson, 2000, 20).

4.2.4 Well-informed consumers

With the growing access to information through various avenues in IT, consumers shop around to satisfy their needs. This is, for instance, seen in medical care where doctors face patients well acquainted with their diagnosis and willing to discuss a treatment plan (Kollberg, 2000). Consumers have become increasingly concerned about the risks associated with food (Weinstein, 1987). These concerns involve worries with respect to the product itself (genetically modified organisms and pathogens such as BSE, E-coli, Listeria or Salmonella) and the diseases that are promoted by a certain diet. It is commonly known that cardiovascular disease, cancer and diabetes are major causes of death, and they are in part attributable to an unhealthy diet. Well-informed consumers are thus seeking alternatives. Health-related products therefore constitute a pro-active alternative to sickness and treatment.

In response to these fears the public responses to functional foods vary. Depending on food habits, life style and perceived risks, individuals are, to a varying degree, willing to change food habits and pay a premium price for a more healthy product (Figure 4.3).

Consumers with the highest motivation to try new health related foods are those with symptoms of a disease, the “*sufferers*”.

Those who are aware of a *risk*, for example hereditary cardiovascular disease, also show a high willingness to change food habits to decrease risk.

The segment labeled as “*prevention*” refers to people who are health conscious, usually with an interest in how food and physical recreation may affect their health.

Mass market refers to the average consumer with little or no interest in functional foods.

Figure 4.3 Market segments with different needs for functional foods (Mark-Herbert & Nyström, 2000, 36).

Assuming that the functional product is a food product (not a capsule or a pill) it is clear that taste to a large extent determines the success of a product launch in Sweden (Nyström & Edvardsson, 1980; Rune, 2001). Future functional foods thus have to be tasty and appealing in addition to having scientifically proven health-effects.

It is also an open question how consumers understand, relate to and believe in health messages for functional food products. Studies of consumers' understanding of health information show that scientific health arguments are not comprehendible for a vast majority of consumers (Laser-Reuterswärd & Svederberg, 1999; Svederberg, 1997) Market investigations show that products sold with a "soft" argument are greeted with acceptance among the vast majority of consumers (personal communication, Wennström, 1999). An example of such arguments is used in marketing the products ProViva, "for a better stomach" – "your stomach will thank you", and Oat Milk, "for a better heart".

4.3 A market analysis

4.3.1 Functional food markets in 2001

The functional food market is hard to quantify. This is in part explained by the fact that functional foods are diverse, which is problematic in defining this group of foods. Assuming that the definition of functional foods is restricted to foods and drinks, which are sold with a specific health claim on packages and in advertisements, the total market in Europe (1999) was approximately $1.79 billion (Hilliam & Young, 2000).

Looking at international development, it is clear that different functional food segments are developed depending on regional food preferences as well as emerging regional developments of technologies (Table 4.4).

Table 4.4 Functional food sales and trends by country/region

Country/ region	Sales in 1999 ($ billion)	Comment on the market
Europe	1.79	A highly developed market in dairy products, dominated by probiotic products.
USA	1.80	A market in development, especially for breakfast cereals and fortified drinks.
Japan	2.13	A large and rapidly expanding market, especially in probiotic and fortified drinks and spreads.

Source: Hilliam & Young, (2000)

Functional food markets have developed in different directions, with Europe seeing the area of 'gut health products' (Hilliam & Young, 2000), in particular probiotic drinks, as an important area (Table 4.5). The US market is characterized by much wider interest in anti-cancer products and the use of botanical raw materials. While

the Japanese market also has a strong focus on gut health products, the range of products makes it unlike any other market.

Table 4.5 Functional foods by sector and country, 1999 (Hilliam & Young, 2000)

Food segment	UK Value (£M)	% share	France Value (FM)	% share	USA Value ($M)	% share
Probiotic yogurt	120	39	1 190	60	115	7
Prebiotic drinks	20	7	182	9		
Spreads	104	34	205*	11	22	1
Cereals	60	19	400**	20	1 500	83
Soft drinks	3	1			166	9
	307	100	1 977	100	1 803	100

* Probiotic 'fromage frais'
** Dietic biscuits
% share refers to the share of total functional foods sold in each country respective
! Note the difference in currency in M (million) for each country (next to value)

Cultural food habits are reflected in the food segments where functional foods are found in different countries (Table 4.5). The following countries are demarcated as important European markets for the functional food markets: the Netherlands, Spain and the Scandinavian countries (Table 4.6).

Table 4.6 Important markets in Europe for functional foods

FOOD SEGMENT	KEY MARKETS
Dairy products	France, the Netherlands, Spain, Scandinavia, Germany, UK
Spreads	UK, Finland, the Netherlands, France
Bakery and cereal	Spain
Drinks	France, Germany, Scandinavia, Spain
Confectionary	Scandinavia

Source: Hilliam & Young, (2000)

The functional food industry is almost as fragmented and difficult to define as the markets. While some sectors, such as the functional drinks sector, is characterized by local brands, other sectors, like the yogurt sector, is dominated by major multinational companies like Nestlé, Unilever and Danone.

4.3.2 Future markets

The future functional foods markets are forecasted to continue expanding in most countries and regions of the world where there is an established processed food market (Heasman & Melletin, 1998). An optimistic prediction for the US market is provided by Dr. Rao at Con Agra, a large food producing company in the US. He estimated the American market for functional foods to a value of approximately $10-20 billion[29] in 1998, with a forecast for growth of about 15 percent per year (Taylor, 1998). Even more optimistic predictions for the US, predicting a market value of about USD 40 billion, and a growth potential of 17-20 percent annually were presented the very same year (BioGaia, 1998, 9). In this market analysis the value of the world market for functional foods that contain microorganisms alone is estimated to USD 3 billion. Market analysis and any kind of prediction differ in outcome depending on what is regarded as functional foods and how the institutional conditions in different parts of the world will develop.

A closer look at the development in the Swedish functional food market shows that most food businesses with an interest in the functional food area welcome a legal framework for marketing functional foods (Alsén-Eklöf, 2001). The allowed product-specific health arguments in marketing functional foods in Sweden apply to *food* products, not food additives. In the US marketing food additives is less legally restricted than marketing food products. Consequently, in marketing functional foods, the choice of launching a product as a food or food additive depends on the legal marketing restrictions as well as how these products are perceived by consumers.

Many predictions are made about future food habits. Some appear more utopian than others. Yet, this is market investigation that provides information about consumers desired developments of food products. What consumers really purchase and need remains to be seen. It is worth keeping in mind that food changes are slow. Most individuals are only willing to change their food habits in minor ways (Feurst, 1991) unless they experience a health related trauma, such as a disease.

[29] This forecast is based on a broad definition of functional foods, which include dietary supplements.

5 Empirical findings

Three narrative cases about the development of functional food products are presented below (Proviva, Magiform and IgY-egg). The products, as they appear on the market in 2001, are shown on the accompanying bookmark. In these narratives the empirical material is chronologically presented. This material involves the development of products, a number of processes and businesses. The focus of these cases is on the *innovation process* as such. This means that the process is described in phases, from the viewpoint of different actors and various perspectives.

In addition to these three cases a brief presentation of the development of a fourth functional food product is provided (dairy products with *Lactobacillus reuteri*). This presentation is not a full case, but it provides an interesting presentation, which demonstrates some contrasts to the three cases.

5.1 ProViva

This case has its origins in the need for a treatment of patients after abdominal surgery. The medical treatment requires a product to help the body recover the functions of the digestive tract (gut). In order to develop this product a process for genetically identifying bacteria is developed. The development of a product thereafter soon follows. The product concept is expanded and the market for this product changes, from a medical market to a vastly larger food market. As the product and processes are developed, a business takes shape. New markets are discovered and the business more ground for further developments.

The following sections introduce the product, the major process and the business, before giving room for the case.

A product
ProViva, means *the living* (Lat.). It is a fruit drink, which is produced by the dairy Skånemejerier, and sold in paper beverage cartons. The drink (juice) contains oats and health promoting lactic bacteria (*Lactobacillus plantarum 299v).* The four different varieties of exotic drinks are: rosehip, blueberry, black current and strawberry.

A process
A technology for genetically identifying bacteria made it possible to differentiate these bacteria from other lactic bacteria. That technology serves as a base for the

patent, and for the scientific clinical studies of effects at a later stage in the innovation process.

A business
The grounds for *Probi AB* were formed in a small research project in 1986. A group of scientists and an entrepreneur challenged a problem. Partnerships to finance the project, as well as to provide technology input, changed several times. Probi AB was founded in 1990 and in 2001 it had two subsidiaries, Probi Food AB and Probi Feed AB.

5.1.1 The idea for a new medical product
The ProViva project started as a purely medical project, in which a need for a medical product was identified at the hospital in Lund. Prof. Jeppsson noticed that after what should be regarded as a successful extensive abdominal surgery (kidney, liver etc.) the patient was in poor condition. Unexplainable complications even resulted in total organ collapse (death). Part of the explanation appeared to be the fact that the patient was treated with antibiotics prior to the operation to counteract any possible secondary post operational infections. The antibiotics put the pathogens, as well as the normal and desired, microbiological intestinal flora, out of action. After the operation pathogens microorganisms re-colonize the gastrointestinal tract faster than the indigenous flora. Thus, the stomach needs help.

The digestive tract harbors a microbial flora[30], which helps the body to break down and absorb nutrients. The turnover time is approximately 3-5 days. If the digestive tract lacks bulk (food for it to digest) during a time when the patient is given intravenous fluids and antibiotics, a leakage may be a result, during which bacteria diffuse through out the abdominal cavity, which may cause organ collapse.

A first attempt at preventing this post-operation condition led to the development of a tube, through which nutrients could be given. Although the tube was functioning satisfyingly, it was clear that the nutrient fluids were not. Professor Larsson, an expert in food technology at Lund University, was asked what would constitute a suitable nutrient solution. This question arose during the 1980s when lots of positive effects from oats were shown. For this purpose the oats would have to be finely ground and in a solution, since it could neither be chewed nor chemically or mechanically digested in the stomach. Grinding oats, adding water and fermenting them would give a suitable nutrient solution.

The next issue was to find the bacteria for fermenting the oats. The primary objective for the bacteria was to digest the oats, leaving nutrients in an appropriate form to be absorbed in the intestine. A secondary objective for the bacteria became

[30] A healthy person has about 1 kg of microorganisms in her gut (800 g for a woman and 1000 g for a man).

apparent in a later stage of the project, when it was thought that the bacteria themselves were essential for the digestive tract. If these bacteria colonized the intestinal mucus, this would provide protection against pathogens (undesired microorganisms). Most of the commonly known lactic bacteria (*Lactobacillus bifidus, bulgaricus* and *acidophilus*) are suitable for products based on milk, but not necessarily for a grain-based product.

Early on in the research project it was thought that the research should be run in a traditional way. That would include listing the desired characteristics this bacteria should have, and screening for the bacteria with the best match with these criteria[31]. Very soon the leading researcher, Professor Nils Molin (in microbiology), realized that a more productive approach would start with the question: "where can we find healthy bacteria?" The research procedures were changed. A large number of biopsies (200) were taken from people with healthy digestive tracts.

From these biopsies about 20 different strains of lactic bacteria were isolated, identified and cultivated. A second biopsy was later taken from persons after they had been given fermented oats, treated with these 20 strains of lactic bacteria. Again, strains were isolated and identified from the biopsies. A few of these strains appeared superior to others with regards to survival (among them *L. Plantarum 299 v).* The mechanisms that may contribute to bacterial survival and other desired health related characteristics are still being investigated. Some of the identified characteristics and abilities of *L. plantarum 299v* are the following:

* the ability to use oats as a substrate,
* the capability to adhere to the intestinal mucus in the digestive tract,
* the capacity to survive in general in a product (through production, shelf life until consumed, and in the product' s route through the stomach, with a low pH, to the digestive tract),
* and the capacity of decreasing levels of blood cholesterol and fibrinogen.

The health benefits from eating ProViva lie in its prophylactic effects in the digestive tract, for example by supporting the immune defense. ProViva is also known to have a curing effect in, for example, some cases of Colon Irritable and during certain critical abdominal post-operative conditions.

The research project in which the probiotic idea grew was within the frame of several doctoral theses at the University of Lund. The university provided an environment in which knowledge from different areas could be combined. The research mainly concerned developing processes, a method for genetically

[31] The desired characteristics of the bacteria include surviving a low pH in the presence of gallic acid, having the ability to colonize the intestine, survive treatment in production and a time in storage, inhibit pathogens, and last but not least, provide a good tasting product for oral consumption in a later, post-operational, phase.

identifying bacteria, and a method to technically handle the cultures of lactic bacteria. It was these technologies that later led to the possibility of filing for patents on the manufacturing process, and eventually on the bacteria in the product (*L. plantarum 299, L. plantarum 299v* and *L. rhamnosus 271).*

Depending on the country, patents will have different emphasis that reflects each country's legislation regarding proprietary rights. The patented process of genetically determining the strain of bacteria are for the most part similar in Europe and in the US. The bacteria, use of bacteria and the product (ProViva), on the other hand, are patented in different ways depending on patent traditions in different countries.

A research project in a university setting is constantly exposed to the critical eye of other experts, and therefore it is continuously the subject of improvements and new solutions. So far, the research had been aimed at finding a solution to the problem, the need for a nutrient solution for the feeding tube, but a new idea was sprouting - that of a probiotic food product (ProViva).

5.1.2 Partnerships and development

A collaborative partner may fill a number of needs, for example that of providing financial support, of finding future customers or representing a source of expertise. In the case of ProViva there has been several collaborative partners along the way. As the project proceeded the needs changed. And as the partners were altered, the aim of the research project was slightly altered as well.

1986 A small group of scientists at the University of Lund (Professor Jeppsson, Professor Larsson, and Professor Molin, with their respective doctoral students) worked on solving a medical problem. *Kabi Invent* (a pharmaceutical firm) was partly supporting the project.

1987 *Kabi Invent* regarded the project as a future medical nutritional solution for probes. At this stage *Cerealia*, a major actor in the Swedish milling industry, was also part of the project, since the base for the product was oats.

When Kabi Invent was sold to *Pharmacia*, another pharmaceutical firm, the project was closed. Pharmacia assisted in finding a new partner.

1989-1993 The new partner was found in a large Dutch pharmaceutical company, *Nutritcia*. The financial support was solid but Nutritcia' s belief in the project was insufficient. The contract, aiming to develop a medical product, was soon terminated. At that point, however, the research group felt that they were pretty far ahead with the development of a good product.

1990 Probi AB was founded, located in the science park in close proximity to the University of Lund.

1990-1991 During the early nineties the first contact was taken with *Arla*, a major actor in the Swedish dairy-industry. The need for a product such as ProViva was rejected because Acidophilus (a yogurt functional food product) had recently been developed. *Skånemejerier*, a large dairy company in the south of Sweden, on the other hand, proved to be interested. Contacts with the food industry during that time did not conflict in interest with regards to Nutritcia, because their interest and contract concerned only medical processes and a medical product.

1994 In February 1994 ProViva was launched, developed as a joint project, produced and marketed by Skånemejerier in Sweden. ProViva was lanuched in the south of Sweden (Skåne), and the market was gradually expanded to cover all of Sweden (in sales and distribution agreements between major dairies in Sweden). The ProViva market was also expanded to include the UK.

1998 Probi AB finds another partner in development in *SIA Glass AB*, a family-owned ice cream dairy. A new ice cream, "god hälsa" (Good health) is developed, launched and sold in three varieties: tropical, lemon/lime and black currant.

1998 Probi Feed AB (subsidiary of Probi AB) launched a probiotic horse product, ProEquo. It was developed in collaboration with the Veterinary hospital in Helsingborg.

2000 The ProViva concept was further developed by Skånemejerier and Probi AB. In August 2000 a new sports drink "ProViva Active", a recap product with *L. Plantarum 299 v*, minerals, vitamins, carbohydrates and proteins, was launched.

As of 2001 there is still no medical product on the market. It could readily be developed, however, when called for by the market. Plans are made for marketing pills (tablets or capsules) containing *L. Plantarum 299v* as a natural remedy product.

A product - ProViva

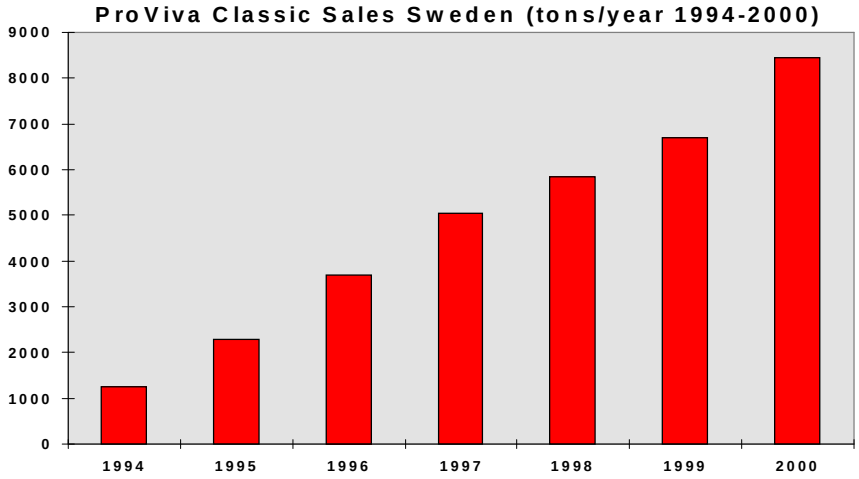
The business Probi AB was founded in 1990. It was the result of the efforts of a group of researchers over several years, which had led to the development of a product at the prototype stage. In 1991 the product (prototype and concept) was

presented to Kenneth Andersson, responsible for R&D at Skånemejerier. He showed a positive response and interest in cooperation for future developments. The product was considered a novel idea, unlike any other kind of known food or beverage on the market (see a comparison in *Appendix 3*).

An agreement was reached as a formal contract between Probi AB and Skånemejerier, in which Skånemejerier became part owner of Probi Food AB (subsidiary of Probi AB). The financial support was not large, but sufficient to maintain research and development continued. Skånemejerier was not just a financial partner, but also a strong partner in the later stages of development of a food product and a possible future producer of the product. As a producer Skånemejerier had a number of advantages, that of great tacit knowledge, market channels and marketing experience, a well established sales organization, distribution net (cool transports and storage facilities) and last, but not least, a large production capacity. ProViva was launched in February 1994.

ProViva proved to have good properties, the main property being health effects for the consumer. Furthermore, ProViva proved to be suitable for production and stable in transport and storage, before reaching the final destination, the digestive tract of the consumer. This stability and product uniformity, allows for a rather long shelf life. A positive consumer response to the product is illustrated in Table 5.1 as a growth in sales. In January 1998 about 200 000 liters a week were sold in Sweden, and the sales were still increasing.

Table 5.1 Sales of ProViva 1994-2000 in Sweden



Source: Personal communication, Lönne (2001).

ProViva was also gaining new markets outside Sweden, mainly through license agreements with dairies in each respective country. In 1998 ProViva could be found in the following countries: Sweden, Poland, Finland, Iceland, Germany (PrimaVita), Belgium, Denmark and the UK.

A business - Probi AB

Probi AB is a research-based business, owning several patents and production rights. Prior to 1998 Probi AB was owned by seven scientific researchers, the director (Kaj Vareman) and the dairy Skånemejerier. In 1988 Probi AB went public on the Swedish stock market. The marketing was carried out in the subsidiaries, Probi Food AB and Probi Feed AB. Within Europe, Probi AB and Skånemejerier coordinate marketing, export and license agreements. Probi AB handles licenses while Skånemejerier is responsible for production, marketing and sales in Sweden and in the UK.

Probi AB relies heavily on the knowledge and skills of each person who is a part of the organization. It is through this expertise in closely related areas and each individual's contact network with other experts that Probi AB can be described in terms of unique knowledge and skills. Connections with experts in different medical fields and in different countries are made. In order to gain legitimacy, clinical tests are carried out in many different countries. A local scientific expert addresses consumer questions. These experts are preferably found in medical specialties, which deal with the digestive tract. They are found in Sweden, Spain, Italy, Germany, the US and in Korea.

Experts within and outside Probi AB have contributed in the R&D process, which has resulted in ProViva. The parallel development of the business in which this has taken place has been managed mainly by the director, Kaj Vareman. It is his philosophy, which clearly marks the way for the development:

> *"I never take on a new project without the knowledge of another market agent who shows enthusiasm and willingness to spend some money on the project" (*personal communication, Vareman, 1998*).*

> *"My philosophy is that the researchers should make money on what they create and do. I want them to feel included in the whole business... That way the corporate culture is one where researchers want to, and will, try new ideas" (*personal communication, Vareman, 1998*).*

The director's role can be described as that of being a translator between two cultures, the scientific research and a financial market. The researchers lack in most

cases a product prototype, a given market, business connections, a budget, a finance plan and a financial language. These are the areas where Vareman's knowledge, experience, skills, and contact network were crucial. His role also includes the tasks of analyzing the market, developing the business and its strategies, finding suitable partners and, above all, marketing Probi AB and its products.

A collaboration partner in Skånemejerier

Skånemejerier is by Swedish standards a rather large cooperatively owned dairy company (medium size by European standards). The owners are the farmers in Skåne, in the south of Sweden. The company is divided into three main business areas: fresh produce, cheese and raw materials & industry. Each director of a business area and of each managerial area reports directly to the Chief Executive Officer.

The supervisor responsible for R&D, Kenneth Andersson, guides the different R&D activities within what he views himself as "chaos with a few steady routines". The in-house R&D activities carried out within Skånemejerier are mainly that of development (in addition to production and marketing). This is perceived as their relative strength. The research, on the other hand, is conducted mainly by small university-bound research groups and businesses, which are in close contact with Andersson and his production personnel.

Information about each R&D-project is kept in a so-called R&D-notebook. In this file the progress of each project is monitored, and ideas for new projects are saved. The ideas for a new project may originate from a Skånemejerier employee, an R&D-partner or from anyone else outside the company. Each project is regularly reviewed by the Development Committee and judged after certain criteria. If an idea for a project at some stage does not pass the screening process, it does not mean that it is forgotten for all future. It will remain in the idea database, to be reviewed at a later point.

