Quality in Market Oriented Product Development

- a comparative study of the food industry in Sweden and Estonia

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Abstract

Title: Quality in Market Oriented Product Development – a comparative study of the Swedish and Estonian food industry

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Problem: The management of market oriented product development is dependent on numerous of factors and it is therefore necessary to adopt different perspectives when trying to get an understanding of the complex network of interactions. Dimensions like quality, complexity, time to market and resource demand influence the preconditions of product development.

Objectives: The objective of this thesis is to describe and analyse different aspects of successful management of market oriented product development processes in food manufacturing companies.

Method: Three fictitious concepts were created to provide a foundation when analysing complexity and resource consumption in product development. Interviews with representatives from the industry and the two companies have been made to cover this area.

Interviews with representatives from Procordia Food in Sweden and Pôltsamaa Felix in Estonia have been made to map activities and resource consumption in product development processes. Attitudes to market orientation have been discussed and characteristics of two different markets have been studied.

Theoretical references have assisted the analysis of product development from the perspectives of market and industry analysis, product creation processes, quality expectations and cost estimations. The Quality Function Deployment-tool was implemented on the three fictitious projects.

Conclusions: The authors have demonstrated that the different levels of maturity on the two markets influence the quality awareness of consumers. The differences in quality expectations will influence the rate of innovation, the character of market orientation, routines and structures of development processes, the time to market, the resource consumption, the challenge and the complexity associated with different development projects. The authors conclude that generic processes for product development, market orientation and assessment of quality fail to meet the conditions of competition on all markets.

It has also been demonstrated that the assessment of complexity and resource demand of different projects is dependent upon factors such as experience, quality ambitions and the organisational context. Different frames of reference will thus influence the outcome of a development project.

The QFD-tool is considered to be suitable to eliminate subjective influences, to encourage cross-functional integration and to provide a structured approach to predict potential problems and plan product development projects. Some suggestions on how to improve the implementation of the tool are presented.

Key Words: Product development, innovation, quality, market orientation, food industry, Quality Function Deployment

Acknowledgements

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Lund, June 2003

Carin Cronström and Ylva Månsson

Table of Contents

1. Introduction

1.1 Background

The food industry is one of the world's biggest businesses but the character of the world's food system is quickly changing due to population growth, the process of globalisation in combination with changes of welfare and scientific advances.[1] The average life cycle for products on the market is currently 1 ½ to 3 years[2] and innovations of products and services tend to play an essential part in this food production system for a variety of reasons. The nature of the competitive market requires that businesses continuously increase profit and market shares, but this can no longer be achieved by increasing sales of basic foodstuffs. Profit has to be increased by turning basic foodstuff into new, innovative products allowing higher margins. Product innovations therefore become an important competitive tool of food production systems in Western countries.[3]

The infinite varieties of foods available means that people frequently are exposed to a range of purchase situations where people make decisions at different levels of complexity and importance. As a consequence, increasing consumer demands for innovative products that can offer enough variety and quality to fulfil every consumer's individual needs and desires constantly challenges the food industry. The changes in consumer demands and needs create market opportunities for new products and services at the same time as a continuous stream of scientific and technological inventions offers new opportunities for product development.[4]

The management of product development become a key success factor when the importance of product development for the competitiveness of companies increases. Companies need to provide products that offer unique features fulfilling the needs and desires of consumers at the right time, at the right cost. The management of product development is further complicated when companies act on global markets with different preconditions of competition and consumer requirements. The aim to "think global but act local" is an often-quoted approach that becomes more and more challenging as new markets, like the Baltic countries for example, constantly emerge.

With new markets exhibiting a lower level of maturity, a different history of competition and quality awareness, the preconditions for successful product development may therefore not be the same as on mature markets, similar to the Swedish market, as on more recently evolved markets, similar to the Estonian market.

[1] Tansey, Worsley (1995)
[2] Fjelkner-Modig, SIK, (2003-04-25)
[3] Tansey, Worsley (1995)
[4] Ibid

1.2 Problem Description

The concept of quality in market oriented product development is dependent upon a variety of factors. To be able to get an understanding of the complex network of interactions it is necessary to adopt different perspectives, which is illustrated in the discussion below.

1.2.1 Quality

Innovations and product developments usually involve addition of a certain quality to a product. The success of the innovation depends on factors related to market preferences and expectations, as well as the manufacturer's ability to communicate superior quality to consumers. A deep understanding of the product and the market is therefore vital to understand consumer attitudes and buying-pattern and a company must not only be well-informed about the product's area of use, but must also be aware of cultural influences and the competitive environment. It is important to understand *when* consumers use the product, *how* the product is used, what the consumers are willing to *pay* for the product, the relative *importance* of the product and the *expectations* consumers have on the product. With a trend towards globalisation it is thus interesting to analyse the concept of quality in a wider perspective.

Do consumers on different markets exhibit different quality expectations and different quality awareness?

1.2.2 Market Orientation

When the success of companies is dependent upon the ability to deliver high-quality products where features and characteristics match consumer expectations, it becomes fundamental to identify and exploit market opportunities. Although the food business arena of today can best be characterized as a mainly technology-driven environment, it is constantly challenged by a highly consumer oriented market place[5]. Market orientation is fundamental for the success of companies but the road to a market-driven product development is filled with complications like customers wanting different things, customers not knowing what they want or need, customers not buying what they need, customers not buying what they or others think they want and finally customers upgrading their expectations.[6] Effective planning as well as implementation of innovation processes is important, but not enough since product development is more than a simple process of translating consumer desires and needs into new products

What are the preconditions of market orientation on different markets and in different organisations?

1.2.3 Complexity

The ability to deliver successful products is dependent upon a complex network of processes. Evaluation of product concepts in relation to both market opportunities and technological skills require market needs being translated into technical specifications – i.e. measurable characteristics that describe the product in the language of the engineer. These technical specifications represent the expected developmental challenges and the level of complexity required to fulfil the needs of the consumer.

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[5] Costa, Dekker, Jongen (2001)
[6] Deschamps, Nayak (1995)

More over, in a company there are usually different departments specializing on different tasks – such as R&D, engineering production, quality control, finance, purchase, sales and marketing.[7] Coordination and communication of these activities is very difficult and product development, which integrates expertise from all these departments, is therefore in itself an incredibly complex process.

What factors influence the perceived complexity of a development project and how is it related to organisational undertakings?

1.2.4 Resource Demand

Different concepts of different character and complexity may require different undertakings from the organisation. It is therefore important to evaluate product concepts in relation to both external factors, such as quality expectations, market conditions and opportunities, and internal factors, such as technological skills, resource consumption and willingness to invest in R&D. The success of a product development process is thus dependent upon the ability to include both knowledge concerning identified market opportunities and expected organisational undertakings in the early process of evaluating and selecting product concepts.

How can the resource consumption – time and costs – better be predicted in early stages of product development?

1.3 Objectives

The objective of this thesis is to describe and analyse different aspects of successful management of market oriented product development processes in food manufacturing companies.

1.4 Outline of the Thesis

The purpose with the model presented is to illustrate the structure of this research.

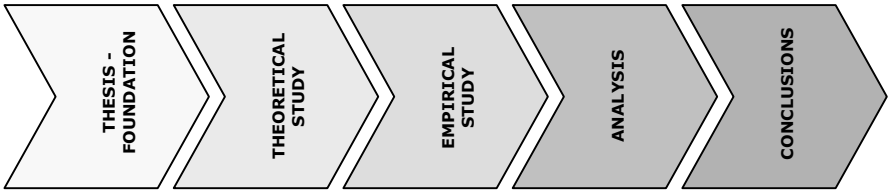


Figure 1 Outline of the report

THESIS - FOUNDATION
1. INTRODUCTION
2. METHODOLOGY

THEORETICAL STUDY
3. EVOLUTION OF MARKETS AND INDUSTRIES
4. MANAGEMENT OF THE DEVELOPMENT PROCESS
5. QUALITY
6. FACTS ABOUT MAYONNAISE

[7] Meulenberg, Jongen(1998)

EMPIRICAL STUDY
7. THE PROCORDIA FOOD CASE
8. THE PÕLTSAMAA FELIX CASE
9. EXTERNAL CONSULTATION

ANALYSIS
10. MATURITY OF MARKETS AND INDUSTRIES
11. MANAGEMENT OF PRODUCT DEVELOPMENT
12. QUALITY ASSURANCE
13. COMPLEXITY AND KNOWLEDGE CREATION
14. ESTIMATION OF RESOURCE DEMANDS

CONCLUSIONS
15. CONCLUSIONS

1.4.1 Frame of Reference

When trying to increase the understanding of how different aspects influence the management of market oriented product development, different dimensions are identified as being of fundamental interest. The structure of this report is therefore built around six interlocking dimensions.

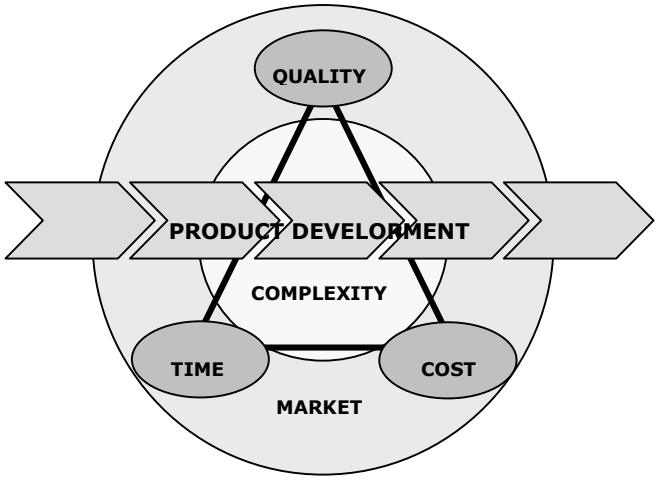


Figure 2 Dimensions covered in this report

Market and Industry Characteristics
With different markets exhibiting different consumption patterns and quality expectations, it is important to consider the environment in which different companies act when evaluating the management of development processes.

In chapter 3, a brief introduction to the evolution of an industry and the market is given to provide a deeper understanding of the context different organisations may act upon. Basic characteristics of the Swedish and Estonian markets are presented in this chapter and in chapter 7 and 8. The analysis of the impact of market and industry on the development process is presented in chapter 10.

The Product Development Process
Different organisations incorporate different routines and structures to secure successful product development.

The management of the development process is briefly discussed in chapter 4, before the production creation process is introduced to provide a deeper understanding of the innovation process. The product development process at Procordia Food will follow in

chapter 7 and the product development process at Pôltsamaa Felix in chapter 8. The management and the character of the development processes are analysed in chapter 11.

Quality
The success of product development is dependent upon the ability to deliver high-quality products that meet consumer expectations.

Chapter 5 gives a presentation of one of the most fundamental aspect of this thesis – quality. An introduction to general characteristics of quality as well as the Quality Function Deployment approach is presented. Implementations of the QFD on the Swedish and Estonian concepts are presented in chapter 7 and 8. Concluding analysis of quality and the QFD approach are presented in chapter 12.

Complexity
Different development projects may involve different levels of complexity in terms of developmental challenges.

To provide a foundation to understand complexity associated with the three fictitious concepts, a presentation of chemical, physical and technological characteristics of mayonnaise is given in chapter 6. The assessments of complexity associated with the three cases are presented in chapter 7, 8 and 9. The dimension of complexity is analysed in chapter 13.

Time and Cost
The success of product development is also dependent upon the ability to deliver products in the right time at the right cost.

To increase the understanding of how the resource consumption with regards to time and cost in product development can be predicted, a brief presentation of the Activity Based Costing-approach is presented in chapter 4. Estimated resource consumptions associated with the three fictitious projects in Sweden and Estonia are presented in chapter 7 and 8 followed by an analysis presented in chapter 14.

1.5 Delimitation

The scope of this study is limited to involve:

- Two companies – Procordia Food AB and A.S. Pôltsamaa Felix
- Two geographical markets – Sweden and Estonia
- One product group – mayonnaise.

The focus in this report is primarily on the product development process, why other development processes, like the process- and package development, are not considered.

The focus of this study is further limited to the actual development phase. Other phases of the innovation process are not analysed in detail.

The Quality Function Deployment tool is only partially implemented. The House of Quality is implemented as the focus of this thesis is on the planning stages of product development but dimensions involving benchmarking with competitors etcetera has not been conducted. In addition, no thorough market research was conducted due to limited time and resources.

1.6 Target Group

The main target group of this thesis is representatives at A.S. Pôltsamaa Felix, Procordia Food AB and Orkla AS, but also students, researchers and others that might have an interest in market-oriented perspectives and product development.

1.7 Presentation of Orkla Foods AS

The story about Orkla dates back to 1654 with the establishment of pyrite mining operations at Løkken Verk.[8] Almost 250 years after the establishment Orkla received the name of today.[9] During the end of the twentieth century Orkla developed into a leading actor in the Nordic grocery market of branded consumer goods and is currently one of the largest listed companies in Norway with an operating income for the year 2001 to NOK 44.8 billion. The number employed, during the same period, amounted to 32,000. The core business involves a wide range from branded consumer goods and chemicals to financial investments.[10]

Orkla is currently the leading supplier of branded consumer goods on the Nordic grocery market with many favourable positions in strategically important product areas.[11] A strategic position in the Nordic region was acquired through the acquisition of Procordia Food and Abba Seafood 1995.[12] With the acquisition of Carlsberg the year 2000, Orkla also received a strategically global position in the beverage sector and the area of branded consumer goods grew significantly. The core business currently counts for approximately 80% of the total operating revenues.[13]

Orkla is the market leader in the product categories of frozen pizza, ketchup, juice, jam and conserved vegetables but is also a strong player when it comes to other product categories. Today the market position is strongest in Norway and Sweden but future growths is expected to be strongest in selected markets in Eastern Europe like the Baltic states, Poland, the Czech Republic, Austria, Russia and Ukraine.[14]

1.8 Presentation of the Swedish Market

The story of Sweden might seem like a fairy tale of success. From being one of the poorest countries in Europe in the mid 19th century it developed into one of the richest and most industrialised countries in the world in a pace often described as the "Swedish economic miracle".[15] It was primarily during the post-war decade that the Swedish economy advanced with a rise in the GNP, increase in prosperity and welfare.[16] The growth that took place is associated with the wealth of forest, ore and hydroelectric power combined with a number of ingenious Swedish inventions, and refinements of

[8] Orkla Annual Report (2001)
[9] www.orkla.com
[10] Orkla (2001)
[11] www.orkla.com
[12] Orkla Annual Report (2001)
[13] Orkla (2001)
[14] www.orkla.com
[15] www.sweden.se, (2003-04-24)
[16] www.svenskainstitutet.se (2003-04-24)

inventions, like the telephone, the safety match and the unique Tetra Pak beverage packaging system. The engineering brilliance of those days continues to form the core of the Swedish business market [17] and Sweden is presently considered to one of the countries investing the largest percentage of its GDP in R&D.[18]

Due to an insufficient domestic market, Swedish companies where forced into international competition at an early stage. Success on the international arena resulted in a very large number of multinational corporations and brands that are still represented worldwide.[19] The Swedish foreign policy did, however, change after the upheavals in Europe during 1989-91. New possibilities opened up for Sweden's international relation with Eastern Europe and the Soviet Union.[20]

The economic growth is currently considered to be relatively good with a low inflation rate, shrinking national debt, declining unemployment rates and a notable rise in wages.[21]

1.8.1 Procordia Food

Although the origins of Procordia Food dates back to 1849 when Henric Eberhard Ekström established a company developing soft drinks and mineral water, the existing organisation was established in 1995 when Felix and Ekströms Önos merged into Procordia Food AB. Procordia Food is one of many divisions within the Orkla-group and the turnover for the year 2001 amounted to 3304 MSEK. The number of people employed to 1800. The outcome of launches made during 2001 resulted in an increase in both sales and market shares, especially for product groups like RisiFrutti, Felix Minipizza and Fun Light. The growth on the Swedish market during the same period was 5 percent.[22]

Procordia Food is one of the biggest producers and marketers of food products in Sweden. Strong brands include Felix, BOB, Ekström, Önos, Risifrutti and FUN light,[23] The product range comprises primarily pizza, pickled vegetables, ready meal, fruit and berry products, sauces and different potato products. The keys to success for Procordia Food are considered to be inspiration, innovation and a good insight in the changing needs of the customers. With many years of collected experience of developing, manufacturing and marketing provisions, Procordia Food is able to provide the consumers with the best solutions of tasty, convenient and secure provisions to the right price.[24]

1.9 Presentation of the Estonian Market

Estonia is one of many countries that recently have undergone the transition from planned economy to market economy. With the collapse of the Soviet empire and the process of independence, the access to the Russian market became restricted at the same

[17] www.sweden.se, (2003-04-24)
[18] Statistisk årsbok för Sverige (2003)
[19] www.sweden.se, (2003-04-24)
[20] www.svenskainstitutet.se, (2003-04-24)
[21] www.svenskainstitutet.se, (2003-04-24)
[22] Orkla Foods As Årsberättelser (2001)
[23] Orkla Foods As Årsberättelser (2001)
[24] www.procordiafood.se 2003-04-20

time as the entry to the Western market was restrained due to a lack of business relations. As a result, the industrial production decreased considerably in 1991 and the economy had to undergo major restructuring to adapt to the new situation.[25] A suitable legal framework was established with the purpose of restructuring the business sector and once the transition to privatisation had taken place a change towards renewed specialisation of production and a search for new markets was initiated. During the time 1992-2001, the importance of the energy sector, the mining industry and the chemical industry declined while the importance of the building material industry, light industry, the timber industry and the machine and apparatus industry increased due to changed consumptions patterns.[26] The intramural expenditures for R&D more than doubled during the same period and the total expenditures for R&D is currently representing approximately 0.11% of net sales and 0.12% of total costs.[27]

The first year after the transition into a free market economy, the inflation rate caused a tenfold increase in prices but has, since then, decreased and stabilised. The household expenditures for food have undergone a decrease of 3 percent during the years from 1999 to 2001[28] while the consumer price index has decreased from 8.2 to 3.6.[29]

One of the country's competitive advantages, in comparison with other European countries, is the low labour cost but with improving education levels of the labour force, an increase in labour costs for low educated workers is expected to take place in the future.[30]

The foreign trade policy in Estonia emphasise liberalisation and no restrictions on the movement of goods and capital, the exception being agricultural products.[31] With Estonia being a completely open market with no customs or subventions in the production, companies are forced to compete at the same conditions and in the same class as players in the world market arena. [32]

1.9.1 Pôltsamaa Felix

The history of Pôltsamaa Felix dates back to 1920, when ETK was founded. Almost seventy years later, joint venture between ETK and AB Felix, Sweden, was established. In 1995 AB Felix merged with Procordia Food AB and later the same year Orkla became the owner of Procordia Food.[33] AS Pôltsamaa Felix is currently one of the leading food processing companies in Estonia and being part of the Orkla-group, the company has access to latest know-how and a secure financial background allowing focus on long-term goals.[34]

[25] Ambassador collection, (2002)
[26] Ambassador collection, (2002)
[27] Eesti Statistika, (2002)
[28] Ambassador collection, (2002)
[29] Statistikaamet (2003)
[30] Chairman of the Board, Pôltsamaa Felix, (2003-04-03)
[31] Ambassador collection, (2002)
[32] Chairman of the Board, Pôltsamaa Felix, (2003-04-03)
[33]Internal material; AS Pôltsamaa Felix, (1999)
[34] Ambassador collection, (2002)

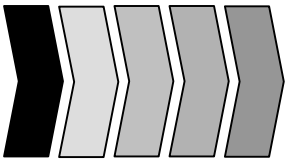
The business concept of Pôltsamaa Felix is to market, produce and develop delicious, convenient food of high quality. The vision is to turn the company into a local, sound, viable and profitable market economy player focusing on long-term aspects with the potential of becoming the market leader within all groups of production. Primary markets involve the Baltic States and the St Petersburg region, but does also include Sweden and Finland. Raw materials should mainly originate from Estonia and the price level of products should allow the average population a possibility to buy the products.[35]

The production at Pôltsamaa Felix involves product groups of mayonnaise, juices, wine, concentrates, jam, beetroots, sauerkrauts, pumpkin, horseradish, ready meals, cucumbers and mustard. The products produced are sold using two trademarks; Felix and Pôltsamaa. The Felix brand holds market-leading positions in the product areas of tomato ketchup, salad dressings, mayonnaise, cucumber, beetroot and mustard, while the Pôltsamaa brand holds market-leading position in the product areas of jam and Estonian made wine. The production for the year 2002 amounted to 5600 tonnes in a total.[36] Available on the market are also products from other companies within the Orkla group with trademarks like Jacky, Abba, Fun light and Guseppe. [37]

AS Pôltsamaa Felix is regarded to be a relatively new entrepreneurial company, with limited levels of bureaucracy and high flexibility. The last decade has involved rapid changes of the Estonian market and as a consequence Pôltsamaa Felix developed and launched approximately 50 products during 1994. Being part of the Orkla-group there is a pressure to implement the same processes and structures that is used within the Orkla-group. As a consequence, the structure has changed by the recent implementation of a matrix organisation.[38] Moreover, Pôltsamaa Felix is currently working more actively with suppliers and long-time contracts are getting more and more common. Audits are continuously performed to control that established target levels are fulfilled.[39]

With increased labour and energy costs in combination with a very price sensitive market place, Pôltsamaa Felix has to maintain profit by rationalising production processes and decrease the proportion of indirect costs. When joining the European Union the company is expecting an increase in raw material prices to levels comparable with the world market.[40]

[35]Internal material; AS Pôltsamaa Felix, (1999)
[36] Internal material; AS Pôltsamaa Felix, (1999)
[37] Ambassador collection,(2002)
[38] Chairman of the Board, Pôltsamaa Felix, (2003-03-28)
[39] Chairman of the Board, Pôltsamaa Felix, (2003-04-03)
[40] Chairman of the Board, Pôltsamaa Felix, (2003-04-03)



"The information we have
is not what we want,
the information we want
is not what we need
and the information we need
is not available" *Finagles law*

2. Methodology

The aim with this chapter is to briefly present the methodology used in this study. Areas such as the methodological approach, theoretical frame of reference, collection of data and criticism of the methods used will be presented.

2.1 Methodological Approaches[41]

The aim with methodological tools is to provide systematic ways to explore the reality with regards to collection and interpretation of information.[42] Three approaches – the analytical approach, the systems approach and the actors approach – are commonly adopted in the field of business. The different approaches make different assumptions about reality and in practice the choice of methodological approach will direct the observations, collections of data and the results of the process.

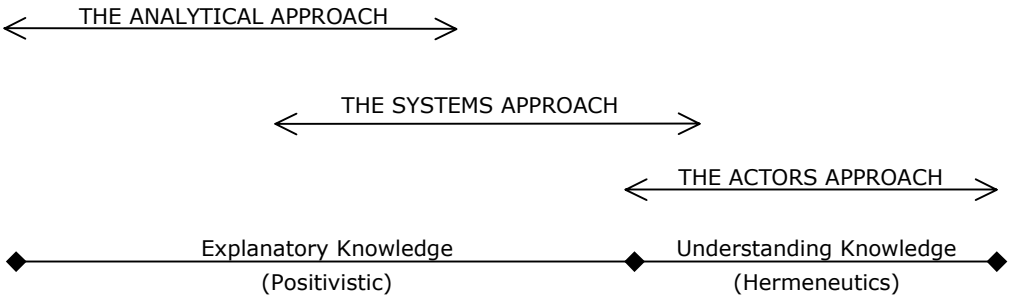


Figure 3 Boundary between the positivistic and hermeneutic approach in relation to the analytical, system and actor approaches. [43]

The analytical approach is not considered as suitable in this particular study as the authors, when they strive to increase the understanding of different aspects of product development management, presuppose that the whole differs from the sum of the included parts and that the knowledge created will be influenced by the observers. In addition, theories and techniques are not implemented to verify or falsify assumptions. The authors have no intentions of establishing strict relationships between cause and effect and logical models and the systems approach is therefore considered as more appropriate as it emphasise how the relations between the different parts influence the outcome. Effects are mainly explained by the search for a driving force and the result is based on synergies. More over, as one objective with this study was to understand the different attitudes to product development, market orientation, complexity assessment

[41] Arbnor, Bjerke (1997)
[42] Halvorsen (1992)
[43] Arbnor, Bjerke (1997); p. 50

and resource estimations, the authors made an attempt to look at product development from different perspectives. The actors approach was thus combined with the systems approach as the authors made an effort to understand the whole as perceived by the included parts.

2.2 Theoretical Frame of Reference

The theoretical frame of reference in this thesis is used to create a better understanding of the dynamics of product development and the food industry. When studying the preconditions for successful product development at Procordia Food and Pôltsamaa Felix, it is essential not only to look at the management of the development processes, but also to look at the context in which the two companies are active. One must have an understanding of external factors when analysing the internal capabilities.

When analysing the environment of the two companies, *Utterback's* model[44] – "the dynamics of innovation" – was considered appropriate due to the attempt to analyse the evolution of industries and markets from dimensions like the rate of product and process innovations, organisation, market and competition.

Three main authors *Nobelius, Deschamps* and *Wheelwright*[45] - were chosen to provide insight into the different approaches of management of development processes. The authors were chosen as they, together, cover different aspects and dimensions of R&D management from evolutionary and managerial perspectives.

The concept of quality is a fundamental issue when analysing the competitiveness of companies and the management of development processes. Authors like *Grunert* and *Ophuis*[46] were consulted to provide a basic understanding of the many dimensions of quality. The tool Quality Function Deployment was chosen as it integrates perspectives of quality and market orientation with the management of development processes.

Two other important dimensions to pay attention to when analysing the management of product development, are the time-to-market and the resource consumption associated with the development of the product. The Activity Based Costing-approach was perceived as suitable to provide insight in the relationship between activities in the development process and their resource consumption.

2.3 Practical Methodology

The starting point for this study was an ill-defined objective with certain limitations and directions. The study should cover some aspects of product development, it should have a focus on the product group of mayonnaise and a comparative study between the Sweden and Estonia market should be conducted. In addition, the topic should preferably make use of the authors' diverse backgrounds in Technology Management, Business Administration and Food Technology. An all-embracing literature research was conducted with the outcome that market orientation, technical complexity, resource consumption were identified as interesting areas to study. The Quality Function

[44] Utterback (1994)
[45] Nobelius (2002), Deschamps (1995), Wheelwright (1992)
[46] Grunert (1995), Ophuis, Trijp (1995)

Deployment-tool and the Activity Based Costing-approach were identified as relevant techniques to use when covering the areas specified above.

A quantitative survey of recipes in the two well-known magazines "Allt om Mat" and "Ica Kuriren" over a period of ten years was conducted to provide insight in the Swedish consumption pattern of mayonnaise and to identify general trends. Insights originating from these surveys were combined with the authors' personal experiences and creativity to create three fictitious concepts of mayonnaise development. The concepts were developed to represent different levels of complexity to provide a foundation when analysing the relationships between market orientation, product development, complexity and resource consumption. Although information concerning the Swedish market provided input to the process of concept creation, the concepts were deliberately designed to suit both the Swedish and the Estonian market. The three concepts involved development of:

- Chilli mayonnaise – intended as a fairly straightforward line extension of regular mayonnaise
- Mayonnaise enriched with omega-3 – intended as a line-extension but with challenges associated with the instability of polyunsaturated fatty acids.
- Instant mayonnaise – intended as the most complex concept to develop, as equivalent products, to the authors' knowledge, do not exist.

Representatives from Procordia Food were consulted to provide insight in the characteristics of the Swedish mayonnaise market and the management of product development. Due to restricted resources and the time limit of this thesis, no thorough market research was done to identify relevant consumer desires associated with the three concepts. The authors thus had to rely on the intuition and experience provided by marketing representatives at Procordia Food.

Challenges associated with development of the instant mayonnaise were identified and a first attempt to implement the QFD approach was made. Activities necessary for developing the product and time estimations for the different activities were assessed in an ABC-manner before focus was transferred to Estonia and Pôltsamaa Felix.

Once representatives from Pôltsamaa Felix had provided insight in the characteristics of the Estonian mayonnaise market and the management of product development processes, it became obvious that one additional dimension was required to understand the relationships between product development and market orientation, technical complexity and resource consumption. The authors needed to get an understanding of how industry and market characteristics influenced the concept of quality and the character of market orientation, the assessment of complexity and in the end the resource consumption. Utterback's model – the dynamics of innovation – provided basis when mapping Estonia, the food industry, mayonnaise market and Pôltsamaa Felix from an evolutionary perspective.

As the authors had no previous experience of Estonian mayonnaise, two focus groups with 7-8 participants were arranged to provide insight in consumer desires and consumption patterns related to mayonnaise. The three fictitious concepts were adapted to the Estonian market in a market-oriented manner. The marketing director and the Product Group Manager were consulted to identify and rank customer desires associated

with the three concepts. The Development Manager was consulted to assess the complexity involved in developing the three concepts. The QFD tool was implemented and activities necessary to develop the products were identified and mapped. An attempt was made to identify the resource consumption of these activities in an ABC-manner but the cost estimations proved to be more complex and more strategically sensitive than first anticipated.

The assessment of complexity involved in development of the three concepts continued upon return to Sweden, but with different R&D representatives due to unexpected organisational changes. The QFD- approach was implemented, activities were mapped and time estimations were made for the remaining concepts. As information concerning resource consumption proved to be too strategically sensitive to be published in a public report. Consequently, a focus on time estimations instead of the intended cost calculations was required.

Representatives from the external organisations of SIK, the Swedish Institute for Food and Biotechnology, and the School of Technology and Society at Malmö University were consulted to provide additional perspectives on product development and the technical challenges associated with development of the three fictitious concepts. The purpose with this step was to study whether there were any differences in attitudes towards product development depending on the organisational background. Comparable experts were not to be found in Estonia although representatives of the Technical University of Tallinn provided some insights.

As the objective of this thesis was not well defined from start, a process of abductive data collection was employed. The abductive approach can be viewed as an integration of the inductive approach – characterised by an initial collection of empirical data before theoretical references are consulted – and the deductive approach – characterised by an established theoretical perspective before empirical data is collected.[47]

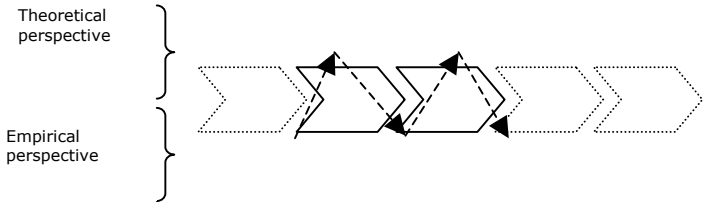


Figure 4 Abductive approach[48]

A considerable amount of time and energy was invested at an early stage to define an objective and identify suitable methods and techniques. Neither Procordia Food nor Pôltsamaa Felix had specified an assignment for this study and a topic could therefore be designed to meet authors' desires. However, as the study progressed it became more and more essential to secure that the topic also offered something in return to the different organisations as the study inevitably required time and attention from company representatives at Procordia Food and Pôltsamaa Felix. As a consequence there are many stakeholders of this thesis and it is a great challenge to satisfy them all.

[47] Alvesson, Sköldberg (1994) p. 42
[48] Ibid.

2.4 Primary Data Collection

A primary source of information can be defined as the collection of new data for a specific purpose.[49] Gathering of information in this study has mainly been done by interviews, but focus groups, observations and surveys have also been implemented. A qualitative approach has generally been adopted as our study is based on the opinions and interpretations of the respondents consulted.[50] A qualitative research method is also characterised of direct observations, a small number of respondents and an indirect measurement of respondents' feelings and beliefs.[51]

2.4.1 Interviews[52]

Numerous of semi-structures interviews were conducted to provide understanding and insights into the different aspects of product development. The semi-structured approach, where the authors had a list of topics to be covered in the interview, was conducted like free and open dialogue. The list of topics was designed for each individual interview and the purpose with these interviews were to conduct explanatory discussions to reveal not only the "what" and the "how", but also the "why".

The interviews have mainly involved representatives from the innovation group, R&D-department and marketing department at Procordia Food and Pôltsamaa Felix. The representatives have commonly been chosen based on their expertise of mayonnaise, product development, package development, project leadership and market communication. In addition, interviews have involved external representatives from a marketing agency, universities and a research institute. Most interviews were taped and transcribed to prevent misunderstandings. Both authors have participated in all interviews. The questions asked were adapted to each occasion.

2.4.2 Focus Groups[53]

A focus group can be characterised as being a group interview but is more focused on collecting data through the interaction with the group. Fairly structured focus groups have been used in this study where a predetermined list of topics was covered at both occasions. The purpose with using this method was to collect data from a wide range of areas to get an insight in the big differences between the different countries.

The participants were chosen to represent average Estonian mayonnaise consumers. Fairly young and well-educated females and men who were living in Tallinn dominated the first focus group. Middle-aged women, working at Pôltsamaa Felix and living in Pôltsamaa, dominated the other group.

[49] Saunders, Lewis, Thornhill (2000)
[50] Gustafsson (1998)
[51] Dillon, Madden, Firtile (1990)
[52] Dillon, Madden, Firtile (1990)
[53] Wibeck Victoria (2000)

2.4.3 Observations[54]

Due to the risk of cross-cultural problems that may occur when conducting a part of a study in another country, direct observations complemented the interviews conducted. Another reason for also using direct observation in this thesis is the avoidance of imperfectly translated questions.