The Development Committee consists of the CEO, the respective director of each business area and the R&D supervisor Andersson. Each of the ideas are reviewed by Andersson. If an idea is perceived as interesting, it is carefully reviewed and sorted in to the most appropriate business area. In an ideal project the person in charge of the business area is involved from the start. This is desirable for many reasons, one of them being that it is easier to make major changes early in a project. Furthermore, it allows for the R&D-process to be carried out in part as parallel activities, rather than as sequential activities. These other activities include market testing, negotiations with business partners regarding sales and distribution, and, when required, development of new packaging techniques. It also enhances the acceptance of changes in technology, products and within the company as such. In the continued R&D process, meetings are held where Andersson, the director of the

business area, the research group or business, and specialized production personnel from Skånemejerier meet regularly to discuss the progress of the project.

The R&D-activities within Skånemejerier can be seen as "r& D", where the relatively small r symbolizes the contact with research carried out at universities or in research-firms, such as Probi AB. The large D symbolizes the vast knowledge, skills and technology within Skånemejerier, related to handling raw materials, production, packaging, marketing, distribution and sales.

5.1.3 Strategies and visions - continued R&D and new markets

At Probi AB the strategies are based on the notion that a good idea and creative minds to solve problems may carry far, but not all the way for the successful commercialization of a project. Within Probi AB there is an awareness of the need to be farsighted in the R&D process. Such foresight requires resources. Some of the resources and conditions for the development to take place are: capital, strong business partners, contacts and patents (legal rights to the unique technology). In the early stages of development, the process was funded through business partners. At a later stage, when the product (patents) and business proves trustworthy, there were other ways to find capital, through a stock market introduction (1998). More capital would allow for Probi AB to grow in areas that have been given low priority thus far (a future Probi Med AB).

As a small R&D-focused firm, Probi AB strives for finding partners who appreciate their relative strengths (technologies). Skånemejerier has proven to be the ideal partner in this respect, and also in many other ways. It is therefore not a coincidence that Probi AB chose Skånemejerier as partner in other development projects after the positive experiences in the ProViva project. The business partners, Probi AB and Skånemejerier, use each other as sources of expertise. These contacts (with special skills and knowledge in different areas) in addition to contacts with persons within certain medical fields throughout the world make up a network of experts, which can readily be consulted. The experts are mainly found in gastroenterology (in Sweden, Poland, Spain and the US), immunology (in Sweden and the US), surgery, microbiology, pediatrics (in Sweden, Poland and the US), cardiology (in Poland) and general medicine.

Probi AB owns two kinds of patents: patents related to the process of making the product and patents on the bacterial culture themselves. The action of covering the process and product with patents was done in many small partial steps. Patents are costly, and may be regarded as an immaterial asset. The assets provide a sense of security and stability in the ownership of technology. It also means revealing an area of technology that may be regarded as an Achilles heal. Thus the main fear for Probi AB is that financially strong competitors will consume its scarce resources by

making legal patent claims, in which costly lawyers are hired to settle the disagreement.

Market studies of the product show that the potential for ProViva is great. The consumption of ProViva 1997 was approximately 1 liter per inhabitant in Sweden/ year (Sweden has about 8,6 million inhabitants). The corresponding number of potential customers in Europe is approximately 400 million inhabitants. In addition to the promising European market, the US and other countries are viewed as interesting markets as well.

Probi AB has chosen to cooperate with reputable and "strong" partners. Through this choice several advantages are gained, for example: covering market channels, production facilities, tacit knowledge regarding food habits, and established and well known brand names.

Skånemejerier

Before reasoning in terms of a technology and a market strategy, a clarification between research and development may be needed (Table 5.2).

Table 5.2 Differences in conditions for process and product development as opposed to process and product innovation (personal communication, Andersson, 1998)

Comparison of/ dimension	Process- and product **development**	Process- and product **innovation (R&D)**
Cost and time	Known	Unknown
Access to information	Possible, relevant and complete	Segmented, scattered, incomplete and unreliable
Possible alternatives	Known, few, "right alternative" easily found	Many possible alternatives, few known, hard to find "a right one"
Experts	Previous experience indicates expert knowledge	Many people regard themselves as experts, but few are
Control	Standards may be used, quick and easy evaluation of results	No standards. It takes a long time before one knows how the project will develop and what the outcome will be.

Skånemejerier regard their strengths to be in the development of products, as well as in marketing, production, sales and distribution. The strategy for the R&D department is that of using the organization's own strengths and being an attractive partner for organizations which have their strength in research. This is clearly stated in the business strategy:

> *"Our customers should regard us as a partner with a sensitive ear and an innovative capacity. Through cooperation with other actors, we want to achieve increased competitiveness."* (translated from Skånemejerier, Annual Report, 1997, 2)

Building a research organization within Skånemejerier does not appear as a strategically fruitful alternative. The organization would be hard to manage. Instead, keeping in close contact with different research teams at several universities gives an idea of what is new in research in the area. The joint projects, such as ProViva, are kept independent, but yet in close contact with Skånemejerier. This is a strategic objective in itself.

> *"As a rather small business, in an international perspective, there are a few different strategic ways to go. We have not chosen rationalizations of different kinds, but rather putting our resources into R&D, in building nets of contacts, strategic alliances and a general awareness of R&D".* (personal communication, Andersson, 1998)

Cooperation is regarded as especially important in certain strategic areas, such as bacteria, enzymes and polar lipids[32] (Figure 5.1).

> *"We build networks. We don't have all the technology or skills within the organization; strong partners carry a long way"* (personal communication, Andersson, 1998).

[32] Polar lipids are fatty acids with ability to mix in water-based solutions (polar solutions).

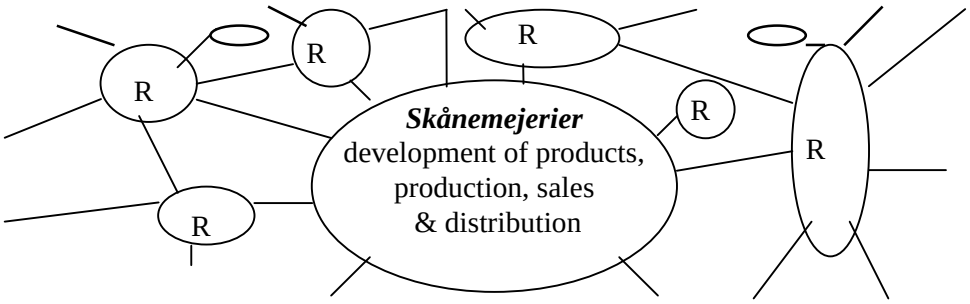


Figure 5.1 Skånemejeriers R&D organization, a schematic figure. Their R&D is conducted as a number of joint projects between Skånemejerier and research groups (R) located at near-by universities.

In the process of developing new products, Skånemejerier' s role is mainly seen as paying attention to new ideas. Some of these ideas come from researchers conducting basic research. This is where most ideas for radically new products are developed, as an early part of the innovation process. Once a pilot process or prototype is developed, much of Skånemejerier' s technology comes to use in the continued development. In what may be regarded as refined development of the products (further improvements of an existing product or new varieties), the taste of the product becomes the critical issue.

As a part of a network, Skånemejerier strives for strategic alliances within as well as outside Sweden. Presently, many of the alliances are with companies of comparable size to that of Skånemejerier (Hansa Milk in Germany, Klöver Melk in Denmark, Milka in Finland, Säntis in Switzerland and Leima in Spain). Products are for the most part produced by the local dairy, as a license agreement.

Legal contracts regarding sales and distribution with other dairies within Sweden may also be considered as parts of the network in which Skånemejerier is a part. Major Swedish dairies, e.g., Arla, NNP, Norrmejerier and Milko have agreements with one another to sell and distribute products, which are produced by the other dairies. These agreements are constructed as many different contracts, for each product and geographical area, and they need to be re-negotiated intermittently.

Success in terms of prosperous new products that are *not* based on the traditional raw material, milk, has provoked thoughts regarding the future business for Skånemejerier.

> *"Being a part of creating something new stimulates new ways of thinking throughout the entire organization"* (personal communication, Andersson, 1998).

A good example is ProViva which is based on oats, water and bacteria with a fruit addition. This is well illustrated in a quote from the 1997 annual report:

> *"Our business has developed - from being a dairy on a small market, to being a food producing company in Europe"*
> *(*translated from Skånemejerier's Annual Report, 1997, p 2).

The development of ProViva is an example of the changes, which are taking place, leading the way, in incremental steps, towards awareness of a new strategy. The previous goal of maximizing the price of milk to the farmer is history. Such aims and thoughts belong to a time when Skånemejerier was a dairy on a geographically smaller market.

A contemporary goal is to produce added value in production of mainly milk-based food products. Functional foods are a part of that strategy and they constitute about 10% of Skånemejerier's annual turnover in 2000/2001 (Olsson, 2001). As a well-established company with many well-known brands, Skånemejerier is very aware of the value of their image. Serious conduct in research is therefore a prerequisite for a long-term engagement in the area of functional foods.

5.1.4 A market in the US through ConAgra Inc.

The following paragraphs are based on interviews with Stirling and Rao (personal communication, 1998), who are supervisors in the development of a new business, CAG Functional Foods in Con Agra Inc. The aim with this outlook is to give an idea of how ProViva may fit into ConAgra functional food strategies. ConAgra enters the innovation process in a phase when new market alliances are sought in licensing agreements by Probi to cover the American market.

CAG Functional Foods

ConAgra was founded in 1919 when four flourmills consolidated and formed a corporation in Grand Island, *Nebraska Consolidated Mills (NCM).* In 1922 the headquarters moved to Omaha, NE and in 1971 NCM changed its name to *ConAgra Inc*. The name ConAgra was derived from the Latin roots "with" and "land" signifying the partnership with the land.

ConAgra is one of the largest food companies in the US, with annual sales of about $ 24 billion (1998, Annual Report). It is a diversified food company, which

operates across the food chain, from basic agricultural inputs to production and sales of branded consumer products. ConAgra consists of roughly 180 independent operating companies, each having their own business areas and brands. Some of the well known brands are: Hunt's, Healthy Choice, Wesson, Orville Redenbacker's, Singleton, Van Camp's, Peter Pan, Knott's Berry Farm, La Choy, Butterball, Inland Valley, Santa Fe Style and Country Pride.

The mission of ConAgra is simple: to increase stockholders' wealth. This is achieved through growth of long-term earnings where the sales of branded food products account for well over half of these earnings (ConAgra Inc., 1998, Annual Report).

CAG Functional Foods is an independent business unit under ConAgra Trading and Processing Companies. It was started in 1996 by Stirling and Rao, to develop and market proprietary supplements and future functional foods to health conscious consumers. The main interest is in grain-based functional foods. Stirling entered the company with a good background in sales of OTC products (Over The Counter, pharmaceutical products that are sold without a prescription) as well as other health related products for consumers at large. Dr. Rao was at that time well established at ConAgra, leading the R&D for the Trading and Processing Companies.

Functional foods are seen as a possibility to promote health through diet rather than to cure a disease already developed. The area of *probiotics* is of particular interest; these are in the form of food supplements that contain health promoting bacteria for the digestive tract. The newly introduced brand is *Culturelle.* It is a capsule, which contains granulated bacteria. Thus far, one kind of bacteria is marketed *Lactobacillus GG*. Marketing rights have been established for the US and the UK markets with the Finnish company, Valio. After further testing in the US a second variety of Culturelle, containing *Lactobacillus 299 V* is expected to be launched as well.

The marketing of functional food in the US market is regulated by the FDA (Food and Drug Administration). The claims in any kind of consumer information are carefully screened (ads, labels, the internet, spots on the radio). In general, no food products can be said to cure or prevent a disease.

A business strategy

CAG Functional Food's way of answering to legal demands as well as to consumer needs and to company objectives is by working according to the a specific strategy and operating model shown, Figure 5.2. .

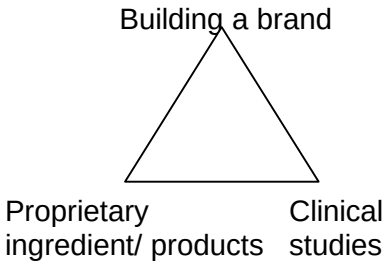


Figure 5.2 CAG Functional Foods, a business strategy *(*personal communication, Stirling, 1998).

These three cornerstones may provide a sustainable competitive advantage, which will result in continued growth with sales and profits to meet the financial objectives. The *proprietary ingredient* or product gives exclusive rights to sales for a certain time. Through the use of *branded products* consumer recognition is gained, along with consumption traditions. *Testing* the product provides a basis for experts in the health field to evaluate the product in a scientific way. The three factors are interdependent and closely connected to the business model, which is essentially how CAG Functional Foods is implementing its strategy. In other words, this is how it operates.

A business model

For the American market, which is the main target for these products, the business model for probiotics is based on***building awareness*** (Figure 5.3). A primary step, which is not part of the figure, of acquiring the proprietary rights to the product or ingredient. In the case of Culturelle, this was done through a contract with the Finnish dairy company, Valio, and the Swedish company, Probi AB. These rights are formalized in continuous contracts for certain phases and time periods.

In the case of functional foods, marketing relies heavily on each phase taken prior to the one in focus in the innovation process. This is illustrated in Figure 5.3. An example of this is how the advertising phase is dependent on previous phases, public relations and clinical studies. In the public relations phase medical facts from the clinical studies are communicated in news on TV and radio. This process is essentially building awareness in different consumer groups.

Clinical studies are associated with rather large investments. Once the phase of clinical studies is started it would be of great consequence if the proprietary rights were jeopardized. Therefore, prior to such investments, contracts to guarantee proprietary rights are drawn up.

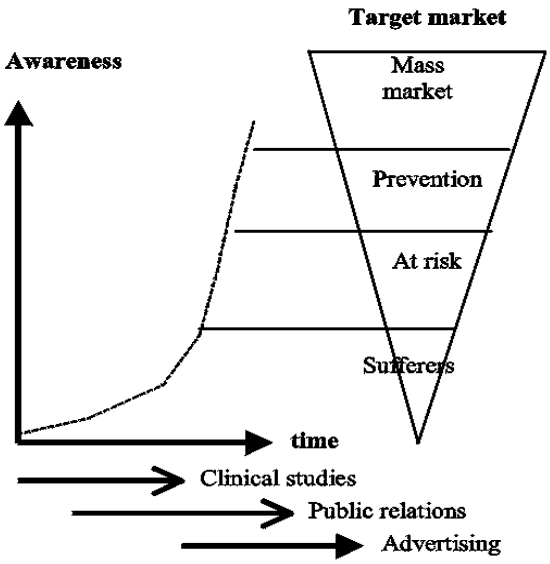


Figure 5.3 The US Business Model of CAG Functional Foods for selling probiotics - *building awareness* (analysis of interview with Stirling, 1998).

Clinical studies are usually carried out at reputable American universities and hospitals. Some of the studies may have taken place outside of the US, but would still carry weight if they were published in internationally recognized peer-reviewed journals (a thorough state-of-the-art summary can be found in Vanderhoof & Young, 1998). The studies, must to show effects on humans, using the actual product or ingredient, as opposed to effects on experimental animals. In the case of Culturelle, an entire supplemental issue of *Nutrition Today* was devoted to such studies, conducted both within and outside the US (*Nutrition Today*, 1996). Clinical studies of the same type as those conducted for *Lactobacillus rhamnosus GG*, are conducted at present for *Lactobacillus plantarum 299v*, with hopes of making a second variety of Culturelle.

Public relations include a number of programs in which different segments of the market are targeted. Channels for these programs include, for example, TV, radio, magazines, newspapers, brochures and samples in direct mail, toll-free telephone numbers, web sites, conventions and newsletters. Much of the PR activities are related to consumer's interest in these new health-related products. National as well as local TV channels may interview a doctor who has conducted the research in the clinical studies to share experiences from these studies - millions of viewers are reached.

"The 'free press' is of enormous value, not only because it does not bring a direct cost, but more so because product information from 'non paid media' is far more reliable in the eyes of the consumers".
(personal communication, Stirling, 1998)

Consumer research conducted parallel to PR programs, , which gives a picture of how the previous information is perceived, and to what kind of food product the consumers could see the supplement added (yogurt, juice etc.). Different concepts are tested in terms of "newness", probability of future consumption and beliefs in the health effects from the product.

The segment, which is labeled "sufferers" (chronic intestine diseases), is most inclined to try a new product to relieve symptoms from the onset of a disease. This is often done through advice from a doctor or a pharmacist. Consequently, one of the first target groups for CAG Functional Foods is the medically skilled professionals. They are reached at conferences, seminars, in meetings and personal letters. They are made aware of the results from published articles on clinical studies. Samples are provided for their own testing as well. The medically skilled professionals are also key persons to success in the following programs.

For the "*at risk*" segment the program looks similar to that of the sufferers, except that this group is approximately twice as large as the sufferers segment (estimated to 50 and 100 million people, respectively). The "at risk" segment includes persons who take antibiotics for some reason, or live a stressful life. They are generally also aware of the risks of illness, and they often seek ways to minimize the risks, ideally without changing their lifestyle at all. Health related news and talk shows on TV are one way of finding information. Culturelle information, for example, reached about 60 million viewers in one month during the fall of 1998 (personal message, Stirling, 1998). In magazines, such as "*Prevention- Americas # 1 choice for Healthy Living*" doctors and journalists tell of new products as well as other ways of maintaining good health. In this magazine one could also find coupons ("save one dollar") for buying Culturelle (October, 1998, p 42).

Positive personal experience from any of the above consumer segments also helps spread the news to the *"prevent"* segment and the broader market. The prevent segment includes people who take vitamins, minerals and herbs - people who are aware of health in general. This brings us one step further in the model (Figure 5.3), to ***advertising***. Through advertisement in magazines and papers, and spots on radio, a broad range of consumers are reached. Efforts are made to target health magazines and papers to raise the general awareness of the product and its benefits.

At this time (1998) the product was sold in a pharmacy, not in a general food store. The product, a capsule, will remain as such until awareness has reached a certain level. Once this level of awareness among consumers is achieved the product may take on a new shape. A medical product thus become an ingredient in a food

product. A capsule and a dietary supplement is the entry point of this product, around which a brand name is built up. As a dietary supplement, a research-supported claim can be made in product information. Once awareness is built up about the effects of the ingredient, the following step is to make it available in a *food form*, for example a yogurt, a juice or in ice cream. Consumers then know to look for that specific ingredient in the food product, to get the health benefits.

Advertisements and marketing

What may and may not be said about a product, in any kind of product information (label, spot on TV, radio, on the wide world web or on a package), is strictly regulated and screened by the FDA (Food and Drug Administration). As a part of a large food business, ConAgra Inc., CAG Functional Foods has to act in a responsible way (Taylor, 1998). This is yet another explanation for the importance of conducting reliable clinical studies. To their assistance, CAG Functional Foods gets scientific expertise through the R&D department, led by Dr. Rao, legal expertise though ConAgra Inc., and PR and marketing services through marketing consulting firms.

CAG Functional Foods relies on *market pull* for information about these new and health associated products. One way of providing this information to consumers is through video releases to TV stations. A video typically include clips about product information, as well as clips from interviews with doctors, pharmacists and other medical experts, who have knowledge of the effects of the product.

A product - Culturelle

The product is a dietary supplement, a capsule, which is sold in packages of 30 capsules per package (at a price of $15/ package in 1998). Inside each capsule is a white, granulated substance, so far *Lactobacillus casei rhamnosum GG* (for history on the discovery, see Sherwood & Gorbach, 1996).

Lactobacillus GG (LGG), is the short name for this bacteria, after the two discoverers Drs. S. Gorbach and B. Goldin, who isolated the strain at Tufts University, Boston in 1985 (Salminen, 1996). A patent was issued in 1987 and shortly thereafter Valio, a Finnish dairy business, acquired the rights to commercialize the bacteria. In 1996 CAG Functional Foods licensed the marketing rights for the US and the UK from Valio. Time was gained through a number of successful clinical studies, conducted in the US as well as in Europe prior to the licensing. These results published in scientific journals enabled CAG Functional Foods to readily start building awareness, and a strong brand name. This occurred in 1997/98.

In 1999 further studies of *L. Plantarum 299V* were planned to provide similar kinds of evidence, to provide a basis for a second variety of Culturelle. Plans were made for developing a functional food product, for example a fruit drink or a yogurt. This future food product has to be marketed without a health argument. That explains the need for CAG to build an awareness of the product / ingredient as long as it is sold as a dietary supplement.

American markets for functional foods

All humans need foods. Practically anybody can consume functional foods, but it takes awareness to see the need. From a business standpoint the consumer market can be divided into segments, as shown in Figure 5.3; the sufferers, the at risk group, people who are acting in a preventive way and the mass market. Health awareness decreases with each of these groups, but it is not a static division. As awareness grows in one group, it continues to the next, like ripples on the water.

Another way of reaching the consumers, in a more indirect way, is through Health Maintenance Organizations (HMOs). The HMOs interest is to keep down the cost of medical care. This does not imply denying people their rights, which are a part of their health plan, but rather, if possible, avoiding complications to medical treatments. An example may be side effects of taking antibiotics, such as diarrhea or vaginal infections. If a product has proven effects that counteract side effects of medical treatment (a product like Culturelle, for instance) it may become a part of a subsidized recommendation in a health plan.

One might question whether people need functional foods or not. ConAgra does not make it their role to decide if there is a need for consumers at large, only to provide information and safe healthy products for those who request it.

> *"It is just an evolution... We are not trying to change what people eat. Consumers are the ones changing the course. We want to go to ingredients that can do some wonderful things to your body in really small quantities (in a way) that doesn' t change taste or texture".* (Rao, in Taylor, 1998, 2)

Primary groups of consumers with needs for functional foods are seen as groups of people who in different ways abuse their bodies (stress, alcohol, medicines), people with an expected onset of certain diseases (diabetes, for example) or people who live in environments where they are subjected to a vast flora of pathogens.

5.1.5 An epilogue (Probi AB in 2001)

Looking back at the development since 1999/2000 the present CEO, Monica Wallter[33], reveals that Probi AB has clarified its technological and marketing strategies. Starting with a major market investigation for probiotics, a strategic analysis was conducted (2000). In this analysis information about key markets was gathered and strategic areas for future research were identified. Future strategies for research are aimed for developments in the following four areas: gastrointestinal disorders, positive effects on the immune system, physiological stress and recovery, and risk factors for cardiovascular disease. Although each of these areas are vast and the areas of application many (foodstuff, sports and health beverages, medical products and feed products), the new strategies have focused Probi's business idea (Annual report, Probi AB, 2000).

The new marketing strategies refer to finding strategic partners in development as well as in production and sales. Strong partners are identified as international actors on the food market, pharmaceutical market or feed market. In some instances national or even local food producers with large market shares prove to be interesting partners as well. Skånemejerier with annual sales of 10 M liter of ProViva/ year[34] is the Swedish strategic partner in production as well as in sales (Probi AB, half year report 2001). In meeting new and potential licensees and partners in development, the presentation of Probi AB becomes essential. Clear strategies, good results in research and good experiences in collaboration in the past are all important parts of a good business image. In terms of changes, the contract with Skånemejerier was re-negotiated. Skånemejerier is now responsible for the sales in England and on the Nordic markets. Probi, on the other hand, manages collaboration agreements in the rest of the world. The collaboration with Con Agra was terminated.

Experiences and contacts from previous collaboration becomes a part of Probi's network. The new CEO brought in a wide net of experiences and contacts from the pharmaceutical industry. With new contacts, focused technological strategies and identified partners, the new CEO lays the foundation for continued successful developments.

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[33] The epilogue is based on a telephone interview. More information about Monica Walter's view on functional food is provided in "Hennes levebröd är folk som inte hinner äta rätt" by Andersson (2001).

[34] The sales of ProViva are 10 M liter/year in Sweden, which is an 11% increase compared to the half year annual report in 2000

5.2 Magiform

This case concerns the development of a new line of cereal-based products using a new technology. The development has been staged by a new business, BioDoc AB, and its growing network. Here is a brief presentation of the product, the major process and the business.

A product
"Magiform" (translates as ' stomach in shape') is the name of a line of cereal-based products (müsli, biscuit, pasta, bread and crackers). These products are primarily sold to consumers with a chronic inflammatory gut problems (for example Mb Crohn and IBS[35]).

A process
The development of the production processes has involved a lot of know-how in cereal processing. Developing ways to assure a premium quality of the raw material has also been an important part in the development process. Prior to product development, basic research has been carried out in the area of gut immunology. Basic research, for example in identifying Protein AF, was a condition for filing a patent and thus for the innovation process.

A business
The company, BioDoc AB, is a virtual organization with only three people on a regular payroll. The network that these three persons maintain, however, is vast and well developed for their needs.

5.2.1 Background
The innovation process in this case is basically grounded in research concerning the function of the gut immune system and in the development of pig feed in the 1980s (in Sweden). This new special-processed cereal feed was needed when the antibiotic treatment of piglets was prohibited in 1986. Research showed that the piglet's immune system was activated by a special-processed cereal-based feed. More piglets, especially piglets of young sows, thus survived without antibiotics.

The research and development of the new feed was a joint activity where Dr. Göransson at Sveriges Svincenter (The Swedish Pig Center) and two medical researchers, Ass. Professors Lange and Lönnroth (at the Gothenburg University / Salgrenska hospital), cooperated. The research, in which the function of the gut was studied, resulted in finding *protein AF*. This protein was isolated and structurally described.

[35] IBS, Inflammatory Bowel Syndrome, is a chronic gut infection.

A patent was filed in 1989 and granted in 1991 for Sweden and other perceived major markets (over 30 countries, including the EC, Japan, the US and Japan). This patent is based on the effect of the feed, in other words the elevated concentration of protein AF in the gut, which indicates that the immune system is activated.

It is commonly known that the pig and the human gut system are quite similar in their functions. With this in mind the head of Sveriges Svincenter, Lars Sjöstrand, pursued a new avenue for a technological achievement - that of a human food for people with chronic gut problems. The base for a new business, BioDoc AB, was founded in 1993, albeit all the challenges were not yet defined.

5.2.2 Developing an idea - from pig feed to high-tech human food

The development of a product, a pig feed, and at a later stage a human food product, is based on years of research in immunology. Lange and Lönnroth study the immunization process in rats during the 1980s. They found indications that the immunization process takes place in the pituitary body[36], which is shown by an elevated concentration of Protein AF.

Animal studies, at Sveriges Svincenter in collaboration with Lantmännen Foderutveckling AB, showed that special processed cereal based feed for pigs was associated with activation of the immune system. This was indicated by an elevated production of Protein AF.

In summary, the idea for a food product was derived from experiences in developing a feed for piglets. Radically new technologies, such as the isolation and structural definition of the protein, made it possible to identify the protein and thus to study the effects of immune system activation.

5.2.3 Realizing a strategy

In retrospect it may look rational to develop a functional food product, given the vast knowledge in the area, and a patent. It took an entrepreneur, Sjöstrand, however, to make reality of the business idea.

"At first it was an exciting idea. It inspired me and my intuition told me that this is an opportunity. It was something new and unknown... A challenge.... One has to be a bit of an entrepreneur to see the possible, not the impossible! If I meet an obstacle I try to see beyond it. It is all about apprehension - about perceiving possibilities and not problems". (personal communication, Sjöstrand, 1999)

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[36] The pituitary body (hypofys) is a small hormone-producing organ in the middle of the brain.

Sjöstrand and the researchers decided to form a joint venture business, BioDoc AB in 1993. It is a subsidiary of a large farmer' s cooperative, SLR, partly owned by the following farmer's cooperatives: AB Cerealia (25%), Skånska Lantmännen (15 %), Odal Lantmännen (5%) and Lantmännen Invest AB (55%).

The perceived advantage of a joint venture is mainly the access to financial strength and expertise in certain areas.

"*The ownership structure does not really affect us a whole lot. The main thing is that the owners are financially strong. Developing functional foods is costly. I would say that the development of a product ranges somewhere around 10-15 million SEK. BioDoc acts independently but we have experts in production, sales and distribution close at hand".* (personal communication, Sjöstrand, 1999*)*

The organization is small. It is a virtual organization where a few people each have access to a large network (illustrated in Figure 5.4). The entrepreneur in this case has carefully hired persons with capabilities, experiences and contacts that are of use for organizing the development and marketing of functional foods. The management style is seen as that of creative management:

"*I see myself as a strategic person - and a creative person. If I want to do something new, to manage a new business in a new area, I can' t manage the operation in a ' business as usual' way. New businesses require new ways of doing things - new management styles!".* (personal communication, Sjöstrand, 1999)

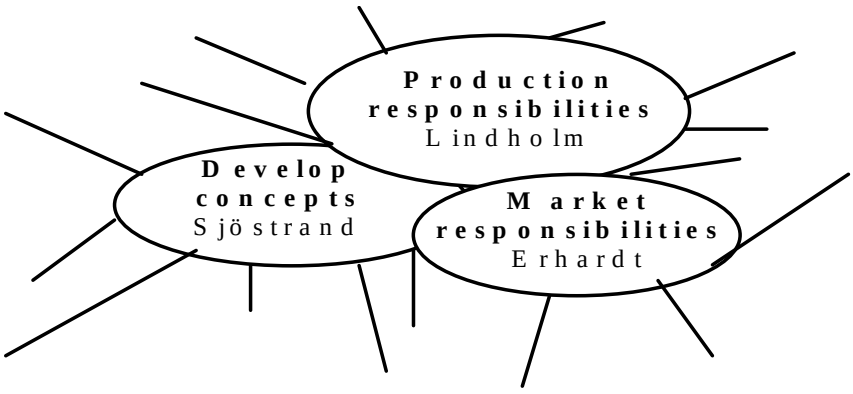

Figure 5.4 BioDoc AB, a virtual organization. It consists of three persons, each with an extensive network (personal communication, Sjöstrand, 1999).

Sjöstrand*: "In this figure, my job is to develop concepts for functional foods. The business idea is to develop functional foods. It does not mean we have to develop and produce the products within the business. On the contrary, we have strategic partnerships to purchase most functions, production, sales*

and even R&D. That way we don' t have to have a large organization to conduct business."

"... Well, I think my most important role is to be enthusiastic towards people I meet, within BioDoc as well as in my contacts outside BioDoc. I ' sell the idea' and if I do it well changes happen more easily... It is incredibly exciting!" (personal communication, 1999)

Lindholm: "*Much of my job is to solve problems. I make sure the development of new products, production, sales and logistics works out well. My experience in the food business comes in handy in many ways. I have a lot of contacts that I need to help me solve problems."*

"...In my previous job, I could use standard ways to solve problems. The problems were distinct and repetitive. This job is different. Everything is new and we have to find new ways of doing things. Of course, when I can I use standard ways of doing things, I do, but for the most part I make use of my network in finding new routines." (personal communication, 1999)

Erhardt: "*I think I was hired thanks to my experiences in the pharmaceutical industry. When I came here I recall thinking that this job is so flexible. Nobody told me what to do. Decisions were made quick and easy, in a spontaneous conversation between the three of us."*

"... we all have our own networks, but we also cover for each other when one of us is out of the office. We actively try to share our contacts with each other so nobody is irreplaceable". (personal communication, 2000)

Strategic partnerships in R&D, production, sales and distribution are all part of BioDoc' s network. Most of the partners are contacts from previous experiences. In qualifying for continued business, however, business partners are regularly evaluated:

"*When I came to BioDoc, a marketing firm was used that I did not care for. The person did not at all seem interested, creative or organized. So, I changed to a consultant I have worked with in my previous job. I simply extended the network a bit ... It is important that we trust our partners in work since we are depending on their work for our own survival.*" (personal communication, Erhardt, 2000)

5.2.4 Developing new products

The "Magiform" products are all cereal-based products that can be a part of a healthy diet for most consumers. The development of these functional foods includes developing new technologies and new markets. Three products were developed (müsli, pasta and bread) for tests in clinical studies.

The first product that was developed was the *müsli*, where the major challenge was to conceal the after-taste that the special processing of the cereal produced. The resulting mix was so appealing that it has not been modified since the time of development.

Pasta was developed as the second product. The minimum batch is 20 tons, so a failure would have been a gigantic failure. The vast technical know-how provided grounds for successful development of a new pasta product.

The previous successful development of new products was a comfort when it came to developing a *bread*. Once the bread was acceptable, it was decided that the packaging was not. It was a time-consuming and effort-filled process. Still, the bread did not turn out well. The taste was altered and the bread moulded. Finally, Hattings (in Denmark, owned by Cerealia) was able to produce the bread. It was sold (as frozen bread) by a health chain, Notana AB.

Positive results in clinical studies of the magiform products stimulated further development of other products; *biscuits* and *crackers.*

> "*I think our partners' know-how in production saves us a lot of time and money. They know the raw material and the technical aspect of production.*" (personal communication, Lindholm 1999)

5.2.5 Markets for new products

In marketing Magiform products BioDoc concentrated on consumers that were interested in health (Figure 5.5). The primary targeted segment is consumers with chronic gut problems. They are willing to try and pay for a new product, instead of using medicines.

The next market segment is health-conscious consumers. They are also willing to consume products to promote their health. Compared to consumers with chronic gut problems these consumers are somewhat less willing to pay premium prices.

People at large are not interested in consuming an expensive product unless it is tasty and provides a perceived added value.

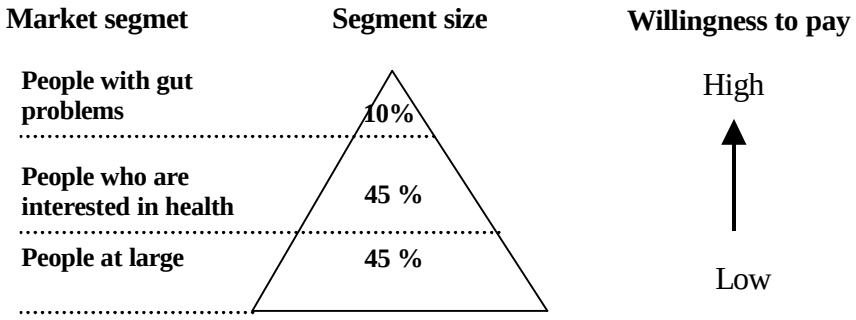

Figure 5.5 Marketing strategy, illustrating different consumer segments' expected willingness to pay for added value in Magiform products (personal communication, Sjöstrand, 1999).

Marketing the Magiform products as medical products is possible due to scientific research and publications that support the health effects. The marketing activities have included, for example, participating in medical conferences and communicating a scientific health message to medical experts. These experts in turn test the product in their clinical work and share their experiences with colleagues. Patients (the chronic gut problems segment in the Figure 5.5) also provide an important marketing channel as they not only share their experiences with friends, but also provide feed-back on the product for BioDoc.

Marketing functional foods, such as Magiform products, is regulated by Swedish food and drug laws. The recent directive from the EU (1999/21/EG - March 25, 1999), however, makes it possible to market functional foods of this type as food for medical use. The legal system appears to have limited the development and marketing of new functional food products:

> *"...We have a food with desired health effects but we are not able to tell consumers about it. It is important that we act in a responsible way, with well documented research. Everything relies on this research - and being able to talk about the results".* (personal communication, Sjöstrand, 1999)

The Magiform products are sold in health food stores. In the future it is possible that the pharmacies (Apoteket in Sweden) may sell a concentrated version of the product and the food stores a less concentrated product. In addition to traditional food stores, Magiform is also sold on the internet (from 2000) where consumers may also find scientific information about the clinical studies of protein AF and Magiform.

5.2.6 Creating new markets

New markets are created in contacts with consumers as well as businesses. The awareness of the health effects is growing locally among consumers. The scientific studies become known through medical experts and the product is requested by health conscious consumers.

The Magiform products are primarily sold in Swedish health stores (2000). Using the health store distribution channel has the advantage that it is easier to enter the market with a new product. Sales volumes, on the other hand, are small and a good proportion of potential customers never even enter a health food store. A planned market expansion in Sweden involves the pharmacies and, in a second step, food stores. A more concentrated version of the product, for people with IBS and Mb Crohn, may be sold in pharmacies, whereas in a food store people are for the most part interested in health maintaining foods (a less concentrated version of the product).

Once products have a strong home base, marketing is less demanding in new areas. Medical experts are informed at conferences and in research journals. BioDoc has numerous examples of consumers sharing their experiences after visiting Sweden:

> *'We have had contacts with consumers from, for example, Spain, Belgium and France who are asking, after a vacation in Sweden, where they can find the product in their home country."* (personal communication, Erhardt, 2000)

Market expansions are not planned far ahead. Possible interesting markets have been sought out by extensive market investigations and patents are filed in countries that are seen as interesting. A market expansion will be made based on experiences from the home market. Countries in close proximity to Sweden are seen as possible markets for export. The advantages are, for example, a larger production volume and the possibility to slightly vary the taste of the products for different markets. In Denmark, for example, consumers like a sweeter müsli than is preferred in Sweden. For markets that are located geographically far away, a strong licensing partner, for example a multi national company such as Novartis Consumer Health, is seen as the most desired alternative.

5.2.7 Strategies and visions - continued R&D

Based on the business idea, "to develop, produce and market products with health effects", BioDoc continues to develop functional food products. Another example is "100% oats", which is a product line of cereal products which are free of the protein "gluten". These products and processes are not protected by patents. They are, however, associated with other competitive advantages, such as a great deal of technical know-how and access to pure raw material.

Continued development of products is grounded in consumer needs:

> *"The starting point for our projects is the consumer, the problems a consumer has, and what kind of product we can develop to counteract these problems. It may sound trivial but, really, that is what we aim for."* (personal communication, Lindholm, 1999)

> *"Ideas for new products are developed in contacts with medical experts and consumers and in conversations within BioDoc. A source of inspiration for future functional foods is nature itself ... I also think that experience from developing food products is important. It takes knowledge in both these fields - and the ability to perceive the possibilities in new things (!), to succeed."* (personal communication, Sjöstrand, 1999)

BioDoc AB continues to carry out research in areas where they have identified needs among consumers. These needs are found in ways to counteract common diseases that are widely spread in society, such as diabetes, obesity and allergies.

5.3 IgY - egg

This case is about the development of chicken eggs for use in immune therapy, which refers to preventing and treating certain infections[37]. It started as a group of scientists' shared thoughts one late night during a conference. These ideas were seen as projects no one had taken the time to pursue. In reasoning about the marvelous creation of life (egg cells and sperm) the discussion narrowed to entail the properties of bird eggs and their abundance of antibodies (IgY). This is where the story started...

The product

Eggs and egg powder are the products in focus in this case. These eggs look just like any chicken eggs we would find in a food store. The medical effects, however, differentiate these eggs from other eggs. The medical effect of particular interest here is the prevention of an infection with a common pathogen (a bacteria), *Pseudomonas aeruginosa*. For a group of patients with Cystic Fibrosis (CF), these bacteria constitute a serious threat to health and even to life (CF is further explained under *5.3.5 Using immune therapy)*.

It would also be possible to develop eggs that would protect individuals from other bacterial infections as well (such as Tuberculosis), fungal infections (*Candida albicans.)* or even viral infections. It is possible that this technology could be used for most infections[38].

The process

Production of IgY- antibodies involves keeping hens and exposing them to an inactivated form of an infectious agent[39], the pathogen of interest. These hens lay eggs with high levels of antibodies against the pathogen. Eggs are naturally rich in antibodies, in the yolk. If the IgY-antibodies are required for medical treatment they are purified in a large-scale purification process (Jersenius et al., 1981) providing a powder for oral intake (as a capsule or a pill).

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[37] Oral immune therapy (boosting the human immune system) with these special eggs is used for prevention and treatment of enteric infections (Carlander et al., 2000).

[38] For treatment of *local* infections the IgY- antibodies are in physical contact with the pathogen. "*A systemic disease, however, would probably not be possible to treat with this kind of immune therapy*" (personal communication, Kollberg, 2000). "However, *since most systemic diseases start as a local infection it would be possible to prevent the onset of such a disease*" (personal communication, Larsson, 2001).

[39] Inactivated infectious agents are, for example, bacteria that have been killed in a desinfection process. These bacteria therefore do not infect the hen – but the hen develops antibodies (IgY) against this agent. See Figure 5.7.

A functional food product or a medical drug with preventive effects could be an egg as it looks when we find it in the store. This egg could be consumed like any other egg, as a part of an ordinary meal. The antibodies are active even when the egg has been partly denatured (for example, cooked up to 6 minutes). This means that the medical effects would be lost when using these eggs in a baked product (for example, a pound cake/ sockerkaka), since the cake is in the oven for well over 6 minutes. The egg would, however, still have a nutritional value.

The business

A group of scientists formed a jointly-owned business, *Immunosystems IMS AB* in 1984. In their spare time these scientists wanted to develop egg antibodies (IgY) primarily for *diagnostic use*. The business idea was later expanded to include a new application for IgY, that of *immune therapy*. Several collaboration partners have participated in the development process. The numerous perspectives and ideas for research and new application areas have resulted in plans to create a center for IgY research.

5.3.1 An idea for a medical product

The story begins with the entrepreneur, scientist and farmer, Wejåker, going to IFS's (International Foundation for Science) conference in Thailand in 1982. One late night a group of researchers in different fields came to talk about their ideas that never had been explored. They shared ideas (and whiskey). After talking about the difference in immune systems for different species the conversation narrowed to revolve around the properties of eggs. An egg carries nutrition, a well-developed immune defense and much more for a new chicken to evolve. Hens cannot, as mammals can, support the developing life with nourishment, or immunity against infection agents, throughout the embryonic development, or in feeding procedures after birth. This explains the abundance of antibodies, IgY, in the yolk. These antibodies thus protect the chicken until it has a sufficient immune system of it's own.

Having worked with hens for medical production for many years[40], Wejåker had a vast knowledge about avian production and an extensive net of contacts in medical research and in the pharmaceutical industry, as well as in poultry production. The idea that Wejåker took to heart was essentially to further explore the usefulness of avian antibodies (IgY) for medical purposes. One answer to why Wejåker perceived this idea lays in the label he uses for himself, "a scientific farmer".

> "*I am an entrepreneur. I see things differently from most other people. It's like thinking widely instead of deeply… I get my inspiration in every day meetings*

[40] Wejåker worked with hens in a medical project with a large pharmaceutical company, Pharmacia. The medical product was *Healon*®, made from rooster's combs.

and in problems I face… Researchers think vertically, deeply in a specific area, whereas I think horizontally. I see challenges and conceivable solutions to problems I face". (personal communication, Wejåker, 2000)

Filled with enthusiasm and a general feeling that this was worth exploring, Wejåker returned to Sweden. In meeting researchers in medicine and poultry the idea was further developed.

A group of five scientists, including Wejåker, was formed. They reviewed the field of avian antibodies for further information. It was concluded that avian poly-clonal antibodies had desirable biochemical properties, that would make them attractive for medical use (Larsson et al., 1993). During the 1980s this group of scientists continued, in their spare time, to learn more about IgY. A small-scale laboratory experiment was set up. The hens were kept at Funbo-Lövsta[41], and the laboratory procedures were at first carried out in the home of one of the scientists, and later in the laboratory of one of the medical scientists. A doctoral student, Larsson, carried out and documented the progression of the research (Larsson, 1988).

"Anders and I worked very closely together during this phase. We did all kinds of crazy things at the time; we tested everything - and it was great fun!" (personal communication, Wejåker, 2000)

The group of five scientists continued exploring the idea in their spare time. A business was founded[42], *Immunosystem IMS AB* (IMS)**,** in 1984. The basis for the business was a sincere interest in exploring the possibilities for using avian antibodies (IgY).

5.3.2 Using IgY antibodies for diagnostic use

The primary application for these antibodies was *diagnostic use*, to determine concentrations of hormones (Larsson, 2001). It was also concluded in review, however, that IgY-therapy was another possible medical avenue. It had been used successfully for animal production (chickens and piglets) in scientific studies (Larsson et al., 1993). The main reason for choosing to develop a medical diagnostic application, rather than a feed or food product, is mainly explained by the experiences and contacts of scientists in the company.

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[41] Funbo-Lövsta is an avian research center for the Swedish University of Agricultural Sciences in Uppsala.

[42] The business Immunosystems IMS existed as a private dormant side business for one of the scientists. It was activated in 1984 and made into a jointly owned business for the five scientists working in the project.

"At first it was all research. I used IgY antibodies for research in my dissertation…" (personal communication, Larsson, 2000).