2.4.4 Surveys[55]

A recipe survey in two well-known household magazines was conducted to get an overview of the Swedish mayonnaise market. This kind of quantitative data collection was used with the purpose to statistically measure characteristics of the Swedish usage of mayonnaise in modern cooking over a ten-year period as well as the attempt to capture major trends of today.

2.4.5 Critical Review of Primary Data

Quite a number of factors could influence the quality of the primary data collected. The notions of reliability, validity, bias and the ability to generalise influence this quality of primary data. Reliability, in this context, means the precision of measurement or how reliable the measurements are. However, reliable measures do not necessarily guarantee that the measurement scale is valid. Validity on the other hand refers to the differences between observed measurement scores and the true differences in the characteristic being measured. It is thus important not only to look for reliability, but also for validity when collecting data.[56]

Biases are commonly present from both perspectives of the interviewer and the interviewee. The use of different comments, tones and body language can consciously or unconsciously influence the response the interviewee will give to a certain question. It is also possible that the interviewee for different reasons withholds information that could have contributed greatly to the study. It is also important to consider the backgrounds, cultural differences, language barriers etcetera when reviewing the data collected.[57]

2.5 Secondary Data[58]

Secondary data is any data originally generated for some other purposes than the present research objective. Different sources of secondary data will be used in this report include statistical companies, searches on the Internet, company material and academic literature. The secondary data used most extensively was articles written about topics related to product development, innovation, quality, Quality Function Deployment, Activity Based Costing, consumer perceptions, and mayonnaise.

2.5.1 Critical Review of Secondary Data

Whenever secondary data is used, it is important to question whether the data is valid and reliable for the intended purpose as secondary data is generally collected with a

[54] Dillon, Madden, Firtile (1990)
[55] Helling. Jan, Helling. Thomas (2000)
[56] Dillon, Madden, Firtile (1990)
[57] Saunders, Lewis, Thornhill (2000)
[58] Dillon, Madden, Firtile (1990)

different purpose than the one in this particular study. Moreover, the secondary data is likely to be less updated than the primary data collected. By using a mix of both primary and secondary data, the authors hope to narrow the possibility of making false assumptions in the end, why also the validity of this thesis should be trustable.

2.6 Criticisms of the Implementation of QFD

The choice of using the QFD approach was based upon its structured way of integrating different perspectives in the planning phase of product development. The ideal way to evaluate the usefulness and adequacy of the QFD tool would be to follow a development project from initiation to the launch and follow-up of the product but this approach was not possible, obviously, as it would have required years of empirical data collection. Instead, a method where QFD tool was evaluated with respect to a verbal assessment of different aspects of product development was adopted.

The authors are aware that the method choice has several weaknesses associated with unreliable documentation of the verbal assessments, limited cross-functional integration etcetera. More over, to complete one QFD implementation is expected to take approximately 50 labour hours when conducted by an experienced organisation. In this study, the authors attempted to make 6 implementations the approach devoting between 8 and 15 hours to each one. Numerous of generalizations, interpretations and estimations have been done to make up for the limited time available. It is also likely that the results would have been different if different representatives were consulted or if the process was repeated.

3. Evolution of Markets and Industries[59]

Increasingly demanding and powerful consumers in combination with a quickly changing market force food companies to offer a continuous flow of innovative products that meet the customers' expectations. The approach described below highlight the dynamics of the industry and the consequences it has on the nature of innovations, competition, markets and organizations.

There are many theories that try to develop different perspectives concerning problems of technological innovations in corporate organisations. The strength of the model below is the attempt to integrate the different components of product innovation, process innovation, the competitive environment and the organisational structure with a life-cycle perspective of the specific industry – divided into the fluid phase, the transitional phase and the specific phase.

3.1 Innovations

The rate of product innovation tends to decrease in the same rate as the marketplace develops preferences and expectations. The result of this process is a focus on incremental innovations of existing features. Users develop loyalties and preferences and once obvious improvements have been introduced, practicalities of marketing, distribution, and maintenance etcetera demand greater standardization. It thus becomes increasingly difficult to better past performance.

Once the rate of the product innovation has slowed down, process innovation will become a more important competitive tool. During the early periods of a new technology, the production processes are commonly characterised as inefficient. Skilled labour is mixed with general-purpose machinery and tools, but as the industry evolves, manufacturing will, to a greater extent, be dependent upon specialized equipment and low-skilled labour.

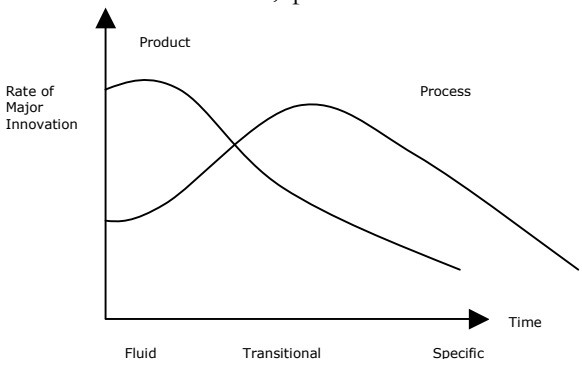


Figure 5 The dynamics of innovation[60]

[59] Utterback (1996)
[60] Utterback (1996), p. 81

3.2 Organisation

The character of the company will commonly evolve from being an entrepreneurial organisation with innovative products to a large-scale manufacturer with standardized products. The organizational structure is likely to shift from being organic, with limited hierarchy and high lateral communication, to more mechanic, with a hierarchical and rigid structure with formal tasks, goals and rules. The innovative capacity of the organization will change towards incremental improvements rather than major innovations.

3.3 Market and Competition

The market is generally highly unstable and fragmented during the infancy of a technology. Many manufacturers tend to rush into the market and the market feedback is rapid. Factors like features, performance and the functionality of the product are more important to the lead users than the actual price. Any incremental changes are likely to be copied rapidly, resulting in the competitiveness of a company being dependent upon price and quality. The number of producers will fall and the market feedback will slow down and the market will stabilise.

3.4 Three Phases of Evolution

Three phases can be described in the evolution process based on the dimensions of innovation, characteristics of the organisation, the market and competition, as described in Table 1 Significant Characteristics in the Three Phases of Industrial Innovation

The fluid phase is characterised by a rapid product change but also a high uncertainty of outcomes in terms of product, process, competitive leadership and the management of firms. On the manufacturing side, general-purpose equipment and skilled labour is used in small-scale plants located near the source of technology. Another characteristic of this phase is the success of unknown and entrepreneurial producers. Brand and company image are consequently not important for the competitiveness of a company in this early phase of industry evolution.

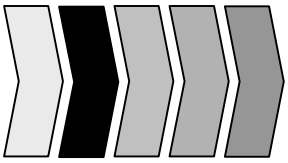
Evolution into the transitional phase commonly occurs when the market has accepted the product innovation and the emergence of the dominant design is on its way. The needs of more specific users are identified and the competition among manufacturers is thus focused on producing and meeting these needs. A more integrated linkage between product and process innovation is emphasised.

The specific phase is characterised by high levels of efficiency resulting in competitiveness based on the value ratio of quality to cost. The relation between process and product is closely integrated, making it expensive and difficult to change parameters in the production process.

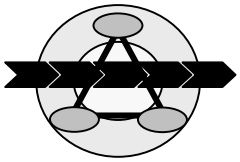
Characteristics	Fluid phase	Transitional phase	Specific phase
Innovation	Frequent major product changes	Major process changes required by rising demand	Incremental for product and with cumulative improvements in productivity and quality
Source of innovation	Industry pioneers; product users	Manufactures; users	Often suppliers
Products	Diverse designs, often customized	At least one product design, stable enough to have significant production volume	Mostly undifferentiated, standard products
Production process	Flexible and inefficient, major changes easily accommodated	Becoming more rigid, with changes occurring in major steps	Efficient capital intensive, and rigid; cost of change high
R&D	Focus unspecified because of high degree of technical uncertainty	Focus on specific product features once dominant design emerges	Focus in incremental product technologies; emphasis in process technology
Equipment	General purpose, requiring skilled labour	Some sub processes automated, creating islands of automation	Special-purpose, mostly automatic, with labour focused on tending and monitoring equipment
Plant	Small-scale, located near users or source of innovation	General-purpose with specialized sections	Large-scale, highly specific to particular products
Cost of process change	Low	Moderate	High
Competitors	Few, but growing in numbers with widely fluctuating market shares	Many, but declining in numbers after emergence of dominant design	Few, classic oligopoly with stable market shares
Basis of competition	Functional product performance	Product variation; fitness for use	Price
Organisational structure	Informal and entrepreneurial	Through project and task groups	Structure, rules and goals
Vulnerability of industry leaders	To imitators and patent challenges; to successful product breakthroughs	To more efficient and higher-quality producers	To technological innovations that present superior product substitutes

Table 1 Significant Characteristics in the Three Phases of Industrial Innovation[61]

[61] Utterback (1996), pp. 94-95



4. Management of the Development Process



The interrelated activities in technology and product development tend to differ depending on factors such as the technical maturity, time horizon, competence availability and process repeatability. By managing the R&D process properly, companies can gain an increase in lead-time precision, quality of final products and reduced development costs. A short presentation of the changing character of the R&D management as a consequence of the market and industry evolution is given. Thereafter, an introduction to the process of product creation will follow. With increasing overhead costs, more accurate and reliable estimation systems are required to support evaluation of ideas in the early stage of the planning process. A brief presentation of the ABC approach is therefore given to analyse the resource consumption in the development process.

4.1 The Change in R&D Management[62]

With the transition from the booming markets in the 1950s to the highly competitive and global market of today, the management of the R&D process has gone through major changes where attitudes has changed from a technology-centred model to a more integration-focused view.

The R&D processes dominating the 1950s to mid-1960s can be described as the first generation of structured R&D. New industries continuously emerged and the market replied with an ever-increasing demand, resulting in most of the products produced being sold. R&D was like the ivory tower with little or no interaction with the company or the overall strategy but the more R&D that was used as input, the more products came out in the end. R&D was viewed as an overhead cost of the company and with focus on scientific breakthrough, the companies pushed the technology towards the market, which was characterised by a demand matching or sometimes exceeding the supply.

The second generation of R&D management followed and during mid-1960s to the early 1970s a period when the demand and the supply were in balance with each other followed. Competition on the marketplace became more intense, and marketing activities were implemented to increase volumes and market shares. Ideas and desires identified on the market were refined and developed by the R&D in a market-pull orientation.

During a shivering economy of the mid-1970s to the mid-1980s, in the third generation of R&D management, a saturation of the demand side as well as high rates of inflation brought a focus on cost control and cost reduction. Elimination of wasteful efforts in R&D processes followed, leading to improvements and a review of the development and monitoring of new technology within the organisation. With the result of a more linked

[62] Nobelius (2002)

and interaction-focused view of the R&D, the technological capabilities was more closely linked with the market needs.

The fourth generation followed after the recovery of the economy during the mid 1980s and early 1990s. A time-based competition paradigm was emphasised by Japanese companies and the focus shifted from the developing of a product to also include for example services, distribution and multi-product platforms, putting the product in a total business concept. Success factors that where highlighted, when striving for speed, where mainly the integration and coordination of activities.

The attitude towards product development has, since the mid-1990s, been focused on increased global competition, rapid technological changes, and a need for sharing heavy technological investments. The fifth generation of R&D management is characterised with boundaries for R&D activities consequently becoming broader. The R&Ds need to interact with other actors in the business environment like competitors, distributors, customers, and suppliers to coordinate and integrate systems from different parties.

4.2 The Product Creation Process[63]

The creations of superb products that satisfy customers and lead the manufacturer's way to market leadership do not happen by coincidence. They are the result of a process called product creation, which can be illustrated as being built upon the six interlocking sub processes called; intelligence development, idea management, technology and resource development, strategy development and planning, project management and product support.

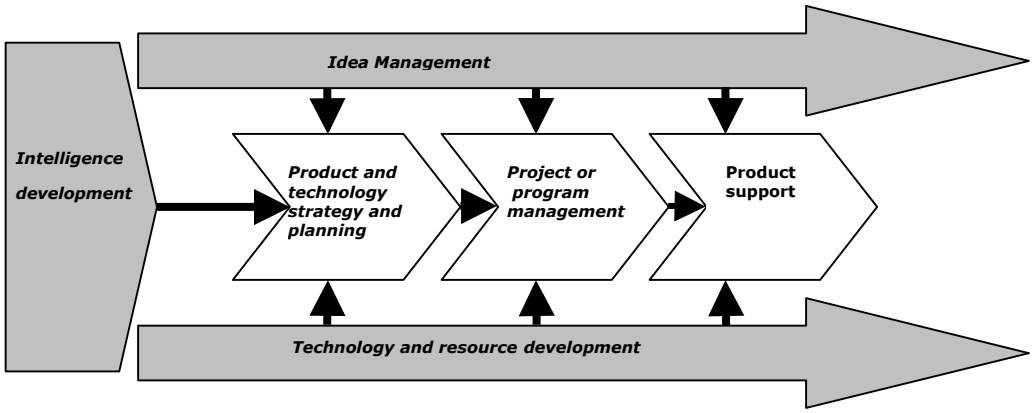


Figure 6 Product creation process[64]

4.2.1 Intelligence Development Process

The intelligence development process involves the collection of relevant data and trends on the markets, of customers, consumers, competitors and available technologies. This input forms the basis of all product creations by transforming data into information and insights. The process can be divided into three categories of intelligences/insights; market-, competitor- and technology intelligence:

[63] Deschamps, Ranganath (1995)
[64] Deschamps, Ranganath (1995), p. 14

- Market intelligence is required to provide a road map of current and likely future trends in customer needs, demands and preferences. It provides information regarding new markets, creative segmentation opportunities and identifies major shifts in marketing and distribution.
- Competitive intelligence is necessary for the evaluation of the competitive intensity over time, through changes in competitors' structure, the emergence of new substitutes or new entrants in the industry.
- Technology intelligence is required to assess the cost/benefit potential of current and new technologies and to identify future discontinuities in technology and their opportunities and threats.

Intelligence and insights are critical for the ability to identify competitive and technological opportunities and threats. These processes should not be taken for granted but should be managed as a multifunctional process as intelligence is the seed from which ideas will grow.

4.2.2 Idea Management

The idea management process is probably the least formalised of all the processes in product creation, but mechanisms and routines needs to be set in order to deliver effective results and to provide true innovation.

It is a process of generation, collection, evaluation, screening and ranking of ideas in an innovation-stimulating manner and it applies to ideas for product improvements and extensions, as well as to entirely new product concepts. The innovation process starts with an attempt to create a vision and identify opportunities generated by changes in the firm's environment. The future environment of the firm should be assessed, strategic directions and priorities should be established and the scope of innovations should be defined before the process of idea generation and evaluation is initiated. The structure of this idea generation may be graphically illustrated as a development funnel[65].

Basic features of a product ranging from fundamental costs to environmental impacts in a life cycle perspective are analysed and defined[66]. All the aspects concerning the desires of the customer, the design, process planning and to the development of product prototype has to be evaluated carefully[67]. Technology deployment strategies concerning which technologies to use to satisfy newly identified customer needs and how to fully exploit the full potential of available technologies as a source of entirely new product ideas should be established. The ideas with the greatest potential are funded as precursor projects to allow further validation from technical, economic and market perspectives before the ideas become embedded in the product, the technology strategies and the plans of the company.

[65] Wheelwright, Clark (1992)
[66] Seo, Park, Jang, Wallace .(2002)
[67] Ben-Arieh, Qian, (2003)

4.2.3 Technology and Resource Development

The development of technology and resources is a fundamental process, as the creation of superb product requires unique skills, capabilities and competences within the company and among suppliers. The building of technical competencies is the process by which the company identifies and decides which technologies will be the core of future activities and will condition the future success of its business. The process involves both strategic activities like assessment and forecasting of technology, assessment of current skills and a competence-building plan to meet future needs, but it also involves more operational activities like the selection of advanced development projects as carriers for the new technologies and the capture and transfer of skills and experience from projects.

The processes of technology and resource development also involve the selection and establishment of a network of suppliers. The skills and capabilities of their suppliers will be interweaved with the product creation process to improve product competitiveness and reduce lead times.

4.2.4 Product and Technology Strategy and Planning

The process of planning product and technology development in a strategic perspective should be an integrative process where decisions are taken about where and how the company intends to compete on the market. The outcome should be a specific product plan determining which new products will be introduced and when, combined with a development plan outlining how the company's developmental capacity will meet the new demands of the product.

4.2.5 Project and Program Management

The process of project and program management involves a series of activities starting in the idea stage and end after the new product has been successfully launched in the market. It thus encompasses the critical product definition phase, technical development project and the market introduction phase. A life-cycle perspective might be added by giving the program manager the responsibility for subsequent extension efforts.

4.2.6 Product and Market Support

The processes of product and market support are initiated by the launch of the created product and do not end until the product is withdrawn from the market and it is time for the next generation to enter. Both processes need to be managed in close coordination with the program management.

The product support process, sometimes referred to as maintenance, involves management of the technical evolution to maintain and enhance the competitiveness of the product throughout successive product generations. It involves all kinds of changes related to quality improvements, reactions to particular problems, standardisations or cost cutting-efforts. It also involves incremental product re-design initiated by cost reduction pressures or by the market. The market support is the process where the marketing and sales department adapt the product to specific customer demands or operational constraints.

4.2.7 Idea Generation as a Development Funnel[68]

The aim of any process development project is to transform an idea to a real product that meet market needs in an economical and manufacturable form. The starting point of this process is the identification, development and refinement of inputs to the selection, completion and introduction of a project. The process of generation and screening of development options can be graphically illustrated as a funnel where a variety of ideas enter but only a fraction become part of a development project. The nature of the funnel is defined by organisational processes and it establishes the overall framework for development including the generation and review of different options and the nature and sequence of critical decisions in the process from idea to reality. Three characteristics of the funnel are of great importance; the width of the mouth, the narrowing of the funnel's neck and the process of securing that objectives established are met.

In order to be successful, an organisation must expand its knowledge base, or the width of the mouth, to increase the number of new products and process ideas. Research institutes and university relationships may offer input as well as creative ideas from manufacturing, marketing, customers, consumers and suppliers. After generation of a variety of alternative concepts and ideas, a process of screening must be performed to allow focus of resources on the most attractive opportunities. The neck must be narrowed while ensuring that a constant flow of good projects flow down it and the process must thus be based on a set of criteria that fit the company's technological opportunities, make effective use of resources available while meeting strategic and financial needs. Once a project has been selected, the challenge is to secure that it delivers the objectives anticipated. Based on these three dimensions, three generic development funnels can be identified.

4.2.8 Model I – R&D Driven, Survival of the Fittest

This model is common in large and technology intensive companies that primarily rely on their R&D team to generate ideas for technologies, products and processes. The challenge, for the R&D organisation is to provide an abundance of ideas and opportunities to evaluate in terms of technical and manufacturing possibilities as well as fundamental economics. Aspects like customer preferences, distribution channel concerns and expectations on financial returns are considered when commercial introduction comes closer. Companies implementing this process often find that screens and decision gates are too generous, resulting in too many projects being approved for market introduction. As a consequence, products offered by the company tend to compete with each other with respect to sales, service and customer attention. One risk with this process is that too many products in the market place may confuse the distribution channel, final customers and add complexity and cost in manufacturing.

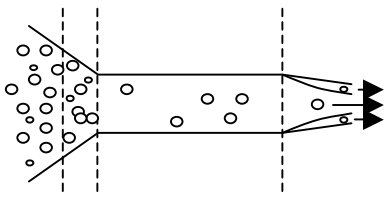


Figure 7 Model I: R&D Driven, Survival of the Fittest[69]

[68] Wheelwright, Clark (1992)
[69] Wheelwright, Clark (1992)pp. 119

4.2.9 Model II – A Few Big Bets

Small firms with limited resources to invest in product development commonly adopt model II. The fundamental feature of this process is the focus on one idea through the entire process after a quick evaluation of a wide range of ideas from a variety of sources. It is common that senior managers in the company establish boundaries, commitment and objectives at the initiation of the project with primary criteria for selection being market potential and financial expectations. To avoid late surprises and disappointments, the senior managers regularly require updates and reviews during the development process. Although this model is the dominant process behind the success of small companies, it is also adopted by larger firms, which are dominating slowly evolving product market areas. These larger companies do, however, require more time to execute the process than their smaller counterparts.

One threat with adopting this approach is that despite the focus and clarity offered, the products introduced tend to achieve very modest market success in combination with gaining a reputation of being "conservative and no longer innovative".

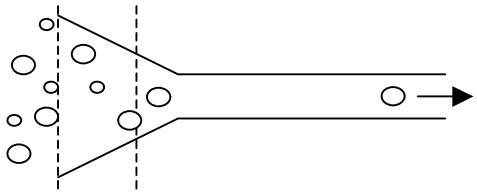


Figure 8 Model II: A Few Big Bets[70]

4.2.10 Model III – Innovative and Focused

An alternative that tries to combine the advantages with model I and model II is called the "innovative and focused" development funnel. The initial part of this funnel represents the phases of concept development and idea generation where the mouth of the funnel is expanded dramatically. The purpose with this expansion is to provide incentives and procedures to encourage innovation throughout the entire organisation. The narrowing of the funnel is performed at two different stages, the first one at the end of the product/process concept development stage where a discussion to determine the additional information required before a go/no-go decision can be made. The boundaries of the project are established and different ideas are combined, integrated and evaluated with respect to overall strategies. At the second screen, the product and process options are reviewed and those that will become development projects are selected. Any project passing this gate will be funded and staffed until market introduction.

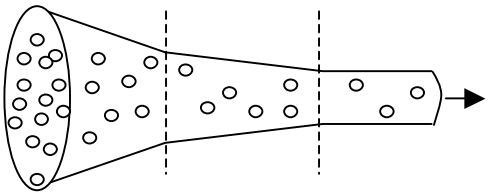
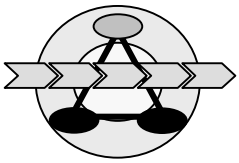


Figure 9 Model III: Innovative and Focused[71]

[70] Wheelwright, Clark (1992) p. 124
[71] Wheelwright, Clark (1992) p. 124

4.3 Activity Based Costing



In the global competition on the marketplace of today's, where manufactures compete with market aspects like quality, cost and time to market, the control and knowing of costs is essential for efficient operation and competitive production.[72] One factor that has influenced the conditions for product calculation is the cost structure. Direct costs of material and labour are no longer considered to be a major part of the total cost mass. The change of the company's internal and external environment has strongly altered the conditions for product calculations by a larger amount of overhead costs.[73] In traditional cost accounting systems, overhead allocations fail to accurately reflect how different products, customers, and processes actually consume resources whereas ABC shows managers what is causing cost and how to eliminate non-value adding costs.[74] The ABC system has been used in different industries like electronics, automotive, aerospace, telecommunication etcetera. Today the activity-based cost method is a well known cost estimation and accounting methodology which offers advantages like accuracy, relevance of products costing and the providing of timely cost information.[75] The development of systems, like CAD/CAM – Computer Aided Design and Manufacturing – open up for new perspectives of product and process development.[76] Although software systems have been developed to assist the implementation of ABC, the identification of activities and the estimations of costs remains a challenging task for the organisation.[77]

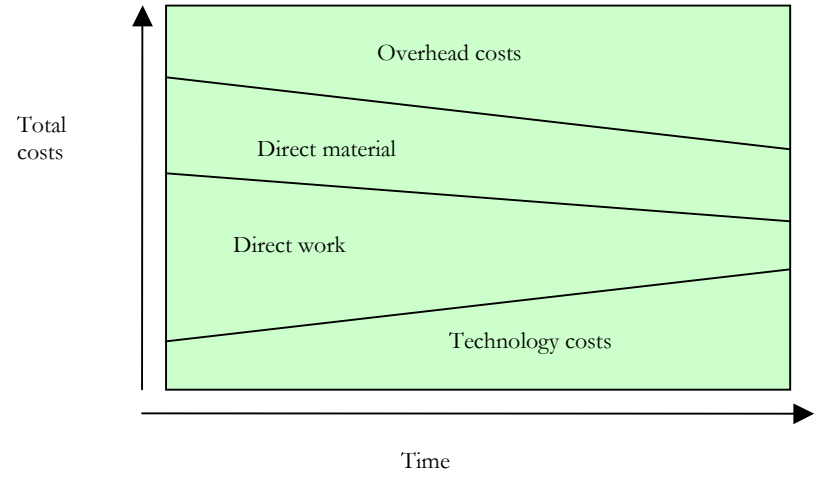


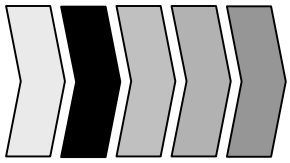
Figure 10 The way the cost structure has changed in the twentieth century[78]

[72] Ben-Arieh David, Qian Li, (2003)
[73] Gerdin (1995)
[74] Kim, Park, Yoon (1997)
[75] Ben-Arieh, Qian (2003)
[76] Gerdin (1995)
[77] Samuelsson, Olve (1989)
[78] Gerdin (1995) p. 16

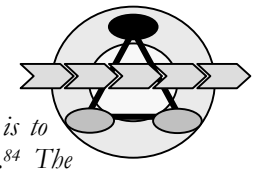
The Activity Based Calculation method differs far and most from traditional methods by defining cost pools as activities rather than as production cost centres.[79] This fundamental assumption of ABC systems that activities consume a company's resources and products consume activities results in products competing for a company's scarce activities in ABC systems.[80]

The ABC system could most simply be described as consisting of the three components; resources, activities and products. Resources can be defined as productions factors like work, technology and material. In calculation situations they are expressed as salary, depreciation and material costs. Activities on the other hand can simply be described as something that consumes a certain amount of input with the purpose to generate a certain amount of output.[81] By using the ABC method those activities that drive costs by the consumption of resources are identified.[82] The level on the detailed description of an activity should be somewhere in the range from function to task. Since the number of activity drivers affects the outcome strongly, a trade off has to be done between the required accuracy and the number of activities that can be merged with the same activity driver. Those costs that cannot be directly derived to activities or calculations object are divided with the help of resource drivers and activity drivers. Resource drivers are used when dividing the cost of the resource consumption to activities, while the activity drivers are used for dividing the costs in the activity cost pool to the individual calculation object.[83]

[79] Ben-Arieh, Qian (2003)
[80] Kim, Park, Kaiser (1997)
[81] Gerdin (1995)
[82] Ben-Arieh, Qian (2003)
[83] Gerdin (1995)



5. Quality



A key determinant factor for successful management of product development is to secure that there is a fit between the new product and the consumer needs.[84] *The perceived quality affects the consumer in different ways when deciding which products to buy.*[85]*The quality aspect is a major key success factor when developing safe food products to the market arena today. A brief presentation of the complexity that customers face when buying products will be followed by an introduction to the Quality Function Deployment tool.*

5.1 What is Quality?

Quality can be defined in many ways and even within a company – different departments may have different opinions on how to view the concept of quality.[86] At one end of the extreme is the notion that a products quality can be defined using measurable and verifiable pre-determined standards[87]. On the other end is the idea that quality cannot be analysed, but can only be recognised through experience[88]. When talking about food it is possible to identify the three categories of food qualities; product-, process- and user-oriented quality. The product-oriented quality is characterised by the products physical properties, while the process-oriented quality has more to do with the extent to which product-quality remains stable in at pre-determined levels.[89] The user-oriented quality is the quality perceived by the customer or the consumer. This "perceived quality approach" is somewhere in between the two extremes described above. It is widely accepted among both practitioners and academics and it claims that quality is mainly dependent on the consumer's judgement.[90] Since both product- and process-oriented quality are measurable attributes, they can also be described as objective quality. Perceived quality on the other hand can only be measured by the individual user and is therefore sometimes called subjective quality.[91] However, the three groups of qualities are interrelated, although the relationships are far from clear and easy. The perceived quality of a product is the result of the process of perception, which in turn is influenced by visible and invisible product characteristics, personal experiences and expectations, the situation and the place.[92]

[84] Jongen, Meulenberg (1998)
[85] Luning, Marcelis, Jongen (2002)
[86] Ophuis, Trijp (1995)
[87] Zeithaml (1988)
[88] Ophuis, Trijp (1995)
[89] Grunert (1995)
[90] Ophuis, Trijp (1995)
[91] Grunert (1995)
[92] Ophuis, Trijp (1995)

5.1.1 Dimensions of Quality as Determinant Factors

In the case of most food purchase situations, major product quality dimensions cannot be ascertained before purchase and consumption. Purchase decisions are therefore dependent upon quality expectations – or quality cues - that a product can stimulate.[93] These quality cues include a wide array of product–related attributes – both intrinsic and extrinsic. Intrinsic cues refer to the physical appearance of the product, while the extrinsic factors are related, but not a part of, the product. The expected quality of fresh fruit, for example, is highly dependent on intrinsic quality cues like colour, shape, size and structure but it is also dependent on extrinsic cues like the price, brand name and country of origin.[94]

The purchasing process could briefly be described by the attributes image, value and satisfaction where the image attribute affect the purchasing process by prestige, service reputation and the firm's established quality as well as the influence it has on design, technology and other product attributes. Value is in the eyes of the beholder and the perceived value can be improved by making a new superior design or to make attributes like technology needs visible at the time of purchase.[95] After the item is purchased and consumed, a quality experience might emerge for the consumer.[96] Within the context of food taste is the foremost important experience quality attribute, but other important factors include freshness and convenience. These are influenced by a number of important factors that can only partly be controlled by the producer.

The quality experienced will often deviate from the expected quality and the relationship between quality expectation and quality experience is commonly believed to determine consumer satisfaction, customer loyalty, repeat purchase, and ultimately reputation and image of the product.[97] In addition to these two categories of quality, it is also common to talk about credence quality attributes.[98] These are dimensions where the consumer cannot experience the quality directly, but has to rely on the judgement or information of others. Health-related qualities are typical credence quality attributes since there, under normal circumstances, are no experienced benefits from consuming a product that is claimed to be health promoting.[99] Increased interest in production processes and organic production is another example of the increased importance of credence attributes for the consumer's perception of quality. In such situations when products are marketed based on mainly credence characteristics, the influence on the quality perception of the consumers becomes a question of communication. Personal values will affect the degree to which certain credence quality attributes are accepted.[100]

The relationships between these different quality attributes and expectations are presented in the figure below.

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[93] Grunert (2002)
[94] Ophuis, Trijp (1995)
[95] Deschamps, Ranganath (1995)
[96] Grunert (2002)
[97] Oliver (1993)
[98] Ophuis, Trijp (1995)
[99] Grunert (2002)
[100] Ophuis, Trijp (1995)

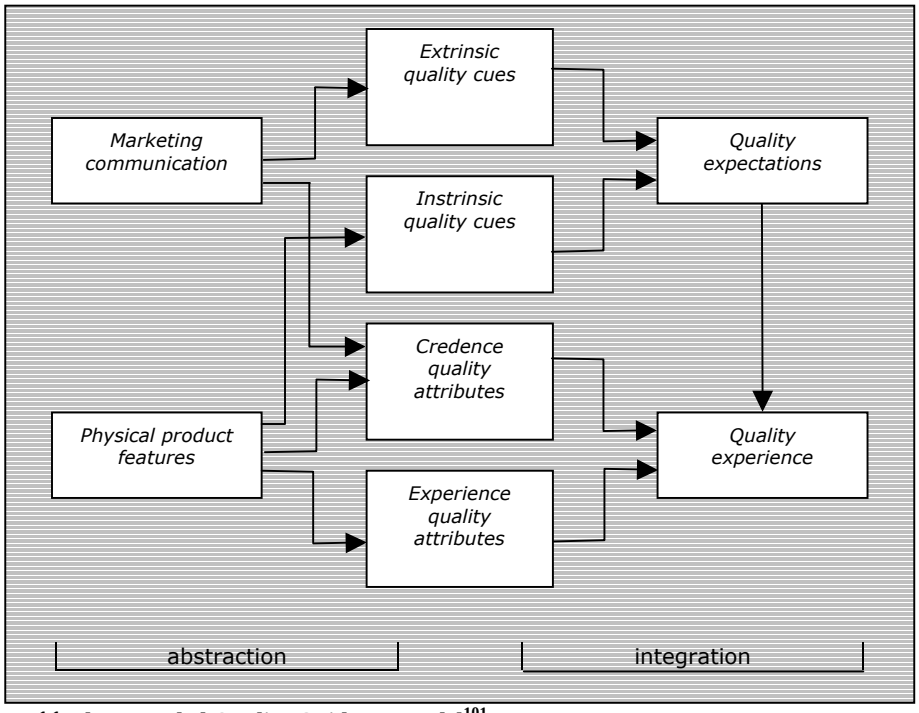


Figure 11 The extended Quality Guidance model[101]

5.2 Quality Function Deployment

With food companies facing increasing challenges of developing products to meet consumer needs and requirements, Quality Function Deployment (QFD) is gaining more and more appreciation as a customer-oriented approach to facilitate this market oriented product design[102]. Originating from the ship industry, QFD was introduced in 1966, with early users including Toyota, Ford Motor Company, Procter & Gamble and 3M. QFD is still mainly used within car and electronic industries, and the food industry did not start to show any interest for the approach until 1987. There is still only a limited amount of research available of applications in the food industry.[103]

The overall aim of QFD is to emphasises a structured way to bring quality – as perceived by the customers – upstream in the product development process by translating the voice of the customer into product characteristics through various stages of product planning, engineering and manufacturing.[104] The approach can be viewed in terms of four different phases involving product planning, product design, process planning and process control planning.[105] Only the first phase, dealing with product planning, will be considered in this thesis.