"*We tried many different things, and we learned a great deal in doing that… The thought was to develop knowledge, and in a second step to find ways to explore this in a commercial way. The research was presented in Anders' dissertation. We also wanted to find a market application. The IgY-area is a very general research area... Diagnostics – it is a field we had experience from and it just seemed like the natural way to go… But really - it is just our thoughts that sets the limit for the use of IgY…"* (personal communication, Wejåker, 2000)

Methods and results were developed and accounted for in a dissertation (Larsson, 1988). The following step involved finding customers with needs that could be met by IgY-antibodies. Most medical applications (kits and supportive products) are built on mammalian antibodies. Even though IgY (chicken) antibodies have biochemical[43], economical[44] and ethical[45] advantages over mammalian antibodies the difficulties in selling these antibodies lie in the development of products (kits and supportive devices) that are based on this radically new technology.

"… Antibodies are somewhat like perfume. You don't buy it because it is cheap, but because you believe in the effect. The price is secondary. To sell antibodies cheaply does not work at all. On the contrary, if you have a high price that indicates hard work in development. This is interpreted as a guarantee for good quality. This business is all about building trust to make sure customer satisfaction." (personal communication, Larsson, 2000)

In commercializing antibodies for diagnostic use the price is secondary. Chances of high revenues are, in other words, high. With increased experience and knowledge in the area it became increasingly clear, however, that a business partner was needed.

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[43] One of the important biochemical properties of IgY is that "they do not activate mammalian complement or Fs receptors, that could mediate an inflammatory response" Furthermore, there is "…practically no risk of toxic side effects of IgY" (Carlander et al. 2000, 4). This advantage, using IgY for medical treatment of humans, is explained by the evolutionary distance between humans (a mammal) and birds.

[44] One hen produces approximately 10 times the amount of antibodies a rabbit would produce in the same amount of time (Larsson et al., 1993, 1807). Hens are, furthermore, less costly to keep, compared to rabbits (Larsson, 2001, 26).

[45] Mammalian antibodies involve bleeding a rabbit (taking blood through a vein in it's ear). Chicken antibodies do not cause any harm to the hen.

5.3.3 Finding collaboration partners

Looking at the development process several collaboration partners have contributed in the development process. Contacts and networks from previous projects constitute technological resources as well as possible partners in development.

1982 Wejåker meets with researchers in poultry, veterinary sciences, and clinical chemistry to investigate in the IgY area.

1983 A small-scale pilot study for research is set up at *Funbo-Lövsta* (a poultry research center at the *Swedish University of Agricultural Sciences*).

1984 *Immunosystems IMS AB (IMS)* is founded by the five researchers. One person works part time and the rest of the researchers work on their spare time. Antibodies for research use are developed and sold. A vast technological area is built up in addressing problems to develop these antibodies.

1984 Contacts with businesses in the *diagnostic area* were made with little result. None of the six approached businesses seemed to take the invitation seriously. This is in part explained by difficulties to communicate the technical advantages with using IgY-technology. This radically new technology did not match the existing R&D strategies for the approached businesses.

One company however, *Pharmacia*, contacted IMS for help in solving a problem with a diagnostic kit[46]. A contract was set up where IMS developed antibodies for research use by Pharmacia. The project dragged out in time and it became apparent that the provided antibodies were not used for research but rather for commercial purposes. This undermined the trust and the project was terminated. Pharmacia shortly thereafter started developing IgY antibodies independently.

1988 starts the era of great beliefs in biotechnology in society in general and in the pharmaceutical industry in particular. A pharmaceutical company, *Procordia Nova/ Kabi* was in search for small research businesses in biotechnology, which could be an acquisitions to gain core competencies in this area. IMS met their needs. Contracts were drawn up and plans were made for Procordia Nova to purchase shares in IMS. Based on expected future value, expressed in speculative business plans which refer to sales in areas where the products did not yet exist, a price was set.

1989 Procordia Nova purchased 40% of the shares for 1.5 MSEK. A traditional CEO from Procordia Nova was responsible for marketing and sales.

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[46] A diagnostic kit for testing TSH (Thyroid Stimulating Hormone)

1992 Procordia Nova withdrew their engagement in biotechnology, focusing on health care. They sold their 40% of the shares back to the researchers for 0.1 MSEK. The joint venture did not result in the expected revenue drawn up in the speculative business plans.

1993 Contacts are made with Kollberg, at the hospital in Uppsala, a pediatric doctor with a special interest in Cystic Fibrosis (CF). Research in a new area of application, *immune therapy*, is further explored. (See 5.3.5 for more details). A part time CEO is made partner in IMS.

1993 An agreement is made with *BioPool AB*, a small business working in *diagnostics* (located in Umeå). BioPool markets the antibodies that are produced by IMS. The patent which is the base for this production is owned by two of the scientists in IMS.

1999 A joint business, Immunonativ AB, is set up with *BioNativ AB* for developing IgY-based products against respiratory infections (*immune therapy*). Scientists in IMS own the patent, and BioNativ AB carries out development of products.

Plans are made for an *IgY- center*.

2000 IMS is in search for partners in exploring new animal feed application areas. Contacts are made with *Kjällbergs Ind. AB*, specialized in making egg powder.

Looking back at the development, several conclusions can bedrawn. Two of these conclusions deal with communication, the difficulty to communicate a radically new technology and the challenge of making a joint venture a truly *joint* venture with communicated and shared visions.

Communicating something radically new can be seen as persuasion. Wejåker was enthusiastic about the research idea. A good track record and personal relations with researchers may in part explain his successful transfer of a radically new and vague idea. With a group of researchers to support the project the prospect was strengthened. Yet, when it came to setting up the pilot study at Funbo-Lövsta, it was time for two research traditions to meet:

> "*We met with Martin Wilhelmsson, who was responsible for the Funbo-Lövsta research center at the time (1983), to talk about the project. We talked and we talked.. . Martin seemed interested and yet hesitant to give it a 'go'. As it turns out he was concerned about having a buffer of only 1000 animals. He thought we would need hundreds of animals – when, really, we had only three or four in mind. This shows how differently you can perceive things. We talked different languages. He was used to LARGE studies and*

we had a very small one in mind. I have a feeling he thought we were a bit odd." (personal communication, Larsson, 2000)

With positive research results at hand from the pilot study the group was up against yet another communication challenge, that of a suitable time for a new technology.

> *"The timing is a key factor. You have to enter a system at the right time when people are ready for the new thing. At the time we presented our IgY [polyclonal antibodies] it was monoclonal antibodies that were in vogue… Our timing was 'off', to put it simple."* (personal communication, Wejåker, 2000)

Even with a partner at hand communication becomes a crucial factor. In the joint venture between IMS and Procordia, there was a need for a common language to communicate shared visions. These visions were expected business plans using Procordia language. IMS tried to project future sales of not yet developed products on not yet created markets to come up with an estimate for the value of the sold shares in IMS.

> *'Within Procordia there are scientists and economists[47], but few bridges between them. The people we were in touch with were mostly economists. They need a value on things, but how do you put a value on a research business?! … We had to come up with a projected expected value. It was very hard. Needless to say we provided a much too detailed (!) prognosis based on the prevailing optimism in biotechnology and it was certainly colored by our own positive connotations".* (personal communication, Larsson, 2000)

The joint venture between IMS and Procordia did not provide access to desired markets for IMS. Nor was it an investment in a strategic and lucrative area that Procordia hoped for. A traditional CEO entered an entrepreneurial system with expectations to run business as though it had been an established business.

> "*… We should have sat down and discussed the plans with Procordia [1989]. We might have realized the importance of producing more scientific documentation. That would have given us arguments to show potential customers. As it was, we had not enough to show."* (personal communication, Larsson, 2000)

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[47] Larsson explains later on in the conversation that he refers to managers, administrators and finance departments as "economists". Their language differs from the scientist's language, hence the division.

Having learned about some difficulties in developing a market, IMS is again a side business for the researchers (2001). Plans exist for continued research and development of a platform for IgY research.

5.3.4 An IgY-center for further developments

A project proposal was presented for an IgY-center in Heby (Figure 5.6). The project could be partly financed by an EU program (Mål 2 - Tillväxtavtalet) if the EU financing was matched equally by Swedish investments. So far it has not been matched.

The main objective for this center would be to constitute an arena where researchers from different backgrounds could meet in cross-disciplinary studies of IgY. Ongoing projects would serve as a start for a network as well as provide experiences for planning future projects.

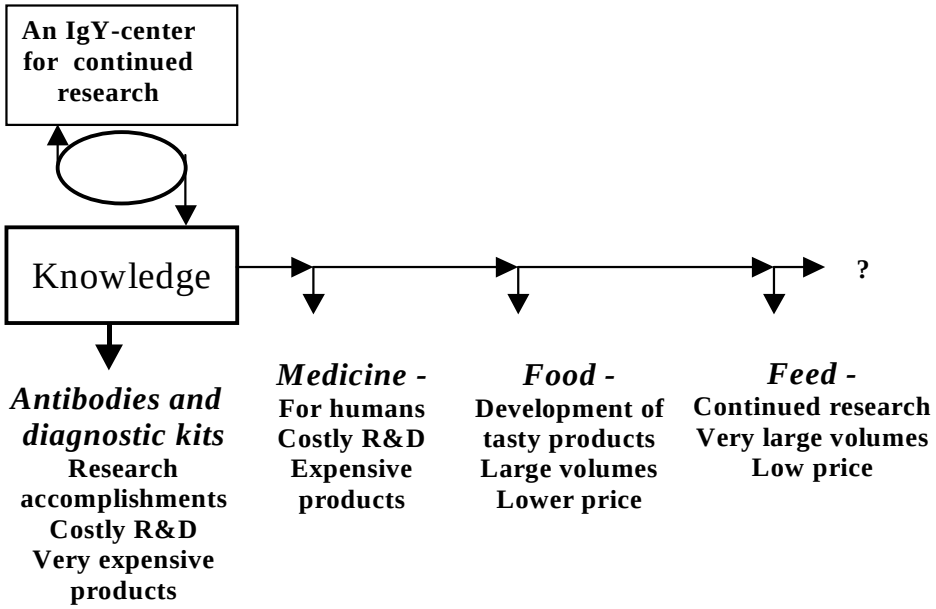

Figure 5.6 Possible areas of application for IgY technologies. The R&D process is based on research, which is conducted in a multi disciplinary, planned IgY-center in Heby. The identified areas of application so far are; antibodies and diagnostic kits, medicine, food and feed. The "?" resembles future areas of application. (This illustration based on interviews with Larsson, Wejåker & Kollberg, 2000).

The IgY-center could furthermore support the development of results from basic research to the industrial production of medical devices, medicines, food and feed products. A strategic geographical position, in Heby, with several major hospitals (in Stockholm and Uppsala), universities (in Uppsala, Stockholm, Västerås, Eskilstuna and Gävle), pharmaceutical industry in the region and an FDA-approved avian business (OVA poultry production) in near proximity, further support the strategic value of this center.

5.3.5 Using IgY in immune therapy

Using IgY in immune therapy refers to an oral distribution of specific antibodies to establish protective immunity against pathogens. For a specific group of patients, with the hereditary disease *Cystic Fibrosis (CF),* this is especially interesting. People with CF suffer from malfunctioning mucus-producing glands. Their mucus is too thick and these patients are highly susceptible to infections in the respiratory tract. The main infectious agent is *Pseudomonas aeruginosa*, a common bacteria, which does not constitute a serious threat to a healthy person.

There are approximately 450 CF patients in Sweden. The disease is hereditary. CF patients are mainly found in Europe and in North America. A few decades ago these children died young, due to lack of treatments. Now, chances of survival increase with each year of research in the area. The CF patients are well organized and their patient's organizations constiture a lobbying force. (*Kollberg, 2000)*

If a person with CF gets prophylactic treatment with IgY (gargling an egg powder solution with ½ an egg/day) a chronic infection with P. *aeruginosa* can be avoided, or the onset can at least be delayed (Carlander et al. 1999). The gains are seen in the quality of life, for the patient as well as in lowered costs for treatment of these patients. The cost of treatment of a CF patient with a chronic infection in Sweden is seen in hospitalization 2-12 times a year for one or two weeks to get treatment, mainly antibiotics. The medical cost for these treatments can amount to 160 000 SEK/year for one patient. This is not taking into account the personal suffering, societal loss and massive amount of additional indispensable costly medicines this person has to take. Hence, the gain for these patients is large in financial terms as well as in quality-of-life factors.

Additional possible areas of immune therapy are illustrated in Table 5.3. Some of these areas are pursued at present as a part of a medical strategy to lessen the use of antibiotics at the University hospital in Uppsala. The immune therapy includes preventive measures as well as treatment after an onset of a disease. It has been proven, for instance, that oral immune therapy with IgY-antibodies may prevent and treat enteric infections (Carlander et al., 2000 A).

Table 5.3 Possible areas of immune therapy using IgY antibodies

Bacteria, virus, fungus	**Disease**	**Treatment**
Pseudomonas aeruginosa	-Cystic Fibrosis (CF) -burns (brännskador) -leg ulcers (liggsår, bensår) -ear infections -urinary tract infections	Gargling compress/ dressing compress/ dressing ear drops "rinsing" in the bladder
Drug resistant pneumococci	-pneumonia	gargling
Enterobact cloacae	-diarrhea for new-born children	milk additive
Toxin producing Escherichia coli	-enteritis*[48]	swallowed capsules
Salmonella and Shigella	-gastroenteritis*	swallowed capsules
Rotaviruses	-diarrhea among children	drinkable solution
Helicobact pylori	-ulcer (magsår)	drinkable solution
Bacillus antrax*	-anthrax (mjältbrand)	swallowed capsules
Tuberculosis	-pneumonia	gargeling
Candida albicans	-candidacies (secondary infections for patients with a suppressed immune system – i.e. cancer/ AIDS patients) -vaginal infections	gargling vagitory capsules

Source: A proposal for a IgY research center, (2000, 8).

It is clear that range of possible medical applications is vast. Clinical studies in some of the areas mentioned in table 5.2 are carried out in a medical treatment plan at present (personal communication, Kollberg, 2000).

Although the possible areas of application are numerous, the network of contacts within the hospital is considerable, and this technology is in agreement with the hospitals' strategy to find alternatives to using antibiotics – the process of changing procedures is slow. One reason for the slow change is that the positive results need to be ensured before a general practice can be changed.

> *"Good ethics is a condition for conducting clinical research. We want to carry out as many clinical studies as possible to be sure of our results. At this point we have a number of studies going on and, for the time being, I doubt we*

[48] * Refers to alterations in the original table as it is presented in the report. These alterations are made by Dr. Bernardh Claesson, who is an expert in clinical microbiology at the Central Hosptial in Skövde (personal communication, 2001). A short comment is provided by Dr. Claesson in the epilogue (p96).

could tend to more studies. …We have, however, seen an increased interest in society, among industry and governmental agencies in supporting this research." (personal communication, Kollberg, 2000)

So far we have discussed IgY-products mainly for medical use in a medical setting in Sweden. This is where the needs are palpable and the alternative procedures are costly. Once these products are developed - a vastly larger market may want a part of these added value products, modified to meet their needs.

5.3.6 Markets for IgY

Looking at the products used for medical care, these are developed with the needs of Swedish CF-patients in mind. The hens are exposed to a dead (sterilized) cocktail of the strains of *Pseudomonas* that are regarded as the main risk for Swedish CF patients. The production procedures are illustrated in Figure 5.7.

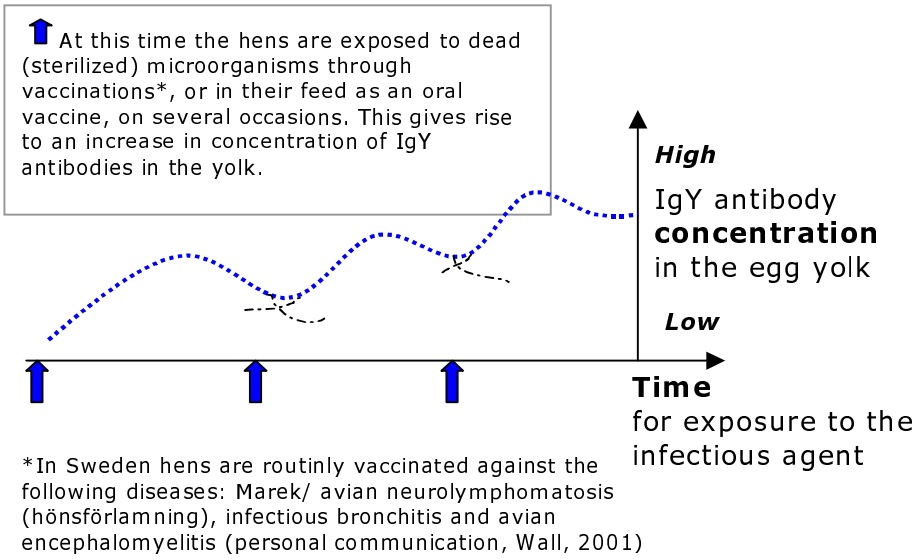

Figure 5.7 Production of IgY antibodies in the egg yolk against, for example, common strains of *Pseudomonas aeruginosa* (personal communication, Larsson 2000; Wejåker, 2000 & Wall, 2001).

Bearing in mind that the common strains of *Pseudomonas* vary slightly in different geographical areas, this very product may not fit the needs of CF patients in the US or even in Germany. To satisfy different needs the sterilized cocktail of Pseudomonas may need to be altered; albeit, the procedures for making the egg powder would be just the same.

The development and marketing efforts so far have resulted in antibodies for research use, for pharmaceutical use (kits) and in immune therapy using antibodies for CF-patients. The possible area of application of this technology is vastly larger, as seen in table 5.2. It is worth keeping in mind that the table illustrates possible medical applications in Sweden. Looking at markets in close proximity, especially the Baltic countries and the former Russia, reveals the needs for proactive treatment against Tuberculosis. Drug-resistant Tuberculosis is a major problem in these countries. In other parts of the world Cholera and Typhoid fever are serious threats to health. All of these diseases could be proactively treated with IgY antibodies in eggs.

Looking into the future it would also be possible for functional food products, such as eggs developed against throat infections or the common flu. Such products could be an egg drink or a spray dried egg component in a ready-to-go meal (personal communication, Larsson, 2001). Contacts are made with Kjällbergs Industri AB for production of egg powder. Their production capacity is high and the CEO, Rosén, is investigating a possible use for IgY in food and feed products (personal communication, Larsson, 2000). The potential markets for food and feed remain to be further explored.

5.3.7 An epilogue

It is clear that there are several possible medical applications for this technology. After reading the case Dr. Claesson, a medical expert in clinical microbiology, comments that this technique may offer a potential in proactive treatment of patients with a suppressed immune defense (such as patients that undergo cancer treatment for example). For people with a normal immune defense, however, it is hard to improve the status of a functioning immune system without a specific immunization (personal communication, Claesson, 2001).

In this day and age, with a world spread fear of *Bacillus anthrax*, the interest in proactive treatment of people at risk of contracting anthrax appears to another interesting medical area of application. There are three ways of contracting anthrax, pulmonary, orally and through the skin (Örn, 2001). The orally contracted anthrax could theoretically be proactively treated with oral intake of special eggs. The anthrax that resides in the skin is less invasive and possible to treat with known medicines. The pulmonary anthrax, however, has a rapid development and the treatment is successful only in the cases where a correct diagnose was made at an early stage (Ibid). The reason that an aerosol (such as used for asthma patients, for example) with egg-powder would *not* be possible to use lies in the risk for allergic reactions due to the egg base in the powder that would meet the pulmonary tissue.

5.4 Lactobacillus Reuteri[49]

This case presents a Swedish research-based business, BioGaia Biologics AB (BioGaia). A scientific discovery in 1985 was further developed and it is today a research business on the stock market. BioGaia owns patents on the use of a complete family of lactic acid bacteria (*L. reuteri*). These patents form the base for licensing agreements with food and feed producing companies all over the world.

A product

The functional food product is a dairy product with lactic bacteria. In Sweden a license is held by ICA-handlarna, that sell milk with lactic bacteria, so-called "*BRA"-milk* (Bifidus, Reuteri, Acidophilus).

Working with probiotics, it was evident that these products require special packages. BioGaia is also responsible for a patented radically new packaging concept for freshness in probiotic drinks, Life Top™. This packaging concept, a capsule on a bottle that allows for the probiotic bacteria to mix with the food when the package is opened, has several advantages. First and foremost it increases the stability of the bacteria and thereby lengthens the shelf life of probiotic functional drinks.

A process

The research process has included methods for bacterial identification, chemical characterization of substances (for instance, reuterin) and methodological development for testing probiotic effects. Testing probiotic effects include methods for detecting prophylactic (proactive health) effects.

A business

BioGaia Biologics AB is a research based company with operations in Sweden, the US and Norway (Figure 5.8).

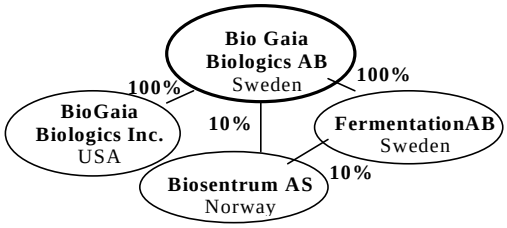

Figure 5.8 Organization of BioGaia AB (Annual report, 1998, 2).

[49] This case is shorter and less detailed than the three previous cases. As a business on the stock market the CEO, Rotschild, felt that it was unappropriate to talk in detalil about technological and market strategies. The case is, therefore, based on two interviews, one presentation of BioGaia at a conference and official written materials about the business.

BioGaia's vision is "to be instrumental in bringing about a change in emphasis, from treating illness with only medicines to improving the natural protection against disease through preventive measures" (Annual report, 1999, 2).

In 2000 their operations are divided into four business areas:
- Animal health,
- Functional foods,
- Health care, and
- Fermentation (BioGaia Biologics AB, press release, "year-end report for 2000").

The fermentation business area is organized as a separate whollyowned subsidiary.

The focus in this case is primarily on the area of functional foods. It is clear, however, that technologies used in one business area provide valuable input for development in other business areas as well.

5.4.1 From basic research to products on a market

Looking at the development process, from findings in an experiment to the development of a market application, several unexpected turns have been made. Basic research provided knowledge that was further developed and explored on a market.

1984 In the lab at the department of Microbiology (at *the Swedish University of Agricultural Sciences*) two scientists, Lindgren and Dobrogosz (on sabbatical leave in Sweden) make a discovery. One strain of lactic bacteria produces an antibacterial substance (Reuterin), given anaerobic conditions and when certain nutrients are present. This means that this substance inhibits the growth of other bacteria.

1985 A patent was filed based on their findings which caught the attension of an American venture capital business, *PBI*. They purchased the patent rights for a planned development of a Herpes zoster medicine[50].

1989 The development of a Herpes medicine did not turn out to be what PBI had hoped for, so when the two Swedes, Rothschild and Annwall, declared their interest in the patents rights they were readily sold. Rothschild and Annwall wanted to find a technique for increasing the durability, qualities for maintaining freshness of organic vegetables when these were transported. This was the primary intended use for these bacteria.

A friend of theirs, Möllstam, pointed out a new possible area of application, using the bacteria in animal feed. Healthy bacteria, such as *L. Reuteri*, would

[50] Herpes zoster is a virus. Once a person has contracted Herpes zoster it is chronic, with dormant periods between outbursts (blisters).

thus constitute a probiotic, an alternative to antibiotics for piglets and turkeys.

Research was also conducted on the possibility of using these bacteria in a *food*. Dobrogosz returned to the US and his group showed that *L. Reuteri* had positive effects in food products as well as in feed products.

1990 BioGaia Biologics was founded.

1991 A food product, BRA-milk (BRA-mjölk & BRA-fil), was launched in Sweden.

1993 The "BRA-milk" is licensed out to *ICA-handlarna* in Sweden. A patent for the Canadian market was gained.

1995 The patents were further extended to cover other interesting world markets.

1996 Licensing agreements were signed with large dairy producers in, for example, Japan, Finland, the US and Switzerland for production of dairy products with *L. Reuteri*.

1997 Fermentation businesses, *MultiFerm AB* (in Lund, 100%) and *Biosentrum AS* (in Stavanger, 20%), were acquired. In these production facilities process know-how is further developed and the bacteria are produced that are needed for the products (for example in the "BRA-milk").

1999 MultiFerm's services include any kind of production from small-scale models to large-scale production. Customers are mainly seen in the pharmaceutical, biotechnological and veterinary medicine disciplines. MultiFerm AB changes name to Fermentation AB.

1999 A strategic alliance with *Christian Hansen A/S* is formed regarding marketing and sales of food ingredients.

The R&D process is based on the notion that BioGaia is good at research and that licenses, in the four business areas, will provide financial grounds, as well as additional know-how, for continued development of products and processes.

5.4.2 Research as a business idea

The base for the business, BioGaia, started in basic research, the discovery of *L. reuteri* by the two microbiology professors Sven Lindgren (the Swedish University of Agricultural Science in Uppsala) and Walter Dobrogosz (North Carolina State

Univ. in Raleigh). They found that under anaerobic conditions and in the presence of glycerol *L. reuteri* bacteria produced an antimicrobial substance (reuterin[51]).

In scientific studies[52], the positive effects in the gastrointestinal tract are manifested in a histological healthy gut[53] and the absence of pathogens. The patents (well over 20) that protect the right to use these lactic bacteria are regarded as strong patents (Möllstam, 1998). This is attributed to the fact that reuterin is easily chemically detected and thus defended.

With production facilities and a strong set of patents at hand, the development of functional food products revealed that the shelf life of the bacteria in the dairy product was limited. The need for a package that would allow for the probiotic bacteria and the food product to mix when the product was consumed became increasingly apparent. A bottle, Life Top™, and a straw, Life Top™ Straw, were developed to keep the bacteria separated from the drink until it was consumed. The Life Top™ and the Life Top™ Straw are patented as well. Licensees are thus offered the use of *L. Reuteri* and a premium packaging for a probiotic product.

Another area of research and development that is prioritized is that of developing a method for evaluating probiotic effects. These probiotic effects are mainly preventive effects, as a compliment to the established methods for evaluating medical effects in pharmaceutical products.

> *"Probiotics should be evaluated in terms of the effects of prevention against an onset, or the delay of an onset, of a disease, not in terms of a cure when symptoms of a disease are diagnosed"*
> (personal communication, Möllstam, 1998).

These studies[54] are extremely costly for a number of reasons. The main reason is that they involve a large number of persons (a large sample as a test group and a "blind" group in a double blind study). Furthermore, the studies would have to be of longitudinal type to ensure that each person at some point would be exposed to

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[51] The substance *reuterin* occurs in three dufferent forms, as a monomer, as a hydrated monomer and as a dimer form of ß-hydroxypropionaldehyde.

[52] Scientific studies show that *reuterin* is produced by an entire family of lactic bacteria, *L reuteri.* These bacteria are found among numerous animals, for example cattle, turkeys, pigs, mice, rats, hens, turkeys, ostriches and humans. The human strain of *L reuteri* that is used in functional food products was isolated from a Peruvian woman living in the Andes.

[53] A histologically healthy gut shows a stimulated epithelial cell development, resulting in long intestinal villi, deeper crypts and hence a more efficient nutrient uptake.

[54] Most methods for evaluating medical effects have been developed in a pharmaceutical tradition. The main objective has been to find efficient substances to treat a disease. In the case of functional foods the challenge is to find new methods for evaluating preventive effects – preferably in studies on humans (as opposed to rats or mice).

pathogens. Another challenge is to find indicating measures, markers that could be used to determine an individual's immune status. The development of methods for the evaluation of probiotic feed products is seen as technological development that might benefit the functional food area as well.

5.4.3 Licensees and partners in development

BioGaia has licensing agreements with a number of strong business partners. These licensees/ partners are listed in Table 5.4 (on the following page). Most of these licensees and partners produce and market consumer products, where BioGaia receives revenues in royalties from sales of these products. The licensees are offered a product package.

> *'We have realized that R&D is what we are good at – so that is what we do. We don't offer our customers the free use of a technology, however, we offer a product. A complete product concept, including packaging, is the ideal offer to make to a customer's marketing department. That way the customers own R&D department may not get engaged in the business proposition."* (personal communication, Möllstam, 1998)

The alliance with the very large company, Christian Hansen A/S, differs from the license agreements described above. In this strategic alliance the products are bulk products, produced to meet the needs of the food industry, and the dairy industry in particular. The alliance with Christian Hansen A/S is a part of a strategy to access food industry markets for ingredients and food-related know-how.

Table 5.4 Licensing agreements and partners in development in the four business areas for BioGaia 2000[55]

Business area/ product	The use of the products	*Licensee* and *partner* in development
Health care/ Tablets & capsules	-for people with an in-balanced micro-flora in their gastrointestinal tract or for persons with a reduced resistance	*McNeal Consumer HealthCare*, a subsidiary of *J & J* (USA, Canada), *Victus* (South America) *BioPro Pty. Ltd.* (S. Africa)
Clinical nutrition products	-a joint venture in developing a "mother's milk replacement" product for children with allergies (trademark: Profylac)	*ALK Abelló A/S* a subsidiary in the Christian Hansen group (Germany)
	- an agreement with the Danish company regarding the rights to sell PreKUnil (for treatment of the metabolic disorder PKU)	*Semper* (Sweden) *Nila A/S* (Europe)
Functional foods Milk, cultured milk products, fresh cheese, ice cream, food additives and baby food products.	- a part of a healthy life style. The *L reuteri* supports the immune system and the nutritional uptake in the gut.	*ICA-handlarna* (Sweden), *Chichiyasu Milk Co Ltd (Japan)* *Ingman Foods Oy Ab* (Finland) *Kraft Jacobs Suchared Iberia* (Spain, Portugal) *germany (Benelux)* *Nature's Way (USA)*
Ingredients for the dairy industry	-a strategic alliance in marketing food ingredients	*Christian Hansen A/S (Denmark/Europe)*
Animal products "ReuterIn Ovo"	– An injecting eggs technique that is used in broiler production is a patented product.	A very large chicken producer (USA)
"Reuteri Chicken Soluble"	– is a product for chicken production. It is administered via the drinking water.	
Fermentation Production capacity and know-how	The plant in Lund, Fermentation AB, offers capacity that include production as well as development of new products.	Possible industrial partners/ customers are seen in industries out-sourcing the fermentation part of their production.

[55] This table is based on information in press releases from BioGaia 1999-2001 (Internet: biogaia.se)

In the business area fermentation, BioGaia shows a clear wish to find industrial partners in production as well as in development. They market production capacity, experience in the field of fermentation and quality authorization for production of pharmaceutical ingredients.

5.4.4 An epilogue

Are lactic bacteria of any help for healthy people? We know that they play an important role in the function of the gastrointestinal system, including immune functions. Do more lactic bacteria bring better health? Are we more sensitive to lactic bacteria in certain phases of our lives than others? Studies of probiotics do not provide any simple answers.

Studies of allergies in young children show that, in certain environments, the children show less signs of allergies (Alm, 2001; Wickman, 2001). These children and their families are exposed to an environment with factors that stimulate the immune system. One of these factors is the presence of lactic bacteria. Recent clinical studies of oral intake of lactic bacteria capsules during the late phase of pregnancy demonstrate an inverse correlation with signs of allergies in the newborn children (Kalliomäki et al., 2001). These studies would indicate that it would be possible to strengthen the immune system with probiotics as capsules or in food products.

Other researchers (Cedegård & Widell, 2001) agree with the possibility to enhance health by intake of probiotics. In good health or poor, the GI-tract requires a continuous re-establishment of healthy bacteria (probiotics) and food for these bacteria (prebiotics). Ideally, they argue, new functional food products should therefore not only contain probiotics but also prebiotics, in so called symbiotic products.

6 Discussion

In analyzing the innovation process, a number of questions, connected to the main research question, are raised. The main question is "*How do Swedish food companies develop new high-tech functional food products?"* This question is partly answered in the empirical material, as conveyed in chronological case narratives (Chapter 5). The market analysis, in Chapter 4, also provides general grounds for understanding the developments in the food industry.

In this chapter, the discussion evolves from a comparison of the innovation process in the cases. It continues in terms of an analysis of vital contextual factors. Building on the analysis of the cases and a contextual analysis, conclusions are presented along with speculations for future development of functional foods.

6.1 A model for technological and market upgrading

In the management literature most models for NPD (New Product Development) have been developed to describe the technological and market upgrading of existing products. Models for developing radically new products, however, have hardly been described at all. This refers to models that allow for the dynamics of going from low-tech to high-tech, as revealed in the case studies.

In the following chapter it is therefore worth keeping in mind that most food businesses do not engage in this high-risk endeavor of developing functional foods. The common strategies within food production aim towards an efficient production of established products. This refers to standardized bulk products, such as vegetable oil, starch and sugar. Development of functional food products, however, requires strategies for change (Figure 6.1).

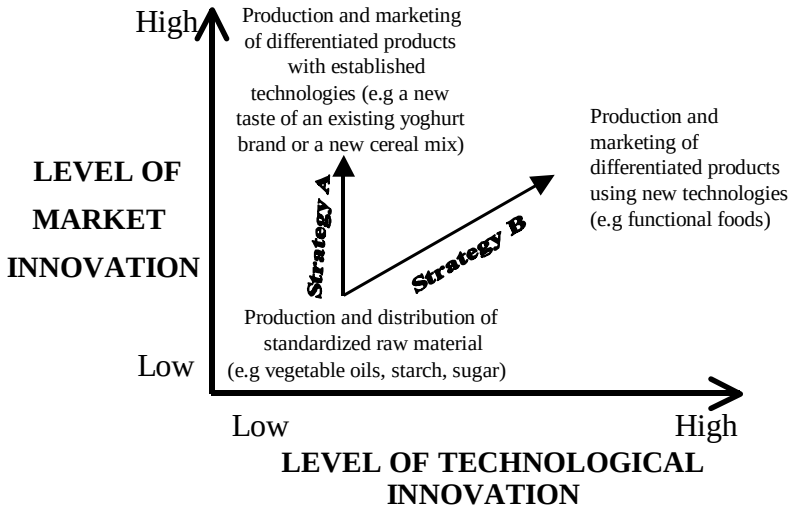

Figure 6.1 Product development strategies gives rise to products with varying levels of innovation (after Nyström & Liljedahl, 1994, 7).

Strategy A and B are strategies for commercial NPD. Strategy A refers to the development of new products in an incremental change process. These products are often the result of a market-driven development process. Using existing products and products with minor alterations existing and new markets are explored. Strategy B, on the other hand, shows a strategy for a high level of technological and market innovation. This refers to the development of radically new products for new markets.

6.2 Grounds for a comparative analysis

In each case, the process of innovation is in focus. Thereby new products, new processes and new businesses are developed. The comparative analysis is limited with regards to which phase the innovation process has reached for the functional food product in each case (Figure 6.2).

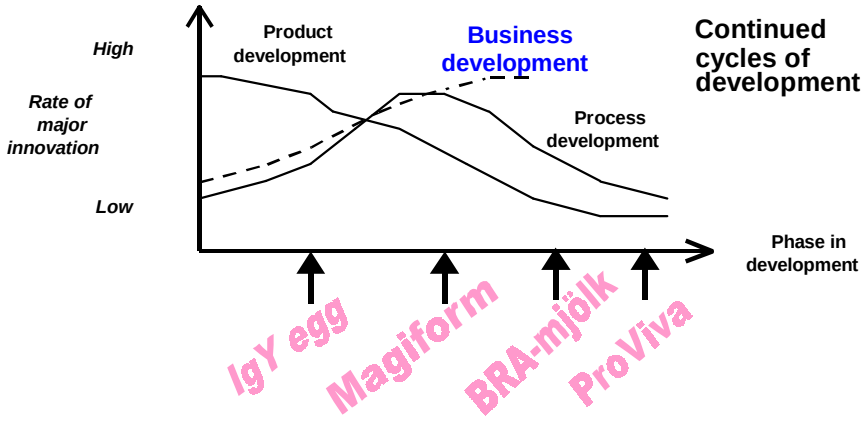

Figure 6.2 Phases of the innovation process using the general model presented by Albernathy & Utterback (1988, 27) for illustration of the development in the case studies. The dotted line is an addition to the model. It refers to the development of a new business, which is interdependent on the development of new products and new processes.

Traditionally, this model (Figure 6.2) is used in discussions of industrial development. It is assumed that the rate of innovation follows a general pattern over time (Albernathy & Utterback, 1988). Using the model as an illustration of product and business development at a company level allows for a comment about the interdependency of these processes. The model shows that the development of a product precedes the development of a process. Looking closely at the cases it seems that a condition for the development of a product (in for example the ProViva and the Magiform case) has been the development of processes (for identifying bacteria and processing grain). We will assume in further discussions that the development of a product and a process are interdependent processes.

Furthermore, the development of a *product* includes the development of production techniques for this new product. The development of a *process*, on the other hand, refers to the development from a small lab-scale experiment to an efficient large-scale production process. This may in turn motivate questioning if the curve for the rate of process innovation should be as high as that for product innovation. A reason for regarding it as lower would be that the objectives for the process development are pre-determined by the desired product outcome.

It is assumed that product and process development are seen as two parts of the same process (Albernathy & Utterback, 1988). It has been argued, however, in a recent study of European food businesses that companies are either process *or* product oriented (Traill & Grunnert, 1997). In Traill and Grunnert's proposed model the orientation towards process or product development has a major influence on the innovation process components that are outsourced and what is

developed in-house. In this empirical material these processes are intimately connected. A clear focus on an orientation towards product *or* process development is not seen in the analysis of these cases. Furthermore, the distinction between what is developed in an in-house activity vs. in an outsourced activity is unclear in the cases. This is further discussed under "Organizing for innovation" (6.4). What is very apparent, on the other hand, is that the development of new businesses is also seen as a result of the innovation process. These new businesses are research oriented, entrepreneurial, flexible and consist of skilled and specialized people, in accordance with Utterback's (1995) model.

The innovation process, in terms of functional food products, has reached different developmental phases in each case (Table 6.1). In the IgY-egg case, a functional food product is not yet developed whereas for the ProViva case, a second-generation health related food product, *ProViva Active* (a sports recovery drink) has been launched as a brand extension.

Table 6.1 Developed products in each case

Case	Functional food product	Additional functional foods or other product/s
ProViva	ProViva (a fruit drink)	ProEquo (a horse feed) ProViva Active (a sports drink)
Magiform	Magiform, a product line: müsli, pasta, bread, biscuits	"100% oats" (gluten free oat flakes)
IgY-egg	---	Medical products for patients with, for example, Cystic Fibrosis or burns
L. reuteri	BRA-milk and cultured milk	"Profylac" (a pill, clinical nutrition) "LifeTop ™" (a bottle for drinks) "ReuterIn Ovo" (animal product)

With these products in mind we will make a cross-case comparison with the focus on technological and market strategies. Starting where the innovation process commences as a strategic intent, often viewed as a problem that needs to be resolved, we will follow the development of these products to a market.

6.3 Strategic intent

Developing a radically new product is preceded by a strategic intent. In this framework these strategies are referred to as intended strategies. These intended strategies are revealed in the cases as visions of the destination of technological and marketing strategies (Table 6.2).

Table 6.2 Intended strategies expressed in terms of visions

Case	Vision statement
ProViva	"From having been a small dairy on a minor market we want to become an actor on the European food market…Our customers will perceive us as a keen and innovative partner in development. Through cooperation with other actors we will achieve increased competitiveness" (Annual report Skånemejerier, 1997, 2). "Probi will develop into an internationally recognized leading biotech company in the area of probiotics" (Annual report, Probi AB, 2000, 6).
Magiform	BioDoc's business concept is to "develop, produce and market products with health effects" (BioDoc, business brochure, 1999, 3).
IgY-egg	A business oriented vision statement is not found for this case. The interviewed researchers share a research oriented vision of building an IgY-center for continued research, where their role would be technological development (R&D).
L. reuteri	BioGaia's vision is " to be instrumental in bringing about a change in emphasis from treating illness with medicines to improving the natural protection against disease through preventive measures" (Annual report BioGaia Biologics AB, 1999, 2).

But, of course, most of these statements are expressed with hindsight, with continued developments in mind. In the IgY-case a business oriented vision is not expressed. This is primarily explained by the early phase of development in this case. This may in turn be attributed to the fact that the business, Immunosystem IMS, consists of full time working scientists with limited time and incentive to drive the innovation process into a marketing phase. The area of application, other than as medical products, is not yet clear and therefore difficult to communicate in a vision statement.

Assuming the vision statements are not perfect measures of the strategic intent, but rather an after-the-fact rationale that directs future developments, what could explain the development? Starting where the innovation process in each case starts, we can compare initial sources of inspiration (Table 6.3). A practical problem seems to have been the initial source of inspiration in all the cases but the IgY-egg case. The problem that inspired the innovation process provided a request for a

solution and, in other words, a "market pull" situation. Looking at the IgY-egg case, it could be regarded as a "technology push" situation where a visionary entrepreneur's interest in science motivated researchers to engage.

Table 6.3 Information and problems as inspiration for the innovation process

Case	Initial inspiration for the innovation process
ProViva	A medical problem after abdominal surgeries
Magiform	A need to find an alternative to using antibiotics in animal husbandry
IgY-egg	Discussions of a scientific entrepreneur's ideas with a group of scientists
L. reuteri	A need for a technology to keep vegetables fresh during transport

The development of *ProViva* is the result of a desire to resolve a medical problem. Little was known about what the final product would look like or how it would be developed. From the case it is clear that a number of actors have participated in the development of this product. It is also clear that the procedures have been radically changed several times. Furthermore, the final product is not even what was imagined or needed. The end product was not the expected medical product for a medical market, but rather a health related food for a broad consumer market.

Developing products with *L. reuteri* (i.e. BRA-milk) is another example of a new avenue that was not the initial objective. The need for a technology for keeping vegetables fresh lead the way to other areas of application (functional foods, health care products and animal products).

When the use of antibiotics during the weaning of piglets was prohibited a need for a feed that would support the immune system for the piglets was evident. One of the persons involved in the development of this feed for piglets was an entrepreneur who recognized a new market for this technology, as functional food products (*Magiform).*

It was through an entrepreneur's sincere interest in science, his previous experiences in research procedures, and his know-how in poultry production, that information was transformed to an idea, in the *IgY-case*. This idea was not an immediate solution to a problem. The idea was rather intuitive, based on scientific experiences, with no immediate commercial application.

We can conclude the analysis of strategic intent as follows. The creative process, in each of these cases, shows entrepreneurship as the visualization and realization of new ideas. Information is thus transformed to an idea and an innovation. As the

unfolding of experience gradually leads the process towards a possible solution to the problem or an area of application, the process gets more focused and thus possible to plan. Once a prototype of a product is developed, the development continues as technological development and marketing. The marketing strategy involves a plan for how the product can be marketed to existing markets and how new markets can be developed.

The innovation process is further discussed below in terms of organizational conditions that allows for flexibility and emerging technological and marketing strategies, a leadership for the creative process, and administrative routines that have promoted the progress.

6.4 Organizing for innovation

Strategies for new product development include organizational arrangements for managing the innovation process. The organizational structure for developing, producing and marketing functional foods ranges from in-house R&D, joint ventures and alliances, to the acquisition of firms. Table 6.4 illustrates a comparison of the organizational arrangements found in the case studies.

Table 6.4 Organizational changes in structure to promote flexibility

Case	Changes in organizational structure throughout the innovation process
ProViva	A cross-disciplinary research project at Lund University ⇒ a science-based business is founded collaborating with a number of partners in development ⇒ a joint venture for development and marketing is formed with Skånemejerier ⇒ Probi goes public ⇒ an alliance in production and marketing with Skånemejerier and licensing agreements with other production and marketing partners.
Magiform	A joint research project with Sveriges Svincenter and Gothenburg Univ. for developing a pig feed ⇒ a joint venture business (BioDoc) and a virtual organization, owned by: Cerealia, Skånska Lantmännen, Odal Lanmännen and Lantmännen Invest ⇒ a search for strategic marketing partners.
IgY-egg	A cross disciplinary research project at Uppsala University and the Swedish University of Agricultural Sciences ⇒ a science based business is founded, Immunosystem IMS, collaborating with pharmaceutical businesses ⇒ a strategic alliance is formed with BioPool, another science-based business working in diagnostics ⇒ a joint business, BioNativ is set up between Immunosystem IMS and BioPool ⇒ a search for partners for the development, production and marketing of functional foods.
L. reuteri	A research project at the Swedish University of Agricultural Sciences ⇒ an American venture capital business, PBI, purchase the patent rights ⇒ the patent rights are sold to become the foundation for a science based business, BioGaia Biologics ⇒ BioGaia Biologics goes public and acquires fermentation plants ⇒ Licensing agreements are set up with food production partners through out the world and a strategic alliance is formed with Christian Hansen A/S for marketing food ingredients to the food industry.