[101] Jongen, Meulenberg (2001), p. 48
[102] Viaene, Januszewska(1999)
[103] Costa, Dekker, Jongen(2001)
[104] Tang, Fung, Xu, Wang (2002)
[105] Gustafsson (1998)

The starting point when preparing for a QFD project is to specify which concept or existing product is to be evaluated, and which customers will be targeted. A cross-functional team, with members from all functions involved in product development and market introduction is assembled.[106]

5.2.1 The Product Planning Process or the House of Quality (HOQ)

The first phase, or matrix, in the QFD approach is the Product Planning Process, also called the House of Quality due to its house-like shape.[107] The main purpose of the House of Quality is to define the objective for product development through the identification of customer needs and desires and the translation of these into measurable technical attributes.[108] The interrelationships between customer requirements and technical attributes is analysed and the correlation between various attributes and the establishment of target levels are determined to ascertain that higher customer satisfaction is achieved.[109]

The House of Quality consists of different parts, called rooms, which are sequentially filled while translating consumer desires into product characteristics. These rooms include:[110]

- The Voice of the Customer
- Strategic Planning Room
- The Voice of the Company
- Technical Correlation Roof
- Relationship Room
- Technical Priorities' Room

The Voice of the Customer

The first room in the House of Quality concerns the Voice of the Customer. The aim with this room is to highlight market orientation and customer needs and desires by listing requirements on the product and its attributes, as described by the customer.[111]

Important sources of information when identifying, listing and prioritising customer requirements are opinion surveys, in-depth interviews, focus groups, market research data, sales data, retailers, observations of the customer and customer complaints.[112]

[106] Costa, Dekker, Jongen (2001)
[107] Andersson (1991)
[108] Bech, Hansen, Wienberg (1997)
[109] Tang, Fung, Xu, Wang (2002)
[110] Costa ,Dekker, Jongen (2001)
[111] Andersson (1991)
[112] Costa, Dekker, Jongen(2001)

Essential in this market research phase, is that respondents represent the target group for the product development process. Relevant information regarding the customers' relations to the product include:[113]

- General characteristics of the customer
- Who are using the product?
- For what purpose is the product used?
- How frequently is the product used?
- Where, in what context, is the product used?
- How is the product used?
- Why is the product used?

These requirements, expressed in the words of the customer, might be vague and loose - like "easy to use" or "good taste" - but they may give an indication of the expected benefits of the product or the service.[114] The subsequent step when creating the Voice of the Customer-room, is to express and list these requirements in short and vigorous statements that summarizes customer desires and usages of the product.[115] Based on quantitative marker research, the QFD-team prioritise between the desires of the customer by attaching relative importance weightings to each customer requirement. The identification of customer requirements is probably the most fundamental step in the entire product development process as its purpose is to ascertain that there is a market need for the product and to assure that available resources are allocated correctly.[116]

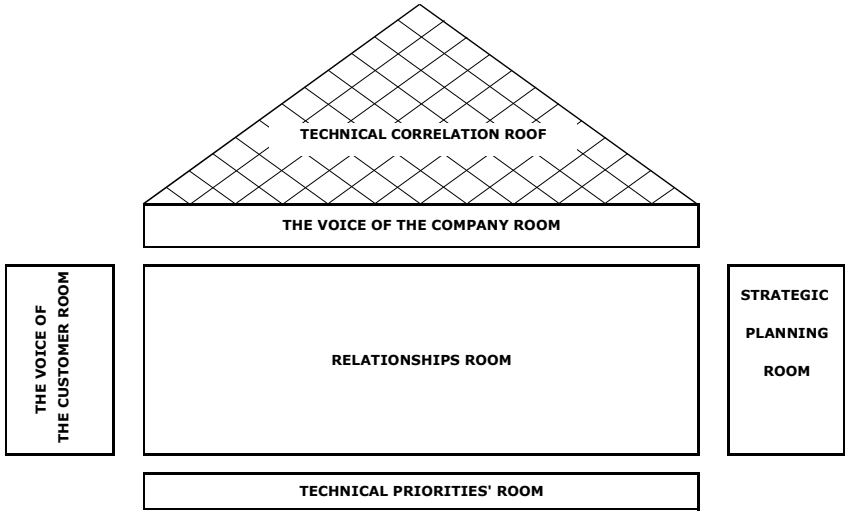


Figure 12 The House of Quality[117]

[113] Gustafsson (1998)
[114] Costa, Dekker, Jongen (2001)
[115] Gustafsson (1998)
[116] Costa, Dekker, Jongen (2001)
[117] Costa, Dekker, Jongen (2001) p.307

Strategic Planning Room

The role of the strategic planning room is to provide a link between the QFD project and the company's strategic vision by identifying market opportunities – the sales points – and priorities for R&D. The weight of each customer requirement gives indications of areas where high quality might offer success opportunities for the company. When the requirements of the customers have been established the company has to understand how good the company and its competitors are to satisfy these requirements in the marketplace. With the help of quantitative and qualitative data, a table is made up about the customer's perception about how well the product or the concept satisfies the requirements in comparison to existing products on the marketplace. If desirable, a customer complaints column could be added.[118] The awareness of competitors' performance, as well as the company's own performance, is important when establishing preliminary weightings of the new product's features.[119]

The Voice of the Company

The next step is to identify how these requirements can be met to assure that the final product gives the customer satisfaction. In this room, representing the Voice of the Company, the technical characteristics of the end product are listed in direct relation to the requirements of the customer[120] The aim is thus to analyse *how* the product can achieve *what* the customer desires.[121] The design requirements and quality functions have to be expressed as measurable parameters to allow objective future evaluation and control of the quality of the product.[122] When expressing the product in technical terms, the product characteristics should also be concept independent.[123]

Technical Correlation Roof

As different technical parameters may be correlated to each other it is important to try to evaluate their degree of interdependence.[124] These relations and interdependencies are expressed in the technical correlation roof.[125] The purpose with this step is to predict how changing one product characteristic may affect other attributes. Increased knowledge regarding this issue may help the team to identify and react to synergistic (positive interdependence) or trade-off (negative interdependence) situations. As trade-off situations commonly indicate R&D needs they should always be solved in the way that most favours the customer.[126]

Relationship Room

The core of the House of Quality is the relationship room. In this phase the relationship between the customer requirements and product characteristic, and the intensity of each relationship, are analysed.[127] Different graphical symbols are used to show if the relation

[118] Costa, Dekker, Jongen (2001)
[119] Andersson (1991)
[120] Costa, Dekker, Jongen (2001)
[121] Andersson (1991)
[122] Costa, Dekker, Jongen (2001)
[123] Gustafsson (1998)
[124] Costa, Dekker, Jongen (2001)
[125] Gustafsson (1998)
[126] Costa, Dekker, Jongen (2001)
[127] Gustafsson (1998)

is strong, medium or weak.[128]To establish and evaluate these relationships is a highly complex task, but it is a critical step in the House of Quality process. It is an important opportunity to control whether the company and the project is adequately addressing the customer requirements from a technical point of view.

Technical Priorities Room

The last task to complete in the House of Quality is to establish priorities among technical characteristics.[129] An assessment of characteristics of products that are currently on the market aims at evaluating performance levels of competitors in relation to the company itself regarding the way that product characteristics directly affecting customer requirements. For each product characteristic, a comparison between the company's and the competitors' technical performance level is made and illustrated in a graph. In addition a row, indicating the level of organisational difficulty related with the realisation of each end-product characteristic, can be added.[130]

The technical competitive assessment is then compared with a customer competitive assessment to determine whether the company share the same view as the customers on how customer requirements are fulfilled by existing products.[131]

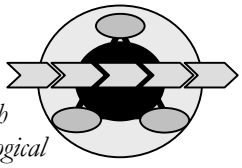
Evaluating technical competitive assessment, customer competitive assessment, sales points, relationships and customer importance ratings contribute when establishing target values for the product characteristics. These target values represent measurable levels of performance for each end-product characteristic that the company has to achieve in order to maximize customer satisfaction. More over, these performance levels act as goals and critical control points that should be analysed at each stage of the product development and market introduction processes.[132]

5.3 Evaluation of the House of Quality matrix

The implementation of the QFD-tool can be evaluated by looking at the relationship room. Blank rows indicate that customer requirements are not being addressed properly by the identified technical features, which might result in product characteristics missing or having to be modified at a late stage in the product development process. An empty column on the other hand may indicate a waste of resources by highlighting product characteristics not satisfying any of the listed customer requirements. It may, however, also indicate a missing customer requirement.[133] Rows without strong relationships are commonly difficult to fulfil. Rows and columns where relationships are repeated, forming clusters or having too many relationships indicates problems in the hierarchical structure of consumer desires and product characteristics.[134]

[128] Andersson (1991)
[129] Gustafsson (1998)
[130] Costa, Dekker, Jongen (2001)
[131] Costa, Dekker, Jongen (2001)
[132] Costa, Dekker, Jongen (2001)
[133] Costa, Dekker, Jongen (2001)
[134] Gustafsson (1998)

6. Facts About Mayonnaise



As a considerable part of this study has focused on the complexity involved with development of mayonnaise, knowledge concerning chemical, physical and technological aspects has been required by the authors. As a major part of the target group for this report does not have an adequate background in food technology, a brief presentation of the product is given. The presentation includes information regarding history, applications, regulations, and formulations.

Mayonnaise is probably one of the worlds most widely used sauces or condiments. It can be described as a thick, creamy sauce or dressing made out of vegetable oil, egg yolk, vinegar or lemon juice and seasonings.[135]

The product is widely used as a sauce, a spread or a dressing but it is also used as the base for a variety of other sauces, such as thousand-island, tartar sauce, rémolade and blue cheese dressings. A typical commercial mayonnaise formula may contain the following ingredients:[136]

Vegetable oil	80.5%
Vinegar, white 10%	3.8%
Water	9.6%
Sugar	1.8%
Salt	1.2%
Spices	0.3%
Dried egg yolk solids	2.8%

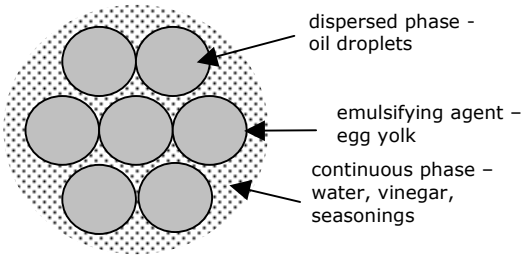
Table 2 Recipe of mayonnaise[137]

There are many varieties of mayonnaise with different rheology, seasonings, and oil content. The taste of mayonnaise also differs in different countries and while it has a slightly sour taste in the main parts of Europe, it has a very sweet and distinguished mustard taste in the north part of Europe and a very sweet taste in Scandinavia. With increased interest in nutritious foods there is a tendency towards lowering the oil contents in mayonnaise.[138]

6.1 Emulsified Dressings

Mayonnaise and mayonnaise dressings are emulsions – i.e. a mixture of two liquids, like oil and water, which cannot normally be combined. Emulsifying is done by slowly adding one ingredient to the other while stirring rapidly. An emulsifier must be added to prevent the two liquids from separating again. Emulsifiers can be described as a hybrid between the two liquids and serve to stabilize the mixture.[139] Mayonnaise is an oil-in-water

[135] Depree, Savage (2001)
[136] Edited by Macrae, Robinson, Sadler (1993)
[137] Edited by Macrae, Robinson, Sadler (1993) p. 1445
[138] Bockisch (1993)
[139] www.howstuffworks.com, 030205



emulsion, despite the very high oil content, which means that tiny droplets of oil are dispersed in a continuous aqueous acidic phase. Tiny oil droplets are closely packed, giving the mixture a high viscosity. The main emulsifier is the protein fraction of egg yolk, which contains lecithin.[140]

Figure 13 Schematic picture of the microstructure of mayonnaise

6.1.1 Components of Mayonnaise

Oil is the major ingredient, contributing to viscosity and stability of mayonnaise. The oil content is commonly around 80%, but in an ideal emulsion, the dispersed phase can only account for a maximum of 74% of the total volume. This means that the oil droplets in mayonnaise become some what distorted from their normal spherical shape. The close packing of the oil droplets allows strong interaction, which is one major factor for the high viscosity of mayonnaise.[141] The choice of oil depends on local preferences and quality, but soybean, cottonseed, sunflower and corn oils are commonly used commercially.[142]

Egg yolk is the most commonly used emulsifying agent due to its superior qualities when forming the emulsion and giving it the desired texture. The egg yolk itself is an emulsion, and it seems like its emulsifying properties are highly dependent on its structure. Any treatment that disrupts this structure might therefore reduce its ability to act as an emulsifying agent.[143]

The functions of vinegar/lemon juice are preservative and flavouring. The low pH makes the mayonnaise resistant to microbiological spoilage but it also affects the structure of the emulsion.[144] When the pH is close to the average isoelectric point of the egg yolk proteins (approximately pH 3.9), the charge of the proteins is minimized giving the emulsion the highest viscoelasticity and stability.[145] The pH–level on mayonnaise on the market is usually between 3 and 4.[146]

Mustard is mainly used for flavouring, but there is also evidence that it helps to stabilise the emulsion, although the mechanisms behind this are not known.[147]

[140] Edited by Macrae, Robinson, Sadler (1993)
[141] Larsson, Furugren (1995)
[142] Edited by Macrae, Robinson, Sadler (1993)
[143] Depree, Savage (2001)
[144] Bockisch (1993)
[145] Depree, Savage (2001)
[146] Bockisch (1993)
[147] Depree, Savage (2001)

6.2 Microbiological Stability

Due to the low pH, mayonnaise is relatively resistant to microbiological spoilage and the main reasons for spoilage are therefore auto-oxidation and decreased emulsion stability.[148] There have, however, been quite a number of outbreaks of food poisoning caused by *Salmonella* associated with consumption of homemade mayonnaise.[149] In these outbreaks, raw egg has been identified as the major vehicle of infection.[150]

6.3 Physical Stability

The volume fraction of the dispersed phase is very important for the stability of the emulsion system. Physical changes in dispersed droplets occur through interactions between the continuous and the dispersed phase through the processes of creaming, flocculation and coalescence. Coalescence is the process when two or more particles fuse to form a single, larger, particle while flocculation is the process where smaller particles adhere to each other to form larger aggregates. Creaming indicates the movements of oil droplets under the action of gravity.[151] Coalescence is generally unacceptable in mayonnaise, but unless phase separation occurs, creaming and flocculation in o/w emulsions may not lead to detectable changes in appearance and rheological behaviour.[152]

Although the emulsifier is essential for the formation of the emulsion and although it confers short-term stability, some kinds of stabilisers are commonly added to ensure long-term stability of the emulsion. Common stabilisers include xanthan gum, guar gum, and gum arabic.[153]

6.4 Chemical Stability

The chemical stability of mayonnaise is mainly affected by lipid oxidation processes. The nature of mayonnaise means that a very large area is exposed to an aqueous phase, which may contain enough dissolved oxygen to initiate auto-oxidation. The stability of mayonnaise to auto-oxidation is highly dependent on the type of oil used and the introduction of air-bubbles during the manufacturing process.[154] Lipid oxidation is related to three main problems:[155]

- the formation of off-flavours
- the reduction of nutritional value as the content of essential fatty acids decrease
- the formation of free radicals may possess a health threat to consumers as they may participate in the development of arteriosclerosis.

During the process of lipid oxidation free radicals, lipid hydro-peroxides and secondary oxidation products – including aldehydes, ketones, alcohols and hydrocarbons – are

[148] Larsson, Furugren (1995)
[149] Radford, Board (1993)
[150] Xion, Xie, Edmondson (1998)
[151] Rao (1999)
[152] Rao (1999)
[153] Dickinson, Stainsby (1988)
[154] Depree, Savage (2001)
[155] Jacobsen (1999)

formed. It is only the secondary products that are responsible for changes in aroma and flavour properties of foods caused by lipid oxidation. The term rancid is often used to describe off-flavours but the depending on the food product in question, the meaning of this term may vary as the fatty acid composition in different oils may give rise to different lipid oxidation products.[156]

6.5 Rheology and Flow Properties

The texture of dressings and sauces like mayonnaise is very complex and multifaceted. The consumer perception of preferred texture is an overall effect originating from all relevant textural attributes involving both visual and sensory assessment. The perception of thickness alone is a combination of perception of viscosity from several different sensory cues like how the sauce pours, perception during basting, its cling and its mouth-feel. It is thus essential to use different approaches and techniques when measuring the rheological behaviour of these products. Even if sophisticated rheological measurements are made, it is very complex to draw correlations between rheology and sensory perception.[157]. With the oil phase accounting for more than 74% of the total volume, the close packing of fat droplets allows them to interact very strongly with each other[158] and the more oil dispersed in the emulsion, the stiffer it will be.[159]

6.5.1 Rheology in Low Fat Products

Due to recent changes in dietary consciousness, there has been an increased interest in low-calorie/reduced-fat products. These products are recognised by consumers not as diet foods, but as "nutritious, lower-calorie counterparts to the standard products, with good sensory properties."[160] Besides less oil, these mayonnaises contain ingredients like modified food starch, cellulose gel and other thickeners and emulsifiers, all of which help contribute to the proper consistency.[161] Water replaces the fat removed and gums like xanthum and alginates are added to stabilise the formula and give similar viscosity and texture characteristics as the original product.[162] When identifying a suitable thickener it must be stable at low pH, be resistant to heat-treatment during the production process and express a long shelf life. Problems associated with replacing fat with starch include addition of odours and decreased stability due to retrogradation of starch. In addition, starch does not have a good meltability in the mouth, resulting in poor release of flavours and thick mouthfeel. Other problems with low-fat mayonnaise are lumpy texture with an acidic taste and sour aftertaste.[163]

[156] Jacobsen (1999)
[157] Friberg, Larsson (1997)
[158] Harrison, Cunningham (1985)
[159] Edited by Althschul (1993)
[160] Macrae, Robinson, Sadler (1993)
[161] Friberg, Larsson (1997)
[162] Macrae, Robinson, Sadler (1993)
[163] Phillips, Williams (2000)

6.6 Mayonnaise Enriched with Omega-3

Two families of fatty acids are considered to be essential for the body – the omega-3 and omega-6 fatty acids.[164] Both groups are essential for good health and normal growth and since the human body cannot manufacture them, they must be supplied in the diet.[165]

6.6.1 Definition of Omega-3 Fatty Acids

Omega-3 fatty acids are long-chain polyunsaturated fatty acids with the first of many double bonds beginning with the third carbon atom (when counting from the methyl end of the fatty acid molecule).[166] The most basic omega-3 fatty acid that is essential to the human body is the α-linoleic acid (ALA; C18:3 n-3)[167] but from a nutritional perspective, it is the long-chain omega-3 fatty acids eicosapentaenoic acid (20:5) – EPA – and docosahexaenoic acid (22:6) – DHA – that are considered to be most valuable.[168] Due to the limited ability of the cells to synthesise EPA and DHA, there is a recommendation to increase the consumption of these long chained fatty polyunsaturated fatty acids.[169] As a consequence, The United States Department of Health and Nutritional Services recommends a daily intake of omega 3 at 1-3 grams per day.[170] The richest and most readily available sources of EPA and DHA are oil-rich fish and supplements such as fish oil and cod liver oil.[171] As the intake of fish and fish products is relatively low in the western world, efforts has been made to increase the consumption of marine fatty acids like omega-3 by incorporating fish oil into different food products such as bread, yoghurt, salad dressing and mayonnaise.[172]

6.6.2 Stability of Mayonnaise Enriched with Omega 3

Chemical analyses and sensory testings have showed that fish-oil-enriched food products generally possess a decreased shelf-life.[173] This reduced shelf life is a consequence of the omega-3 fatty acids susceptibility to oxidation as a consequence of their high degree of unsaturation.[174] With oxidation of these fatty acids follows unpleasant off-flavours and decreased nutritional value, but the time for development of these off flavours is, however, strongly food-product dependent. The time for development of these off flavours is, however, strongly food-product dependent and studies have showed that mayonnaise (16% w/w fish oil) develops off flavours much quicker than for example salad dressings.[175]

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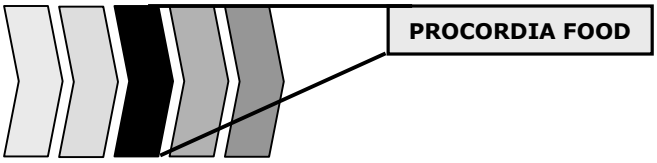
[164] Horrocks, Yeo (1999)
[165] Shahidi, Udaya, Wanasundara (1998)
[166] Brown (2001)
[167] Harel, Riggs, Vaz, White, Menzies (2001)
[168] www.omega-3info.com, 030326
[169] Harel, Riggs, Vaz, White, Menzies (2001)
[170] www.gmi-canada.net, 030326
[171] Gower (2001)
[172] Jacobsen et al.(1999)
[173] Jacobsen (1999)
[174] Jacobsen et al.(1999)
[175] Jacobsen (1999)

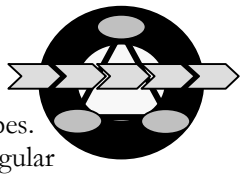


7. The Procordia Food Case

Challenges associated with securing quality in market oriented product development in the Swedish food industry were studied by considering different aspects of product development at Procordia Food.

Representatives from the marketing department, the innovation group and the R&D department at Procordia Food were consulted and complemented with information from a survey of food magazines to provide insights in the characteristics of the Swedish mayonnaise market, the product development process at Procordia Food and to adapt the three fictitious concepts to suit Swedish consumers. Challenges associated with development of the three concepts were assessed, the QFD tool was implemented and activities of product development were mapped.

7.1 Mayonnaise and the Swedish Market



Swedish mayonnaise is commonly associated with a very thick and creamy sauce sold at room temperatures in glass jars or plastic tubes. Some standards of Swedish mayonnaise have emerged with regular mayonnaise containing approximately 80% fat, and the low calorie alternative 30%. The usage of mayonnaise is mainly restricted to special occasions and the preparation of traditional smörgåstårta, but with increased consumption of subs and salads, the pattern of mayonnaise consumption has the potential to change.

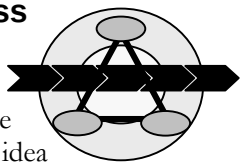
As the Swedish market is currently characterised by trends towards health, easy-cooking and ethnic cooking, mayonnaise is facing troubles competing with dairy products like Crème Fraiche. While mayonnaise is often associated with negative attributes like fatty, greasy and unhealthy, consumers generally perceive dairy products as fresh, convenient and relatively healthy. The attempt to make mayonnaise more attractive to health-concerned consumers by developing fat-free alternatives gave limited success due to alterations of the taste and market communication issues.

There are currently three dominant actors on the Swedish mayonnaise market – Findus, Kavli and Felix. Findus holds a market leader position with its high quality image, followed by Kavli, offering a low-price alternative. The market position of Felix has, however, continuously decreased the last ten years and is now facing severe troubles competing on the Swedish mayonnaise market. With decreasing importance of mayonnaise in modern cooking, the entire mayonnaise market is considered to be mature and slowly declining. As a result, product development activities have, during the last ten years, been restricted to incremental developmental efforts like line-extensions and redesign of package and labels. Although these activities may have offered temporary increase in market shares, no revitalisation of the market has been obtained. The total market for mayonnaise in Sweden is approximately 3000 tonnes/year with a retail value of approximately MSEK 200.

Due to the limited market opportunities and the weak position on this declining market, Procordia Food has chosen not to invest in any developmental efforts associated with

mayonnaise. The strategy is, contrary to win new market shares, to increase profit by increasing margins through rationalisation of production- and distribution processes. One possible future scenario is the development of a company wide product, which would allow opportunities of economies of scales.

7.2 Management of the Development Process



7.2.1 Idea Generation

Before deciding to initiate a product development project, a phase characterised by idea generation is conducted. Active in this idea process is the innovation group, which assembles co-workers with competences in a variety of areas like marketing, product development, concept development, strategy, sensory analysis and project leadership, but also consumer representatives. The idea generation phase usually requires two months of work and may be initiated by the chief of marketing, a project leader or the innovation group manager. Direction of the process is decided after strategic evaluation of product portfolio and market plans. The input to the idea generation may originate from a database, which is continuously updated with ideas from other idea generation processes. Other sources of information include the idea box, which collects ideas from team members and consumers, trend analysis and competitor analysis.

When ideas have been collected it is necessary to evaluate, develop and elucidate the ideas that are considered to be most interesting with the greatest market potential. To be able to analyse and evaluate the ideas further it is also important that the ideas are specified and explained in a way that is easily communicated to team-members as well as potential consumers.

Further evaluation of ideas is performed using tools of concept screening and scoring. The aim of the concept screening is to test the market potential to identify the idea with the greatest potential. The ideas are expressed in the language of the consumer, consumer attitudes are analysed and only the most promising idea is considered when planning for a development project. In cases where it is hard to identify the most promising idea, concept scoring might be of interest. At this stage, the main responsibility of the process is passed on from the innovation group to the market group. External organizations, like SIFO, are generally involved to conduct extensive market research. A formal decision to "enter" the innovation process is taken after evaluation with respect to market plans and product portfolio.

7.2.2 The Innovation Process

The innovation process can be described as a process going through four different stages. Different competences and different people are active in the different phases and the closer to the launching of the product the more resources are required. The total time span from an idea to an actual launching is somewhere between one and a half year to two years but the intensity of workload is fluctuating.

Project Planning – Phase I

Based on the project-proposal specified and developed during the idea generation process, a comprehensive analysis is conducted. Needs of the consumers and market potential will be identified and analysed and a product concept is developed. The

product concept takes into consideration various aspects like the package, price, production strategy and targeted market segment. The fit with market plans and product portfolio is evaluated. Financial as well as resource undertakings are studied. A preliminary project plan is developed and the future project organisation is proposed.

All the available information concerning the concept in terms of market opportunities, competitive environment, resource requirements, financial undertakings, market potentials and product characteristics is put together in a project establishment paper to support a decision of initiating the project. This decision, where a project is either established or rejected, can be identified as the first decision gate in the innovation process. The collection of the necessary information to make such a decision may require anything from one week to six months, depending on complexity and the level of innovation.

Business Case – Phase II

Once the project has been approved, the project group will conduct a more detailed analysis of aspects previously presented in the project establishment paper. Market segment, expected sales volume, product volume and package size are analysed more deeply to estimate production costs, technical possibilities, price level, investments and marketing strategy. One of the major challenges at this stage is the estimation related to production costs as neither product nor processes have been developed at this stage. Personal experiences and benchmarking with similar products are sources of information in this matter and preliminary recipe developments may sometimes be conducted. Estimations and analysis form the business case. The most important function of the business case is to show whether the project has opportunities of making profit within the following three years. If there are reasons to believe that the profitability will be lower than anticipated at the project establishment stage, there is still an opportunity to stop the innovation process before any major resources have been invested. The decision of whether to proceed with the project or not is described as the second decision gate in the innovation process.

Approximately 20% of all the projects admitted at the first gate are frozen at the second gate. A project establishment gate that is working satisfying, or a too generous business case gate could explain the fact that no more projects are stopped at this stage. At this stage, approximately 15-20 % of the total development costs are consumed with test drives and consumer tests included.

Development Phase - Phase III

During the development phase product-, package- and process development is conducted. When the product development process is initiated, information is collected from various sources. Personal experience and benchmarking with similar products are two important sources of information. A limited number of possible ingredients are identified in cooperation between team members responsible for product development and recipe development. Experimental design is carried out to optimise the number of test necessary. Tests are carried out on a laboratory scale and an internal sensory panel is used to evaluate taste, texture, mouthfeel and other sensory characteristics. Internal sources are preferred when evaluating product-alternatives, as it is very expensive to do external tests of consumer preferences. It is quite common, especially when developing more complex products, to combine internal with external sensory tests.

Depending on the complexity of the project – process and package development may be conducted more or less parallel with product development. Some consideration to process development is, however, taken from start as product development process is generally adapted to one particular process in one particular factory. When a product prototype is selected after sensory evaluations, the production must be tested at full scale. New equipment might sometimes be needed at this stage, although investments are restricted as much as possible.

With increased knowledge regarding production costs etcetera, more detailed cost estimations may be conducted. Production costs, investment requirements and marketing efforts are analysed and profitability calculated. In essence, all the criteria that where analysed in relation to the business case will be re-evaluated before a launch decision can be established. In addition, preparations for launch of the product are made.

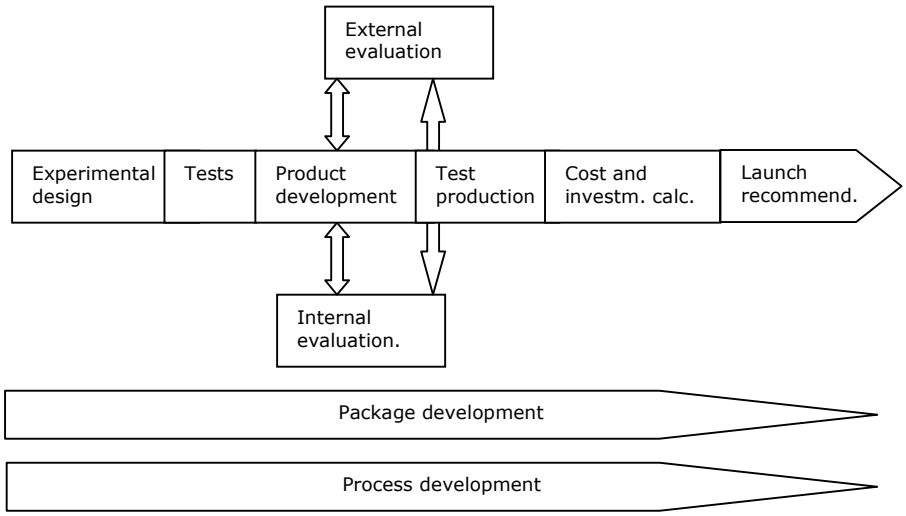


Figure 14 Development phase at Procordia Food

The development phase commonly requires two months of work with 15-20% of the total costs. Heavy investments thus remain. The launch decision, or the third decision gate, is therefore an investment decision and at this stage results from the development process are evaluated with reference to targets established in the business case. Approximately 10% of all projects are frozen at this stage due to a variety of reasons including lack of resources, lack of fit with the product portfolio or the brand, better projects to invest resources in, or reasons originating from the project group not following the original plan.

7.2.3 Launch – Phase IV

It takes a minimum of 16 weeks from the presentation to the wholesalers to the launching date. At this stage relevant information and material regarding the product, media introduction, market communication etcetera should be ready. The time from launch decision to market introduction is therefore at least 5 months. As the launch decision allows heavy investments for example in equipment, raw materials and package material, it is essential to reduce the time to the actual launch.

7.3 Brief Concept Characteristics at Procordia Food

Representatives from the marketing department and the innovation group were consulted to adapt the three fictitious concepts to conditions on the Swedish market.

Concept I- Chilli mayonnaise
The varieties available on the market involve regular mayonnaise, low-fat mayonnaise and fat free mayonnaise. In addition, different tastes, like garlic, lemon and citrus, are added. Market research has identified an opportunity to introduce a new more modern taste influenced by oriental cooking and the healthy trend of today's society.

Portrayal of the product
A chilli mayonnaise, marketed as a cold sauce, is suitable to use together with meat, potatoes and salads. With a fat content of approximately 30% and with a unique freshness and trendy taste, the chilli mayonnaise is also suitable for the taco dinner, the BBQ party and for the daily subs. The product will be sold in an appetizing glass jar, with a 100 ml volume, suitable to put on the table. The tempting chilli-red colour is attracting the consumer at the buying moment. The market potential of the product is estimated to be approximately 150 tonnes/year (5% of the mayonnaise market) at a retail price of 15 SEK/jar.

Concept II - Mayonnaise enriched with Omega 3
One of the strongest trends that have been observed among Swedish consumers today is the increased concern for health issues. Obesity, stress and other life-style related health problems are getting more and more common and there is an ever-increasing need for products offering health-beneficial effects. The market for traditional mayonnaise facing increasing difficulties to grow under such circumstances as the product is generally perceived as a highly unhealthy and greasy food component.

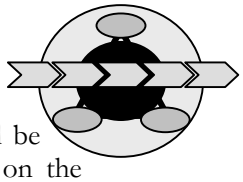
Portrayal of the product
The needs of health-concerned consumers can be met by offering a mayonnaise with low fat content (approximately 15%) and an elevated level of omega-3 fatty acids. The perception of freshness is enhanced by making the texture thinner and by adding a slight lemon taste. The product will mainly be used as a salad dressing but can be expanded to compete with dairy products. The product should be packed in suitable and attractive glass jars with a 150 ml volume. The market potential of the product is predicted to be approximately 300 tonnes/year (10% of the mayonnaise market) at a retail price of 15 SEK/package.

Concept III - Instant mayonnaise
Due to infrequent consumption of mayonnaise and the small quantities being used each time, leftovers of the product are often stored and forgotten in the refrigerator until it is thrown away. The combination of high fat content, greasy texture and the relatively long storage period add to the notion of the product as being unhealthy and unfresh. These negative associations of the product can be reduced if, for example, the name mayonnaise is substituted with a message communicating a modern and fresh appearance or if the size of the package is adapted to the consumption pattern.

Product description
Central for this concept is the innovative product of mayonnaise as a semi-manufactured article. The product can be prepared at home at the time of consumption by adding oil and water to the powder. The consumer may experience a perception of freshness in combination with a sense of pride for being involved in the preparation process and the texture and fat content can be adapted to the specific needs by altering the relative proportions of added oil and water. The product can, thus, be suited for a diversity of situations like subs, salads, BBQ-sauces or traditional areas like shrimp-sandwiches. The shelf life is increased when the product is in the shape of a powder. The package is easier to handle for consumers, distributors and wholesalers and since it is easy to store at home for longer periods of time, the odds for unplanned consumption increases. Central for the success of this concept is that the outlay for product – packed in the size of 3 serves – is less than a package of traditional mayonnaise. The concept offers an opportunity to revitalise the mature mayonnaise market by communicating attributes like simplicity, freshness, flexibility and convenience and the market potential is therefore anticipated to be approximately 25% of the mayonnaise market, or 750 tonnes/year

Figure 15 Fictitious concepts, adapted to the Swedish market

7.4 Assessment of Concepts at Procordia Food



7.4.1 Chilli Mayonnaise

Taste and Flavour
As the product will be marketed as a cold sauce, the taste should be both fresh and spicy. The spiciness of the mayonnaise depends on the choice of chilli, other spices and taste enhancers. The choice of mustard does not affect the taste at all. The strength of the chilli mayonnaise should be medium but it should also expose the characteristics of natural chilli taste. It is important that the mayonnaise gives the consumer an immediate taste sensation and the chilli should therefore be balanced with other spices and taste enhancers that are identified with the help of supplier knowledge. One possible solution is to use vegetable broth with yeast extracts, which in a natural way contain taste enhancers like monosodium glutamate (MSG). Lovage is another useful spice and natural taste enhancer. The fat and sugar content will also affect the taste sensation. With a spicy chilli taste, the acid flavour will still be detectable but not dominating.

Colour
The colour of the chilli mayonnaise should be appetizing. The regular pale colour forms the base and the deep red colour is obtained using tomato purée, fruit and vegetable extracts. The choice of tomato purée thus affects both colour and taste. The colour intensity and transparency is also important and is affected by the choice of thickeners.

Texture and Rheological Characteristics
As the product will be used as cold sauce, the viscosity should be somewhat thinner than regular mayonnaise. Small pieces of carrots, chilli and capsicum will be added to give a slightly chunky texture instead of the smooth texture of regular mayonnaise. With this chunkiness, an image of freshness and "homemadeness" will be communicated to the consumer. The size of the particles should, however, not extend 2 mm as this will interfere with production processes.

Stability of Mayonnaise
As the product is competing with Crème Fraiche and is promoting freshness that normally is not associated with mayonnaise, the chilli mayonnaise should have a shorter shelf life than regular mayonnaise.

Physical Stability
No problems related to physical stability are predicted.

Chemical Stability
A problem with using naturally occurring colouring agents is that the colour looses its intensity after some time. This process is mainly associated with chemical reactions initiated during storage or exposure to light or heat. In addition, spices and herbs may loose some strength in similar ways, and using a transparent glass jar might therefore affect both taste and colour in a negative way. As the shelf life is fairly short, these problems are not considered to be of major concern.

Microbiological Stability
To enhance the consumer perception of the product as being fresh, it should be distributed and stored at cold temperatures. This distribution have positive effects on the

microbiological growth, but the contamination rate must never the less be controlled. The production process needs to be adapted to provide a microbiologically safe product without adding preservatives. This production step may increase the shelf life of the product, but may also affect both taste and colour depending on the stability of the components.

Production Process
The production process of mayonnaise must be adapted to provide safe and preservative-free products, but knowledge concerning mayonnaise behaviour and suitable processes are available.

7.4.2 Mayonnaise Enriched With Omega-3

Central for this concept is the perception of the product as being fresh and healthy. Healthiness is related to both fat content and concentration of omega-3, while the freshness is related to all kinds of factors such as taste, distribution, shelf life and consumption pattern.

The primary sources of omega-3 fatty acids that will be used in this product include fish oil and egg yolk enriched with omega-3.

Taste and Flavour
The taste of this product must be similar to regular mayonnaise but with enhanced freshness through added citrus flavours. The addition of citrus flavour is not perceived as complicated as suitable extracts and oils are available. The major problem when developing a good taste of the product is to secure that no off-flavours are present. Such unpleasant flavours are mainly associated with the development of fishy off-flavours – originating from fish oil that has started to oxidise. The choice of fish oil and the chemical stability are thus important for securing good taste and flavour.

Colour
No problems related to the colour of the mayonnaise are anticipated.

Texture and Rheological Characteristics
The mayonnaise should have a texture similar to spoonable dressings, and the quantity of thickeners must therefore be adapted. As knowledge regarding characteristics of the thickeners is available, this is not considered as complex or problematic.

Stability of Mayonnaise
The most challenging task when developing this product is to secure stability during the whole shelf life period.

Physical Stability
No problems associated with physical stability are anticipated.

Chemical Stability
The shelf life of this product is mainly affected by the degree of oxidation of the polyunsaturated fatty acids as this oxidation process initiates formation of compounds with unpleasant fish flavours. The extent of oxidation in the product is both dependent on the quality of the fish oil and the stability of the oil in the mayonnaise system. The quality of fish oil is highly dependent on the purification process. In high-quality fish oil, oxidation processes have not been initiated and no fishy off-flavours have developed. Such oils are very expensive and a lot of research has to be done to identify suitable oil.

Supplier knowledge is combined with information from universities and R&D-departments.

Once suitable oil is identified, the oxidation process is mainly affected by package material and design. Although aluminium tubes are the best choice, the environmental policies of Orkla state that such materials should be avoided. Second best alternative is therefore glass bottles. In glass bottles there is always some headspace present and it is therefore important to prevent initiation of oxidation due to presence of oxygen in this headspace. The use of modified atmosphere might decrease oxidation initiation during storage. Chilled distribution might further decrease the oxidation rate.

Microbiological Stability
The production process needs to be adapted to provide a microbiologically safe product without adding preservatives. This production step may increase the microbiological shelf life of the product, but may also affect the oxidation rate depending on the stability of the components.

Production Process
The product will be produced in the process currently used for dressings. Complications regarding the production process are therefore not anticipated.

7.4.3 Instant Mayonnaise

The instant mayonnaise case is considered to be the most challenging product to develop at Procordia Food.

Taste
The product should taste like regular mayonnaise and same ingredients will therefore be used whenever possible. Egg yolk powder will be used instead of egg yolk, citric acid instead of vinegar, and dry beta-carotene instead of liquid.

Colour
Dry beta-carotene will substitute the liquid beta-carotene that is used when preparing regular mayonnaise. No complications concerning the colour of the prepared product are anticipated.

Texture and Rheological Characteristics
The product should be designed to give a tasty mayonnaise, similar to spoonable dressings, with a fat content of 40%. However, as one of the advantages with this product is the opportunity to alter fat content and viscosity, this has to be considered when constructing the recipe for the product. The flexibility of the fat content and the viscosity are related to each other. The higher the fat content, the higher the viscosity and vice verse.

Central for the concept is that the product is easy to prepare at home by the consumer whenever it is needed and it is therefore essential to consider the physical characteristics of the components when developing this product.

As the consumer is reluctant to use kitchen machines like mixers, it should be possible to prepare the mayonnaise using only a spoon or fork. As the time and force required for preparing the product should be minimised, this requires ingredients adapted for instant preparation. To avoid formation of lumps during the preparation stage, the consumer should be advised to mix the powder with the oil before adding the oil-powder mixture,

very slowly and while stirring intensively, to the water. To further avoid formation of these lumps, the solubility and efficiency of the ingredients are essential to guarantee that gel-like structure does not form around powder particles.

The solubility depends on both the choice and the particle structure of emulsifying agents and thickeners. A particle with agglomerate structure, similar to instant coffee, has higher solubility than a particle with dense structure. Knowledge regarding the relationship between structure and solubility is available from people working with mashed potatoes. Knowledge regarding structure and characteristics of emulsifying agents and thickeners is available from suppliers. The efficiency of the emulsifying agent and the thickeners are critical success factors. The emulsifying agent should instantly assist in the formation of oil droplets when mixed with water but with longer preparation time and stronger force applied the mayonnaise will contain smaller droplets, increased glossiness, smoother and creamier texture.

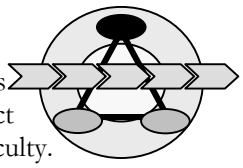
Physical Stability
The shelf life of the powder is affected by exposure to moisture and possibly also light and heat. The choice of package material is therefore essential for the shelf life of the product. The package material should provide protection to moisture, heat and gas. Knowledge regarding package material is available from people working with mashed potatoes. Using modified atmosphere may further increase the shelf life.

Chemical Stability
Although the powder is not going to contain any oil, the fat content will not be zero as both mustard powder and the emulsifying agent will contain some fat. Oxidation therefore limits the shelf life of this product to.

Microbiological Stability
To strengthen the image of freshness, the powder should not contain any preservatives or other additives. Due to the low moisture content, the product is perceived as microbiologically safe. The limiting factor for the product once prepared is the microbiological contamination rate.

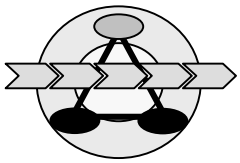
Production Process
As the company has long lasting experience from powder technology, the production process does not seem like a major obstacle.

7.5 Implementation of QFD



The QFD approach was implemented on the three fictitious concepts. Consumer desires were mapped and ranked, product characteristics were identified and ranked according to level of difficulty. Target values, relationships and were established. The outcomes of these processes are presented in appendix A.

7.6 Estimation of Resource Consumption



Activities and time consumption in the development phase of the fictitious concepts were predicted. The outcomes of this process are presented in appendix B.

8. The Põltsamaa Felix Case

Challenges associated with securing quality in market oriented product development in the Estonian food industry were studied by considering different aspects of product development at Põltsamaa Felix.

Representatives from the marketing department, marketing agency, Tallinn Technical University, the production and the R&D department at Põltsamaa Felix were consulted and complemented with information from focus groups as well as internal information to provide insights in the characteristics of the Estonian mayonnaise market, the product development process at Põltsamaa Felix and to adapt the three fictitious concepts to suit Estonian consumers. Challenges associated with development of the three concepts were assessed, the QFD tool was implemented and activities of product development were mapped.

8.1 Mayonnaise and the Estonian Market

Mayonnaise on the Estonian market could be described as a pale-yellow, thick and creamy sauce with a strong taste of mustard, vinegar and salt. The product is distributed and stored at cold temperatures and has a shelf life of approximately 2 months. The fat content of regular mayonnaise is commonly around 45%, with low calorie alternatives offered by Põltsamaa Felix with a fat content of 19%. The product is perceived as unhealthy only in situations of abnormal consumption.

Mayonnaise is traditionally used as an essential ingredient in potato salads, which is popular to serve at occasions like birthdays, graduations and Christmas. Common usage areas also include cooking of meat, fish, potatoes, rice, pasta, sandwich, marinade, sauces and cookies. It is also very popular to use as glaze for example on chicken in the oven or as spread on bread. The average mayonnaise consumer is a woman in the age of 30-45 using mayonnaise on a regular basis - between one and three times a week.

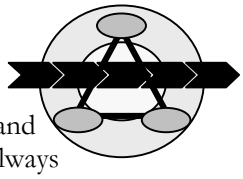
During the Soviet time, there was only producer of mayonnaise in Estonia. The company, called Formeer, remained market leader after the Estonian independence and following the acquisition by Felix, a market share of approximately 23% was achieved. Mayonnaise is currently sold under the Felix brand name even though the old brand name, Formeer, remains as a part of the product name. The Estonian mayonnaise market of today is very fragmented with more than 20 different producers active. The majority of these mayonnaise-producers act on a local market and the main competitor on the market of branded mayonnaise products is therefore Tarplan with a market share of 18%. Other competitors include Hellmann's and Maggy.

The growth of the mayonnaise market in Estonian is moving towards stabilisation, with approximately 3600 tonnes a year. Approximately 30% of the consumers are considered to be fairly loyal to brands but limits in buying power exists due to approximately 50% of the population not being able to afford the products they would prefer to buy. Approximately 50% of the total mayonnaise market is represented by Provansaal mayonnaise, preferred by the Russian population. For Russians, the product name

Provansaal is synonymous to the word mayonnaise but the products also have a milder taste and slightly more yellow colour. The strategy of Pôltsamaa Felix is to achieve a market leader position on the branded mayonnaise market with high quality products allowing price levels approximately 5% higher than closest competitors and approximately 20% higher than the average competitor. With a market reaching maturation, the strategy is focused on winning consumers from competitors rather than attracting new consumers. After an acquisition in January 2003 Pôltsamaa Felix entered the mayonnaise market for private labels and increased its market shares to approximately 30% of the total mayonnaise market.

During the last decade there has been few major product developments related to the product group of mayonnaise. Development projects have involved labelling and package design, change of package material, development of fat-reduced mayonnaise (19%) and Provansaal mayonnaise. One of the most recent projects involved the development and the 250 ml plastic cup. With the entrance into the European Union 2004 different legalisations and increased pressure on domestic producers are expected to change the market situation further. Parallel with this development is an expected change of eating habits due to increased globalisation and a growing household economy. The increased competition on the market in general is expected to result in a significant decrease of the number of actors on the mayonnaise market.

8.2 Management of the Development Process



At Felix Pôltsamaa, product development can be divided into the categories of roll out, re-launch, line extension, new launch and brand extension. Pôltsamaa Felix states that it is strategically important to always have at least one project in each phase of the product development process.

8.2.1 Idea Generation

Before establishing and initiating a product development project, a phase characterised by idea generation and idea evaluation will be performed. Central in this phase is the innovation group, the so-called A-team, involving representatives from different organisational areas like marketing, product development, production, purchase and finance.

The idea generation at Felix Pôltsamaa could briefly be described as a guided or non-guided process. The guided idea generation is initiated at brainstorming sessions with the A-team, which are arranged approximately four times a year. The brainstorming sessions generally result in a number of new ideas. Some of these ideas are stored in the idea bank for future evaluation. The unguided idea generation is mainly characterised by a continuous flow of new ideas from external sources like magazines, exhibitions and contacts with clients and influences from abroad but also from personnel at Pôltsamaa Felix. These ideas may be stored in the idea box.

The sales secretary manages information from clients and consumers and complaints are registered and managed according to the available Hazard Analysis and Critical Control Plan (HACCP). Due to the limited size and resources of the company, structured steps with consumer involvement and concept evaluation has not been performed during the idea generation phase at Pôltsamaa Felix. Focus groups are used selectively due to

limited resources. Information regarding consumer desires is therefore considered, at this stage, through analysis of sales reports, customer complaints and personal experiences of the people involved.

If an idea is considered as interesting, the idea will be further evaluated with regards to resource demand, market potential and risks. The greater the extent of news value a product is regarded to possess, the higher the risk associated. The main resource consumption considered when estimating costs associated with a development project, are mainly related to marketing activities, test productions and investments in production equipments. The projects are prioritised with regards to their relative importance, to strategic fit, uniqueness, market potential, competition and need for speed on the market. The main costs, apart from investments and marketing activities, associated with product development at Felix Pôltsamaa are generally considered to be labour costs.

8.2.2 Project Establishment

After development and evaluation of ideas from the idea generation phase, the most promising idea will be the subject of project establishment preparations. The project establishment paper takes factors like target group, brand, product idea, competitors, emotional criteria and critical success factors into consideration. If the innovation group concludes that the concept has enough market potential, a project group will be appointed and a product development project will commence. By Orkla standards, the project establishment would be followed by detailed planning and profit estimations to create a business case for the particular project. At Pôltsamaa Felix, however, the scope of the project establishment paper is commonly extended to allow the business case phase to be disregarded. As a consequence, the development phase will follow directly after a project establishment decision.

In addition to this standard procedure of idea generation followed by project establishment and product development, a less structured and less bureaucratic development process is accepted at Pôltsamaa Felix. This process is characterised by ideas originating from development of a related product that may initiate a parallel product development process. The result of this parallel process is a prototype that will be evaluated with respect to market potential, production processes. The borders between development phase and idea generation phase thus become vague and overlapping, which in combination with the involvement of few people forms the basis for a fast and flexible innovation process.

8.2.3 Development Phase

The official starting point of the development phase is the project establishment but in reality, preliminary tests may be conducted parallel to the idea generation phase. Package development may be performed parallel to product development but due to limited resources, the package development process is mainly occupied with identification of a suitable package that is already used for other products. Guidelines for the package development are therefore established during the concept development phase.

Planning the product development process involve identifying, ordering raw materials and constructing a basic recipe. Experimental design is performed to direct the recipe development. During this experimental design the choice and content of various components are combined in different ways. Internal expertise is used for taste

evaluation of the prepared samples and to give direction for future development. The aim with this process is to secure that all relevant parameters are analysed in a limited number of samples but the method involves the risk of overlooking the optimal combination of ingredients in case wrong direction is established early in the process. The innovation board is continuously assembled to evaluate the products under development.

When a final prototype is selected, the product is, depending on the character of the product, tested in a small-scale test production. The normal test production volume for mayonnaise is 300 kg, one batch, and the total time from weighting raw material to finished product takes approximately one hour, excluding time for cleaning the equipment. The cost for a test production is strongly related to the volume produced. In addition to recipe development and test production, shelf life tests are conducted and detailed product specifications and cost estimations are made before launch decision.

The actual time for a line extension development project within the mayonnaise group is estimated to 3-4 months, including a launch phase of approximately 2 months. With focus on the speed of developing products and rapid introduction on the market, products sometimes fail on the market. The reasons for these failures may include both the product and the market not being ready for introduction. These failures could sometimes have been avoided with stricter decision gates and thorough market research in the development process. The cost for failure on the market is, however, currently considered to be less than the cost required for improved research and planning. Although some main decision gates exists today, it rarely happens that development projects are completely stopped once the organisation has started to invest time and resources in the project. It is more common that unsatisfying results call for modifications of the product before launch is accepted.

8.2.4 Launch Phase

The launch phase involve various marketing activities like design and printing of labels as well as market communication. The marketing department at Põltsamaa Felix cooperates with the marketing agency TANK in this design of strategies for market communication. Common means of communication include TV advertisements and informative articles published in household magazines.

The products also have to be presented to retail organisations to allow coordination of activities associated with the launch. Retail organisations require approximately four weeks of notice to prepare market introduction of the products. If investments in equipment are necessary, these will occur at this stage in the development process. Due to the costs involved in marketing activities and equipment investments, this phase is considered to very resource demanding.

8.3 Brief Concept Characteristics at Pôltsamaa Felix

Representatives from the marketing department, TANK and focus groups were consulted to adapt the three fictitious concepts to conditions on the Estonian market.

Concept I- Majonaasidip chilliga (Mayonnaise dip, chilli)
Estonian consumers are using more and more dip in their modern cooking and different versions of dip sauces are constantly emerging on the Estonian market. An opportunity to offer a mayonnaise dip has been identified and by adding different combinations of flavours and colours, it is possible to expand the mayonnaise area to also include the market of snacking. A new product group could thus be established.

Product description
The concept idea is a dip with a trendy taste of chilli and other spices and an appetizing red colour. The fat content will be approximately 25%, which is comparable with the fat content of dairy products, and will be sold in 200 ml plastic cups, which are suitable to put on the table for dipping. Main competitors include other dip products, dairy products and other mayonnaise products with added taste components. The market potential of the product is estimated to be approximately 45 tonnes/year at a retail price of EEK 6.95/cup.

Concept II - Tervisemajonees – omega (Mayonnaise enriched with Omega 3)
The increased concern for health issues is one of the strongest growing trends on the Estonian market. Market research has identified an opportunity for a mayonnaise product aimed at health-concerned consumers who are looking for an alternative to regular mayonnaise or dairy products.

Product description
The needs of health oriented consumers can be met by offering a low-calorie (19%) mayonnaise spread, enriched with omega-3. Lemon taste is added to enhance the perception of freshness. The product is distributed in a 200 ml plastic cup made of PP, an environment friendly package. The market potential of the product is estimated to be approximately 60 tonnes/year at a retail price of 6.50 EEK/cup.

Concept III - Kiirmajonees (Instant Mayonnaise)
Mayonnaise is a product of great importance for Estonian consumers and it is used frequently in daily cooking. With 50% of the population not being able to afford the products they would prefer to buy, the possibility to signal high quality and achieve high marginals while offering consumers a low-price alternative offers great opportunities.

Product description
Central for this concept is the innovative product of mayonnaise as a semi-manufactured article. The product can be prepared at home at the time of consumption by adding oil and water to the powder. The consumer may experience a perception of freshness in combination with a sense of pride for being involved in the preparation process and the texture and fat content can be adapted to the specific needs by altering the relative proportions of added oil and water. The product can, thus, be suited for a diversity of situations like subs, salads, sauces or traditional areas. The shelf life is increased when the product is in the shape of a powder. The package is easier to handle for consumers, distributors and wholesalers and it is easy to store at home for longer periods of time. Central for the success of this concept is that the outlay for product – packed in plastic cups – is less than a package of traditional mayonnaise. Additional convenience is added as these cups can be used as a preparation bowl with the proportions of water and oil to be added, marked on the outside of the cup. The final volume of the prepared product is approximately 350 ml. By allowing the consumer to add the most expensive ingredient – the oil - to an instant mayonnaise-mix, the retail price may be reduced and the consumer, who normally could not afford to buy Felix mayonnaise, can now experience the sense of quality associated with the brand while feeling proud for being involved in the process. The market opportunity for the product is estimated to be approximately 40 tonnes/year at a retail price of 8 EEK/cup.

Figure 16 Fictitious concepts, adapted to the Estonian market

8.4 Assessment of Concepts at Pôltsamaa Felix

8.4.1 Chilli Mayonnaise

Taste and Flavour
A key success factor when developing mayonnaise with chilli is the taste of the product. Estonian consumers are not very familiar with chilli and there are no established measures on what consumers perceive as a too strong or too weak chilli taste. The strength of the chilli taste must therefore be examined thoroughly during the development phase. The taste is mainly dependent on the chilli, sugar, salt and acid balance

There are different alternatives of how to add the chilli. These alternatives include chilli powder, chilli flavouring, chilli extract and fresh chilli. As one consumer request is to develop a mayonnaise that is "natural" – i.e. free from chemicals and unnatural ingredients – the artificial chilli flavour is not considered to be an alternative in this development project. Another request from the consumer is a shelf life of 60 days. This shelf life requires that the product is produced with high quality raw materials with a low contamination rate. Fresh chilli is therefore not considered as an alternative due to microbiological contamination. The two remaining alternatives for adding chilli taste to the mayonnaise are therefore chilli powder and chilli extract. The choice between these two alternatives depend both on price and taste quality.

Colour
The colour of the chilli dip must be very attractive and appetizing. As there are few chilli products on the market, there are no standards established on what colour to associate with chilli. Some minor market research activities might therefore be required to evaluate consumer perceptions when developing a red-orange colour for the chilli dip. More over, the development of the suitable colour is a challenge at laboratory scale due to the high concentrations of colouring agents. Three colouring agents will be used: beetroot extract (dark-red), beta-carotene (orange) and paprika extract (red-orange).

Texture and Rheological Characteristics
Mayonnaise characteristics that the chilli mayonnaise has to meet include a smooth, thick and creamy texture, a shiny appearance and the extent that mayonnaise adheres to vegetables. When developing a chilli dip, the texture is fundamental for the success of the product. It is important that the dip adheres to the different vegetables, meats and snacks that the consumer might use with the product and the adhesiveness must therefore be increased compared to regular mayonnaise. The texture should thus be both thicker and "stickier" than regular mayonnaise – more similar to Crème Fraiche.

The smoothness and chunkiness of the dip also affects these parameters. Although the mayonnaise base must be very smooth, as in regular mayonnaise, some chunkiness is likely to be welcomed by the consumers. Carrot pieces will be added to provide this chunkiness and also lower the product costs. The size and distribution of these carrot particles may affect taste, texture and the production process but it is not clear what effects the carrot pieces might have on the physical and chemical interactions in the mayonnaise. The size of these particles is likely to be fairly small to minimise disturbances in the production process and to minimise any taste confusion between carrot pieces and chilli mayonnaise.

Physical Stability
No problems associated with physical stability are anticipated.

Chemical Stability
No problems associated with chemical stability are anticipated.

Microbiological Stability
As Pôltsamaa Felix is producing many different products – including wine, sauerkraut, pickles, ready-meals and mayonnaise – many aspects has to be taken in to consideration to avoid the risk of contamination.

Production Process
With a thicker consistency and added chunkiness, the production process might be influenced. Three steps in the production process that are likely to be critical when producing chilli dip are identified: dosage, pumping and filling.

- Dosage: the chilli pieces must not be too big or have such a shape that they will block the dosage funnel.
- Pumping: the consistency must not be too thick and the carrot pieces too big to avoid blocking the pipe-lines or to require a capacity that the equipment cannot meet.
- Filling: the filling machines must be able to fill the plastic cups without introducing air bubbles.

8.4.2 Mayonnaise Enriched With Omega-3

The development if mayonnaise enriched with omega-3 is considered to be the most challenging of the three concepts described.

Taste and Flavour
The most important challenge when developing a mayonnaise enriched with omega-3 is to secure a good taste. The concentration of the essential fatty acids like omega-3 is higher in fish than in most other foodstuffs and some kind of fish oil will therefore be used in this mayonnaise. Fish oil might however give the mayonnaise a slight fish-like taste if the oil is not pure enough. The more refined the oil, the more expensive the product will be. A challenge is therefore to find oil that contains omega-3 in great enough quantities to provide health benefits but leaving a minimum of off-flavours and still can be found at an acceptable price. The choice of fish oil is therefore a critical success factor. With a mayonnaise with a slight taste of lemon it is, however, easier to balance a potential fish taste but the choice of lemon taste is also important as there are many alternatives on the market. The citrus flavour chosen should be fresh but very mild.

Colour
No problems associated with the colour are anticipated.

Texture and Rheological Characteristics
As the mayonnaise will be used as a spread, the texture must be thicker than regular mayonnaise in the Baltic States. This increase in viscosity is fairly uncomplicated to achieve by increasing the contents of xantan and starch.

Being a product that will be promoted as health beneficial it is also perceived as important that the product does not give a fatty mouth feel. With a low fat content this is not considered as a problem.

Physical Stability
No problems associated with physical stability are anticipated.

Chemical Stability
Negative effects associated with oxidation processes include development of rancid off-flavours and decreased nutritional value.

To be able to communicate these health beneficial effects, the concentration of omega-3 fatty acids must be elevated compared to regular products. The content of omega-3 fatty acids must fulfil current legislation and recommendations but the effective content is, however, expected to change during the shelf life of the product as a consequence of oxidation- and saturation processes. The nutritional value will thus decrease the longer the product has been stored. Documentation and specification of the product is therefore essential. To increase stability to oxidation processes, a combination of tocopherol and ascorbic acid can be added.

If high-quality fish-oil is used, no problems associated with oxidation processes will influence the shelf life.

Microbiological Stability
Using the product as a spread will affect the shelf life as the contamination rate will increase dramatically when the consumer dip contaminated kitchen utensils and foodstuffs in the mayonnaise. Preservatives will be used to prolong the shelf life after the first day of consumption.

Keeping the product in cold storage is expected to prolong the shelf life by decreasing the rate of microbial growth and oxidation.

As Pôltsamaa Felix is producing many different products – including wine, sauerkraut, pickles, ready-meals and mayonnaise – many aspects has to be taken in to consideration to avoid the risk of contamination.

Production Process
Available production methods are expected to be suitable for this mayonnaise.

8.4.3 Instant Mayonnaise

Taste and Flavour
The development of an instant mayonnaise with similar taste as regular mayonnaise possesses no major difficulties, as a basic recipe is already available from the production of regular Provansaal majonees. When producing regular Provansaal majonees the dry ingredients salt, sugar, mustard, thickeners, egg powder and milk powder are mixed with water and β-carotene extract before acetic acid and oil is slowly added to the mixture to produce the mayonnaise. The differences in the choice of raw material affecting the taste therefore include:

- Acid must be provided as powder and citric acid is suggested to be used instead of acetic acid. As citric acid has a different taste than acetic acid, some taste

modifications of the recipe are probably necessary no secure a good taste and suitable pH (approximately 4.8 in the final product).

- As consumers have required that the product must appear as natural as possible, no preservatives will be added. This will affect shelf life negatively but will promote the perception of freshness.

Apart from these changes of using citric acid, dry β-carotene and no preservatives, all other dry ingredients in the basic recipe can be used without modifications.

Colour
The colouring agent, β-carotene, must be provided as powder. No major complications associated with the colour of the prepared product are anticipated.

Texture and Rheological Characteristics
There are several differences between preparation of regular Provansaal majonees and the instant mayonnaise:

- In the instant mayonnaise the acid is provided in the powder, which is dissolved in water. Acid is thus added at an earlier stage than in normal mayonnaise production.
- The quality of the oil used when preparing the powder-based mayonnaise is not controlled. This might affect the taste, consistency and shelf life of the prepared product.
- The proportions of the added oil and the water affect the taste and consistency of the product.
- It is difficult to control that the mixing of the powder with water does not leave any lumps of powder.
- It is difficult to control that oil is added at a suitable rate and mixed with enough strength.

Physical Stability
No problems concerning the physical stability are anticipated.

Chemical Stability
The shelf life of the instant mayonnaise is restricted by the chemical stability of egg powder and milk powder. Under favourable conditions, the powder is expected to have a shelf life of up to 12 months.

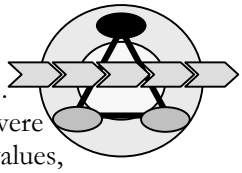
Microbiological Stability
The shelf life of the powder is foremost dependent on the moisture content of the powder. If the powder is dry enough, no microbiological growth will occur during storage of the powder.

The shelf life of the prepared product is limited by the contamination rate from the environment when preparing the product. As no preservatives are added and as the quality of the oil and the hygiene of kitchen equipments can not be guaranteed, the shelf life of the prepared product is expected to be no longer than 3 days, when stored in the refrigerator.

Production Process

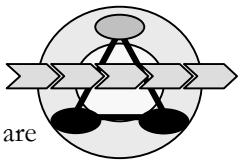
As there are no equipments available at Pôltsamaa Felix that can handle powder ingredients, the production process of the instant mayonnaise face many challenges. One possible solution is to mix all the dry ingredients in the available nail mixer and transport the powder mix to mayonnaise department using vessels before the powder is filled by hand in plastic cups that are sealed in the available capping machine. A challenge with this process is to decrease the contamination rate during mixing and packaging.

8.5 Implementation of QFD

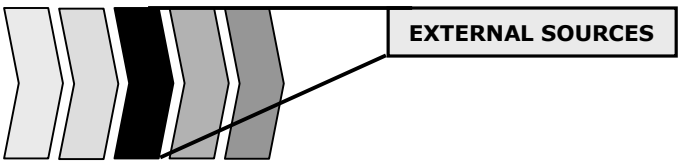


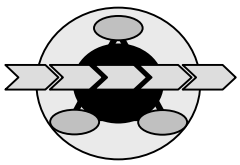
The QFD approach was implemented on the three fictitious concepts. Consumer desires were mapped and ranked, product characteristics were identified and ranked according to level of difficulty. Target values, relationships and were established. The outcomes of these processes are presented in appendix C.

8.6 Estimation of Resource Consumption



Activities and resource consumption in the development phase of the fictitious concepts were predicted. The outcomes of this process are presented in appendix D.





9. External Consultation

To get more perspectives on challenges associated with the development of the three fictitious concepts, contact was taken with SIK and Malmö University. At SIK, Stina Fjelkner-Modig contributed by giving a brief assessment complexity involved when developing the three cases. Fjelkner-Modig has a comprehensive background in the food industry and has, for example, been responsible for product design at Nestlé/Findus for approximately 15 years. The outcome from the discussion with Fjelkner-Modig is presented in "assessment of complexity by external expertise I".

Thomas Arnebrant, professor at Malmö University, contributed by giving his perspective of challenges associated with the development of the three concepts. Arnebrant is appointed professor with expertise in the surface and colloid field. He has a background in the pharmaceutical industry and has recently worked at an institute for Surface Chemistry .The outcome from the discussion with Arnebrant is presented in "assessment of complexity by external expertise II".

9.1 Assessment of Concepts by External Expertise I

9.1.1 Chilli Mayonnaise

The development of the chilli mayonnaise is perceived as rather straightforward, like a "me too"-project. Suitable spices can be identified through good relations with suppliers and the development of the final prototype (test production included) is estimated to take approximately 1 month. Dominating activities in this development project include:

- Preparations to develop a clear vision of the project
- Contact with suppliers to identify ingredients for taste and colour

Taste and Flavour
The product will be flavoured using some kind of chilli. The choice of chilli is identified through dialogue with raw material suppliers. Important aspects to consider when identifying suitable flavourings are:

- Which system (water, oil, starch etcetera) is considered suitable for adding the chilli?
- Which strength of chilli is desired?
- Other taste-related characteristics (smoothness, roundness etcetera)? Benchmarking with other products is generally helpful.
- Homogenous/heterogeneous product?
- Company specific policies regarding production methods, origin etcetera?

As this product has a fairly low fat content, suppliers will be consulted to evaluate whether to dissolve the chilli in the continuous or dispersed phase. The supplier has the knowledge of how different spices act in different environments and situations, while the company has product specific knowledge.

As chilli has a characteristic taste, it is not necessary to add other spices, but the balance between sugar, salt, mustard and vinegar might have to be adjusted.

Colour
As the chilli extract probably won't give the product the desired colour, suppliers will be consulted to identify suitable colouring agents, such as paprika powder. In-house experience is combined with advise from suppliers. Company specific policies regarding acceptable additives and ingredients will direct this process.