Different organizational arrangements in these cases appear to have promoted changes. They have allowed for exploring unexpected avenues and changing the direction when the traditional procedures did not serve the needs. In reading the cases these changes are expressed as, for example, new product applications, new markets, new procedures in the R&D-process and as new partners throughout the innovation process. What is needed in early phases (flexibility and access to certain resources) is gradually replaced by other needs (resources for production and distribution and communication) in later phases. To accommodate for these different needs, the organizational arrangements need to allow for change. Organizational aspects of different collaboration arrangements in the cases are illustrated in Figure 6.3.

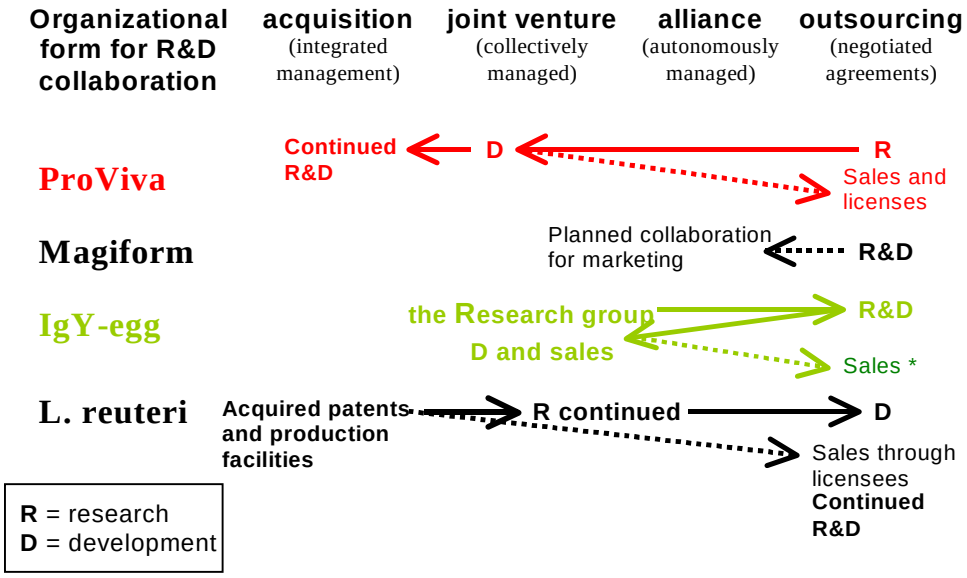

Figure 6.3 Organizational and managerial implications of different forms for R&D collaboration in the cases. (* = Planned sales)

In the four cases the progression of the innovation process[56] – from research projects to manufacturing and distribution of products – has required organizational changes. The simplified illustration of these changes in Figure 6.3 shows that these strategic changes allow for some comments.

In the study by Chiesa and Manzini (1998) and other studies of organizational forms for innovation (e.g Ford, 1988) businesses are analyzed at one point in time. It is rarely discussed how the organizational form may *change* in different phases of a creative process. A closer look at the cases reveals that the organizational arrangements change throughout the innovation process. What starts as a research project with different collaboration partners and formal contracts, turns into alliances and joint ventures in the case of ProViva and IgY-egg.

The ***ProViva*** research project has several collaboration arrangements with partners in development (as negotiated outsourcing). The organizational arrangements for collaboration were rather formal and regulated by contracts in the introductory phase. This is also the case for the collaboration with Skånemejerier. What started as negotiated outsourcing became an acquisition and later a joint venture. The

[56] Collaborative arrangements can be discussed at great length in deciding the differences between negotiated outsourcing, an alliance or a joint venture. Therefore, the terms used by the respondents serve as basis for the discussion.

reasons for a more formal arrangement in the early phase of the joint activities is illustrated in Figure 6.3 as low start up time and costs, high reversibility, low risk, and low impact on a firm's resources. Successful collaboration between Probi and Skånemejerier stimulated a closer collaboration arrangement as a joint venture in the development, production and sales (Figure 6.4). Less successful collaboration arrangements (for example with ConAgra) were terminated. The engagement continued to grow between Probi and Skånemejerier in development of additional products. Their organizational collaboration arrangements changed, from a joint venture to an alliance. In this alliance the ownership of the brand name, the patents and the markets are carefully divided. The change from a joint venture to an alliance is seen as a clarification of roles in the collaborative activities (Figure 6.4).

In the case about the development of the ***Magiform*** products, the organization is described as a virtual organization. Each member of the organization has an extensive net of professional contacts, i.e., partners in the development. The applied strategy is seen as negotiated outsourcing, ranging from research to production and distribution of products. Theoretically the arguments for this arrangement are low commitment and high reversibility. In working with the case, however, it is clear that it is a strategy to build viable and long lasting relations with collaboration partners. The collaboration provides benefits for both parts involved. The main argument that supports this strategy is rather that of efficiency, where a collaboration partner performs one part of the innovation process with more experience and resources at hand. The BioDoc company regards itself as a coordinator of all these activities. Although BioDoc is jointly owned, it is managed rather autonomously.

The development in the ***IgY-egg*** case started as a cross-disciplinary research project. A science-based company was founded. In order to gain access to a market, as well as a partner in development, a joint venture was formed. This joint venture with a pharmaceutical industrial partner did not prove to be fruitful. High costs, high risks and low reversibility did not provide the needed flexibility for the innovation process to proceed. A strategic alliance and later a joint venture was formed with a company in the same field. Strategies for the future include continued R&D and production of functional foods with strategic partners.

The case about the development of ***L.reuteri*** shows organizational arrangements where acquisition has been an important way to access resources and gain control. The patent rights were purchased and they became the base for a biotechnology firm, BioGaia Biologics AB. The development involved a joint venture between researchers in the research phase and an acquisition strategy for the newly-founded biotech company (where patents as well as production facilities are acquired). The company went public and acquired plants for fermentation. Licensees are offered a product concept based on the development that has been staged and patented by BioGaia. The acquisition is associated with high commitments (impact on resources, control over activities, risk and start up time and costs) and low

reversibility. As a company on the stock market, in a high-tech area, BioGaias strategy for ownership of intellectual properties as well as production facilities appears to be a way to communicate commitment. This commitment may in turn result in stable finances and investments for continued research as negotiated outsourcing. This organizational arrangement allows for continued development in strategic fields as well as strategic partnership in marketing products.

An analysis of how the organizational form has changed in these cases further supports the need to understand the conditions for supporting the innovation process. For a food business, for instance, this implies finding procedures and organizational forms that allow for collaboration, thereby accessing resources and building competencies that strengthen the competitive position on the market.

A close look at the collaboration condition shows that it is unclear what parts of the R&D process take place within the company between collaboration partners, and in contacts with other actors in the surrounding network. Unclear boundaries for technology development and transfer is an explanation for difficulties in discussing the development in terms of where the R&D process takes place - as an "in house" activity or an activity mainly outside the organizations. A more productive approach is to look at how companies perceive their strategic roles in the innovation process (Figure 6.4).

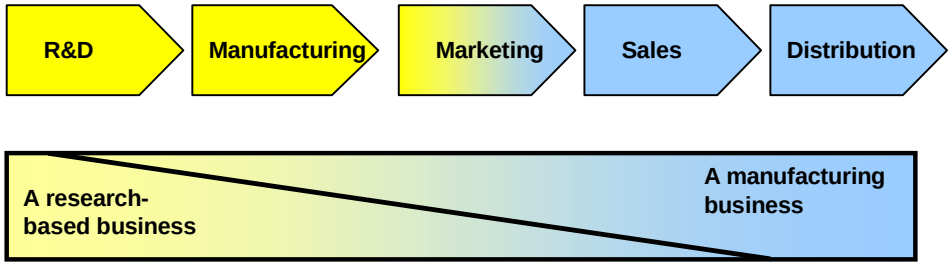

Figure 6.4 Strategic roles in the development and marketing of functional foods (modified after Annual report for Probi AB, 2000, 11).

The innovation process, i.e. the development of functional food products, has its origin in research and in most cases a problem or a genuine interest in science (Table 6.4). Understanding scientific research is thus a condition for being able to make a strategic choice in collaboration partners. Hence, the functional food actors take strategic roles with regards to their business idea. The chosen roles for research businesses and food manufacturing businesses are further discussed and analyzed as technological and marketing strategies.

6.5 Technological strategies

Technological strategies are not just words on a paper, or a creative person's visions. It is how things are done, patterns of behavior (Mintzberg, 1976). Technological strategies refer to the acquisition and use of knowledge in different phases with regards to a technological life cycle (Nyström, 1990, 77). In the early stage of the life cycle model the technology is more implicit. Its use is not yet clear and describing it is rather that of conveying an image of possible outcomes. At a later stage, the technologies become more explicit. The technology has at that point an accepted name, and the application is a product concept.

Technological strategies are seen as mechanisms for creating more knowledge and skills. This includes all kinds of knowledge: technical, market, administrative and social knowledge. A technological strategy reveals the future aims of a business (see Strategic intent, 6.3). The case narratives are mainly concerned with realized technological strategies, but in historical and in contemporary actions lie possibilities for tomorrow's intended strategies.

6.5.1 Strategies for technology development

Strategies for technology development are seen in for example organizational arrangement and administrative routines. These strategies for R&D and acquisition of technologies are discussed below. Figure 6.5 illustrates strategies for technology development from the IgY-egg case. Similar thoughts are conveyed in the other cases.

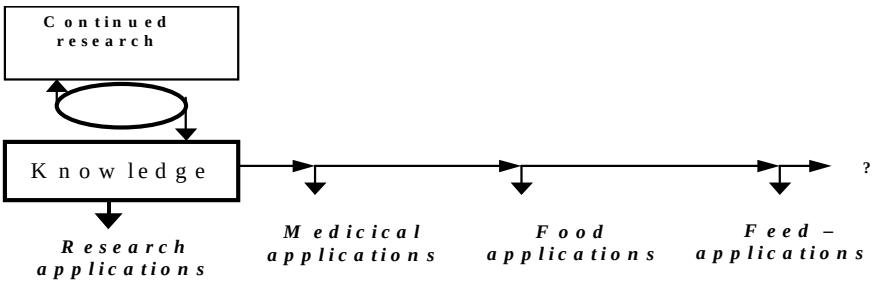

Figure 6.5 Possible areas of application for new technologies. New knowledge is developed in cross-disciplinary research projects (from the IgY-case). These areas of application for new technologies; research, medical, food and feed appear in each of the cases.

A vision is created for continued development in the case of **IgY**. Keeping the R&D entity in an IgY-institute is a solution to the experienced problem of *not* taking the time for documentation prior to exploring a new technology. The institute would ensure creative freedom, intellectual properties and academic quality. These new technologies would become the basis for continued development in four different areas of application. At present, the reason for the development so far in research applications is, of course, the fact that this is a familiar avenue for the researchers. They have medical contacts in their every day routines. Finding collaboration partners for development in the food and feed areas is thus a critical technology in this case. Ideally, the institute would also provide partners in development and production.

In the **ProViva** case Skånemejerier views the R&D process as a semi-structured phenomena. It starts as a project with time limits and go/no go points. It is perceived as a process in which scattered information is brought together and analyzed by a group of experts. Sometimes a vision of a new product or process is the outcome of this time and resource-consuming process. Skånemejerier has chosen to form joint ventures with groups of experts, often from the nearby university science park in Lund. These groups of experts become a part of their network.

In practical terms, the process is described as "structured chaos". Skånemejerier follows research projects in the food area conducted at universities, and sometimes these projects become a joint R&D project. The scanning and reviewing of projects is carried out regularly at Skånemejerier. Strategic aims, financial possibilities and a general judgment of how commercially successful a product might be, puts the project in financial order of priority.

The American partner in collaboration, ConAgra, entered the innovation process at a time when the development of a product and a process had taken place. Their strategy was mainly that of clinically testing and selling the product. Thereby, an access to a new market was provided for the product (ProViva). In return, ConAgra received access to critical technologies. This was accomplished through license agreements between the patent holders, Probi AB, and ConAgra Inc.

In the case studies, the technological strategies are also reflected in organizational arrangements with many collaboration partners and openness towards possible areas of application. Open technological strategies may in part be explained by the cross-disciplinary approach and the many skills that have been required for the innovation process to proceed (Table 6.5).

Table 6.5 Technology development

Case	Technology development
ProViva	Identification of bacteria, methods for screening for appropriate bacterial strains, application areas, products and processes.
Magiform	Processing cereal to develop a feed that would activate the immune system in piglets, understanding the mechanisms behind protein AF, application areas, products and processes
IgY-egg	Production of IgY-antibodies, areas of application for specific IgY-antibodies, mechanisms behind the immune system supporting effects and a product for CF-patients (immune therapy as an area of application)
L. reuteri	Identification of a bacterial strain and a chemical substance, functions of this substance, areas of application, products, processes, methods for evaluating prophylactic medical effects, packaging for probiotics.

Table 6.5 illustrates significant technological development in all of the cases. For the development, it should be noted that all of the above cases have resulted in numerous immaterial rights, mainly patents. In the Magiform case, however, it was shown that technology development to increase know-how may play just as an important role as patents in developing functional foods. The comment alludes to the development of another product where the know-how and production quality control provide a company position that yields increased competitiveness.

6.5.2 Creating an innovative culture

Technological strategies are also expressed as conditions that make individuals and organizations engage in a creative process.

"My philosophy is that the researchers should make money on what they create and do. I want them to feel included in the whole business... That way the corporate culture is one where researchers want to, and will, try new ideas." (personal communication, K. Vareman, 1997, the ProViva case)

"Our customers should regard us as a partner with a sensitive ear and an innovative capacity." (Skånemejerier, annual report, 1997, 2, the Proviva case)

"Anders and I worked very closely together during this phase. We d id all kinds of crazy things at the time; we tested everything – and it was great fun!" (Personal communication, Wejåker, , 2000, the IgY –egg case)

"… I think my most important role is to be enthusiastic towards people I meet, within BioDoc as well as in my contacts outside BioDoc. I ' sell the idea' and if I do it… well, changes happen more easily... It is incredibly exciting!" (Personal communication, Sjöstrand, 1999, the Magiform case)

A closer look at organizational structure reveals that a non-hierarchical structure may provide the needed freedom, which is associated with creative production.

"In my previous job, I could use standard ways to solve problems. The problems were distinct and repetitive. This job is different. Everything is new and we have to find new ways of doing things. Of course, when I can I use standard ways of doing things, I do, but for the most part I make use of my network in finding new routines". (Personal communication, Lindholm, 1999, the Magiform case)

"*I think I was hired thanks to my experiences in the pharmaceutical industry. When I came here I recall thinking that this job is so flexible. Nobody told me what to do. Decisions were made quick and easy, in a spontaneous conversation between the three of us."* (Personal communication, Erhardt, 1999, the Magiform case)

This reasoning about organizational structure opens up for a comment on overall corporate culture. Most of the interviewed persons have their background and experiences from a university setting, where freedom is considerable and output is not measured strictly in monetary terms. It is accepted that the cost and outcome of process and product innovation is to a large extent unknown. This uncertainty of the outcome of the research project is also reflected in a number of partnerships throughout the R&D-process. Hence, difficulties in evaluating and forecasting a research program appear to be an accepted part of the innovation process.

6.5.3 An entrepreneur as a manager of technology development

It has been shown that the creative process, in any kind of organization, is often driven by an entrepreneur (Gaddefors, 1996; Howell & Higgins, 1990). It is through his or her insight that information is transformed to an innovation, and thus, a new idea is visualized and realized (Nyström, 1990, 55).

In each of these cases an entrepreneur has acted as a manager of technology development. Vareman at Probi AB, Andersson at Skånemejeriner, Sjöstrand at BioDoc, Vejåker and Larsson at Immunosystems AB and Rotschild at BioGaia Biologics AB – they all have the role of 'a translator between two cultures', the scientific research community and the market. It is through their eyes and in their management that information is interpreted, technology is developed and new ideas are developed and exploited.

Through personal contacts the entrepreneur meets a challenging problem. In finding solutions to this problem the entrepreneur's experiences of solving problems through research, and access to technologies become key factors for innovation success. Since the innovation process is not an individual achievement previous experiences of cooperation with a group of researchers has proved to be of particular value.

The entrepreneurs have developed several "good ideas" into businesses (in addition to the innovation process described in the cases). It is not through responding to an awaiting opportunity (Kirtzner, 1973) that the entrepreneur contributes in a creative process. He rather *creates* a technological and market innovation. Despite difficulties and restrictions, the entrepreneurs create the setting in which the innovation process can take place. It is in challenges from problems and 'horizontal thinking' that the entrepreneur envisions future possibilities. The concept of 'horizontal thinking' is used by Vejåker, in the IgY-case, when he describes how he thinks of an idea (personal communication, 2000). It refers to thinking in 'wide' and practical terms, making use of experiences and common sense. In contrast, 'vertical thinking' is what the researchers do, according to Vejåker, when they structure problems and look closely in detail at a limited problem for cause and effect. By associating and assembling technologies, individuals and resources, a stage is provided for the act of innovation.

6.5.4 Critical technologies

The potential for technological and market uniqueness is found in the handling of critical technologies. This refers to recognizing areas of strategic value, where the technologies are regarded as critical for the future development of processes and products. Many of these strategic areas correspond to the technology development described in Table 6.4. Some businesses spell out what their strategic areas are, such as Skånemejerier's recognition of the areas of bacteria, enzymes and polar lipids. Other businesses reveal their areas of critical technologies in patents and the

development of know-how. An example of this is seen in the BioGaia case, where packaging is developed (and patented) parallel to their probiotic products.

Accessing critical technologies is a strategic matter. It ties organizational aspects of development to the development of technologies and markets. A virtual organization, such as BioDoc, relies on their network of partners in the development as well as in the production and sales of products. In the ProViva case it is especially clear that Skånemejerier has chosen a strategic partnership strategy to access the identified critical technologies.

> *"We build networks. We don't have all the technology or skills within the organization; strong partners carry a long way." (Personal communication, Andersson, 1998, the ProViva case).*

Critical technologies are reflected in the product itself as well as in the processes. During the different phases of the innovation process certain technologies appear more critical than others with regards to the development of a product, a process and a market. It appears as if the development is not a process in even and incremental steps, but rather of breakthrough and uneven phases.

These leaps in development are seen in the cases as, for example, technological break-through and market establishments. The method to genetically determine the strain of lactic bacteria, in the ProViva case, is an example of a major technological breakthrough. A published article with clinical results in a well-known journal may be another manifestation of a technological breakthrough (*The gut*, in the Magiform case). A certain technological development is critical in a particular phase, and as the innovation process proceeds, other technologies come into focus for the process to continue.

As a part of business strategies, technological strategies also reflect the maturity of a market. The general domain of the food industry is a mature market, which is signified by consolidated and closed technological and marketing strategies (Nyström, 1990). Most critical technologies are therefore seen as efficient production techniques and market strategies, designed to erode the position of existing brands.

6.6 Marketing strategies

Marketing strategies are ways to develop and find customer segments. In each of these cases, technological strategies lead the way to increased knowledge, immaterial rights (seen in, for example, patents) and products with added value. Developing markets for these products are discussed below. Commercialization of

technological strategies is also seen in terms of licensing agreements (see 6.6.5 Licensing agreements).

Depending on how the product is defined, the customer segments in focus will vary. If the functional food product is seen as, on one extreme, a cure for a disease or, on the other extreme, a traditional food, the marketing strategy will vary. These strategies are manifested in the selection of targeted market segments, the use of marketing arguments and in the choice of distribution channels for the product (Figure 4.2).

In the model in Figure 4.2 for marketing strategies, a number of possible strategies for functional food products are presented. It is *not* assumed that products by themselves necessarily determine the category in which they belong. It is rather the marketing argument by which they are sold that determines their categorization.

Unprocessed (natural) functional foods, such as garlic, broccoli, citrus fruits and beans, are labeled as "*traditional foods*". They are sold with little or no health argument (Edgeson & Marber, 2000). It is assumed that customers are aware of their health effects. *Health nutrition* would be products, in many cases food additives, that have a preventive medical effect, for example cholesterol-lowering margarine. These are sold with product information about the health advantages. *Medical nutrition* products refer to tube feeding and special foods for medical conditions. Consumers in need of these products are, for the most part, well acquainted with their needs and the product properties. *OTC* is a vast group of products that are seen as drugs that can be purchased without a prescription. Information about these products varies from vague health arguments to strict information of dosage and effects (for example on headache medicines). *Prescription drugs* are sold in pharmacies with information on dosage and side effects.

6.6.1 Distribution channels

Depending on the strategy, distribution channels will vary for sales of a functional food. If a functional food product is sold as an OTC, for example, the distribution channel (in Sweden) would be a pharmacy or possibly "Naturapoteket" (a store for natural remedies) or health stores. The marketing strategy would include information to medical professionals and marketing activities on for example medical congresses. If, on the other hand, a product is sold as a normal food/ health food the expected distribution channel would be the retail market, where consumers would find the product in a food store, or possibly a health food store.

Selling a product through a food retail channel assumes large volumes and a willingness to compete for exposure in the shelves. Consumers will compare prices with existing products that may fill their needs equally well. Hence, this strategic choice results in a low price margin but a larger volume. If the distribution channel

is a medical professional (a doctor or a pharmacy), on the other hand, the volumes are smaller and it is expected that the price margin is higher.

The distribution channel will also have an effect on the revenues through a differentiated taxation. Food products are burdened with a 12% VAT[57], whereas medicines are burdened with 25% VAT. This difference may amplify the effects of difference in sales volume depending on the choice of marketing channel.

6.6.2 Targeted market segment

The choice of targeted markets is closely related to the choice of distribution channel. Which markets are the targets for these functional food products? Who is the consumer? In Sweden the chosen distribution channel will to some degree automatically limit the market. Consumers go to the pharmacy mainly to purchase medicines, and possibly hygiene products. At the pharmacy consumers might expect to find functional foods as capsules or tablets. These products are not possible to evaluate in terms of personal benefit from an added value for most consumers. Many consumers, if convinced of medical benefits will, however, probably be willing to pay a premium price for the expected added value of this product.

In a food store, on the other hand, consumers expect to find food products; products that the consumer recognizes as 'food' with many competing products and relatively low prices compared to medical products. The functional food product in a food store would thus have to taste well, be priced as a food product and be recognized as a food product.

Looking at the rapid changes in the food retail market, it is clear that not only the food industry, but also the retail market is changing towards fewer and larger actors (Traill, 1997; Lagnevik & Kola, 1997). The stores become larger supermarkets and they are fewer in number. In these stores, it is also possible to find aisles with an extended health food assortment compared to average food stores in Sweden. In the US, large food stores commonly have a pharmacy within the store in addition to a wide assortment of natural remedies and health foods. It is possible that in the future this kind of integrated supermarkets where one can find a pharmacy and other services within the store will be more common in Sweden. If this is the case, it will enhance the possibility to market functional food product as illustrated in Figure 6.6.

[57] VAT Value Added Tax, for food 12% and for medicines 25 %, in Sweden (2001)

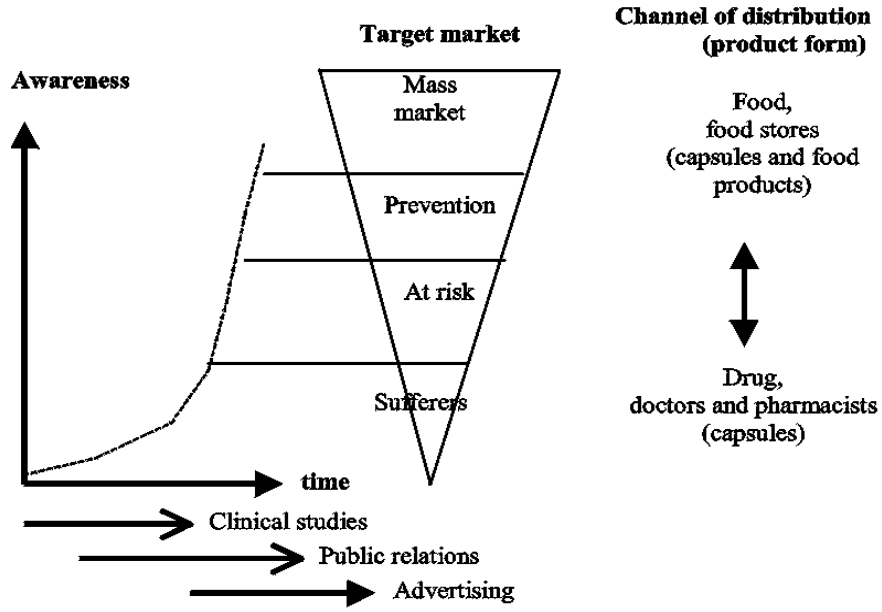

Figure 6.6 Marketing functional food products for targeted markets (from the ProViva case, CAG Functional Foods).

The model in Figure 6.6 shows graphically, in the center, how the size of different targeted markets may vary. It also shows that the channel of distribution affects the consumer's expectations for the product. The curve at the left in the model shows an increasing awareness among consumers of the new product throughout the process of innovation. CAG Functional Foods (in the ProViva case) builds consumer awareness by targeting the "sufferers" first. They are the primary market segment, in need of a product and willing to pay a premium price for it. As the awareness increases, new products containing the functional food ingredient (lactic bacteria in this case) are introduced. The dietary supplement, a capsule, thus becomes an ingredient in a food product.

The IgY-case appears to show the same type of marketing strategy as CAG Functional foods. A medical application for 'the sufferers' has been introduced. Products for broader markets are not yet developed.

In the other case studies, the products (ProViva, Magiform and BRA-milk) have all been introduced as a food product sold in food stores. Positive results in clinical studies have stimulated the development of a more concentrated version of the product, for example in the ProViva and Magiform case. How these products are going to be marketed remains to be seen. Furthermore, in all of these cases continued efforts are aimed at developing a medical product (a capsule or a pill).

6.6.3 Marketing arguments

An analysis of the products in each case shows that the functional food products are sold as normal food products with limited scientific information on the products packaging (Figure 6.7).

In the IgY-case a functional food product is not yet developed, so it was labeled as a drug (a prophylactic treatment for patients with a disease). In the future, an egg, as natural as those most of us consume today, with an immune supporting effect could be sold as a normal food, with a positive health image. This is further discussed below.

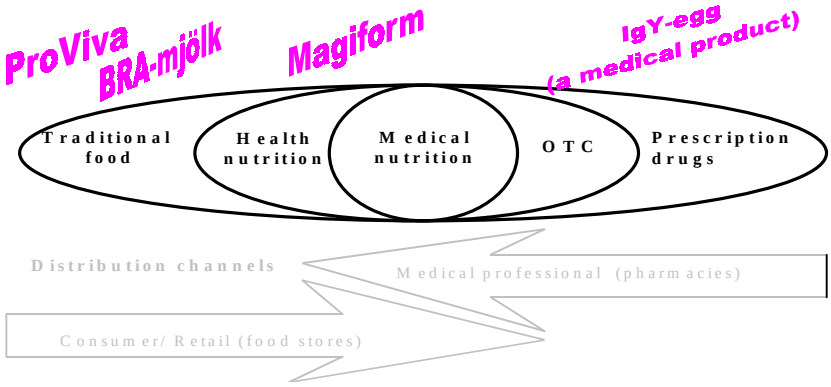

Figure 6.7 Marketing strategies for the functional food products in each of the cases.

Clearly, all of the products in these cases could be sold with 'heavy' health arguments, providing solid scientific results of positive medical effects. In the past the food industry has argued for the need to inform the consumer of the scientific results in marketing arguments and yet none of the products remotely touches on the science behind the development, in the consumer information[58]. At a first glance this seems like a waste of resources (costly R&D) if the consumers are not informed. What could possibly explain these strategic choices? An analysis of each case provides interesting possible explanations for the findings.

In the **ProViva** case the product is sold by Skånemejerier, a large food producing company with many other health-related products (milk-based products providing calcium and healthy bacteria in fermented products). The choice of selling ProViva as a "normal food" with a soft argument " *Your stomach will thank you*" does not interfere with the company image or sales of other products.

[58] An internet address, with more information about the product, the scientific results and possibility to make inquiries, is provided on the packages of these products.

A soft marketing argument "*Enjoy it and feel good*" (Skånemejerier, 2001) is also the main message in the advertisement for ProViva in ICA-handlarna's paper. The heading for this advertisement is "*Swedish research offers the Swedish people 5 crowns discount*". It continues as: *"It took eight years. Plus nine doctoral dissertations and thirty clinical studies. By then we, at Skånemejerier, and the researchers in Lund, had managed to develop a natural fruit drink with the healthy bacteria that provides protection, Lactobacillus Plantarum 299V (pardon, but that is the name for researchers)..."* In this advertisement the extensive research in developing the product is given attention. The main message is still, however, the health effects that the product brings to the consumer. The sales arguments for ProViva Active also conveys a positive health message: *"Drink it afterwards. The Swedish elite does*". ("Drick den efteråt. Det gör den svenska eliten").

BRA-mjölk is sold by ICA-handlarna as a private label and the reason for selling BRA-mjölk as a normal food product is, of course, the fact that ICA-handlarna is a large food retail chain. No advertisements have been found to promote this product, but that is the case for many other private brand products that are sold by ICA-handlarna.

The **Magiform** products (müsli, biscuits, pasta, bread and crackers) all have food-like appearances with regard to how they look and taste. The packages have a picture of a tanned and healthy looking stomach with the text "*Developed for you who want to feel better in your stomach and in your gut*".

The **IgY-egg** case does not have a functional food product on the market yet. For comparison, however, an egg product, which is sold in the UK under the name "Columbus' eggs", is popular among consumers. These eggs have a high content in omega three, which is associated with preventive effects in the area of coronary heart disease. The sales argument for these eggs is not focused on preventing a medical condition. It talks of hens that are fed a natural, wild and nutritionally balanced feed, and thus making a health association.

We can summarize that these products all have sales arguments that are 'positive health messages'. They do not talk of threats, limiting risks and complicated scientific studies. Instead they focus on making the consumer feel good about purchasing and eating these products. An example of a product that has chosen to use a "negative health message" is Benecol. The information about lowering the cholesterol is, of course relevant and scientifically solid and many consumers are aware of the risks associated with a high level of cholesterol in the blood, but the message has a negative connotation. It makes consumers feel at unease about themselves and about eating food.

The motive for choosing positive health messages in these cases is probably explained by a number of reasons. One of the most important reasons is the

positive health image for the product as such and the business at large. Lack of a legal framework for marketing health effects is another important institutional factor but even in Japan, where it is legally recognized to make a scientific claim in sales of "Fochu" (Japanese for functional foods), about 90% of the products are sold with soft health arguments rather than scientific facts (Wikström, 2001). The marketing strategies are focused on developing a positive relation to the customers. The institutional conditions are further discussed in "Marketing functional foods in Sweden" (6.7.1).

6.6.4 Branding

A brand name is a carrier of beliefs, an image of a product and, in many cases of the entire company. It provides grounds for firm image marketing and product differentiation where the consumer shows his or her identity by purchasing certain products.

The brand names in these cases are: ProViva (for life), Magiform (stomach in shape) and BRA-mjölk (good milk). These names, logos and illustrations on packages, all give health associations. Assuming that is desired by the food company, what are the underlying reasons? The main reason is that reputable brand names provide confidence that allows customers to differentiate these products from other products, and they are thereby willing to pay a premium price for the value added product. It is assumed that the brand names create grounds other than the function of the product (taste, nutritious etc) for making a choice of a product.

The strength of a brand name can be determined in a customer survey in terms of recognition and purchasing patterns. Another dimension of the strength of a brand name is the elasticity of the name (how much the name can be stretched). The brand name Nike, for example, is a considerable asset with high elasticity as it is associated with a large number of good quality (highly priced) products. Examples of how the brand names are stretched in the cases are seen in the development of ProViva Active and a product line, Magiform.

A brand positioning strategy is based on the values that each product are meant to support as a part of a company image. These images are illustrated in the cases in Table 6.2, as self-images. The positioning strategy is also a means to strengthen the competitive position by attracting interesting partners in development and licensees.

6.6.5 Licensing agreements

Licensing agreement is another way of gaining pay-back on R&D investments. In the cases, Probi AB (ProViva) and BioGaia Biologics AB (L. reuteri) have pursued this avenue. Both these companies are on the stock market. They are internationally renown and dependent on a positive company image.

In looking at the innovation process it is clear that both companies have patents and brand names to protect their intellectual properties. BioGaia Biologics have offered licensees a complete product, including a brand name and a package, which, in this case, is also associated with major R&D efforts (LifeTop™, a bottle for drinks).

A licensing agreement requires trust. A condition for sharing technologies or know how, such as a secret recipe, is some kind of assurance of control and trust. This condition for trust is expressed in rigorous contracts and legally binding agreements. Another way of gaining control is to maintain the dominion of a critical part of the production process, for example in production of a 'starter culture'. In both of these cases (ProViva and L. reuteri) the starter cultures are produced in their own biotechnology plants. The production facilities (Multiferm AB in Lund and Biosentrum AS in Stavanger) have the capacity to meet the needs of the licensees. Keeping the production know-how within the company is a way of ensuring long-lasting customer relationships and dependencies.

6.7 Marketing functional foods in a societal context

Functional food products are developed in a context of politics, legal systems, norms and values, finances and other societal factors. In earlier studies of functional foods the lack of a legal definition and system for functional foods has been pointed out as major problems for the food industry (Mark-Herbert & Nyström, 1993). Yet, the institutional conditions have allowed for development of functional foods in these case studies.

6.7.1 Marketing functional foods in Sweden

In the presented cases, the lack of a legal system has not hindered the development of functional foods. The National Code of Practice, though not a law but rather an agreement, has provided guidance as to how products with health effects may be marketed. Investments in R&D, resulting in products with medical effects, have been launched thanks to a close cooperation between state authorities and companies. Since Sweden has become a member of the EU, in 1995, however, it has become increasingly clear that harmonized legal systems for food and medicines would facilitate production and trade with these products.

In Sweden the majority of functional foods are launched as food products. They are sold with a health image at a premium price. The image is to a large extent created by consumers and professionals in the medical field, spread by the internet and by the word of mouth. The interest for health has increased in the 1990s among people at large. Nowadays we commonly find a health issue page, column or even an entire section of a paper devoted to health issues on a regular basis.

If we look at societal interest expressed in terms of financial support it is apparent that governmental funds for research in this area are rather moderate compared to the financial support for similar activities found in for example Finland and Japan. In Japan, it is societal interest in limiting costs for medical care that motivates the financial support. In Finland, however, like in Sweden, these investments are motivated by forecasted industrial competitive advantages.

6.7.2 Marketing functional foods in the US

The food industry at large shows interest in pff in the US. Several large companies have started R&D programs of their own, or alliances with other businesses such as seen in the case in this study. Functional foods face many problems, which may be explained by their relative newness to the market to the FDA (Food and Drug Administration) as well as to customers.

For the sake of beliefs, as well as for legal reasons, ConAgra' s goal (from the ProViva case) is to build strong science to back up the product. It serves as a base for their business strategy. This means scientific, well documented double blind tests on people using the product or ingredient, and preferably studies conducted in the US. Their reasoning is that if the FDA is not convinced, the consumer might not be satisfied either.

If a claim and the product become an object of investigation for the FDA, experience shows this may be a time- and resource- consuming process. It took eleven and nine years respectively for Johnson & Johnson to get approval for their Sucralose sweetener, and for Procter & Gamble to get approval for Olestra (a calorie free fat replacement). Consequently, marketing the product as a dietary supplement, as opposed to a food-additive, is a faster way to reach awareness, i.e., to reach the consumer market.

6.8 Strategies to meet the future

The food businesses have traditionally been regarded as rather low tech, producing bulk products for a traditional market. It is commonly labeled as a raw material-driven strategy. With contextual changes, new strategies for meeting the future are emerging. Interest in gaining financial return on the products as well as a strong market position may account for developing new and more specialized products as well as finding new markets. These new strategies are driven by market values.

6.8.1 New strategies

These new strategies require new organizational forms, new management styles and new definitions of business raison d´être. We have discussed the strategies revealed in these cases as different ways to allow for the development of radically new

products. But what about all other companies that have not been subjects of this study? What are their options if they want to engage in development of functional foods? Three strategies are theoretical options, for the existing food businesses.

One option is developing a variety of healthy substances, protected by immaterial property rights, and formulating products that meet existing consumers needs. A second option is to extend product lines by combining the portfolio of existing and new product forms with innovative new substances. The third option is to follow a strong trend, to identify emerging growth opportunities that can be accelerated into the mainstream market through competencies in marketing and distribution. As pointed out by Teece (1986) a fast second mover or even a slow third might outperform the innovator. They may have access to the complimentary assets that are needed to commercialize an innovation. "Innovating firms without the requisite manufacturing and related capacities may die even if they are best at innovation" (Ibid, 285).

Some of the success factors required for each strategic option would be the ability to develop and identify healthy substances, accessing consumer behavior information, capacity to build brands, partnering skills and a strong distribution base. Time to market will vary with the strategic pathway chosen, as will the risk. There is no guarantee for success in either of these strategies. A suitable strategy, however, is based on a thorough analysis of the company competencies, willingness to take risks and the fit with the overall business strategies.

In theoretical terms, as shown in Figure 2.4 (and 6.1), strategies for development of functional foods can be illustrated as changes from the lower left corner outwards in the quadrant. What is illustrated as a strategy for development with high technological uniqueness (strategy C) may be of little commercial value in a short time perspective but it may provide grounds for strengthened future market competitiveness. Developing a high uniqueness on the market, on the other hand, (strategy A) is most commonly used as it involves less investment in R&D. The strategies in the cases would serve as examples of a strategy for development of high technological and market uniqueness (strategy B). This upgrading process, development of new technologies, is commonly carried out in different forms of collaboration agreements.

6.8.2 Access to technologies

One of the reasons for collaboration is to reduce costs and risk. One way of managing risk is to protect the technology tied into this product or process through proprietary rights, for example patents. These patents may cover several applications of a technology and use of, for example, a strain of bacteria. A common understanding among the interviewees, in the cases, is that patents, as well as strong brands, are vital. This perception also dominates in the field of pharmaceuticals where the production of certain medicines is discontinued when the time for the patent is running out, even though the product is not replaced with a superior one (Gustavsson, 2001).

Baring these perceptions of the importance of proprietary rights in mind, one might ask if the food and pharmaceutical industry has something to learn from the computer operative system industry? It was in the development of Linux, a computer software, that the concept of *open source development* received increased attention (Wayner, 2000; Meliam 2001). Open source development refers to a situation where technologies (knowledge) are shared within a community while still maintaining commercial potential. The contrary would be a more closed strategy for development of technology, which is used by, for example, Microsoft Windows. The key to development in the open source strategy, in development of Linux, was creating something together and taking pride in the peer recognition that resulted from each addition to the program. The open source tradition also reflects the kind of environment that presumably is characteristic for an academic environment.

Assuming that scientists get their schooling in an academic community, where technologies are developed in collaborative arrangements with openness towards a larger community, why do proprietary rights become so essential in food and medical applications? A possible explanation is that in an open source development the innovation process is difficult to manage. Some scientists will argue that the innovation process in itself, independent of strategies and organizational arrangements, is "a nonlinear dynamic system" better described with chaos theory than any planning models (Van den Ven, 1999, 5). If that is the case, an open source development could be an option given the appropriate context and resources. If the innovation process, on the other hand, is linear and possible to plan, an open source development would certainly make the coordination of contributions and the direction for development arduous tasks.

The other possible explanation to rejecting an open source development is the question of financing these developments. In the case of Linux many private persons devoted their spare time at home to contribute to the program. For the development of functional foods, however, it would require resources that are not accessible to most individuals.

The last, and perhaps most important, reason for rejecting an open source development for functional foods is lack of motivation among people at large. In

the case of Linux many individuals were frustrated with the monopoly situation that Microsoft had acquired. There were simply too few alternatives for people who did not want the highly-priced Microsoft products. In the development of functional foods, although radically new, other food products do exist. Consumers rely on food and medical authorities to act in their interest. So far these interests have been communicated in collaborative arrangements between industries and authorities.

In Japan, state funds were directed towards the development of technologies that ultimately would provide lowered costs for health and medical care in society and a commercial potential for the food industry. In an on-going open source development of technologies as collaboration arrangements between industry and state universities, these objectives are met.

Albeit, the open source development is probably not a likely developmental path in the area of functional foods in Sweden - at least not the way we have defined it here. If, however, the term *open* is somehow limited to a smaller and well-defined community, such as the collaborative arrangements illustrated in the cases, the open source development might be a fruitful conceptual model assuming there are well-allocated resources and trust among collaborative partners.

6.8.3 Industrial marriage

The future market for functional foods also depends on the willingness of food companies to invest in R&D. When major food companies decide to close down their R&D departments it raises the question of future development and the need for skilled labor (Leife, 2001, 6). Swedish Meats decided to close down the R&D department in 2001. As one of the largest food businesses in Sweden, in an industry that strives to attract people with higher education, it raises a question of a choice of strategy that has led to this decision.

Swedish food manufacturers spend less than two percent of their annual turnover on R&D (Mark-Herbert & Nyström, 2000 B, 22)[59]. Compared to the pharmaceutical industry (with nineteen percent of their annual turnover on R&D), which very well could play a major role in development of functional food markets, this seems very low indeed (Ibid). Where the pharmaceutical industry has an advantage, in a strong R&D tradition, the food industry seems to have a need. The food industry, on the other hand, is more focused on consumer marketing; it has shorter development

[59] The figure, 2% of annual turnover, for R&D in the food industry (Mark-Herbert & Nyström, 200B) seems low, yet it reflects a wide definition of R&D, including environmental development and new product development. In the most recent edition of *'Fakta 2001. Pharmaceutical market and healthcare"* the comparative figures are even more differentiated; where the pharmaceutical industry spends 26,8% of their annual turnover and the corresponding figure for the food industry is 0.4% (Läkemedelsindustriföreningen, 2001, 23).

cycles and it is less stringent on safety and efficacy evaluations. These areas are all shortcomings of the pharmaceutical industry in the area of functional foods.

It seems reasonable that partnerships would benefit food and pharmaceutical companies. These collaboration agreements, such as joint ventures, are seen in for example the strategic agreements between General Mills / Protein Technologies Inc. and Novartis Nutrition / Quaker Oats (reported in *New Nutrition Business*, 2000). Collaboration may provide advantages such as access to critical technologies, as in the case of General Mills / Protein Technologies Inc., or new markets, as in the case of Novartis Nutrition / Quaker Oats.

In a recent presentation by one of the CEO for a leading pharmaceutical firm in Sweden he clearly stated that the strategic aims for future developments were leading the way for products that impede, delay or all together prevent the onset of a disease. The business idea is thus extended from products for treatment and alleviation to include proactive and preventive products. These products are especially interesting in the area of weight reduction, allergies, cancer and coronary heart diseases (Personal communication, Hassan, 2001).

The closing of an R&D department in a major food company, mentioned above, could signify that new strategies for collaborative R&D activities will be the new way of managing the innovation process. Skilled, experienced and well-informed managers will simply have to build on networks of experts and coordinate the development process, as a part of the new economy. This will be an interesting field for studies in the future.

7 Conclusions and reflections

In addressing the research question *How do Swedish food companies develop radically new food products?*, several factors appear to have explanatory value. Some of these factors are described in the cases, in a contextual analysis and in discussions in the preceding chapters. These factors are also summarized below in terms of conclusions, a re-visitation with the research question, and a future outlook.

7.1 Conclusions

7.1.1 A new product category

On a relatively stable market, such as the traditional food market, changes are gradual and slow. The consumers are conservative and thus contribute to preserving of prevailing conditions. In that environment, a strategic plan works well. It provides conditions to achieve efficiency and a direction for future accomplishments. New products and processes are developed with minor alterations from those currently in use.

Radically new functional foods differ greatly from the vast majority of established food products is the. They are *radically new products* in *a new product group*. That is why developing these products is such a challenge. The development of functional foods involves managing the innovation process and marketing products with added value. A planned strategy thus has to be replaced by a strategy that allows for flexibility. These strategies evolve over time and they change throughout the innovation process.

The functional food market is a rapidly expanding market. It has characteristics of a changing market where flexible strategies are reflected in strategic collaborative development that is ahead of the development of a legal frameworks, on the market as well as in individual companies.

Businesses that want to succeed in this market will have to find new ways of conducting management, in particular in identifying critical technologies. This refers to building internal skills, employing innovative external sourcing, developing new markets, establishing alliances, developing packaging, building strong brands and finding venture capital for new developments. The strategic options also include strategies of communication.