Texture and Rheological Characteristics
No problems associated with texture and rheological characteristics are anticipated.

Physical Stability
No problems associated with the physical stability are anticipated.

Chemical Stability
No problems associated with the chemical stability are anticipated.

Microbiological Stability
No problems associated with the microbiological stability are anticipated.

Production Process
No problems associated with the production process are anticipated

9.1.2 Mayonnaise Enriched With Omega-3

One challenge associated with this concept is to communicate omega-3 as something positive and value adding. The major challenge for the development team is to assure that taste and stability are not affected by the presence of omega-3 fatty acids.

The time required for development of this product is dependent on both stability of omega-3 fatty acids and the choice of package, but is estimated to be somewhere between 6 months to one year.

Taste and Flavour
The product should not exhibit any off-flavours. Depending on the choice of oil for enrichment of omega-3, the taste and flavour might be affected. For example in fish oil there might be fat-soluble components giving rise to fishy flavours if the refinement is not performed satisfactory. The taste of the product is also affected by the lipid oxidation, which gives rise to rancidity. The character of the rancidity is mainly dependent on the oxidation rate, but is also affected by the source of the fatty acid.

Colour
No problems associated with the colour are anticipated.

Texture and Rheological Characteristics
No problems with texture and rheological characteristics were anticipated

Stability of Mayonnaise
Even with a short shelf life, there are several problems associated with the stability of the system. The stability of the omega-3 fatty acids is critical due to two aspects:

- Taste and flavour
- Nutritional value

A short shelf life requires well-coordinated distribution and production processes. A shelf life of one month, for example, would require production at least once a week with relatively small quantities of mayonnaise.

Physical Stability
No problems associated with the physical stability are anticipated.

Chemical Stability
Polyunsaturated fatty acids oxidise faster than monounsaturated fatty acids. The omega-3 oxidation will cause a decrease of the nutritional value at the same time as the presence of off-flavours will increase. The addition of stabilising agents, such as antioxidants, is necessary to increase the stability of the system. The choice of these stabilisers will be identified through dialogue with suppliers.

The choice of oil for enrichment with omega-3 thus affects the stability of the system and close cooperation with suppliers is therefore often necessary to identify a stable alternative that is suitable for the mayonnaise system, the production process, the shelf-life etcetera.

As the oxidation process is dependent on the presence of light, oxygen and heat, the package design and material is very important for the stability of the system. Although glass jars are considered to provide good oxygen barriers, the consumers generally prefer transparent material and thus the probability for light-initiated oxidation increases. Plastic material may offer good protection against light, but the gas barrier is less effective. If glass bottles are used, the headspace has to be modified using either vacuum or modified atmosphere.

Microbiological Stability
No problems associated with the microbiological stability are anticipated.

Production Process
The production process affects both taste and stability. To decrease oxidation, it is important to minimise the exposure to air during the production process. An adapted production process may increase microbiological stability, but may also influence the taste profile and the oxidation process. Suppliers have to be consulted to identify raw materials suitable for the production process.

9.1.3 Instant Mayonnaise

The greatest challenge associated with development of this product is to allow emulsion formation when the oil content can be anything from 20% to 60%. Preferred approach to this challenge is to study the systems at the two extreme levels - 20% fat content and 60% fat content – to try to identify similarities. These similarities will represent the starting point when continuing development of the product.

The development of this product will require a lot of cooperation with suppliers to identify suitable choice and structure of ingredients. The project is expected to take anything from one to three years.

Taste and Flavour
The product should have a taste similar to regular mayonnaise, which depends on the choice of components in the powder. The taste and flavour of the product were not discussed further.

Colour
No problems associated with the colour of the product were anticipated.

Texture and Rheological Characteristics
The product will, in itself, represent different systems as the conditions for forming emulsions at 20% fat content is very different from a fat content of 60%. Different fat contents might require different emulsions systems and consequently different thickeners and emulsifying agents. The challenge is therefore to identify thickeners and emulsifiers that work independently of the fat content.

Potential problems related to this are:
- The emulsifying agent is incapable of stabilising the oil phase when the fat content is changed
- Thickeners interact too strongly or weakly when the water phase is changed

As consumers tend to forget reading instructions, the product should work, no matter the preparation method. The ability of ingredients to dissolve in water and/or oil is dependent on both the choice and structure of ingredients. Small or porous crystals dissolve more easily than dense particles. Other factors influencing the solubility include the presence of static electricity and the extent of water activity.

Close cooperation with suppliers is necessary to evaluate how different thickeners and emulsifying agents act in different systems. This knowledge will be combined with experience from existing mayonnaise products.

Physical Stability
As the shelf life for this product will be fairly long, it is important that the package prevents the powder from moisture uptake, evaporation, diffusion of taste components and lump formation.

Chemical Stability
Some oxidation of components in the powder could affect the shelf life, but no major problems associated with the chemical stability were anticipated.

Microbiological Stability
No problems associated with the microbiological stability were anticipated.

Production Process
Problems associated with production process where not considered.

9.2 Assessment of Concepts by External Expertise II

9.2.1 Chilli Mayonnaise

No major complications are expected with development of this product as the organisation already has knowledge regarding the basic low-calorie mayonnaise. Technical challenges associated with development of this product include:

- Identification of taste and flavour components
- Evaluation of which phase to add taste, flavour and colouring components
- Identification of suitable strength and intensity of taste and colour
- Identification of suitable quantity of thickeners

The total time for development of the product is predicted to minimum 6 months.

Taste and Flavour
The taste and flavour may be added as chilli powder or liquid but using a liquid extract probably is easier due to increased solubility and decreased lump and dust formation. The taste and flavour also depends on whether the chilli is added to the oil or the water phase. If the chilli is added to the oil phase, the taste and flavour is likely to exhibit a milder and rounder character than if added to the water phase. Addition to the water phase will thus result in a stronger and sharper taste at lower concentrations. Increased salt content may further accentuate the chilli aroma. The majority of the taste and flavour components will interact with the oil and water interface.

Colour
As an intense red colour is preferred, some colouring agents must be added. The colour intensity is affected both by the choice and content of colouring agents, but is also dependent on whether the agents are added to the water or the oil phase. The agents should, preferably be dissolved in the oil phase as pigments commonly exhibit hydrophobic characteristics.

Texture and Rheological Characteristics
The texture of the mayonnaise is dependent on the oil content as well as the choice and content of thickeners.

The shelf life of the product is not considered to be influenced by the addition of chilli taste and flavour.

Physical Stability
No problems associated with the physical stability were anticipated.

Chemical Stability
No problems associated with the chemical stability were anticipated.

Microbiological Stability
No problems associated with the microbiological stability were anticipated.

Production Process
Aspects concerning the production process were not considered.

9.2.2 Mayonnaise Enriched With Omega-3

The development of the mayonnaise enriched with omega-3 fatty acids is facilitated as the character of the product is deliberately designed to diverge from regular Swedish mayonnaise.

The total time for development of the product is predicted to be between 0.5 to 1 years.

Taste and Flavour
Oxidation of fatty acids is a problem when the product contains elevated levels of polyunsaturated fatty acids as it gives rise to rancid flavours. Other unacceptable off-flavours that might affect the quality of this product include fish-taste resulting from bacterial degradation of muscle tissues in the fish. The choice of fish oil may have effects on the oxidation initiation, but the major influence on taste and flavour is related to the refinement process where components responsible of fishy off-flavours are eliminated.

As the product will have a citrus flavour, some work has to be done to identify a suitable citrus extract.

Colour
No problems associated with the colour were anticipated.

Texture and Rheological Characteristics
With a low fat content and a texture similar to spoonable dressing, some attention to the choice and content of thickeners is required. This work is, however, simplified as the company in question already has knowledge regarding production of fat-reduced mayonnaise.

Problems associated with the shelf life are considered as fundamental for the success of the product.

Physical Stability
No problems concerning the physical stability were considered.

Chemical Stability
The shelf life of the product is mainly affected by the oxidation processes which give rise to off-flavours and decreased nutritional value. The shelf life may be increased by adding antioxidants like ascorbic acid (water phase) and tocopherol (oil phase) to increase stability against oxidation. The emulsion system itself affects stability of the product in a negative way as the interface between water and oil phase is fairly large, increasing the probability of oxidation initiation.

Microbiological Stability
The shelf life is also affected by the microbiological contamination rate. With reduced fat content, there is an increased risk of microbiological contamination and addition of preservatives might therefore be added.

9.2.3 Instant Mayonnaise

The total time for developing this product is predicted to take more than one year.

Taste and Flavour
The taste should be similar to regular mayonnaise, but no further detail regarding this issue was considered.

Colour
No problems concerning the colour were considered.

Texture and Rheological Characteristics
The quantity of emulsifiers should be suitable for the highest fat content – i.e. 60%. With a fat content lower than regular mayonnaise, the powder should contain some thickeners. The identification of a suitable quantity of these thickeners is the most difficult task for the development team as it is difficult to predict whether the texture will be too thin at low fat contents or too thick at higher fat contents. One possible approach to this problem is to construct a powder suitable for preparing mayonnaise with fat contents of approximately 40-60% and provide the consumer with an additional pouch of thickeners that can be used when fat reduced mayonnaise is prepared.

The powder should exhibit excellent solubility and agglomerate structure is therefore recommended. Preparation of mayonnaise, using the instant powder, should be

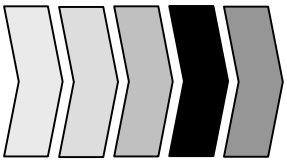
conducted in similar ways, as regular mayonnaise is prepared at home. The powder should thus be mixed with the water phase before the oil is slowly added.

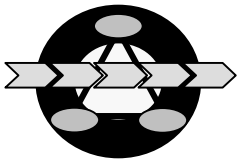
Physical Stability
Some separation of components could occur, but is not considered as a major problem. No other problems concerning the physical stability were considered.

Chemical Stability
Oxidation processes of the fatty acids in egg powder mainly restrict the shelf life of the powder. Some oxidation of proteins is likely to occur, but as this does not cause any major off-flavours it is not considered to be a major problem.

Microbiological Stability
The shelf life of the prepared product is restricted by microbiological contamination.

Production Process
As it is difficult to form agglomerate of all the components, Arnebrant suggests that major components like thickeners and emulsifiers are purchased as agglomerates and mixed with remaining components to produce a homogenous powder.





10. Maturity of Markets and Industries

As already highlighted in this report, the continuous flow of innovations and launching of new food products is necessary for preserving and increasing market shares and profit. Since the environment that a firm is acting upon is continuously changing when it comes to aspects like competition, consumer acceptance and organizational changes, a life-cycle approach has to be adopted when analysing the innovation potential of an industry or company. The model– "the dynamics of innovation" – as described by Utterback is employed to analyse the innovative process at Procordia Food in Sweden and Põltsamaa Felix in Estonia.

10.1 Innovation

The process of product development at Põltsamaa Felix has, due to its short and dramatic history, mainly been occupied with continuous introductions of products and product groups. Product development at Procordia Food, on the other hand, is likely to have been dominated by incremental improvements, line extensions and some introductions of new product groups like RisiFrutti and frozen ready-meals. None of the product developments can, however, be described as radical innovations.

Utterback states that the opportunities of product innovation tends to decrease as consumers' performance criteria become more and more articulate. As improvements are introduced and the differences between competitors become more and more vague, people develop preferences and loyalties. Dimensions like marketing and distribution thus become more important. Research conducted in Estonia give indications of consumers with not yet well-defined and articulated preferences when it comes to food products. Brand loyalty is not well developed and the importance of aspects like marketing and distribution are likely to increase in the future. With a quickly changing competitive environment, it becomes more and more important to get a better understanding of the market to be able to communicate innovations noticeable for consumers whose demands become more and more articulated.

Sweden is perceived as having evolved to a more mature stage. Consumers indicate quality awareness with well-developed preferences and loyalties. Practicalities of marketing and distribution etcetera require increased standardisation, which can be illustrated when looking at products like mayonnaise that show similarities in terms of package design, fat content, colour and taste, indicating standardisation on an industry level. With demanding consumers showing high quality awareness, it becomes very important to communicate any changes in terms that matter for the consumer. Product development is therefore focused on the needs and desires of the consumers.

As the focus of this study is on product development, there is insufficient information to make a solid analysis of the evolution of process innovation at Procordia Food and Põltsamaa Felix. Some observations can, however, indicate the stage of maturity from a process innovation perspective.

Although specialised processes exist at Pôltsamaa Felix, such as for mayonnaise, there are other processes that can be characterised as inefficient, unsophisticated and operated mainly by manpower. Automated, "islands" are created with some areas of automation and some manually operated. With a relatively low extent of specialisation of the production process, it is assumed that resources required to implement changes in existing processes are quite moderate. With pressure on efficiency in combination with increases in labour costs, it is likely that investments will be made in process changes in the near future.

At Procordia Food, it is assumed that a focus on low production costs in combination with high labour costs would have called for investments in specialised and highly automated production processes. Utterback states that as the rate of product innovations decrease, it is common to observe an increase in process innovation resulting in more efficient but also rigid and capital intensive processes. The two different production processes for two related products like mayonnaise and salad dressing indicate the rigidity of processes available at Procordia Food.

Based on this analysis it is possible to draw the conclusion that Pôltsamaa Felix is likely to be somewhere between the transitional phase and the specific phase, depending on the product in question. Procordia Food is likely to be in the specific phase when studied from the process innovation perspective.

10.2 Organisation

Pôltsamaa Felix is a relatively young company with entrepreneurial spirit, acting in a quickly developing environment. The recent history of Pôltsamaa Felix shows an organic organisation with informal control, limited hierarchy and an atmosphere where individuals act together to make progress and realise innovative ideas. Utterback states that such a company, typical in the fluid phase, is generally very innovative and flexible and is appropriate when the degree of uncertainty is high. During the last years some organisational changes have been implemented at Pôltsamaa Felix, indicating that the company is evolving into a more mature phase. Increased focus on coordination and control has resulted in a more bureaucratic organisation requiring more documentation. A new matrix structure with focus on projects has been introduced. This new organisational shape is coherent with Utterback's model, indicating that the organisation recently has moved to the transitional phase.

Procordia Food is likely to be at a more mature stage in the organisational evolution process. Organisational control seems to be provided by structures, goals, rules and routines to secure that inefficiencies and unnecessary resource demanding steps are eliminated. Rigid coordination is implemented to secure that different department and functions act together. The growth of production units tends to rely on stretching and extending the life of existing products and processes to profit from past investments. Such organisations, which show similarities to Utterback's mechanistic structure, tend to appreciate administrative abilities and focus is generally on financial results and predictable performance improvements. Procordia Food should thus belong to the specific phase, as described by Utterback.

10.3 Market and Competition

The Estonian independence was followed by a period of drastic changes and the number of actors in the market place grew significantly. The situation on the Estonian market is currently stabilising and the number of actors is constantly decreasing, which is in accordance with Utterback's theory that states that there is a relation between the number of competitors and the maturity level of the market. The Estonian market is likely to change from being a very fragmented market with a high number of competitors and where brand is not considered to be important, to an oligopoly situation with few actors. The recent changes of the competitive environment and the increased focus on brand loyalty from the consumers' point of view, indicate that the Estonian market should be somewhere in the transitional phase.

The situation in Sweden is, however, quite different as the competitive environment is restricted to a limited number of dominating actors. A classic oligopoly, as described by Utterback, characterise the mayonnaise market, indicating evolution into the specific phase. With a relatively stable competition and a mature market, the market shares are relatively stable and competition is mainly based on quality performance in relation to price. In mature and declining markets, like the mayonnaise market, there are few incentives of innovation and investments in new production equipment are rare. Focus of the organisation is consequently on efficiency and providing of high quality. Procordia Food is thus likely to belong to the specific phase.

10.4 Maturity Level and Quality Awareness

Based on the information presented, the authors conclude that Procordia Food and Sweden has, when analysed from perspectives of product innovation, process innovation, organisation, market and competition, evolved into the specific phase.

Procordia Food, Sweden	Fluid	Transitional	Specific
Innovation			√
Organisation			√
Market and competition			√

Table 3 Utterback, industrial evolution at Procordia Food, Sweden

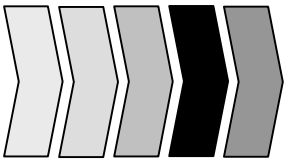
The authors also conclude that Pôltsamaa Felix and Estonia has, when analysed from the same perspectives, gone through a very quick evolution from the fluid phase to the transitional phase. Pôltsamaa Felix and Estonia can currently best be described as being in the transitional phase, although it is starting to move towards the specific phase.

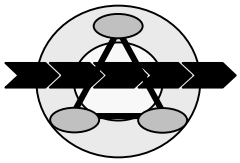
Pôltsamaa Felix, Estonia	Fluid	Transitional	Specific
Innovation		√ →	
Organisation		√	
Market and competition		√	

Table 4 Utterback, industrial evolution at Pôltsamaa Felix, Estonia

Utterback's model tries to establish a relationship between evolution of the industry, maturity of the market and the degree of articulated quality expectations of consumers. The discussion above concludes that Pôltsamaa Felix and the Estonian market have not

yet reached the maturity stage of the specific phase. There is a trend of declining numbers of producers and the organisation can still be characterised as entrepreneurial. The great variation in product quality on the market could indicate that product standards have not yet emerged since consumers sometimes accept "unfinished" products. In the same rate as the market evolve and become more mature, the consumers are able to specify and articulate their needs and desires in more detail. With increased quality awareness and increased pressure upon producers to meet these demands, the acceptance for unsatisfying products will be reduced. It can thus be indicated that as more demanding consumers emerge when the industry evolves, the expectations of quality is likely to differ in accordance with the maturity level of a market. If this is the case, then the conditions for competition and quality assurance will differ on the two markets, which will require adapted organisational structures and routines to secure that the desires of the consumers are met. The character and requirements of market orientation would thus be very different. The character of different organisations in relation to market maturity and the competitive environment will be discussed in chapter 11.





11. Management of Product Development

With previous analysis concluding that the different maturity levels of the two companies and the two markets require different organisational structures, the attention is transferred to the evolution of R&D processes. The different competitive environments and different degrees of quality expectations require different means and methods for securing successful product development. The evolution of R&D management and the structure of the current product creation processes will be analysed in this section of the report.

11.1 The Change in R&D Management

A historical and evolutionary perspective on R&D management is offered by Nobelius and is used to analyse changes associated with the product development process at Procordia Food and Pôltsamaa Felix.

11.1.1 Pôltsamaa Felix

The management of the R&D process at Pôltsamaa Felix has undergone major changes during the last ten years following the independence. During this period, the processes developed in similar manners as Nobelius describes when studying Swedish R&D management over a period of fifty years. Some of these steps and transformations will be highlighted in the discussion below.

With the emergence of a new market, the number of actors initially exploded and the market reacted with a demand allowing companies like Pôltsamaa Felix to introduce a great abundance of products. There was little time to secure that consumer desires were met and the R&D management was mainly focused on delivering new products to the market. The technological capabilities directed the choice of development projects. The R&D management at Pôltsamaa Felix during these years shows similarities with Nobelius' first generation process but when the situation calmed down, a process more similar to the Nobelius' second-generation process was adopted.

Once the market started to stabilise, the number of actors quickly decreased as a consequence of supply exceeding the demand but also because of increased quality awareness by consumers. Marketing efforts became more important and Pôltsamaa Felix involved marketing agencies and marketing research agencies to assist in market communication and analysis. Although limited resources require some technology orientation in product development projects, market orientation was considered as important for the success of the company.

High rates of inflation and changes in cost structure resulted in increased focus on cost efficiency and control. Consumers are relatively price sensitive when it comes to food products and the company cannot increase retail prices to cover increased costs of labour, energy etcetera. The R&D management show an increased focus on eliminating wasteful efforts, for example by reducing the number of employers in the production as

well as in the R&D department. A matrix structure was implemented at Pôltsamaa Felix last year, resulting in a more linked and interaction focused view of the R&D department. The technological aspects of the company are more closely linked with the market needs as the marketing department and R&D department are represented in development projects. The company interacts more frequently with consumers, although not at the same extent as Procordia Food. Pôltsamaa Felix thus exhibits characteristics typical for third-generation processes, as described by Nobelius.

Some characters of R&D management that are commonly associated with the fourth and fifth generation processes are observed at Pôltsamaa Felix. Long-term contracts with suppliers are signed and common routines of quality assurance and supply management are developed. Interaction and integration with other actors on the market arena, such as retail organisations, is essential for staying competitive on a market that is continuously facing increased globalisation. The time to market when developing and producing products is a critical success factor for the R&D management and the expertise of suppliers is to an increasing extent exploited in product development. Interaction with customers and consumers is taking a larger part in R&D activities even though this integration is more structured at Procordia Food, which will be described.

The management of R&D at Pôltsamaa Felix thus shows greatest similarities with the third generation process, but has some resemblance with the fourth and fifth-generation processes too.

11.1.2 Procordia Food

The R&D organisation at Procordia Food is likely to have gone through the same changes as Pôltsamaa Felix, but over a longer period of time and the organisation has therefore had time to integrate the changes into the organisation.

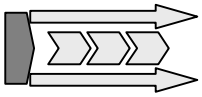
The R&D management at Procordia Food is currently characterised as structured integration with consumers, as the ability to meet the desires of the consumers is perceived as the basic condition for competition. Integration with suppliers is also regarded as essential and close cooperation in the developmental stages is often perceived as both important and appropriate.

The management of R&D processes at Procordia Food show similarities with the fourth and fifth-generation processes as they focus on integration and coordination of activities with different actors on the market.

11.2 The Product Creation Process

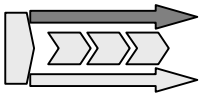
The product development processes at Procordia Food and Pôltsamaa Felix show similarities and dissimilarities from a few perspectives. Some of these differences are based upon the different prerequisites in terms of market, competition, quality expectations and resource availability that the companies act upon.

11.2.1 Intelligence Development



Too little information concerning the intelligence development process is available, as our study has only focused on the phases of product creation from the idea generation phase to the launch. Some discussion concerning knowledge creation and technology intelligence is presented in chapter 13.

11.2.2 Idea Management



The process of idea management involves generation, evaluation, screening and ranking of ideas. Innovation should be stimulated to provide projects with high potential. The idea management process at Procordia Food and Pôltsamaa Felix are analysed using the concept of development funnels, as proposed by Wheelwright *et al.*.

Development Funnel at Procordia Food

The idea generation process at Procordia Food, as described in chapter 7, has a very structured approach and can best be characterised as a "model II development funnel", as described by Wheelwright *et al.*. The company will commonly select only one idea in the idea management phase, which will become a project and be transferred to the project/program management phase. As the resource consumption tends to increase continuously during implementation of a development project, it is essential to prevent that resources are spent on the wrong projects. Structured means of idea generation and screening processes are implemented with evaluation of market potential, complexity, and resource demand before the most promising idea is identified.

A wide range of ideas originating from a variety of sources is initially considered, but quick and efficient screening processes will combine and refine ideas to better meet identified market needs. Market potentials and financial expectations are the primary criteria of project selection. The proposed projects will be evaluated by top managers a few times every year to secure that initiated projects are supported by market strategies and product portfolio. The development process at Procordia Food is built up around regular reviews and updating to avoid late surprises and disappointments.

Mature companies that are dominating slowly evolving product market areas often adopt this model, according to Wheelwright *et al.*. The previous analysis of the evolution of the Swedish industry and market, indicate that Procordia Food and the Swedish markets have reached a relatively high level of maturity and it is therefore not surprising to find that they also implement this model of development funnel.

Although Wheelwright *et al.* states that this model might offer clarity and focus of the organisation in some situations, there are also drawbacks of this model that should be considered by Procordia Food. Wheelwright *et al.* warns that adopting the model II approach in large firms with multiple segments and product families is likely to result in numerous of corrections, limited success upon market introduction and a reputation among customers as being "conservative and no longer innovative". Wheelwright also states that larger firms, when adopting this approach, tends to devote more time than smaller companies when executing this development process, which is very true when comparing product development at Procordia Food and Pôltsamaa Felix. This will be discussed later in this report. With organisational guidelines like innovation and inspiration, Procordia Food should consider evaluating its methods of screening ideas and executing projects in order to stay innovative.

Development Funnel at Pôltsamaa Felix

At Pôltsamaa Felix, the situation is quite different. With a more flexible and less bureaucratic product creation process in combination with an entrepreneurial spirit, the innovative atmosphere prospers. Due to the two accepted paths of product development initiation, the process at Pôltsamaa Felix can be described as either model I development

funnel or model II development funnel. The formal process of product development follows Orkla standards, although adapted to the market situation and the resources available, and indicates similarities with the model II funnel. This structured approach of product creation is implemented only for very resource demanding projects. Typical characteristics of this funnel that can be identified at Pôltsamaa Felix include the regular updating and reviewing by the senior management as well as the postponement of the project only if serious problem arise.

With focus on cost efficiency and technological capabilities, the evaluation of ideas at Pôltsamaa Felix is commonly restricted by the flexibility of existing production processes. One path of product development is therefore focused on exploiting capabilities of existing production processes. This path of product development is technology driven and exhibits similarities with the model I development funnel since the early evolutions is focused on technical possibilities while the later evaluation emphasise manufacturing possibilities and fundamental economics. Projects are rarely cancelled as they become "pet projects" after some time and as a result a large number of products are introduced on the market. The market is, to a greater extent, allowed to make the decision whether a product is acceptable or not.

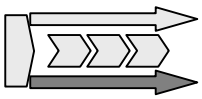
Although this method can be suitable in situations where being on the market and attracting consumers is more important than maintaining a stable level of quality and communicating a constant and reliable image of the company, it is likely that the process at Pôltsamaa Felix will change in the near future in order to meet the more quality demanding consumers as Pôltsamaa Felix moves into the specific phase.

Improved Development Funnel

Based on the discussion above, the authors would like to suggest an alternative to the funnels currently implemented. The purpose with suggesting another funnel is to allow Pôltsamaa Felix to keep its innovative capacity and short time-to-market as the need for quality assurance increase. It is also an attempt to avoid that Procordia Food is perceived as "conservative and no longer innovative" at the same time as the time-to-market is reduced.

The third funnel, as suggested by Wheelwright *et al.* offers advantages of combining and integrating the best features of the model I and model II and attempts to be both innovative and focused. It emphasises the importance of expanding the width of the mouth to gather ideas from a variety of sources. Pôltsamaa Felix should thus, if implementing this approach, encourage innovation and input from all parts of the organisation, from consumers, customers and competitors. Incentives such as special funding and released time for individuals to pursue and refine ideas should be offered to a greater extent at Procordia Food. The outcome of implementing this approach is that more ideas are allowed to be evaluated and explored as precursor projects before a go/no-go decision is made.

11.2.3 Technology and Resource Development



The creation of successful products require, according to Deschamps *et al.*, skills, capabilities and competencies within the company and within the network of suppliers. The outcome of the technology and resource development process is not primarily new products, but it forms the basis of successful development of innovation and new product programs. The development of these

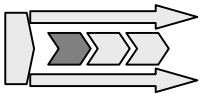
technologies and skills are closely related to development projects as the projects tend to establish the context in which technologies and competences develop. The source of technology or resource development may be either in-house development or through cooperation with suppliers. The process of technology and resource development thus involves the establishment of networks with supply partners to interweave their skills and capabilities into the product creation process. This process of knowledge creation will be discussed in chapter 13.

Networking in Product Creation

The attitude to increased reliance on networks has changed parallel to the evolution of the industry, market and the R&D management. As product development becomes a primary source of competitive advantage, companies have to secure that the available competences, capabilities, resources and organisational structures support the innovation process. Since companies do not posses expertise knowledge in all areas relevant for product development, which is mainly explained by cost saving strategies in combination with a strive to provide short time-to-market, they are becoming more dependent upon cooperation with suppliers. The importance of establishing and maintaining networks with suppliers, universities, and research institutes is increasing in the process of continuously providing innovative and high quality products that meet the ever changing needs on the market.

Increased focus on networking may involve both advantages such as speed to market and efficiency in not having to "reinvent the wheel", but it may also involve drawbacks such as increased dependence on external actors. All R&D representatives that the authors have encountered in this study emphasize the importance of collaborating with suppliers when identifying suitable ingredients. The supplier will provide knowledge regarding physical and chemical aspects but may also assist in more technical matters, allowing the R&D team to focus on integrative aspects to secure that desires of the consumer are met. Uniqueness and innovation are considered as important for the competitiveness of a company, but when there is only four different suppliers providing knowledge-intensive ingredients, like thickeners and emulsifying agents, it is likely that most actors on the market will be dependent upon the same sources of knowledge. The tendency to rely on networking will be discussed in more detail in chapter 13.

11.2.4 Product and Technology Strategy

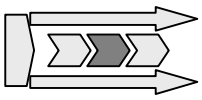


The process of establishing product and technology strategies is on a strategic level that we have not focused on in this study. Some basic characteristics concerning the strategies are, however, identified. Both companies compete in the high-quality segment of respective markets and both have strategies concerning what products they want to offer, but Procordia Food seems to have a more permanent plan over product introductions, which is evaluated a few times every year. Pôltsamaa Felix seems to be more flexible concerning long term and mid-long term plans of product introductions.

The process of product and technology strategy can also be analysed from the perspective of market orientation. Both companies claim to be market oriented, but Pôltsamaa Felix expresses to a greater extent than Procordia Food that technical capabilities guide their development process in a technology-push manner. More

thorough analysis of the extent of market orientation at Procordia Food and Pôltsamaa Felix is presented when analysing the project and program management.

11.2.5 Project and Program Management



As stated by Deschamps *et al.*, the creation of products that satisfy the needs of consumers does not happen by coincidence. Both Procordia Food and Pôltsamaa Felix recognise the need for identification and integration of consumer needs and desires into the development process but the methods used to achieve this market orientation does, however, differ.

Market Orientation at Procordia Food

Procordia Food follows Orkla standards, which emphasise the importance of involving consumers early in the development process. During the idea generation phase, consumers should be involved in the concept generation and evaluation. Time, as well as resources, are thus invested in securing a market need before product development is initiated. Different steps and routines are developed to assure that market orientation is central during product development and external panels are engaged to secure objective evaluation. The structured process of consumer involvement and market orientation is perceived as necessary in such a large organisation as Procordia Food where the distance between consumers and members of the product development team is fairly large. Cross-functional integration, which is commonly viewed as necessary for successful product development, does not happen by coincidence when the size of the company grows and people's skills are getting more and more specialised.

With Procordia Food acting on a mature market, consumers generally have well-defined expectations on product quality and it is important to identify and meet these desires as the brand identity and consumer loyalty may be damaged otherwise. The routines of quality assurance create a more bureaucratic organisation, resulting in an average time-to-market in product development projects of 18-24 months. More over, as the Swedish market is fairly big, when compared to the Estonian, investments in equipment etcetera can more easily be covered if the demand is appropriate. The access to a greater market in combination with higher quality demands by consumers allows Procordia Food to express a greater extent of market orientation.

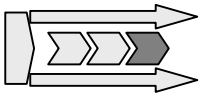
Market Orientation at Pôltsamaa Felix

At Pôltsamaa Felix, the needs and desires of consumers are communicated through product group managers and marketing representatives, but consumers are generally not involved during the idea generation phase. Factors such as resources availability, time-to-market and the competitive environment influence the character of market orientation at Pôltsamaa Felix. Increased involvement of consumers during idea generation and evaluation requires time and resources that are rather spent on investments in areas as production equipments. With lower degree of market maturity, consumers do not have as articulated quality expectations. This, in combination with a relatively low level of brand loyalty, results in a brand image not being as vulnerable as it is in Sweden.

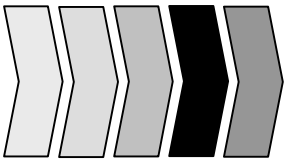
With Estonia being a small and very price sensitive market, it is important to develop products that meet consumer desires without requiring major investments and other costs that might increase the retail price. During project planning it is therefore equally important to evaluate concepts from perspectives of market potential, technological capabilities and investment requirements. A trade-off must be made between fulfilling

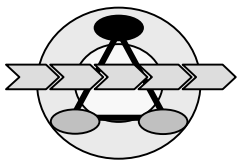
desires that consumers might have on features, package design etcetera and the requirement of keeping costs down to offer a low retail price. The consequence is that the development process becomes more oriented towards available technology than market desires. The limited size of Pôltsamaa Felix, on the other hand, require that the employers do a bit of everything and thus, when the innovation board meets, all functions in the organisation are represented resulting in more efficient cross-functional integration.

11.2.6 Product Support



The last stage of the product creation process becomes particularly important when the market is constantly changing but an thorough analysis of this process will not be conducted as insufficient information is available concerning product and technology support. The authors would like to emphasise the importance of this product support process to secure that products meet market expectations and desires.





12. Quality Assurance

After previous sections in this report it should be obvious that securing high quality throughout the entire life cycle of a product is essential for the competitiveness of a company. Clear as it may be that high quality is a fundamental challenge for companies, the meaning of this concept may not be as unambiguous. The notion of quality will be discussed and the quality assurance tool, QFD will be implemented and evaluated.

The analysis presented so far has been on a fairly comprehensive level where market and organisational characteristics have been analysed from various perspectives. However, in the subsequent chapters, focus will be transferred to a more detailed level where the development of the three fictitious concepts constitutes the basis of the analysis.