A summarizing figure is presented to capture some of these strategic choices (Figure 7.1). One of the underlying assumptions is that the food industry is facing a challenge of changing attitude towards food production. In this perspective a faster moving market requires a strategy that combines market pull and technology push as driving forces for the innovation process.

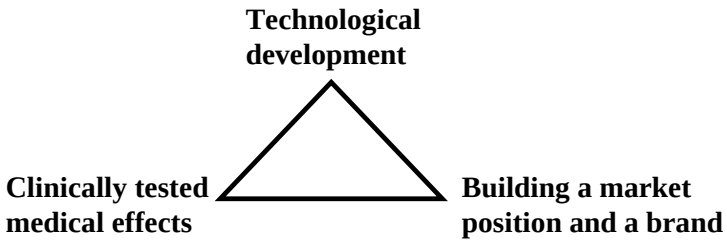

Figure 7.1 Three corner stones for creating added value in developing functional foods; technological development, clinically tested medical effects and building a market position.

These strategic choices are summarized below in terms of technological development (technological and marketing strategies), clinically tested medical effects (organizational collaboration in the innovation process) and building a market position (the use of market channels and brand names).

7.1.2 Technological development

In the past decades the Swedish food market has become more exposed to competition. With increased competitive pressures, low prices and large volumes may not suffice as strategic advantages in a long-term perspective. One way of gaining competitive advantages requires finding new ways of creating added value. Added value, as it is seen in these cases, is based on technological development. It is a *technological upgrading process* that refers to making use of technologies (knowledge, illustrated in Figure 6.1). In these cases the technological upgrading leads to the production of value added products, profits from licensing agreements and a boost for the company image.

These new technologies are protected by proprietary rights, that serve as an assurance of ownership. They also provide grounds for a reinforced image for the company. For a company on the stock market the image is reflected in the expected future value of the shares. A company that is not noted on the stock market may still receive benefits from a strong image as it may attract other successful business partners to collaborate in sales or future development projects.

7.1.3 Clinically tested medical effects

In this study the innovation process is seen as technological and market development. The development of new products and processes are dependant on one another. A successful innovation process, where a radically new product is developed, requires that these processes are well coordinated.

The technological development, as it is carried out in these case studies, is not an in-house achievement where one company has all the needed technologies and skills. It is rather a collaborative accomplishment between research groups and food companies. During the collaborative process, partners were changed several times and the organizational forms changed to meet the new conditions throughout the process. A virtual organizational arrangement provided a high degree of freedom in, for example, the selection of collaboration partners. Alliances and joint ventures signified a need to collectively manage the innovation process. Acquisitions, on the other hand, required a large capital investments and it provided a situation of integrated management.

In the technology development, the knowledge in itself and the proprietary rights play central roles. These proprietary rights, for example patents and brand names, provide an assurance of greater payback on the invested resources in the development process. The knowledge in itself is expressed in scientific studies to back up medical claims (Eliasson & Bergqvist, 2001) and an awareness of different areas for application. The companies in this study did *not* settle for using a newly developed technology in one area, for example food (functional food). All of the cases reveal plans for using new technologies in different areas of application, for example in developing feed, medical products and even products for research purposes (Figure 5.6).

The added value, and thus the revenues, in different areas of application will vary depending on prices, volumes, taxes and the cost of developing and marketing products. However, very few food businesses in Sweden express a business strategy that includes making use of technological skills through licensing (Mark-Herbert & Nyström, 2000 B, 29-30). These businesses are simply food producers with little ambition to explore new avenues. What Wejåker refers to as "thinking horizontally" (personal communication, 2000) could lead to new areas of technological application, even for established technologies where patents and tacit knowledge provide assurance of ownership within collaborative arrangements. This avenue is not possible to take unless the raison d'être is re-defined for most food businesses.

7.1.4 Building a market position and brand

It seems reasonable to assume that many more functional food products will appear on the market in the near future. Consumers with high expectations of health, comfort and appetizing products will pay a premium price for these products.

Depending on how these products are marketed the revenues may vary, as will the marketing channel and marketing arguments (Figure 4.2). If a product is sold as a medical product (prescribed drug, OTC or a medical nutrition product) the sales volumes will be smaller and the price higher. The sales will depend on medical professionals. If a product is sold as a food product with a health image, the sales volume will be larger and the price lower. These products can be found in food and health stores.

These strategic decisions also affect product design and the marketing arguments used. Looking at food products in general, it is evident that sales arguments have changed drastically the past three decades, even if some of the food products are basically the same. Prior to the 1970s sales arguments were often built on a strong brand name alone (and the face of a happy house wife in her home). In the 1970s and 1980s the health related arguments were based on "absence of negatives", for example fat, sugar, salt, in information such as: "This product is 96% fat free". In the 1990s these arguments have changed to positive information, "presence of good stuff", for instance, fibers, minerals and 'good-for-you-bacteria'. Increased awareness and interest in health among consumers at large has certainly facilitated the marketing of functional foods.

The marketing strategy in each of these case studies reveal two very different strategies – either targeting the "sufferers" with a specific medical product or the mass market with a food product (Figure 6.6). Marketing a product of a medical kind (capsule, pill or concentrated version of a product) means that the "sufferers" are targeted as the primary segment. Medical effects in scientific clinical studies provide grounds for research reports and "hard facts" in marketing these products. Positive experiences from this group provide a spillover effect in the "at risk" and "prevention" segment, consumers with a high awareness and priority of health. The broad mass-market is eventually targeted with a food product where the active substance is an ingredient.

Another possibility is marketing a food product without medical claims. Instead, soft marketing arguments like, " X will make your stomach happy", provide a positive association between health and the product. In the cases where the product has started as a mass-market product continued development may lead the way towards medical products.

7.2 Revisiting the research question

Looking back at the research process, several choices were made along the way. Some were mine and deliberate, other choices were intuitive or my advisors'. Having tried different theoretical perspectives my choice was a creative management perspective. Other perspectives did not provide grounds for understanding the entire process, the development from idea to a product on the market, including both technological and market development.

I choose to focus on the process of innovation as it is seen in managing changes. In studying the process, conditions that are necessary to cause an outcome were discussed. It is the combination of these conditions that reveal the story and how the outcome occurs. The case studies, however, were selected on the basis of the outcome. A creative management perspective refers to the development of technologies, markets and new businesses. My perspective also includes a choice of model and method for conducting the study.

7.2.1 A theoretical perspective ex post

In my theoretical understanding of the innovation process one step leads the way for the next in the development of a radically new product and process. It is a learning process in a new territory, followed by processes of refinement and efficiency. This perception has affected my theoretical focus and my crafting of the narratives (Barry & Elmes, 1997, 434).

During the interviews a story is told of how something new was developed. For reasons of logic and rhetoric a story is often told as a chain of chronological events. Detours are forgotten, mistakes are suppressed and uncomfortable situations are neglected. In addition, constructive vagueness allow for a number of interpretations. That is why we often get a rational story 'on the expressway' instead of a winding trip on a countryside back road. The story may therefore seem more linear than it was, but careful interview technique will uncover some of the detours and winding trips taken.

Crafting case narratives with a sense of novelty is a careful balancing act between making the too familiar mundane and the unfamiliar lacking in credibility (Barry & Elmes, 1997). A new area of studies, such as that of functional foods, thus creates a sense of novelty that has to be balanced with familiar wordings and structure to achieve credibility.

In these cases it was sometimes hard to clearly separate the different phases of the innovation process. The collaboration was carried out in such a way that it was hard to draw lines between phases and the allocation of labor in the innovation process. It became increasingly clear to me, however, that product, process and business

development are highly interdependent processes, all of which are needed for living up to tomorrow's expectations.

7.3 Future developments and research

In these cases, the innovation process is discussed as it is carried out by research businesses in collaboration with food businesses. The outcome of the successful collaboration is radically new products with high technological uniqueness and a high degree of uniqueness on the market. The market for functional food is forecasted to continue expanding. It remains to be seen for how long the functional food market will continue to be dominated by food businesses. Research shows that pharmaceutical and biotechnology firms do considerable research in for example probiotics (Childs, 1997). Another area of interest for the pharmaceutical industry is phyto-chemicals as future ingredients in functional foods (internet, Leatherhead, 2001, *foodlineweb…*). Pharmaceutical companies also demonstrate strategic aims that go beyond treating symptoms and curing diseases. Pharmaceutical and biotechnological companies have the capacity and perhaps an interest in making an entrance on the functional food market.

There are over 20 000 launches of new food products in Europe alone each year (Internet, Leatherhead, 2001, *foodline…*[60]). Faced with an increasing competitiveness, food manufacturers are under pressure to find products with added value. Added health benefits is one option and convenience is another. Ideally, many consumers want both of these added values. These products are developed for 'cash-rich and time- poor' consumers. Their snacking habits are linked to an active life style with little time to cook and many meals 'on the go'. An awareness of major changes in life style and eating habits is a condition for the successful development of new food products.

These conclusions raise a question of the interest of society at large in these foods. Assuming these products delay the onset of a disease, offer a cure or a better treatment of a disease[61], does this make the development of these products a societal interest? A person eats on average 50 tons of food in a lifetime (Sandberg, 2001). The composition of this food and life style in general will to a large extent

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[60] According to Leatherhead (internet, 2001, foodline…) the number of new food product launches in 2000 in Japan and Europe is about 20 000 respectively. The corresponding number in the US (for 2000) is about 12 000 products per year.

[61] The diseases that functional food products may prevent, or be a part of the treatment of, are for example AIDS (Coghlan, 2000), Diabetes Type 2 (Hellénius, 2001, Tuomilehto et al., 2001),Crohns disease (Almer, 2001), Cystic Fibrosis (Carlander et al, 1999), cancer and cancer treatment (Rafter, 2001; Tingåker-Johansson, 2001 A, 8), coronary heart disease (Saldeen, 2001; Anonymous in *Kemivärlden*, 2001) and allergies (Alm, 2001; Tingåker-Johansson, 2001 B, 3-5).

determine the risk for so called welfare diseases (for example, cancer, coronary heart disease, diabetes and osteoporosis). Many of these diseases can be proactively treated by choice of food products and lifestyle.

Since the costs of medicines and medical care in western societies are very high, and rapidly increasing (Axelsson, 2000; Grewin, 2001; Carrey & Barret, 2001), we may expect these products to benefit both the food industry and society at large[62]. After all, rather than subsidizing the treatment of a disease it seems more logical to support prevention in a proactive strategy for health. If society does not subsidize the products, should the development be funded through research grants as is the case in Japan and Finland?

The area of *novel foods*, foods containing genetically modified raw material, is also an area of growing concern. The techniques to enrich products with certain components and give products desired characteristics are available. Is this development desired and needed by consumers? Consumers' attitudes will have an impact on the development of legislation and the acceptance of new products (Bech-Larsen et al, 2001; Bredahl et al, 1998). The ethical aspects of food production and health will increase in importance as the boundaries between food and medicines, traditional processing and genetic techniques, and information and marketing, are fading.

Let the food be your medicine and the medicine be your food.
(Hippokrates)

[62] According to The Swedish Association of the Pharmaceutical Industry (Anonymous, 2001,8) the sales of medicines in Sweden has increased significantly. In 1980 the sales of pharmaceuticals per capita was 453 SEK. Twenty years later, 2000, the sales, per capita, is 2822 SEK.

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Personal communication

Case/ market	Person	Position and organization	Time and place	Kind of contact
ProViva	Kenneth Andersson	Responsible for R&D, Skånemejerier Ek. för.	98.05.11 Malmö	personal interview
ProViva	Mats Lönne	Product manager, ProViva product group, Skåenmejerier Ek för.	00.02.14 Stockholm 01.03.05	conference mail
ProViva	Claes Lönner	CEO, ProbiFeed AB	98.05.11 Lund	personal interview
ProViva	Sam Rao	Vice president of Science and Technology, ConAgra Inc.	98.11.12 Omaha, USA	personal interview
ProViva	Steven Stirling	Vice President Marketing and sales, CAG Functional foods	98.11.11 Omaha, USA	personal interview
ProViva	Kaj Vareman	CEO, Probi AB (until 2000)	97.11.26 Stockholm 98.02.03 Lund	IVA-seminar personal interview
ProViva	Monica Walter	CEO, Probi AB (from 2000)	01.05.10 01.06.19	mail telphone interview
Magiform	Ingmar Börjesson	Responsible for R&D at AB Cerealia	99.06.11 Stockholm	personal interview
Magiform	Johanna Ehrhardt	Responsible for marketing, BioDoc AB	00.02.22 Stockholm	personal interview
Magiform	Carola Lidholm	Responsible for R&D, BioDoc AB	99.12.17 Stockholm	personal interview
Magiform	Lars Sjöstrand	CEO, BioDoc AB	99.08.24 99.12.17 Stockholm	personal interviews
IgY-egg	Bernardt Claesson	ÖL, Klin. Mikrobiologi, Kärnsjukhuset	01.01.09 01.12.06 Skövde	written feedback, mail
IgY-egg	Hans Kollberg	Prof. Pediatrics, UAS, Uppsala	00.08.31 Uppsala	personal interview
IgY-egg	Anders Larsson	Dr., Head of dep. Dep. of Medical Sciences, UAS, Uppsala	00.05.19 Stockholm 00.07.04 Uppsala	conference personal interview

IgY-egg	Per-Erik Wejåker	Agr. and farmer, Sörgården, Vittinge	00.08.10 Uppsala	personal interview
IgY-egg	Helena Wall	PhD-student in avian studies, SLU, Uppsala	01.03.27	mail
BRA-mjölk	Anita Lindström	Corporate Communication, BioGaia Biologics AB	98.09.01 98.11.25	conference mail
BRA-mjölk	Bo Möllstam	Technical Coordinator, BioGaia Biologics AB	98.11.30. Stockholm	personal interview
BRA-mjölk	Peter Rothschild	Managing Director, BioGaia Biologics AB	98.09.01 98.10.12 Stockholm	conference personal interview
Market	Göran Alsterlind	Consultant , market analysis in the medical field	98.09.02 Stockholm	conference, informal talk
Market	Åke Bruse	Medical expert, National Food Administration	00.05.19 Stockholm	conference + informal talk
Market	Fred Hassan	Pharmacia Upjohn AB CEO (Plenary speech at NFF conference)	01.08.17 Uppsala (UU)	NFF conference
Market	Karin Malmcrona -Friberg	Managing Director, Swedish Center of exellence and innovation in Functional foods	99.09.07 Uppsala 00.05.18 Stockholm	personal interview conference
Market	Bertil Nobelie	President , National Food Administration	99.08.26 Uppsala	personal interview
Market	Jan Rosenström	Managing Director, Livsmedelsindustrierna	99.07.03 Stockholm	telephone interview
Market	Håkan Rudérus	Professor, Uppsala University	93.01.08 Uppsala	personal interview
Market	Peter Wennström	Marketing Consultants, Lund	00.04.20 Stockholm 99.05.18 Göteborg	Personal conversation Conference
Market	Per-Olof Sjödén	Professor, Uppsala University	93.05.05 Uppsala	personal interview

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Magiform

BioDoc (på svenska och engelska, en presentation)

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Appendix 1

Perspectives of the innovation process in different management schools

Studies conducted by researchers from different disciplines and schools reflect several choices in perspective. The business model, main focus and whether or not the innovation process is at all recognized will determine what perspective might be a fruitful one. Shown below is a timetable for how ideas and concepts have developed in management studies during the second half of the twentieth century Table A.

Table A. Development of management studies (based on Nyström, 1997, 3-4)

School of thought	**Time**	**Business model**	**Main focus**	**Examples of authors[63]**
Economic	- 1960	One entire unit, rationality, efficiency & predictability	Short run efficiency	Kotler, Porter, Simon, Taylor
Organizational	1960:s	Different functional units	Adaptation to a given environment	Lawrence, Losch, Porter
Strategic	1970:s	Different strategies needed at different times	Search for the right environment	Ansoff, Crawford, Day Mintzberg
Resource-based	1980:s	Firm specific capabilities and assets, emphasis on efficiency	Ultimate use of resources in the environment	Penrose, Rummel, Teece, Wennerfeldt
Creative	1990:s	Intellectual capital, technological acquisition and management	Creating opportunities and the environment	Nyström, Tushman, Utterback, von Hippel

The perspective for this study would sort under the creative management school. The innovation process is seen as creating opportunities – development of new products, processes, markets and businesses. These opportunities are discussed (in Chapter six and seven) in terms of innovation management where an external environment that sets the outer limits and driving forces for the innovation process (presented in Chapter four and five).

[63] These authors are not listed in the reference list.

Appendix 2

An interview guide

Prior to each interview contacts were made with the interviewee. Procedures for reviewing the material were decided prior to the meeting. During the interview questions are asked based on the themes below in a relaxed conversation. During some interviews the first question lead the way for a long "story" that entails most of these themes. My follow-up questions, during all interviews, aimed at making sure I understood the interviewee's story.

(date, place, conditions)

Interview person
Name, position, personal history

(What is your role at...?)

Description of the company and its environment

(Would You tell me a little about the development of...?
critical incidents... how did You... ?, when did You...?, why did You...?)

Themes covering:
A. General characteristics
B. Company organization
C. Markets served by the company
D. Market strategy for the company
E. R & D strategy for the company
F. R & D organization
A description of products and processes
G. Product characteristics
H. Process characteristics

(My own reflections regarding the interview)

Appendix **3**

Products and websites for functional foods products
(www.FunctionalFoodsToday , 2001.03.01, Leatherhead, UK)

4 Plus (www.emmi.ch), ACTIMEL (www.actimelusa.com; www.actimel.tm.fr),
AKTIFIT (www.emmi.ch),
AVIVA www.wander.ch/cgi/de/products/functionalfood/index.asp,
BARRES MEMOIRE/CARRES MEMOIRE (www.gerble.com),
BECEL PRO.ACTIV (www.becel.com.br), BENECOL (www.benecol.com),
BIENESTA (www.hero.es), BRAIN GUM (www.braingum.com),
CANDIA (www.candia.fr), CHEERIOS (www.cheerios.com)
COLUMBUS EGGS (www.columbuseggs.com),
DANONE BIO (www.danone.it/bio.html), EVOLUS (www.valio.fi),
FLORA PRO-ACTIV (www.flora.net.au), GAIO/CULTURA (www.mdfoods.dk),
GEFILUS CHEESE/GEFILUS PRODUCTS (www.valio.fi),
INDOMILK OMEGA 3 MILK POWDER (www.indomilk.com),
JOUR APRES JOUR/LACTEL ET OMEGA 3/LACTEL CALCIUM (www.lactel.fr),
JUVER CALCIO (www.juver.es), KAIKO CALCIUM (www.iparlat.com)
LC1(www.lc1.com/homepage.html), LEYMA CALCIO (www.leyma.es),
LINOBENE (www.hk-ruokatalo.fi), MAMAN
(www.parmalat.net/www/product/ita/prodotti/parmalat/latte_speciale_uht_split.htm)
MILRAM (www.nordmilch.de),
NESPRAY (www.nestle.com.my/products/nespray_milk_powder.htm),
NUTRIBREAD (www.williamjacksonbakery.co.uk/news.html),
OCLEA (www.wander.ch/cgi/de/products/functionalfood/index.asp),
OMEGA 3 MILK
(www.parmalat.net/www/product/ita/prodotti/parmalat/latte_speciale_uht_split.htm)
PLUS(www.parmalat.net/www/product/ita/prodotti/parmalat/latte_speciale_uht_split.htm)

PROBIOTIC PLUS OLIGOFRUCTOUS/PROBIOTIC MIT CEREALIEN
(www.bauer-milch.de/de/i_produckte.html),
PROCULT (www.muellermilch.de), PROVIVA (www.proviva.com),
PULEVA CALCIO/OMEGA 3 (www.puleva.es/_marcos/puleva.htm)
QUAKER OATS (www.quakeroatmeal.com; www.oatmealforwomen.com),
TAKE CONTROL (www.takecontrol.com),
THIS WHITE STUFF/HYFIBE (www.tiptop.com.au)
TROPICANA CALCIUM (www.tropicana.com),
UNCLE TOBYS HI-GRAIN (www.uncletobys.com.au)
VERUM HALSOFIL (www.norrmejerier.se),
VIVIL FUN FUN + ENERGY/ANTJES ENERGY (www.vivil.de),
WASA VITAL FIBER+/WASA VITAL SPIRIT+ (www.wasabrod.se),
YAKULT (www.yakult.co.jp) and YOSA (www.bioferme.fi)

Appendix **4**

World Wide Web sites to functional food organizations
(www.FunctionalFoodsToday , 2001.03.01, Leatherhead, UK)

AACC Functional Foods Online (http://www.scisoc.org/aacc/funcfood),
Agriculture & Agri-food Canada Food Bureau
(www.agr.ca/food/markets/nutraceu/enutrace.html),
American Nutraceutical Association (www.americanutra.com),
British Columbia Functional Food & Nutraceutical Network (www.bcfn2.com),
Cranberry Institute (www.cranberryinstitute.org),
Emerging Cran-Health News (www.oceanspray.com/cran_health_news.htm),
Food Navigator (www.foodnavigator.com),
Food Processing' s Wellness Foods (http://www.wellnessfoodnet.com),
Forbes Medi-Tech (www.forbesmedi-tech.com/ffnab.asp),
Functional Foods Alberta - Centre of Excellence (www.fface.com),
Functional Foods from Finland (virtual.finland.fi/finfo/english/funcfood.html),
Functional Foods Today (www.functional foodstoday. com),
Herb World News Online (www.herbs.org/current/topnews.html),
Infant Vision (www.infantvision.com),
International Food Information Council (www.ific.infohealth.org/index6.htm),
Japanscan (www.japanscan.com),
Loders Croklaan Lipid Nutrition (www.lipidnutrition.com),
Natural Products Industry Center (www.npicenter.com),
Nutraceutical Alliance (www.nutraceuticalalliance.com),
Nutrition Business Journal (www.nutritionbusiness.com,
NUTRA Solutions (www.nutrasolutions.com),
Saskatchewan Nutraceutical Network (www.nutranet.org) and
Swedish Centre of Excellence and Innovation in Functional Foods
(www.functionalfoods.nu)

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This thesis is focused on the innovation process. It has been a long, once-in-a lifetime personal and professional journey of innovation for me. It is not the end of my journey. This thesis is merely a roadmap of the paths taken during a part of the trip. I owe thanks to a lot of people for guiding, supporting and helping me along the way. However, for any faults or misconceptions I alone bare responsibility.

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Cilla