12.1 What is Quality?

In a highly competitive environment where the supply exceeds the demand, the success of companies is dependent on their ability to provide high quality products. When limited opportunities of improving the quality experience related attributes are identified, companies often try to compete by increasing quality expectation related attributes. Extrinsic quality factors become more important when development is focused on changing package design/material and increasing marketing activities. Although a temporary increase in market share may be achieved as a result of these changes, it is unlikely that the modifications will result in any permanent changes or revitalizations of the market. These kinds of activities have, during the last ten years, dominated product development within the product group of mayonnaise at Procordia Food.

In addition to expectations and experiences of quality, the third dimension – credence quality attributes – tend to obtain greater importance in the competitive environment on mature markets. Trends associated with health, wholesomeness and environmental concern is gaining more and more recognition as important quality attributes and opportunities for increased competitiveness in both Sweden and Estonia. Using such quality attributes may allow higher margins but requires well-considered market communication activities.

With the perception of quality being dependent upon a complex network of expectations, experiences and credence attributes it should be clear that each individual is likely to have different opinions of quality associated with a particular product. In connection with product development it is thus essential to identify a common set of quality characteristics that a group, or segment, of consumers express and assure that these quality aspects are met. The more heterogeneous the group, the more compromises has to be made and the more likely it is that the product in the end won't satisfy anyone.

The perception of quality is influenced not only by individual preferences, but also by cultural and historical aspects. It is, according to Utterback, also influenced by the degree

of maturity on the market and the extent of more or less demanding consumers. The differences in quality perceptions become very obvious when studying the product group of mayonnaise on the Swedish and the Estonian market:

12.1.1 Quality Attributes of Estonian Mayonnaise

Positive attributes are mainly used when Estonian consumers are asked to describe the product mayonnaise. It is used regularly and in a variety of situations with an average consumption of 2.8 kg per capita. One fundamental aspect that influences the quality expectations and credence quality is whether the product is domestically produced or not. Mayonnaise alternatives with domestic origins are perceived as having a much higher quality than international competitors.

Both regular and low-calorie mayonnaise in Estonia has a much lower fat content and thinner texture than the Swedish equivalence and as a consequence it is not perceived as unhealthy or fatty. The chilled distribution, the short shelf life and the whitish colour further enhances the perception of the product as being both fresh and modern, which allows competitiveness in a future with increased health concern. The shelf life of the product is commonly around 2 months in cold storage. Recent development projects involve change of taste (Provansaal), label design and package design.

12.1.2 Quality Attributes of Swedish Mayonnaise

Negative attributes are commonly used when Swedish consumers are asked to describe the product mayonnaise. It is primarily used at special occasions where traditional foods, like smörgåstårta or shrimp sandwiches, are used and the average mayonnaise consumption among Swedish consumers is estimated to only 0.34 kg per capita. Although the domestic origin is an important quality attribute in Sweden, it is not as significant as in Estonia when it comes to products like mayonnaise that are consumed rarely and infrequently

The high fat content, the thick and creamy texture, the yellow colour and the long shelf life further enhance the perception of the product as being unfresh, fatty, greasy, unhealthy and not suitable in modern and every-day cooking. The shelf life of the product is commonly around 9 months at room temperature. Recent development projects involve change of label design and package material.

12.1.3 Quality and Market Orientation

If quality is synonymous with the ability to meet the needs and desires of the consumer, this will require a market-oriented approach, but when focusing on mayonnaise there are major differences both in terms of basic product features and in terms of importance on the two different markets. As a consequence, it is not possible to establish generic quality attributes or measurements for mayonnaise as consumer expectations and perceptions of quality diverge too much on the two markets.

Parallel to the trend of increasing consumer demands of products fulfilling their specific needs and desires is the pressure upon companies to rationalise. It is understandable that large, international companies are appealed by the opportunity of scale economies by concentrating production and R&D activities. Major cost savings can be achieved when one part of the organisation supplies products for all markets, but in order to fully benefit from scale economies, a company-wide product must be developed.

The authors thus conclude that there must be a trade-off between market orientation and organisational rationalisation and when studying mayonnaise, this becomes very obvious. It is not possible to develop an "Orkla mayonnaise", and achieve cost savings through economies of scale, without sacrificing consumer orientation on the Swedish market, the Estonian market or both. It is not possible to develop one product that meets mayonnaise expectations in both Sweden and Estonia, as the basic features of the product are so different.

12.2 Tools for Quality Assurance

One approach to bring clarity and consumer orientation to the product development process to assure that needs and desires of the market are obeyed is the Quality Function Deployment tool. The choice of using this tool in this study is based upon characteristics like the attempt to ensure that customer or market requirements are accurately translated into relevant technical requirements and actions in a cross-functional manner. Another purpose with using QFD is to document knowledge for future development projects and to bring structure to communication processes.

12.2.1 Correct Implementation of the QFD

The results from implementation of the QFD approach on the fictitious concepts in Sweden and Estonia are presented in appendix A and C. Before making any conclusions whether the QFD approach is suitable in the food industry or not, some aspects concerning the authors' ability to successfully implement the approach will be highlighted. The evaluation of the implementation focuses six patterns of information available in the relationship matrix of the QFD charts

		Empty rows	Empty columns	Rows with no strong relationships	Row/column with identical relationships	Groups of relationships	Row/column with too many relationships
Procordia Food	Chilli mayonnaise				√	√	√
	Mayonnaise w omega-3		!	!	√	√	√
	Instant mayonnaise	!	!		√	√	√
Pôltsamaa Felix	Chilli dip	!	!		√	√	√
	Mayonnaise w. omega-3		!		√	√	√
	Instant mayonnaise		!	!	√	√	
! Parameter requires attention					√ Pattern identified		

Table 5 Evaluation of the relationship matrices of the fictitious concepts.

The table above indicate that problems associated with "identical relationships", "groups of relationships" and "too many relationships" are frequently occurring. These patterns indicate that product characteristics and customer desires have not been specified appropriately.

12.2.2 Reliability of the QFD Implementation

The implementation of the QFD tool, as presented in appendix A and C, is combined with a written statement concerning technical difficulties associated with development of the three concepts at Procordia Food and at Pôltsamaa Felix. These written statements

are presented in chapter 7 and 8. Both methods can be used in the planning stages of product development and to document the complexity involved in product development. The QFD charts and the verbal statements should thus match each other and provides a method to analyse the reliability of the QFD charts. This analysis makes no attempts to state whether the assessments are valid or not.

Prioritised Consumer Desires and Product Characteristics
To highlight the aspects that should be, according to the QFD approach, prioritised during development of the concepts, a technical importance rating was calculated. The outcome of this analysis was the identification of:

- Three consumer desires that should be prioritised in the development process (importance rating)
- Five product characteristics that should be prioritised to secure consumer satisfaction (importance rating)
- Five product characteristics that are likely to require most resources by the development team (complexity rating)

A more detailed description of this calculation is presented in appendix E.

Based on the verbal descriptions given by the company representatives – i.e. the same people that were consulted when implementing the QFD tool – equivalent ratings of consumer desires (importance rating) and product characteristics (importance and complexity rating) were conducted. The outcome of the verbal assessment and the QFD implementation of the two companies are presented in the table below and in appendix F. When the verbal assessment and the QFD analysis highlight the same consumer desires or product characteristics as being important or complex, coherence is achieved as the two methods communicate the same information. Deviations, when the verbal assessment and the QFD analysis highlight different consumer desires or product characteristics, consequently indicate that the two methods communicate inconsistent information. A more detailed presentation of an attempt to analyse the coherence and deviations between the verbal assessment and the QFD analysis is presented in appendix F.

The table below and the table in appendix F indicate that the two methods of predicting challenges and complexity involved in product development do not support each other fully. With a coherence ranging between 31 to 69% we conclude that the QFD approach, as implemented in this study, does not provide information reliable enough to motivate implementation of the approach in its current shape. Some general benefits, shortcomings and suggestions of improvements of the QFD tool are identified and presented below.

Procordia Food		QFD-Chilli	Verbal-Chilli	QFD-Omega-3	Verbal-Omega-3	QFD-Instant	Verbal-Instant
Desires	Easy to prepare					√	√
	Fresh	√	√	√	√	√	
	Good taste	√	√	√	√	√	√
	Healthy			√	√		
	Shelf life						√
	Suitable as cold sauce	√	√				
Importance Rating	Chilled distribution		√		√		
	Choice of emulsifier	√					√
	Choice of spices	√	√				
	Choice of thickeners			√			√
	Colour		√				
	Content of mustard	√					
	Content of oil			√			√
	Content of omega-3			√			
	Oxidation rate			√	√	√	
	Package design					√	
	Package material	√	√	√	√	√	
	Shelf-life powder					√	√
	Shelf-life prepared product					√	
	Source of omega-3				√		
	Viscosity	√	√		√		√
Complexity Rating	Chilled distribution			√			
	Choice of emulsifiers	√					√
	Choice of spices	√	√				
	Choice of thickeners						√
	Colour		√				
	Content of spices/flavours		√	√			
	Production process	√	√		√		
	Oxidation rate			√	√	√	
	Package material					√	
	Retail price	√					
	Shelf life			√	√	√	√
	Shelf-life prepared product					√	
	Smoothness						√
	Source of omega-3			√	√		
	Viscosity	√	√		√	√	√

Table 6 QFD vs. Verbal analysis at Procordia Food, Eslöv

12.2.3 Benefits of the QFD Tool

Despite some problems encountered in the implementation of the QFD tool, the authors conclude that there are several aspects contributing to the benefits of the tool.

Market Orientation

One fundamental benefit with the QFD approach is that it focuses the attention of the project team on the desires of the customer through the entire process. Project members, from different parts of the organisation, thus have to evaluate the product and plan product development with respect to consumer desires, and not primarily technical aspects. The systematic analysis of relations between customer desires and product characteristics further secure that the desires of the consumers are met. The QFD approach thus facilitates market orientation throughout the entire development process.

Cross-functional Integration

As the QFD approach require that representatives from different functions in the organisation are involved it will encourage and provide structure for cross-functional integration. Knowledge and experiences are more easily shared across divisions and

working for a common goal may strengthen motivation and commitment to the particular project and to the organisation as a whole. Improved means of communication may also be offered by the QFD approach. As different representatives will gather around the same tool, common frames of references will develop which may improve and encourage communication across division.

Documentation
Even after the QFD project is executed it may continue to provide knowledge and insights to the organisation as it documents experiences and knowledge created in a development project. The documentation of the QFD may thus be integrated in a company-wide knowledge base. Having structured means of documentation and knowledge management becomes more and more important as the organisation grows. With Orkla being a wide spread organisation with activities in numerous of countries, such a knowledge base could provide opportunities of sharing information and knowledge across borders which may, in the long run, increase the competitiveness of the company and decrease the time to market in development projects.

Quality Assurance
With the QFD tool emphasising the product characteristics that are most important from the consumers' perspectives, the project team may focus their resources on value adding activities and minimise resources spent on non-value adding features. The structured planning increases the chances of identifying problem areas in time, before major resources have been invested.

12.2.4 Shortcomings of the QFD Tool

Some shortcomings of the QFD tool were identified when implementing the approach on the three fictitious concepts.

Time Consuming
One disadvantage with the QFD approach is that its implementation tends to become somewhat time-consuming. The tool promises efficiency, decreased time-to-market and improved quality but it is important that the project team understand the purpose and the strengths of the tool in order not to feel that too much time is spent in the planning stages of the project. If the project is very time consuming and the advantages with the approach are not communicated appropriately, it may result in insufficient commitment by the project team.

The implementation of the tool appears, however, to run smoother as the organisation collects experiences and knowledge of the tool. One possible approach to minimise this shortcoming of the tool is to start implementing QFD on smaller projects and gradually increase the complexity and scope of the projects as experience and understanding is increased.

Interpretation of Directions
The most serious shortcoming of the QFD approach is related to difficulties when implementing the tool. Although numerous of articles and books have been written about the implementation of QFD, there is limited research done concerning QFD in the food industry. The guidelines available are sometimes hard to follow and do not give sufficient directions, for example regarding on what level of detail to express the

customer desires and the product characteristics. It is far too easy to get lost in details, to float away on sidetracks or to keep the discussion at a too universal level.

Interpretation of Results
Once implementation of the tool is completed, the QFD chart will express numerous of relationships, values, consumer desires, and product characteristics. Although it does provide extensive information regarding the particular project, it may sometimes be difficult to interpret, as every little mark in the chart will represent a complex net of assumptions and interactions. Information that may be totally obvious by the project team may seem impossible to grasp by someone else. This shortcoming of the QFD approach may limit benefits associated with documentation and knowledge management in the organisation.

12.2.5 QFD Applied on Food Products

The QFD approach has, as mentioned in chapter 5, been implemented in a variety of industries, although not very frequently on food products. Food products are complex products that people have equally complex relations to. As a consequence, it appears very difficult to identify and specify a manageable number of attributes and to map the interactions of the different components. Quality perceptions are influenced by numerous of aspects, some more rational than others, and it is often noted that user-panels give misleading results when consumers are asked to motivate or express reasons for quality perceptions. These problems are, however, not solely related to the food industry but are probably typical for all consumer-goods industries. The methods implemented to understand buying pattern and quality evaluation thus remain to be improved before the values of the QFD approach can be fully exploited.

The authors conclude that the QFD approach is an excellent tool to increase awareness and improve communication in a cross-functional manner. Despite problems with identifying appropriate consumer desires, which in fact is a separate issue that is not related to the structure of the QFD, it encourages and communicates market orientation up-stream in the process. It decreases the extent of subjective interpretations, informal decision making and provides superb means of supporting planning processes in early phases of product development. If the QFD approach is implemented appropriately during planning phases of product development, considerable amounts of time and resources may be saved due to more focused approach to development. In addition, higher quality may be secured. As the QFD approach offers substantial benefits if implemented the correct way, some suggestions on how to improve the method to better suit the characteristics of the food industry are presented.

The Voice of the Customer
Although problems associated with the identification of customer desires is a separate discussion and not primarily related to the benefits and shortcomings of the QFD tool, some aspects that might improve the "voice of the customer"-room are suggested.

As one problem identified when establishing customer desires is to express the desires on an appropriate level of detail, the authors suggest that a limited number of all-embracing desires are identified and combined with a number of more specified desires. The identified customer desire of "good mayonnaise taste" could thus be complemented and expanded also to include more specified customer desires expressed as: "taste of mustard", "taste of salt", "taste of egg" etcetera. An advantage with this approach is that

the likelihood of misinterpretations by team members will be minimised. To bring market orientation upstream in the development process it is thus essential to communicate requirements in very clear way to secure that no misinterpretations occur.

Voice of the Company
Similar problems associated with the expression of customer desires are identified when expressing product characteristics and the same approach of identifying all-embracing characteristics and complementing with more detailed characteristics is suggested to minimise misinterpretations.

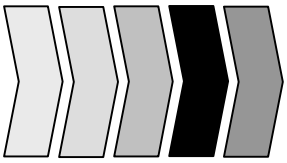
In addition, the authors would like to emphasise the importance of sensory attributes in development of food products by expanding the voice of the company room to include both technical aspects and sensory aspects of the product. The voice of the company room could thus express the technical parameter related to the content of sucrose, while the sensory parameter expresses sweetness as a product characteristic. The sweetness of the product is obviously related to the sucrose content, but may also be related to other technical parameters.

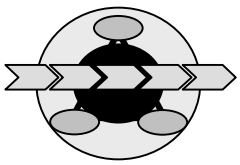
More over, the authors would like to suggest that retail price is not used as a product characteristic as it will be influence by too many parameters resulting in imbalance of the importance rating and complexity rating.

Correlation Roof
Another problematic area was the relationship roof where trade-offs and synergistic effects between different product characteristics should be analysed. Information regarding the interpretation of these effects and from which perspective the effects should be analysed was very contradictory. The relationships should be established from the consumers', and not primarily from the company's, perspective. In general, better information regarding implementation of the QFD approach is appreciated.

Documentation
Although the QFD provides structure of documentation and knowledge management, it should be complemented with a written statement regarding the challenges identified, the assumptions and the trade-offs made. Software systems should be used to facilitate the documentation and implementation process as the complexity of the projects increase.

Flexibility
The QFD tool is, in its current shape, rather rigid once it has been completed in the planning stages. One purpose of the tool is to provide structure and focus to the development team, but in order to provide full market orientation there should be a continuous communication to secure that the product meets the market needs on the day of introduction. With an ever-changing market, flexibility and continuous market orientation is perceived as necessary, and the tool should thus be adapted to this context.





13. Complexity and Knowledge Creation

The previous chapter has concluded that suitable tools for planning development projects may encourage cross-functional integration and provide quality assurance, reduce time to market as well as the reduce resource consumption. During these planning stages, the complexity involved in the development projects will be assessed, but different individuals and organisations may identify different challenges and opportunities associated with different concepts. The identified complexity associated with different concepts is also influenced of the ability to utilise knowledge create in previous projects, by project members or by the organisation.

The three fictitious projects provide the foundation when analysing the identification of complexity and the process of knowledge creation in different organisations.

13.1 Predicting Complexity

One purpose with the study conducted was also to analyse how the perceived complexity in different projects was dependent upon factors like experience, creativity, knowledge and quality ambitions of individuals and organisations. Representatives from Procordia Food, Pôltsamaa Felix and two external organisations were consulted, each with different frames of reference. Individuals consulted were encouraged to briefly describe what major challenges they associated with development of the three fictitious concepts. The critical parameters identified and documented do not represent a detailed analysis of complexity involved but indicate the general impression of challenges anticipated.

Summarising tables with all the parameters emphasised by the different individuals as being critical for the development of the different concepts are presented in appendix G. The purpose with summarizing the identified critical parameters in this manner is to highlight how different the perception of complexity is dependent upon different factors, some of which will be discussed later in this chapter.

To illustrate these differences in complexity assessment, some interesting aspects related to the assessment of the instant mayonnaise concept are presented below.

13.1.1 Instant Mayonnaise

Very different opinions are presented when analysing complexity involved with the development of the instant mayonnaise, which the table below clearly indicates. The Swedish representatives generally perceive the project to be very complex to develop due to the very different characters of the two emulsion systems when the fat content is 60% and the texture is thick and creamy and the emulsion system when the fat content is 20% and the texture is thinner, but still creamy. The major challenges associated with this project are related to identification of emulsifiers and thickeners that can secure high solubility, efficient emulsion formation and whose interactions in the different systems can be controlled. The structure of components – crystal size, agglomerate structure– is thus a very important factor to consider. Central for the success of this concept is, in

Sweden, that the consumers can prepare the product in a quick and uncomplicated manner. No mixers or other ungainly kitchen utensils should be used as convenience will be communicated as a quality attribute of the product. The product should thus be easier to prepare than regular mayonnaise.

In Estonia, on the other hand, a completely different approach is adopted. While the Swedish representatives generally perceive the instant mayonnaise case to be the most complex of the three. The product developer at Põltsamaa Felix perceives it as being the easiest one to develop. As mayonnaise, when prepared in Põltsamaa, is prepared using different powder components and adding liquids like vinegar, colouring extracts, water and oil, the product developer at the company predicts that development of the instant mayonnaise will be a process of adapting the citric acid content to provide a product with a suitable pH and acidity and to establish recommendations to the consumers on how much water and oil to add to get best viscosities. The development of the product is thus perceived as being pretty straightforward and the major challenge associated with the project is to secure a suitable production process and environment as the stability of the product is primarily limited by environmental factors.

The different attitudes to the development of the instant mayonnaise are the reflection of a complex net of assumptions based on previous experiences and knowledge but also on quality expectations and ambitions. The quality expectations and ambitions are in turn influenced by factors related to the market and the organisation, as discussed in previous chapters. The character of the instant mayonnaise will thus be very different depending on the company responsible for the development. Factors influencing this process include the different character of the Swedish and Estonian mayonnaise, higher quality awareness of Swedish consumers – especially when it comes to instant products – and factors related to individual experience, features of naivety or pessimism and the organisational context.

Instant Mayonnaise		Procordia Food	Pôltsamaa Felix	External source I	External source II
TASTE	Ingredients as in regular mayonnaise	√	√	√	√
	Content dry egg powder	√			
	Content citric acid	√	√		
	pH		√		
COLOUR	Dry β-carotene	√	√		
VISCOCITY	Viscosity	√	√	√	√
	Oil content	√	√	√	√
	Choice of emulsifying agent	√		√	√
	Content of emulsifiers			√	√
	Solubility emulsifying agent	√		√	√
	Structure emulsifying agent	√		√	
	Efficiency of emulsifying agent	√		√	
	Choice thickeners			√	√
	Content of thickeners			√	√
	Structure thickeners	√		√	√
	Solubility thickeners	√		√	√
	Efficiency of thickeners	√		√	
	Interactions-thickeners			√	
	Size of crystals			√	
	Water activity – components			√	
	Static electricity – components			√	
	Preparation time	√		√	
	Preparation force	√		√	
	Lump formation	√			
	Character of 20% emulsion system			√	√
	Character of 60% emulsion system			√	√
STABILITY	Moisture content – powder	√	√	√	
	Package material	√		√	
	Modified atmosphere	√			
	Lipid oxidation	√		√	√
	Microb. Contamination – production		√		
	Chemical stab. – emulsifiers		√		
	Moisture evaporation			√	
	Diffusion of taste components			√	
	Separation of components				√
	Protein oxidation				√
Expected time to develop		12	3	12-36	>12

Table 7 Critical parameters when developing instant mayonnaise

13.1.2 Experience

When making individual predictions concerning challenges associated with product development, the outcome will most certainly be influenced by previous experiences of related problems. Aspects, such as whether the person consulted has participated in projects with similar character as well as the depth of knowledge concerning the product influence the character of the complexity analysis.

The academic representative, for example, has very deep knowledge and experience relating to chemical and physical interactions in emulsion systems, but he has limited experience of the particular product mayonnaise. The product developer at Pôltsamaa Felix on the other hand, is not a specialist in the surface and colloid field but has

extensive experience of physical, chemical and technological properties of mayonnaise and will therefore give a different picture of the complexity involved with mayonnaise development.

The mapping of critical parameters indicates that the depth of knowledge influences the character and level of detail of the parameters in a positive way. The more knowledge available, the more detailed parameters identified:

- The chilli mayonnaise in not considered as very challenging, but many parameters influencing the quality of the product may be identified.
- The instant mayonnaise is generally perceived as rather complex to develop, but many parameters on a fairly detailed level can be identified as knowledge and experience related to the problem areas is available.
- The dominating problem areas are quickly identified when analysing the enrichment of omega-3, but all persons consulted in this report state that they have limited experience of omega-3. Even though critical parameters are identified, the level of detail is fairly low. It is likely that the picture of complexity would, if described by someone with more experience, look very different.

It is likely that the context and the available frames of reference will also influence the complexity identified. If the main occupation of an individual is concerned with analysing very complex situations and issues, it may happen that the complexity identified is more extensive when compared with a person with limited experiences of analysing such problems. The outcome of such detailed planning may be better understanding of the complexity involved with development of the product, or a too pessimistic appraisal of the probability of success of the project.

The ability to benefit by experiences is also dependent on the ability to manage knowledge by individuals and by the organisation. Are there any established routines for securing that knowledge created in one project is communicated and maintained within the organisation to facilitate implementation of future projects? Is knowledge re-created in every project? An attempt to map sources of knowledge creation and opportunities of recycling knowledge created in each fictitious project is made and will be presented in the subsequent section of this chapter.

13.1.3 Market Characteristics and Quality Expectations

The character of the market, as indicated in chapter 10, will also influence the predictions of complexity in market oriented product development. The requirements on products are influenced by the extent of well-articulated quality expectation among consumers. The Swedish consumers should, according to the analysis of industry evolution, have a more multifaceted and complex perception of quality when compared to Estonian consumers. Swedish companies must, due to more vulnerable brand images in combination with more demanding and powerful consumers, provide products that fulfil quality expectations in a variety of dimensions. It is not possible to compromise between different quality parameters like price and package. As a consequence, the character and quality ambitions of critical parameters should be more comprehensive in Sweden, when compared to Estonia, which is supported by the results presented in appendix G.

13.1.4 Organisational Influence

Organisational factors are likely to influence the perception of complexity involved with product development, as the persons consulted will base their judgement on resource availability and technological capabilities in the organisation. Chilled distribution is, for example not, perceived as a challenge at Pôltsamaa Felix as this is currently implemented but it would require major changes at Procordia Food.

13.2 Creation of Knowledge

The critical parameters identified by R&D representatives require some kind of knowledge creation. Some created knowledge is closely related to the specific product, while other can be recycled in future projects and thus add knowledge to the company-wide knowledge base.

There are many sources of knowledge available in this process, such as in-house research and development (past and present), knowledge offered by suppliers, through cooperation with research institutes or universities, or through cooperation with other actors on the market. The balance of internal and external experience in product development is an often-debated issue. Nobelius states that networking with various actors is fundamental to keep up with rapid changes and increased competition, but being too dependent on the knowledge of external sources could also involve a risk of slowly diluting the knowledge base that is fundamental for the innovative capacity of the company. With creation of knowledge being an often-quoted source of success it is important to manage it appropriately. The knowledge created in different projects should be documented in a company-wide knowledge base to allow knowledge and experiences to be shared throughout the entire organisation. The incorporation of new knowledge adds to the intelligence of the organisation and may increase the competitiveness in the long term through increased innovative capacity and decreased time-to-market in future R&D projects. But the ability to recycle knowledge is dependent on whether the creation process is made more or less explicit and if the outcome is communicated and preserved in the organisation.

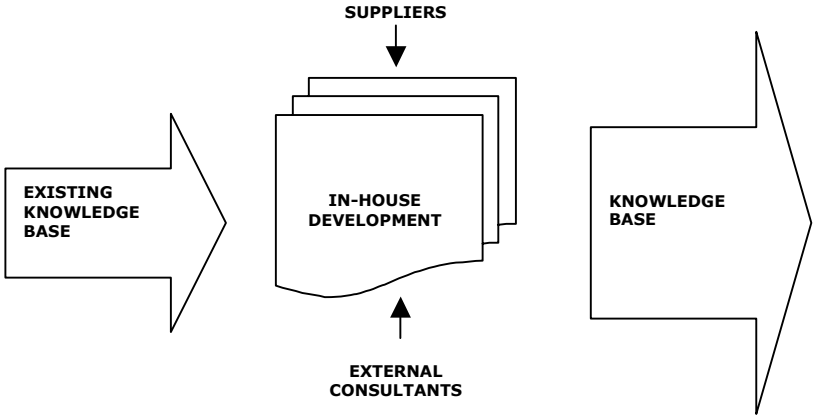


Figure 17 Knowledge creation associated with product development

An attempt is made to map the preferred source of knowledge when developing the fictitious concepts and to analyse how the knowledge can be recycled in future projects. Four categories of knowledge-sources are identified:

- Knowledge base – documented experiences from previous development projects conducted by the organisation.
- Suppliers – provide information of chemical and physical characteristics of raw materials. May also provide technical support and assist in basic research.
- External consultants – research institutes, universities or cooperation with other actors.
- In-house development - activities to increase the understanding of interactions of various compounds relevant for the particular project.

The sources of knowledge most likely to be consulted when creating knowledge concerning the identified critical parameters are identified and recorded in the tables presented in appendix G.

13.2.1 Preferred Source of Knowledge

The analysis of preferred sources of knowledge in product development indicate a trust in the ability of the suppliers to provide knowledge regarding both the chemical and physical characteristics of individual components but also regarding their interactions in the particular system. The project predicted to require close cooperation with external actors is the development of the mayonnaise enriched with omega-3. As previously stated, it is expressed by the R&D representatives consulted that the knowledge regarding fish-oil and omega-3 is limited and extensive research therefore has to be done to identify appropriate source of omega-3 and to secure stability throughout the shelf life of the product.

It is interesting to note that there is a clear difference between attitudes to using external expertise between academic sources and the other R&D representatives. The academic source does not state as often as the other representatives that external assistance will be used. The reasons to these differences in attitudes are mainly ascribed to the diverging backgrounds and experiences. With a background in the academic environment and experiences from the pharmaceutical industry, the academic source is familiar to development projects lasting sometimes more than ten years. With such long development cycles it would be very risky to trust the knowledge of suppliers too much. Suppliers can be used as sources of ideas, but the major parts of knowledge concerning the research and development must originate from the organisation.

The attitudes among representatives from Pôltsamaa Felix and particularly among representatives from Procordia Food are dominated by the assumption that it would be too expensive to develop in-house expertise in all relevant areas. As costs and time-to-market are two critical success factors in product development, the cooperation with suppliers is perceived as a method to create the required knowledge while speeding up the development cycle. This attitude is in accordance with Nobelius' perception of R&D management in mature companies acting on mature markets, but the authors find it a little bit surprising that suppliers seems to be used as a source of knowledge more often than the knowledge base available in the Orkla group. If a company-wide knowledge base is available, it does not seem to be fully exploited.

13.2.2 Expanding the Orkla Knowledge Base

Some of the knowledge created in a development project is product specific – as optimisation of mustard, sugar, salt and vinegar content to provide a good taste of the mayonnaise – while other aspects of knowledge can be recycled in future projects that are not related to the product group of mayonnaise. The scope of the knowledge base will thus increase during execution of a project but the extent of this increase is dependent upon the ability to express the knowledge created in an adequate way. It is thus important, when evaluating potential projects, not only to look at the challenges associated with the product but also to consider the future benefits of knowledge creation and expanding the knowledge base of the company.

To illustrate how the knowledge base can be expanded as a consequence of product development, an attempt is made to identify possible areas of knowledge creation that should be relevant for the Orkla-group.

Development of the Three Fictitious Projects

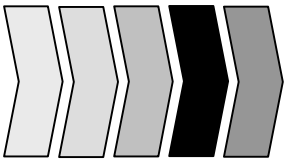
Although development of the chilli mayonnaise is perceived as rather simple, knowledge concerning different appropriate chilli flavouring could be added to the company-wide knowledge base as well as texture related-issues concerning appropriate adhesiveness in dip-sauces if the product was developed in Estonia.

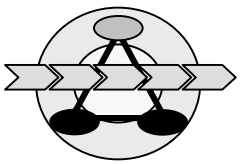
The development of the mayonnaise enriched with omega-3 is perceived as a little bit more demanding but would probably add knowledge concerning the use of fish-oil in different foodstuffs, health benefits and other characteristics associated with essential fatty acids, relation between antioxidant activity and lipid oxidation and the sensory aspects of such reactions. Development of preservative-free chilli mayonnaise and mayonnaise enriched with omega-3 would add knowledge concerning the production process and chilled distribution of mayonnaise.

Development of the instant mayonnaise would require increased knowledge concerning powder-technology if developed in Estonia. Extensive knowledge concerning this issue is already available at Procordia and would therefore not add a large amount of knowledge to the knowledge base. If the product were developed in Sweden, however, knowledge would be created concerning the relation between structure, solubility and efficiency of emulsifiers and thickeners in different emulsion systems.

Benefits with Expanding the Knowledge Base

One of the advantages with being a multinational enterprise similar to the Orkla-group is that there are possibilities of developing core competences, knowledge and expertise in a number of areas through out the organisation. The available knowledge base is allowed to become much more comprehensive, if the different organisations act together, than would be possible if the individual organisations has to manage on their own. Presently, it does not seem like the different parts of the Orkla-group are working together in an optimum way and improvements regarding attitudes and exploitation of the knowledge available could thus have various benefits including increasing the innovative capacity, encourage cooperation across divisions, decrease time-to-market and strengthen the Orkla-culture and solidarity. If the different R&D functions within the group could be managed in an optimal way, were information could easily be exchanged, this would probably open up for an efficient usage of current competencies within the whole group as well as shorten time to market and develop new and more attractive products.





14. Estimation of Resource Demands

As a consequence of increased awareness of the competitive importance of innovations, the attitudes toward R&D investments have changed dramatically. Expenditures made in product development are constantly increasing and in Estonia, for example, the expenditures have more than doubled during the last two years. With increasing costs associated with product development it becomes more important than ever to carefully plan the development process to decrease the risk of spending time, money and other resources on wrong projects.

Estimations of costs associated with product development are currently focused on costs related to investments in technology and marketing activities. Little emphasis is put on the costs incurred in the development phase and the authors thus identify an opportunity to increase the understanding of resource consumption in the product development process.

14.1 The ABC Approach

With indications of increasing expenditures in R&D activities on both the Swedish and the Estonian market in combination with increased proportions of over-head costs, as stated by Gerdin, a cost estimation method suitable for this situation should be implemented by the two companies. The main advantage with the Activity Based Costing approach is, according to Kim *et al.*, the ability to more accurately allocate overhead costs to illustrate how different activities and steps consume resources and to give indications on how to eliminate non-value adding costs. When adopting the ABC approach in the planning stages of product development, more accurate predictions of resource consumptions can be made. In addition a useful tool for evaluating the implementation of the process is offered. The approach was thus considered useful when analysing resource consumption in the product development stages at Procordia Food and Pôltsamaa Felix.

14.1.1 Implementing the ABC Approach

Application of the ABC approach on the development stages at Procordia Food and Pôltsamaa Felix involved the identification of activities needed for development of the three fictitious concepts. An attempt was made to identify cost centres, resource drivers and activity drivers. Information was gathered with the intent to get an all-embracing picture of the resource consumption of each activity. However, the attempt to identify costs associated with people involved, raw material consumption and production proved to be very complicated as information regarding costs associated with product development, and allocation of overhead costs was either unavailable or considered as too strategically important to be distributed in a published report.

Inadequate information and direction regarding the appropriate level of detail, when identifying activities, further complicated the implementation of the ABC approach. Gerdin states that a trade-off generally has to be made between the desire of

documenting the process at a fairly detailed level to provide accuracy in the cost estimation, and the desire to keep the number of activities on a manageable level. When identifying activities on a very detailed level, it becomes difficult to estimate the appropriate resource consumption. Doing such an analysis would most certainly be very time and resource consuming and will not provide the efficiency intended. However, when these detailed activities are merged to more comprehensive activity groups it becomes very complicated to identify appropriate activity drivers.

The difficulty of establishing appropriate activities and activity drivers in combination with problems associated with getting access to information concerning costs resulted in the authors restricting the usage of the ABC approach to focus on the identification of activities in the development process. The activities identified were complemented with information concerning time estimations, number of people involved and, in some cases, estimations of raw material, package material and production time. The subsequent analysis will thus focus on the identification of activities in product development and the estimation of time, in labour hours, required when developing the three fictitious concepts.

14.2 Activities in Product Development

Activities identified in product development at Pôltsamaa Felix and at Procordia Food are presented in appendix B and D. As there are many similar activities in the fictitious development of the three concepts 8 major groups, or steps, of activities were identified. Each one of these steps thus involve several smaller activities that may, depending on the particular project and the organisation in question, consume more or less resources. In addition, each one of these steps could, if necessary, be performed more than once, which will be discussed in the next section.

The development phase at Pôltsamaa Felix could thus be illustrated as comprising the following generic activities:

Figure 18 Activities in the development stage at Pôltsamaa Felix

Features of this development process that are unique for Pôltsamaa Felix is the step called innovation meeting. At the innovation meeting, representatives from different functions within the organisation evaluate the product prototype in terms of taste, production capabilities and market opportunities. The innovation meeting will conclude whether the taste and other features of the product are considered as satisfying or not. Fundamental characteristics of this process are the speed, efficiency and flexibility achieved.

When looking at product development at Procordia Food, the following generic steps were identified:

Figure 19 Activities in the development stage at Procordia Food

The main difference from the process at Pôltsamaa Felix is thus the substitute of innovation meetings with the sensory test. External experts with training in sensory evaluation are consulted to provide objective assessment of pre-specified characteristics. Consumer panels will be consulted at later stages to evaluate whether the product attracts consumers or not. This investment in market orientation and quality assurance was discussed in chapter 11.

14.2.1 Loops in the Development Process

When R&D representatives are asked to predict the execution of activities when developing the three fictitious concepts, it is stressed that there is a great extent of uncertainty involved in such estimations. A development project should, ideally, only perform the steps described only once. In reality, project teams commonly encounter numerous of unforeseen obstacles and challenges. The steps above may therefore have to be performed several times. With one of the most fundamental features of product development being a process full of opportunities and challenges that cannot be foreseen, it is understandable that R&D representatives are reluctant to specify the time and resources required to complete a project.

Although there are a great uncertainty involved in estimating time and resource consumption in future development projects, the authors states that the uncertainty is restricted to a limited number of factors, which is illustrated in the figure below.

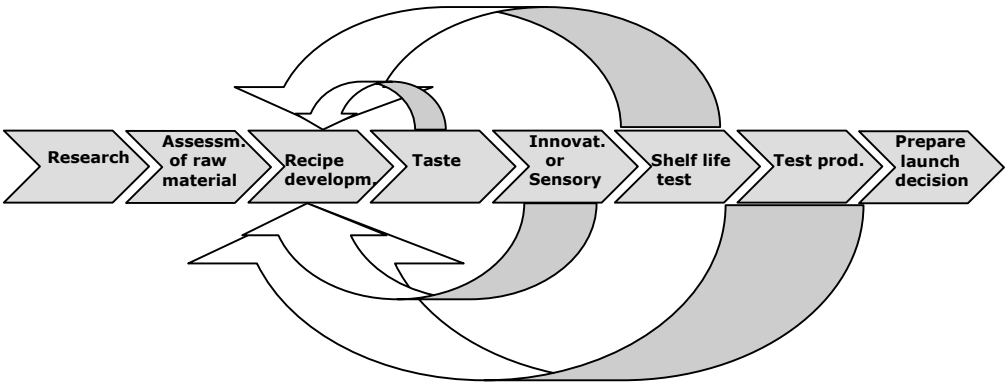


Figure 20 Loops in the development process at Pôltsamaa Felix/Procordia Food

The arrows in the figure indicates that the steps in the development process may be re-initiated as a consequence of results provided by the different stages of taste evaluation, innovation meeting/sensory test, shelf life test and test production. If the taste is not considered as satisfying in the taste evaluation session or by the innovations board/sensory test, the development process will re-initiate a process of recipe development followed by a new session of taste evaluation and innovation meeting/sensory test. In the same manner, if the results from the test production or shelf life test are not considered satisfying, the development process may be re-initiated at the recipe development stage.

The identification of these loops and the mapping of activities facilitates cost estimation and follow-up of development projects as the resource consumption is primarily proportional to the time spent in each activity and number of loops executed.

14.3 Resource Demand in the Development Stage

The R&D representatives consulted in this study were asked to estimate the time required (actual work hours) to execute the different activities previously identified. They were also asked to specify the number of people involved in the different stages as well as expected waiting times that might influence the time period required to complete the project. Identified activities and time estimations for the three fictitious projects are presented in appendix B and D. An example of a corresponding time plan is presented in appendix H.

Although one should, when analysing the results, be aware of the great uncertainty involved when performing these estimations there are a lot of interesting aspects that will be highlighted later in this section of the report.

14.3.1 Basic Cost Estimation at Pôltsamaa Felix

With focus on the identified activity groups, an attempt was made to map the resource consumption in each stage of the development process at Pôltsamaa Felix. The resource consumption was evaluated from the following perspectives:

- Labour costs (managerial and operational level)
- Raw material costs
- Package material costs
- Production costs

In order not to give out information that might be strategically important, only stereotyped values of labour costs/h, raw material cost/h, package material cost/package and production costs/h were used. The calculations will thus not provide any realistic results with respect to the actual expenses associated with development, but will give indications of proportions between different cost categories. The estimated proportions between cost categories when developing chilli mayonnaise at Pôltsamaa Felix are presented in the figure below.

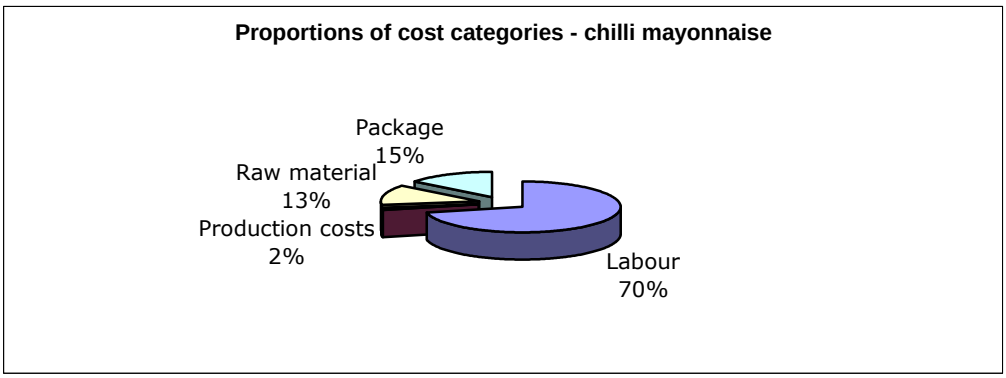


Figure 21 Proportions of cost categories, development of chilli mayonnaise, Pôltsamaa Felix, Estonia

The basic estimation of costs associated with the three fictitious projects support the assumption that the primary cost involved in the development is associated with labour. It can thus be concluded that concentrating on estimation of labour time provides sufficient information about the resource consumption.

14.3.2 Time Estimations

A basic assumption made in early stages of this study was that the time required to complete a particular development project is somehow proportional to the complexity involved. It is also assumed that organisations continuously has to value the market opportunities associated with a concept against the complexity involved in delivering the product. It is also assumed that the more complex the project is perceived to be, the greater uncertainty involved in estimation of time and resource requirements. Supported by the previous discussions of the relation between industrial evolution, quality awareness and complexity it is also assumed that the time required will also be dependent upon the organisational context.

Time Estimations at Pôltsamaa Felix

Estimations of resource demand, indicated by estimating labour hours, during the development phase in the three fictitious projects at Pôltsamaa Felix was conducted. The total amount of labour hours required in different phases of the process was summarised on an activity group level. The chart below indicates how the different activity groups are consuming different amounts of labour hours.

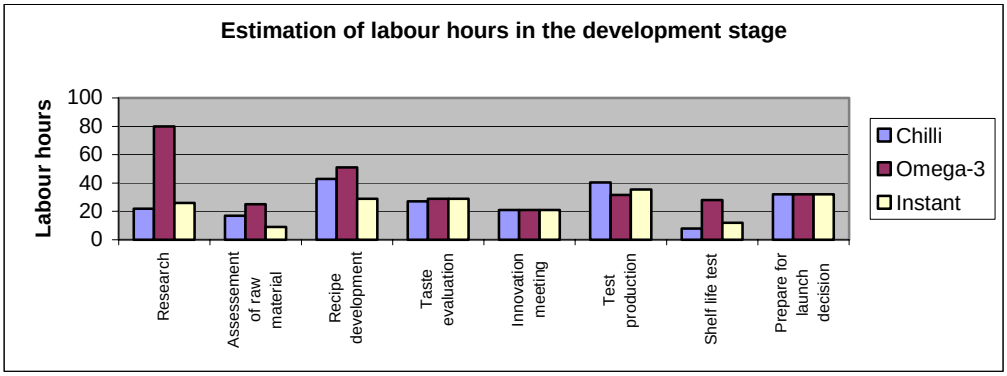


Figure 22 Estimation of labour hours in the development stage at Pôltsamaa Felix, Estonia

In the analysis of time estimations in the development stages of the three fictitious projects, it is demonstrated that the activity group of recipe development is one of the most resource-demanding step in the development process and will influence the time period required for completing the project. The stages of taste evaluation, innovation meeting, test production and preparation of launch decision will also consume comparable amounts of resources as they involve quite a number of people during a short period of time.

The analysis of the estimated resource demand for the three fictitious projects, indicated by estimation of labour hours, support the perception of complexity involved in the different projects. The relative proportions of estimated resource demands of the three projects are presented in the table below.

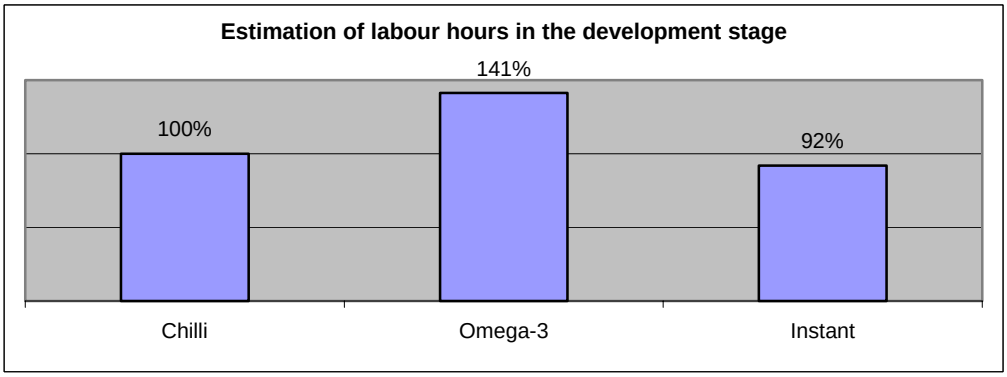


Figure 23 Relative proportions of total labour hours spend in the development stages of the three fictitious projects at Pôltsamaa Felix, Estonia

The instant mayonnaise is perceived as the easiest product to develop when ignoring problems associated with the production process. The chilli mayonnaise is not perceived as difficult, although some efforts in adapting the strength of chilli and finding the right colour are anticipated. The development of the mayonnaise enriched with omega-3 is perceived as the most difficult product to develop. This complexity ranking is supported by the correlating time estimation.

Time Estimations at Procordia Food

Estimations of resource demand, indicated by estimating labour hours, during the development phase in the three fictitious projects at Procordia Food was conducted. The total amount of labour hours required in different phases of the process was summarised on an activity group level. The chart below indicates how the different activity groups are consuming different amount of labour hours.

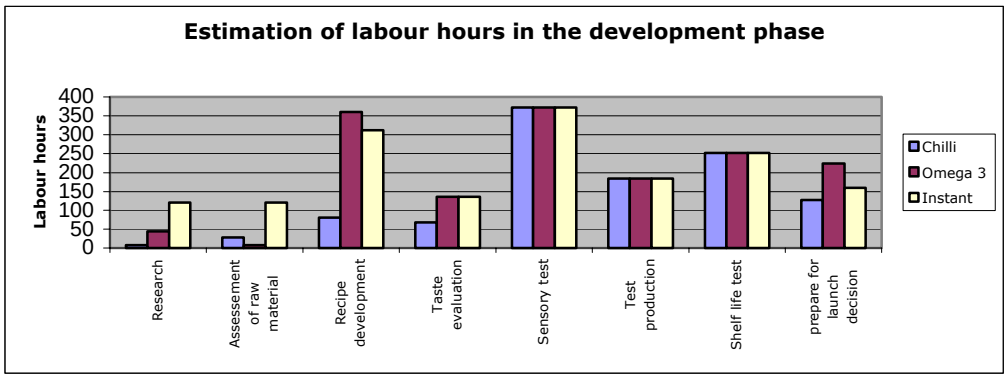


Figure 24 Estimation of labour hours in the development stage at Procordia Food

When analysing the chart above it may seem little bit surprising that the activity group consuming the greatest amount of resources seems to be the sensory analysis. However, as the sensory analysis involves 12 sensory experts, resources will quickly be consumed whenever its expertise is consulted. The purpose with these sensory testings is to secure that the evaluation of the product is not influenced by subjective opinions but remains focused on the characteristics that the target consumer is likely to appreciate. The great

amount of resources spent on the sensory analyses could therefore be viewed as an investment in quality assurance and market orientation.

The analysis of the estimated resource demand for the three fictitious projects, indicated by estimation of labour hours, support the perception of complexity involved in the different projects. The relative proportions of estimated resource demands of the three projects are presented in the table below.

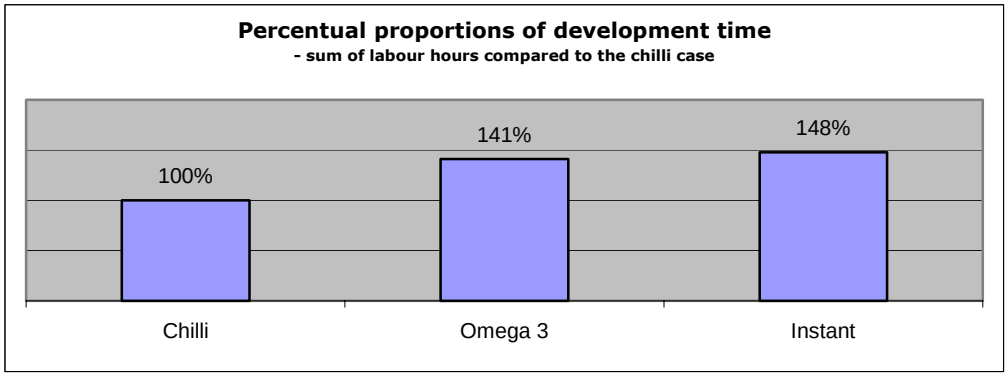


Figure 25 Proportions of labour hours in the development stages at Procordia Food

The estimation of labour hours supports the perception of the instant mayonnaise as being the most complex product to develop, followed by the mayonnaise enriched with omega-3 and the chilli mayonnaise.

Reliability of Time Estimations

Before commencing time estimations on an activity group level, representatives from Procordia Food, Pôltsamaa Felix and external organisations were asked to estimate the time period required to develop the three fictitious concepts. These initial estimations are presented in the table below:

	Procordia Food	Pôltsamaa Felix	External expertise I	External expertise II
Chilli	2 months	1 month	1 month	1 month
Omega-3	6 months	6 months	6-12 months	6-12 months
Instant	12 months	1 month	12-36 months	> 12 months

Table 8 Initial estimations of time to develop the fictitious concepts

These initial time estimations illustrate how the complexity associated with different concepts influence the anticipated time required for development. The more complex a concept is perceived to be, the longer development time predicted. This relationship between complexity and resource consumption is also demonstrated in the previous discussion when time estimations was performed on an activity based level. However, the two methods of time estimation indicate different patterns when looking at the proportions of time consumed by the different concepts.

For example, Table 8 Initial estimations of time to develop the fictitious concepts indicate that it would require approximately 12 times longer time period to develop the instant mayonnaise in Sweden compared to the chilli mayonnaise but the activity group

analysis indicate that less than 50% more labour hours would be required when developing the instant mayonnaise. The same pattern is recognised for all concepts and it can therefore be concluded that the two time-estimations methods give different indications of organisational undertakings associated with development of the concepts. The authors suggest three interpretations of these indications:

One possible interpretation is that the initial time estimations and the activity based time estimations do support each other when reflecting the resource consumption associated with development of the fictitious concepts. The more challenging projects would thus require longer time period to develop, possibly due to waiting times and increased time spent early phases of research, but do not require a corresponding increase in resource consumption.

Another possible interpretation is that the activity based time estimations give the best reflections of resource consumption associated with development of the fictitious concepts. The results of the study conducted at Procordia Food and Pôltsamaa Felix should thus indicate that developments of complex products are not much more resource consuming than line extensions products of rather straightforward character. As more challenging products with greater news value may offer substantial market opportunities and generate larger profits, these projects should, consequently, be prioritised when evaluating different concepts.

Finally, the authors would like to suggest that it is likely that the initial time estimations give the best reflection of resource consumption associated with development of the fictitious concepts due to an incapability of translating complexity into time consumption on an activity based level. Better means of resource estimations are thus required to improve the accuracy and reliability of cost estimations in early planning stages of product development.

Differences and Similarities Between the Two Situations

When comparing the estimations of labour hours required when developing the three fictitious projects in Sweden and Estonia it becomes very clear that some major differences exist between the two situations:

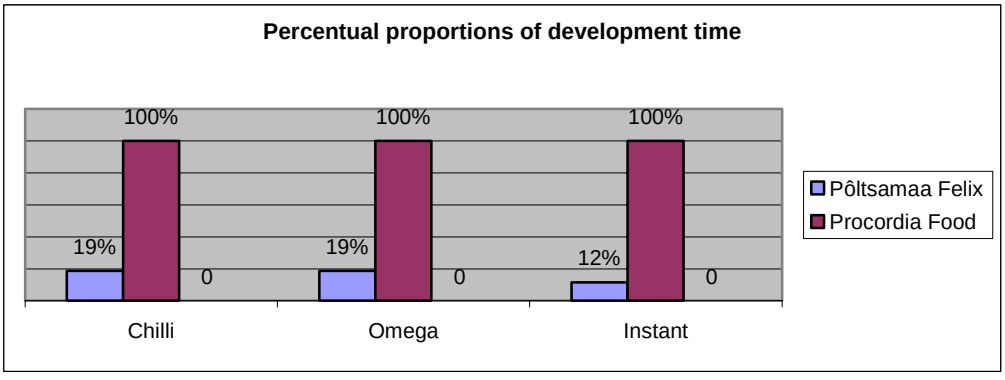
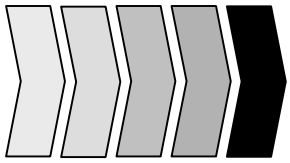


Figure 26 Relative proportions of estimated labour hours in development stages at Pôltsamaa Felix and Procordia Food

With the previous discussions concluding that the two companies represent different situations in terms of stages in the industrial evolution, extent of market orientation, organisational structure, management of R&D and quality awareness it should not be surprising that the estimated times differ. These factors, in combination with the different experiences, ambitions and personalities of the representatives consulted, gives a fairly good background to understand why Procordia Food is likely to spend more time and resources on product development than Pôltsamaa Felix.

Mature companies acting on a mature markets are likely to face more demanding consumers, requiring sophisticated procedures and routines of quality assurance and market orientation. The bureaucracy will increase, which will require longer periods of development than in Estonia whose competitiveness is dependent upon their ability to offer products, in a variety of product groups, at reasonable retail prices. Both companies are differentiated into the high-quality segments of their respective markets but the conditions of competition are different due to different attitudes among consumers regarding the notion of quality.

It should thus be emphasised that the time estimations cannot be used to value whether the product development process at Pôltsamaa Felix is to prefer to the process implemented at Procordia Food as this report clearly shows that the context of the two companies are very different. The conclusion to draw from this study is contrary that it is not possible to develop a universal set of quality measurements, a universal development process – as emphasised by Orkla- to suit all different contexts of competition, innovation capacity and market orientation. In order to secure quality in market oriented product development, one must consider the internal, as well as external, context of the development organisation.



15. Conclusions

This report has covered different dimensions of quality and complexity in market oriented product development. The study has been conducted partly in Sweden and partly in Estonia and aspects such as market characteristics, consumer preferences, organisational contexts and individual influences have been taken into consideration. This chapter presents extracts and conclusions from this study. Some recommendations of future research areas are also given.

15.1 Evolution of the Market and Industry

The analysis of Procordia Food and the Swedish market, Pôltsamaa Felix and the Estonian market have demonstrated that the level of maturity of the two markets and companies differ when analysed from the perspectives of product and process innovation, organisation and competition. Procordia Food is a mature company acting in a stable environment with consumers demonstrating power and well-articulated quality expectations. The image of the brand is an important dimension of competition that needs to be managed properly and routines of quality assurance thus have fundamental importance in the product development process. Pôltsamaa Felix and the Estonia market, on the other hand, demonstrate a lower level of maturity and consumers, consequently, exhibits less articulated quality expectations. Brand loyalty and consumer preferences are not as well developed and the quality awareness is not yet as articulated as in Sweden.

Organisational structures and routines should be adapted to the specific context, as the two companies are acting on two different markets and exhibiting different conditions of competition. Routines that are essential in one situation may be inaccurate or simply unnecessary in another situation, but belonging to the same enterprise may require coordination of activities, structures and processes. The authors would therefore like to stress that Orkla standards, developed with the Nordic market in mind, should not be forced upon organisations like Pôltsamaa Felix who are acting in very different contexts. It is likely that Pôltsamaa Felix will adapt more structure and routines to meet the increasing needs of the consumers, but these changes should follow the evolution of the market and the industry.

15.2 Innovative Development Process

When studying the development processes at Procordia Food and Pôltsamaa Felix, some differences in structure and attitude were identified. Procordia Food is currently implementing the Orkla-standard innovation process, which encourages idea generation from a variety of sources followed by effective means of evaluation and screening to selecting the most promising idea before project establishment. This process shows similarities with a development funnel commonly referred to as "a few big bets" and is commonly adopted by large and mature organisations acting on mature markets. Potential drawbacks associated with this process that are identified at Procordia Food

include a reduced innovative capacity and increased time-to-markets, when compared to smaller companies adopting the same method.

The management of the product development process has changed rapidly in Estonia since the independence in 1991 and elements of the Orkla-process are being implemented at an increasing extent at Põltsamaa Felix today. With aspects such as time-to-market, market orientation and innovative capacity being key success factors, the authors would like to give a few suggestions on how to stimulate the innovative capacity and decrease time-to-market on a mature market, without reducing quality awareness or increasing resource demand.

Neither Procordia Food nor Põltsamaa Felix is likely to be suffering from shortage of good ideas. However, more resources are commonly consumed by R&D processes on mature market and the efficiency of evaluation and screening processes become critical to prevent that resources are spent on wrong projects. There is a danger that when market potential and financial results are the primary criteria for evaluation, true innovative ideas are discarded as they usually involve some extent of uncertainty. To encourage creativity and stimulate an innovative atmosphere within the Orkla-group, the authors would therefore like to promote a more generous attitude in the early phases of idea management, before major investments have been incurred. Ideas should, to a greater extent, be funded as precursor projects and product developers and innovation group representatives should be encouraged and offered some financial support to explore own ideas and concepts of interest.

15.3 Quality and Market Orientation

The study of mayonnaise on the Estonian and Swedish market has demonstrated that the concept of quality and quality expectations is not universal. When looking at the product group of mayonnaise it has been illustrated that basic product characteristics, the relative importance and the areas and frequencies of use differ too much between the two situations and it is, consequently, not possible to develop a mayonnaise satisfying both Swedish and Estonian consumers.

With a quality awareness differing between Swedish and Estonian consumers, it is also concluded that the character and prerequisites of market orientation will depend upon the context. Routines of quality assurance that are perceived as fundamental for success at Procordia Food are currently considered to be inappropriate at Põltsamaa Felix. As the market matures and consumers develop brand loyalties and preferences, it will become increasingly important for Põltsamaa Felix to secure that the products are satisfying the needs of the customers. Routines for quality assurance will be adopted at a greater extent and the challenge is to provide this assurance without decreasing the innovative capacity or increasing time-to-market too much.

The authors would like to give a few suggestions on how to increase market orientation without investing vast amounts of resources or implementing bureaucratic structures. Simple versions of focus groups could be used continuously to generate ideas and map the preferences of lead users as well as average consumers. Consumer complaints should be used as important sources of information and customer inputs should be gathered by, for example, calling customers regularly. Subjective interpretations by the development

team should be avoided by direct involvement of consumers in the product development process.

Another possible approach to provide market orientation, without increasing time to market too much, is to implement the Quality Function Deployment tool. Benefits of this tool include increased cross-functional integration, improved communication and methods of structuring information, opportunities of identifying potential problems in advance and a reduction of informal decision-making based on subjective criteria. In addition, the QFD approach may contribute to a better planned development process where potential problems may be identified and eliminated at an early stage in the process before major investments have been done.

The QFD approach was implemented on three fictitious concepts in Sweden and Estonia with the purpose to analyse its potentials as an integrative planning tool in product development projects. Some drawbacks were recognised, such as contradictory directions concerning the level of detail when expressing customer desires and product characteristics. Some improvements of the QFD tool must therefore be done to fully exploit the values of the tool. The authors suggest that consumer desires and product characteristics are expressed in two levels of detail to avoid misinterpretation. In addition, it is suggested that the technical parameters in "the voice of the company room" are complemented with sensory parameters to better suit the prerequisites of the food industry. The tool could also be used to document knowledge and experiences created in a development project, but the QFD chart should then be complemented with a written statement concerning the challenges identified and course of action implemented.

15.4 Complexity and the Creation of Knowledge

It has been illustrated that the assessment of complexity involved in product development is dependent on the eyes of the beholder. Previous experiences, quality ambitions and organisational characteristics influence the challenges identified and as a consequence, the character of the developed product will differ depending on the individual and the organisation responsible for the development. To avoid late and costly surprises, thorough planning, where team members act together to identify potential problems and course of actions, should be conducted in early stages of product development. As different individuals have different backgrounds and ambitions, it is important to establish a common frame of reference. The authors would like to stress that the Quality Function Deployment tool is a useful approach for this purpose.

Fundamental for the success of all companies is the process of intelligence development where information is transformed into insights and competitive as well as technological opportunities and threats are identified. The ability to exploit in-house knowledge is essential for the innovative capacity of the company, but based upon an assessment of preferred sources of knowledge in product development, the authors conclude that the Orkla-group is not using the available in-house knowledge in an optimal way. Suppliers are more frequently consulted than in-house expertise but with limited numbers of suppliers on the market, companies risk diluting their competitive knowledge, as competitors tend to rely on the same sources of information.

To improve the use of in-house knowledge, a user-friendly database system – a knowledge base – should be developed or more frequently exploited.

15.5 Resources in Product Development

Analysis of anticipated of resource consumption when developing different products of different levels of complexity indicate an inability to translate assessed project complexity into organisational undertakings. Moreover, the study of resource consumption associated with product development at Procordia Food and Põltsamaa Felix indicate that there are major differences between the two companies. Differences in resource consumption, measured as labour hours, indicate that factors such as market and industry maturity, quality awareness, organisational routines, the level of bureaucracy and individual features influence the development time at a greater extent than anticipated. With the Estonian market moving towards a more mature stage and Põltsamaa Felix adopting a structure more similar to Nordic companies within the Orkla-group, it is likely that the time-to-market and the resource consumption will increase. Precautions should be taken, as previously suggested, to assure that the innovative capacity, the cost efficiency and the time-to-market do not deteriorate too much.

15.6 Recommendations for Future Research

Although the study has covered many dimensions influencing the conditions for quality in market oriented product development, some areas remain to be explored.

Focus in this study has been, due to limited resources, solely on product development although the processes of package and process development are equally complex and dynamic.

The concepts of quality and market orientation are dependent on the ability to identify appropriate customer desires. The identification of customer needs and desires is a complicated process as consumers want different things, don't know what they want or need, don't buy what they want or need, don't buy what others think they want and keep upgrading expectations. Improved knowledge and understanding concerning how to map the desires of the customers are therefore required.

The study has indicated that companies tend to increasingly rely on their ability to establish good cooperation with suppliers. The long-term effects of such network activities are not fully understood and therefore needs to be further investigated.

The study has demonstrated that the resource consumption tends to increase with the maturity of the market and company. With increasing proportions of expenditure on R&D, effective methods of cost-estimations that can handle the uncertainty of development projects, needs to be developed.

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Appendix A – Implementation of QFD on the Swedish concepts

The implementation of the QFD approach at Procordia Food on the three fictitious concepts is presented in three matrix-figures.

Representatives from the marketing department and information from magazine surveys were consulted to map consumer requirements and to assess the importance ratings of these desires. The higher score attached to the consumer desires, the more important the customer desire. The requirements and their assessed importance are presented in "the Voice of the Customer Room" of the QFD matrix.

Company representatives with experience from product development were consulted when analysing how to develop products meeting the established consumer requirements. Associated product characteristics are identified for each consumer requirement. The outcome of this analysis is presented in the "Voice of the Company Room" in the QFD matrix. Target values were established for the identified product characteristics whenever possible. These target values are presented in the "Technical Priorities Room" of the QFD matrix.

As one product characteristic may influence several consumer requirements at varying extents, relationships between characteristics and desires are market as weak, medium or strong in the "Relationship Room" of the QFD matrix.

Moreover, different product characteristics may influence each other in different ways. These relationships are indicated in the "Correlation Roof".

Finally, an assessment of the difficulty of meeting the established target values of the product characteristics was made. The higher score attached to the product characteristic, the more challenging to meet. The rating of technical difficulty is presented in the "Technical Priorities Room":

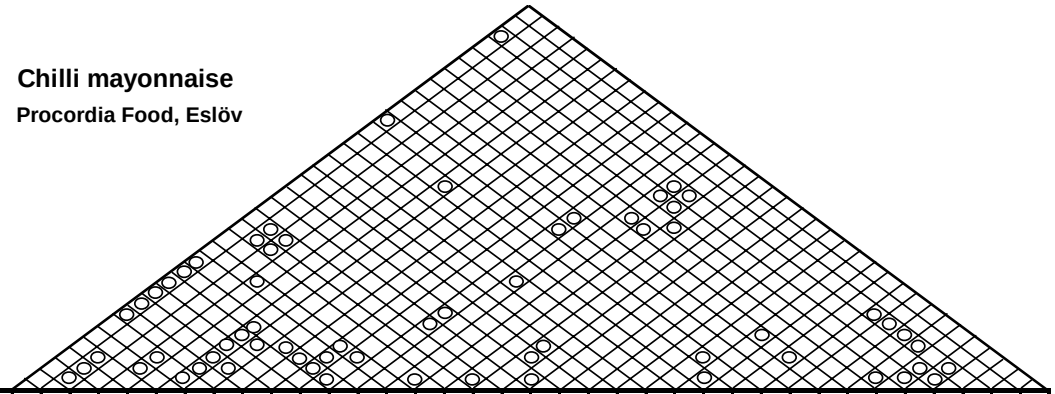
PRODUCT:
COMPANY:

Chilli mayonnaise

Procordia Food, Eslöv

CORRELATION ○

RELATIONSHIP
Weak ○
Medium ◎
Strong ●



Customer-desires / Product-characteristics / Weight	Fat content	Choice-chili	Content-chili	Content-sugar	Content-salt	Choice-mustard	Content-mustard	Choice-emulsifyer	Content-emulsifyer	Choice-thickeners	Content-thickeners	Viscosity	Glossyness	Choice-acid	Content-acid	Choice-spices	Content-spices	Choice-tomato purée	Content-tomato purée	Choice-taste enhancers	Content-taste enhancers	Choice-particles	Size-particles	Colouring extracts	Colour intensity	Oxidation rate	Package-design	Volume	Package-material	Preservatives-content	Heat treatment	Cold storage	Shelf life	Retail price		
Good taste 10	●	●	●	●	●	◎	●	○	○	○	◎	◎		◎	◎	●	●	◎	●	●	●	◎	◎	○		●			●		●	◎	●	◎			
Easy to use 9	○						○	●	●	◎	●	●															●	○	●								
Suitable as cold sauce 9	◎	●		○	○	○	◎	●	●	◎	●	●	●	◎	●	●	●	◎	●	◎	◎	◎	●	◎	◎	●	●	◎	◎	◎		●				
Spicy 8	○	●	●	◎	○	○	●	○	○			◎		○	○	●	●	○	○	◎	◎										◎	○	●	○			
Appetizing colour 8	○	◎	◎			◎	●	○	○	◎		○	●			○	◎	●	●					●	◎				●		○	○	●				
Chunky texture 7						◎	●						○									●	●		◎												
Thickness 7	●					◎	●	●	●	●	●	●	◎	○	○										○						◎						
Good value for money 7		●	●					○	○	○	○	◎	◎		◎	◎		◎	○			●	●		◎	○	◎		●		◎	◎		●			
Fresh 7	◎	◎	◎	○	○	○	○	○	○	○	○	◎	◎	◎	◎	●	●	○	◎	○	○	●	●	○	●	●	●	●	●	◎	◎	●	●	●			
Fat content 6	●						○	●	◎	◎	○	◎	●			◎	◎					●			○	●					◎			○			
DIFFICULTY [1-5]	1	3	1	1	1	2	1	3	3	3	3	3	3	2	1	3	3	2	1	2	2	3	2	4	3	3	1	1	1	4	4	2	1	4		
Goal targets	15%	Natural chili flavour	Medium strength	3-5%	1.3-1.5%	Regular	2%	Fresh egg yolk	1.5%	Xanthan, starch	Existing recipe	Similar to Creme Fraiche	Similar to regular mayo	Acetic acid	pH4	Lovage, vegetable stock	To be developed	Strong taste and colout	To be developed	Lovage, yeast extract	To be developed	Carrot, capiscum, chili	2mm	Beet root, capiscum, β-caroten	Pale base with deep red colour		Jar	150 ml	Glass	No preservatives	Pasteurisation	+4C	3 months (3-4 days)	SEK 15			

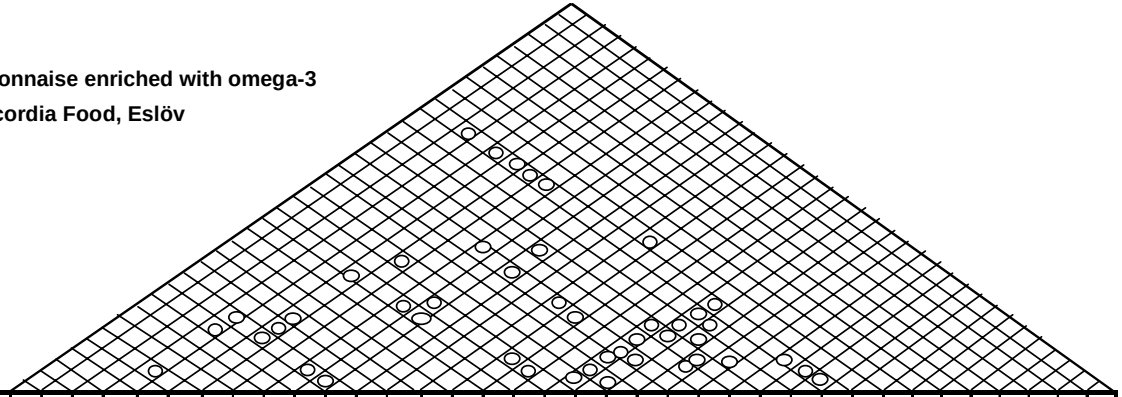
PRODUCT:
COMPANY:

Mayonnaise enriched with omega-3

Procordia Food, Eslöv

CORRELATION ○

RELATIONSHIP
Weak ○
Medium ◔
Strong ●



Customer-desires \ Product-characteristics	Weight	Content-sugar	Concentration of salt	Choice of mustard	Content-mustard	Choice of oil	Content-oil	Choice-Omega 3	Content-omega 3	Choice of thickerness	Content-thickerness	Viscosity	Choice of emulsifyer	Content-emulsifying agent	Chocie of acid	Content-acid	Colouring extracts	Shinyness	Shelf life	Package material	Oxidation rate	Concentration of preservatives	Heat treatment	Distribuion speed	Chilled product	Package design	Volume	Retail price	Flavour concentration								
Good taste	10	◔	◔	○	●	●	●	●	●	◔	◔	◔	○		◔	●		○	●	●	●		○	◔	●				◔								
Low fat content	10					○	●			◔	◔																										
Healthy	10	◔	◔		◔	●	●	◔	●	◔		◔	○	◔	○	○	○		○	◔	●	●	◔	○	●		○	●	◔								
Fresch taste	10	◔	◔	○	○	◔	●	◔	●	◔		◔	○		○	○			●	●	●	◔	○	◔	●		○	○	●								
Freshness	9																								●	◔		◔	●								
No greasy mouthfeel	9				◔	○	◔	◔	●	●	●	●		◔		○					◔																
Suitable for sallads	8	◔	◔		◔	◔	●	◔	◔	●	●	●	◔	◔	○	○		◔		○	●	◔			○				◔								
Easy to use	7						●	◔	◔	●	◔	●	○		○	○			◔	●	●	◔			○	●	◔		●								
Colour	7						●	◔		●		●	◔		◔	●	●	●	●	●			◔	◔	○	◔	◔										
Good value for money	7					●	●			○			●		○	◔		●	●	◔	●	◔	○	●	◔	●	○	●								
DIFFICULTY [1-5]		1	2	3	2	1	1	4	3	2	2	3	1	1	1	2	2	2	5	1	5	4	5	5	5	1	1	1	4							
Goal targets		3-5%	1.3-1.5%	Regular	2%	rapsead oil	15%	Refined with low rate of oxiadn	no fishtaste	Xantan, guar, no E-numbers		Similiar to salad dressing	Fresh egg yolk	1.50%	acetic and citric acid	Ph 4	Beet root	Similiar to regular mayonnaise	1 month	Glass		No preservatives	Pasteurisation		4 C	Bottle/jar			lemon								

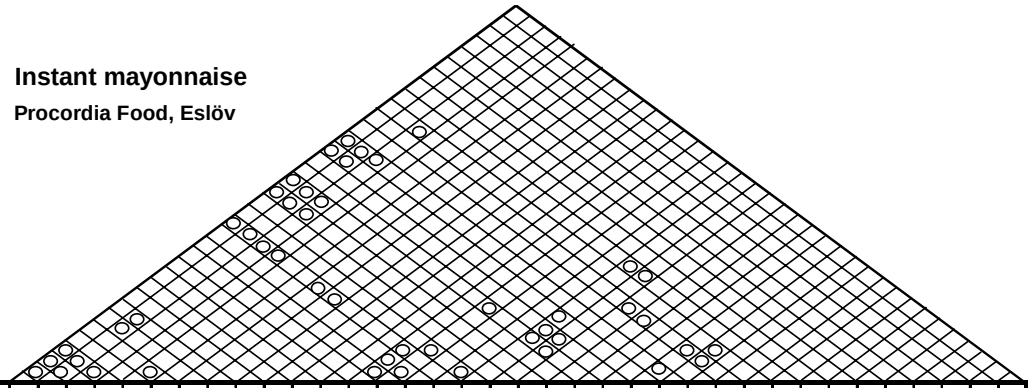
PRODUCT:
COMPANY:

Instant mayonnaise

Procordia Food, Eslöv

CORRELATION ○

RELATIONSHIP
Weak ○
Medium ◎
Strong ●



Customer-desires / Product-characteristics	Weight	Choice-emulsfyer	Content of emulsifier	Choice-thickeners	Content-thickeners	Choice-acid	Content-acid	Choice-mustard	Content-mustard	Choice of salt	Content-salt	Choice of sugar	Content of sugar	Volume	Package-material	Package-design	Retail price	Shelf life powder	Shelf life - prepared product	Time to prepare the product	Force to prepare the product	Oxidation rate (powder)	Modified atmosphere	Fat content	Viscosity	Choice of colouring	Shinyness	Mouth feel
Good taste	10	○	○	○	◎	◎	◎	◎	●		●		●		●		◎	●	●			●		●	◎	○		
Freshness	10	○	○	○	○	◎	◎	○	○		○		○	●	●	●		●	●			●		◎	◎	○	◎	
Flexibility	9																							●	●			
Convenient	9														●	●		●	◎	●	●							
No preservatives	8									○		○			●		○	●	●			●						
Shelf life	8	◎	○	◎	○	◎	○	◎	○	◎	○	◎	○		●	◎	○	●	◎			●			◎			
Easy to use	7					◎	●	◎	●	◎	●		●											◎	●		◎	◎
Good value for money	7	○	○	○	○	○	○	○	○					●	●	●	●	◎	◎									
Package	7														●	●	●	●	●			◎	◎			◎		
Easy to prepare	7	●	◎	●	◎	●	◎	●	◎	●	◎	●	◎	◎						●	●			○	○			
DIFFICULTY [1-5]		1	4	1	3	1	3	3	3	1	1	1	1	2	2	2	2	3	2	2	2	4	3	3	3	1	3	3
Goal targets		Fresh egg yolk	10% of the oil content (4%)	Xanthan, starch, guergum	Like mayonnaise in estonia 40%	Citric acid	pH around 4	Mustard	Like mayonnaise	Regular	1,3-1,5%	Regular	3-5%	1 dl prepared product	Paper, plastic, alminium	Bag	SEK 10/ 3 bags	18 months	3 days	1 min	Hand wip	Existing recipe	Existing recipe	20%-60%	Dressing-mayonnaise	Beet root, capiscum,β-carotene	Like regular mayonnaise	Like regular mayonnaise

Appendix B – Activities and Resource consumption at Procordia Food

To develop products similar to the ones presented in the three fictitious concepts, multiple tasks and activities needs to be performed to secure that the product meets the requirements of the consumers. These tasks can be grouped into more comprehensive groups or steps. These steps will commonly be referred to as activities in this report. Activities may sometimes involve people with different competences and experiences. They may require different amounts of time and resources depending on various factors like level of complexity. An attempt to map activities and estimate time requirement for the three fictitious concepts is presented in the tables below.

Activity Based Calculation of the Development Phase
Company: **Procordia Food, Eslöv**
Fictitious development project: **Chilli mayonnaise**

Activity	Tasks	Estimation of resource consumption	Comment
Research	Look for related recipes Consult colleagues Construct basic recipe Order raw material from storage	1 Product manager:1 day 100% Total: 8 hours	3 days delivery time
Assessment of raw material	Interactions between raw materials are subject to initial evaluation Mayonnaise base is prepared (CSF: thickeners)	1 Product manager: 1 day 100% Total: 8 hours	If initial construction of mayonnaise base does not give satisfactory results, recipe will be adjusted and new base produced
Adjust recipe	Adjust basic recipe Order raw material from storage	1product manager: 1 day 100% Total: 8 hours	3 days delivery time
Assessment of raw material	Interactions between raw materials are subject to initial evaluation Mayonnaise base is prepared (CSF: thickeners)	1 Product manager:1 day 100% Total: 8 hours	
Assessment of spices and taste enhancers	Strength and chunkiness is evaluated Interactions between spices and mayonnaise base are evaluated	1 product manager:1 day 100% Total: 8 hours	
Prepare recipe development	Contact with suppliers Browsing the internet Order spices and taste enhancers Construct recipes Construct test plan	1 product manager: 2 weeks (10 days) 25% Total: 20 hours	Potential spices and taste enhancers are identified using internet and suppliers. Information from suppliers give directions for construction of recipe
Recipe development	Preparation of samples according to test plan	1 Product manager: 1 day 100% Total: 8 hours	
Taste evaluation	Taste and texture evaluation give direction for future development	1 Product manager:1 day 50% No. others: 1 1 day 50% Total: 8 hours	
Prepare recipe development	Adjust recipes Construct test plan	1 product manager:1 day 50% Total: 4 hours	Taste evaluation gives direction for adjustment of recipes
Recipe development	Preparation of samples according to test plan	1 product manager:1 day 100% Total: 8 hours	

Taste evaluation	Taste and texture evaluation give direction for future development	1 product manager:1 day 50% No. others: 1 1 day 50% Total: 8 hours	
Taste evaluation	Taste and texture evaluation	1 product manager: 1 day 50% No. Others: 2 1 day 50% Total: 16 hours	
Sensory test	Preparations Sensory panel Evaluation of results	12 sensory experts: No. Others: 4 Total: 6h*12 persons*2*10+8+8*3h= 124 hours	Sensory panel – 6h/week Preparation by Christina Hall and assistant – 10h/week Evaluation of results by Christina Hall – 1 day Discuss results (Mats, Uno, PGM) – 1 day If results not satisfying, another loop with recipe development will be conducted
Recipe development	Read report from sensory panel Adjustments of recipe Preparation of samples	1 product manager: 2 days 100% No. Others: 1 2 days 25% Total: 20 hours	
Taste evaluation	Tasting samples	1 product manager:1 day 50% No. Others: 1 1 day 50% Total: 8 hours	
Test production	Planning Registration of recipe Ordering raw material Test production plan Transportation Test production Evaluation	1 product manager: 4 days 100% No. Others: 7 1 day 100% No. others: 1 1 day 50% Total: 92 hours	3 weeks
Taste evaluation	Comparison test production and pilot scale	1 product manager: 1 day 50% No. Others: 2 1 day 50% Total: 12 hours	
Sensory test	Preparing sensory panel Sensory panel-compare test production and pilot scale Evaluation	12 sensory experts: No. Others: 4 Total: 6h*12 persons*2= 144 hours	As products produced in test production rarely taste the same as products from pilot scale, especially when spices involved, it is likely that two test productions has to be performed
Recipe development	Read report from sensory panel Adjustments of recipe Preparation of samples	1 product manager:2 days 100% No. Others: 1 2 days 25% Total: 20 hours	
Taste evaluation	Tasting samples	1 product manager:1 day 50% No. others: 1 1 day 50% Total: 8 hours	
Shelf life test	Products stored and analysed	6h*12 pers+3*10+6 Total: 252 hours	Shelf life test is conducted to assure that quality is maintained during the 3 month storage period. Sensory panel 3 months shelf life test

Test production	Planning Registration of recipe Ordering raw material Test production plan Transportation Test production Evaluation	1 product manager:4 days 100% No. Others: 7 1 day 100% No. Others: 1 1 day 50% Total: 92 hours	
Taste evaluation	Comparison test production and pilot scale	1 product manager:1 day 50% No. others: 2 1 day 50% Total: 12 hours	
Sensory test	Preparing sensory panel Sensory panel-compare test production and pilot scale Evaluation	12 sensory experts: No. Others: 4 Total: 6h*12 persons*2*10+8+8*3h= 124 hours	Sensory panel – 6h/week Preparation by Christina Hall and assistant – 10h/week Evaluation of results by Christina Hall – 1 day Discuss results (Mats, Uno, PGM) – 1 day If results not satisfying, another loop with recipe development will be conducted
Prepare launch decision	Construct final recipe Instructions Registration Nutrient declaration Specifications	1 product manager: 4 days 100% Accredited laboratory 4 days 100% Total: 214 hours	

Activity Based Calculation of the Development Phase
Company: Procordia Food, Eslöv
Fictitious development project: Mayonnaise enriched with omega-3

Activity	Tasks	Estimation of resource consumption	Comments
Research	-Consult R&D department -Consult universities -Consult suppliers -Construct basic recipe -Order raw material from storage	1 Product manager: 2 weeks + 1day 50% Total: 44 hours	3 days delivery time
Assessment of raw material	-Interactions between raw materials are subject to initial evaluation -Mayonnaise base is prepared (CSF: thickeners)	1 Product manager:1 day 100% Total: 8 hours	If initial construction of mayonnaise base does not give satisfactory results, recipe will be adjusted and new base produced
Prepare recipe development	-Contact with suppliers -Construct recipes -Construct test plan using experimental design	1 Product manager: 2 weeks (10 days) 25% No. Others: 10 days 25% Total: 60 hours	
Recipe development	-Preparation of samples according to test plan	1 Product manager: 5 weeks 100% Total: 200 hours	
Taste evaluation	-Taste and texture evaluation give direction for future development	1 Product manager:1 week 50% No. Others: 2 1 week 50% Total: 60 hours	

Sensory test	-Preparations -Sensory panel -Evaluation of results	12 sensory experts: No. Others: 4 Total: 6h*12 persons*2*10+8+8*3h= 124 hours	Sensory panel – 6h/week Preparation by Christina Hall and assistant – 10h/week Evaluation of results by Christina Hall – 1 day Discuss results (Mats, Uno, PGM) – 1 day If results not satisfying, another loop with recipe development will be conducted
Prepare recipe development	-Contact with suppliers -Construct recipes -Construct test plan using experimental design	1 Product manager:2 weeks (10 days) 25% No. Others: 2 10 days 25% Total: 60 hours	
Recipe development	-Preparation of samples according to test plan	1 product manager:1 week 100% Total: 40 hours	
Taste evaluation	-Taste and texture evaluation give direction for future development	1 Product manager:1 week 50% No. Others: 2 1 week 50% Total: 60 hours	
Sensory test	-Preparations -Sensory panel -Evaluation of results	12 sensory experts: No. Others: 4 Total: 6h*12 persons*2*10+8+8*3h= 124 hours	As above
Test production	-Planning -Registration of recipe -Ordering raw material (2.5 tonnes) -Test production plan -Transportation -Test production -Evaluation	1 product manger: 4 days 100% No. Others: 1 1 day 50% No. Others: 7 1 day 100% Total: 92 hours	3 weeks
Taste evaluation	-Comparison test production and pilot scale	1 product manager: 1 day 50% No. Others: 2 1 day 50% Total: 16 hours	
Sensory test	-Preparing sensory panel -Sensory panel-compare test production and pilot scale -Evaluation	12 sensory experts: No. Others: 4 Total: 6h*12 persons*2*10+8+8*3h= 124 hours	As above
Shelf life test	-Products stored and analysed	6h*12 pers+3*10+6 Total: 252 hours	3 months Shelf life test is conducted to assure that quality is maintained during the 3 month storage period.
Prepare launch decision	-Construct final recipe -Instructions -Registration -Nutrient declaration -Specifications	1 Product manager: 4 days + 2 weeks 100% 1 Accredited laboratory 100% Total: 214 hours	

Activity Based Calculation of the Development Phase
Company: Procordia Food, Eslöv
Fictitious development project: Instant mayonnaise

Activity	Tasks	Estimation of resource consumption	Comments
Research	-Consult R&D department -Articles and literature -Consult universities -Consult suppliers -Construct basic recipe -Gathering information about raw material (emulsifiers and gelling agents in particular) -Order raw material from storage	1 Product manager: 6 weeks 50% Total: 120 hours	3 days delivery time of raw material
Assessment of raw material	-Initial evaluation of interactions between raw materials. -Evaluation of emulsifiers, gelling agents etcetera -Construct basic recipe	1 Product manager: 4 weeks 75% Total: 120 hours	If initial combination of components does not give satisfactory results, recipe will be adjusted
Prepare recipe development	-Construct test plan Experimental design	1 Product manager: 2 days 100% No. Others: 1 1 day 100% Total: 24 hours	
Recipe development	-Preparation of samples according to test plan -Optimise proportions of components	1 Product manager: 6 weeks 100% Total: 240 hours	
Taste evaluation	-Taste and texture evaluation give direction for future development	1 Product manager: 1 week 50% No. Others: 2 1 week 50% Total: 40 hours	If no samples are considered to be satisfying, another loop of recipe development will be conducted.
Sensory test	-Preparations -Sensory panel -Evaluation of results	12 sensory experts: No. Others: 4 Total: 6h*12 persons*2*10+8+8*3h= 124 hours	Sensory panel – 6h/week Preparation by Christina Hall and assistant – 10h/week Evaluation of results by Christina Hall – 1 day Discuss results (Mats, Uno, PGM) – 1 day If results not satisfying, another loop with recipe development will be conducted Waiting time 3.5 weeks
Prepare recipe development	-Contact with suppliers -Construct recipes -Construct test plan -Basic experimental design	1 Product manager: 2 days 100% Total: 16 hours	
Recipe development	-Preparation of samples according to test plan	1 Product manager: 3 weeks 100% Total: 120 hours	
Taste evaluation	-Taste and texture evaluation give direction for future development	1 Product manger: 1 week 50% No. Others: 2 1 week 50% Total: 60 hours	
Sensory test	-Preparations -Sensory panel -Evaluation of results	12 sensory experts: No. Others: 4 Total: 6h*12 persons*2*10+8+8*3h= 124 hours	Sensory panel – 6h/week Preparation by Christina Hall and assistant – 10h/week Evaluation of results by Christina Hall – 1 day Discuss results (Mats, Uno, PGM) – 1 day If results not satisfying, another loop with recipe development will be conducted Waiting time 2.5 weeks

Test production	-Planning -Registration of recipe -Ordering raw material (2.5 tonnes) -Test production plan -Transportation -Test production -Evaluation	1 Product manager: 5 weeks 100% No. Others: 7 1 day 100% No. Others: 1 1 day 50% Total: 100 hours	3 weeks delivery of raw material
Taste evaluation	-Comparison test production and pilot scale	1 Product manger: 1 day 50% No. Others: 2 1 day 50% Total: 16 hours	
Sensory test	-Preparing sensory panel -Sensory panel-compare test production and pilot scale -Evaluation	12 sensory experts: No. Others: 4 Total: 6h*12 persons*2*10+8+8*3h= 124 hours	Purpose of sensory evaluation is to secure that no major differences in taste when produced at pilot scale compared to full scale.
Shelf life test	-Products stored and analysed	6h*12 pers+3*10+6 Total: 252 hours	Shelf life test is conducted to assure that quality is maintained during the 18 month storage period.
Prepare launch decision	-Construct final recipe -Instructions -Registration -Nutrient declaration Specifications	1 Product manager: 1 week 100% No. Others: 3 1 week 100% Total: 120 hours	

Appendix C – Implementation of QFD on the Estonian concepts

The implementation of the QFD approach at Põltsamaa Felix on the three fictitious concepts is presented in three matrix-figures.

Representatives from the marketing department, Tallinn Technical University and information from focus groups were consulted to map consumer requirements and to assess the importance ratings of these desires. The higher score attached to the consumer desires, the more important the customer desire. The requirements and their assessed importance are presented in "the Voice of the Customer Room" of the QFD matrix.

Company representatives with experience from product development were consulted when analysing how to develop products meeting the established consumer requirements. Associated product characteristics are identified for each consumer requirement. The outcome of this analysis is presented in the "Voice of the Company Room" in the QFD matrix. Target values were established for the identified product characteristics whenever possible. These target values are presented in the "Technical Priorities Room" of the QFD matrix.

As one product characteristic may influence several consumer requirements at varying extents, relationships between characteristics and desires are market as weak, medium or strong in the "Relationship Room" of the QFD matrix.

Moreover, different product characteristics may influence each other in different ways. These relationships are indicated in the "Correlation Roof".

Finally, an assessment of the difficulty of meeting the established target values of the product characteristics was made. The higher score attached to the product characteristic, the more challenging to meet. The rating of technical difficulty is presented in the "Technical Priorities Room":

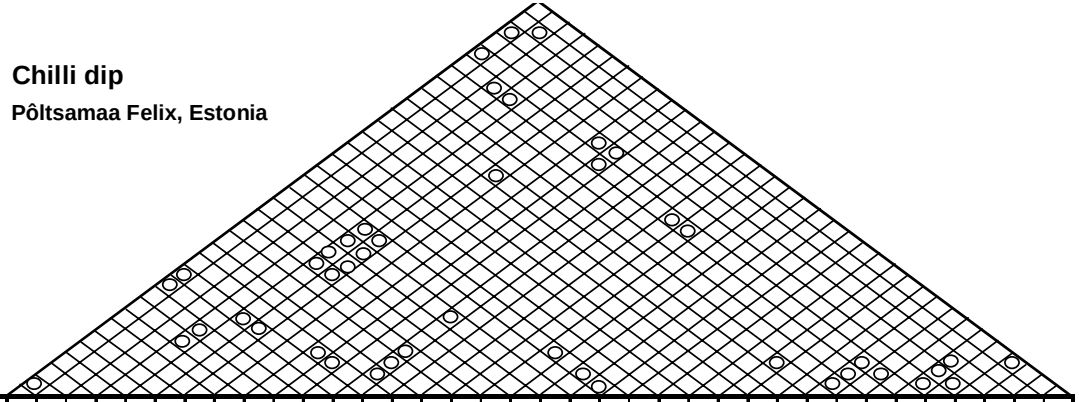
PRODUCT:
COMPANY:

Chilli dip

Pôltsamaa Felix, Estonia

Correlation ○

Relationships
Weak ○
Medium ◒
Strong ●



Customer-desires \ Product-characteristics	Weight	Retail price	Volume	Salt content	Sugar content	Choice of thickener	Thickener content	Chilli choice	Chilli content	Acid choice	Acid content	Oil choice	Oil content	pH	Choice of emulsifying agent	Egg powder-content	Milk powder content	Smothness	Shinyness	Viscosity	Stickiness	Particle size-carrots	Paprica extract content	Beetroot extract content	β-caroteen content	Preservative choice	Preservative content	No chemicals	Microb. Cont. in mayonnaise	Microb. Cont. In milkpowder	Microb. Cont. In egg yolk	Shelf life	Chilled distribuion	Serving temperature	Packaging material	Package size	Easy to close
Good value for money	7	●	●	○	○	◒	◒	◒	◒	○	○	●	●	○	◒	◒	○	◒	◒	◒	◒	◒	○	○	○	○	◒	◒	○	○	○		◒		●		◒
Good taste	10			●	●	●	●	●	●	●	●	●	●	●	●	●	●	○	○	○	○	○	○									◒		●			
Good for dipping	10						●						●			●	●	●	●	●	●	●												●			
Attractive colour	9							●	●				○						○				●	●	●												
Generous volume	5		●																																●		
Suitable package	8																															●			●	●	●
Cold storage	10	◒									●			●						●						●			●			●	●	●			
Natural product	5					◒		●				◒														●		●									
Long shelf life	7			●	●						●		○	●	●	◒	◒									●	●		●	○	○	●	●		●		
Fresh	8						?			○		◒	●	◒	◒								◒	◒	◒	●		●	○	○		●	●	●	●	○	○
DIFFICULTY [1-5]		3	0	1	1	5	4	5	5	2	2	1	1	3	2	2	2	2	2	2	2	2	4	4	4	1		3	3	1	1	3	3	1	1	1	1
Goal targets		3 kr	200 ml	1-1.5%	1-4%	Xantan, LBG, starch	Existing recipe	Powder, extract	pap,M<taste>c,ketchup	Citric, lactic, acetic	Existing recipe	Rape seed	0,2	Less than 4	Existing recipe	Existing recipe	Existing recipe	Like mayonnaise	Like mayonnaise	Thick>creme fraiche	Better than mayo	0,5-3 mm	Existing recipe	Existing recipe	Existing recipe	Existing recipe	Existing recipe	Existing recipe	max 250 bact/g	max 2500 bact/g	Existing recipe	60 days	1-8 C (+)	4 C (+)	PP	200 ml	Plastic cup

PRODUCT:
COMPANY:

Mayonnaise enriched with omega-3

Pôltsamaa Felix, Estonia

CORRELATION:

RELATIONSHIP

Weak ○

Medium ◎

Strong ●

Customer-desires / Product-characteristics	Weight	Content-oil	Choice-fish oil	Content-omega 3	Taste-fish	Choice-thickeners	Content-thickeners	Choice-acid	Content-acid	pH	Content-salt	Content-sugar	Content-milk powder	Content-egg powder	Choice-lemon flavour	Content-lemon flavour	Content-colour	Content-preservatives	Viscosity	Smoothness	Shinyness	Adhesiveness	Shelf life	Lipid oxidation rate	Chilled distribution	Serving temperature	Microb. count-bacteria	Microb. count-yeast, moulds	Stability	Package material	Convenien package	Label design	Price	Volume	Content-Asorbic acid			
Healthy	10	●	◎	●		○			○	○	●	●	○	○			◎	●					◎	●	◎	○						●			●			
Fresh	10	◎	●		●	●	●	◎	◎	○	◎	◎				◎	◎	●			○	○	●	◎	●	●			◎									
Good taste	8	●	●	●	●	●	●	●	●		●	●	◎	◎		●							●	○	○	●												
No fatty mouthfeel	10	●	○			●	●	○								●			●	●	○	●				●												
Good as a spread	10	●				●	●						○	○					●	◎	○	◎				●			●									
Cold storage	10				●													●	○				●	●	●	●	●	●	○				◎					
Good package	5																						●	●	◎		●	●	●	●	●	●	●					
Good value for money	5	●	●	●		◎	◎	○	○	○	○	○	●	●	◎	◎	○		◎				●	●	◎		○		◎	●	◎	●	●	◎				
Long shelf life	8	●	●					○	●	●	●	●						●	○	◎	◎	◎	●	●	●	●	●	●	●	●		◎		●				
No off-flavours	10		●	●	●	●	●	●	◎	●	◎	◎	○	○		○	○	●	○	◎	◎	◎	●	●	●	◎	●	●	●	●	●	◎						
DIFFICULTY [1-5]		1	5	3	5	4	4	2	2	2	1	1	1	1	5	5	1	1	2	2	2	2	2	5	2	1	2	2	1	1	1	2	4	1	4			
Goal targets		19 % fat content	Existing recipe	30% of RDI/100 g	No fish taste must be detected	Starch, Xantan	Compare 30%-more S & X	Citric acid or acetic acid	Approx. 0.2% (80% acetic acid)	Approximately 4.0-7.0	Approx. 1%	Approx. 4%	Compare 30% mayo	Less than 30% mayo	Existing recipe	Similar to Kavli mayonnaise	Similar to regular mayo	Max allowed	Between sour cream & Swedish mayo	80% mayonnaise	Existing recipe	Similar regular mayo	3 months	Saturation of ALA, DHA and EHA	+3 C	+10 C recommended	250 bacteria/g	0 yeasts or moulds/g	No separation	PP	Plastic cup	Existing recipe	6.50 kr	200 ml	Existing recipe			

PRODUCT:
COMPANY:

Mayonnaise enriched with omega-3

Pôltsamaa Felix, Estonia

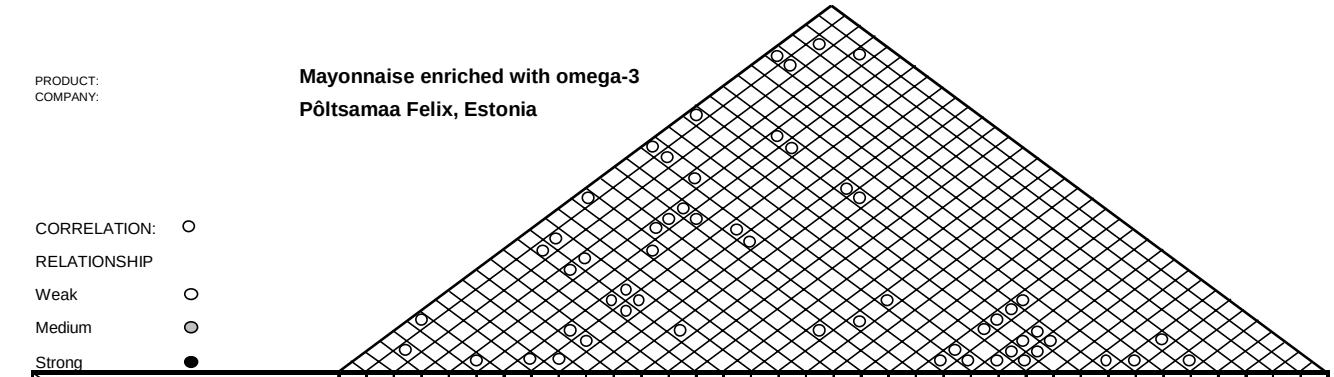
CORRELATION:

RELATIONSHIP

Weak

Medium

Strong



Customer-desires / Product-characteristics	Weight	Content-oil	Choice-fish oil	Content-omega 3	Taste-fish	Choice-thickeners	Content-thickeners	Choice-acid	Content-acid	pH	Content-salt	Content-sugar	Content-milk powder	Content-egg powder	Choice-lemon flavour	Content-lemon flavour	Content-colour	Content-preservatives	Viscosity	Smoothness	Shinyness	Adhesiveness	Shelf life	Lipid oxidation rate	Chilled distribution	Serving temperature	Microb. count-bacteria	Microb. count-yeast, moulds	Stability	Package material	Convenien package	Label design	Price	Volume	Content-Asorbic acid		
Healthy	10	●	◒	●		○			○	○	●	●	○	○			◒	●					◒	●								●			●		
Fresh	10	◒	●		●	●	●	◒	◒	○	◒	◒				◒	◒	●			○	○	●	◒	●	●			◒								
Good taste	8	●	●	●	●	●	●	●	●		●	●	◒	◒		●							●	○	○	●										
No fatty mouthfeel	10	●	○			●	●	○								●			●	●	○	●				●										
Good as a spread	10	●				●	●						○	○					●	◒	○	◒				●										
Cold storage	10				●													●	○				●	●	●	●	●	●	◒			◒				
Good package	5																						●	●	◒		●	●	●	●	●	●				
Good value for money	5	●	●	●		◒	◒	○	○	○	○	○	●	●	◒	◒	○		◒				●	●	◒		○		◒	●	◒	●	●			
Long shelf life	8	●	●					○	●	●	●	●						●					●	●	●	●	●		●			◒		●		
No off-flavours	10		●	●	●	●	●	●	◒	●	◒	◒	○	○		○	○	●	○	◒	◒	◒	●	●	●	●	●	●	●	●	◒	●	◒			
DIFFICULTY [1-5]		1	5	3	5	4	4	2	2	2	1	1	1	1	5	5	1	1	2	2	2	2	2	5	2	1	2	2	1	1	1	2	4	1	4		
Goal targets		19 % fat content	Existing recipe	30% of RDI/100 g	No fish taste must be detected	Starch, Xantan	Compare 30%-more S & X	Citric acid or acetic acid	Approx. 0.2% (80% acetic acid)	Approximately 4.0-7.0	Approx. 1%	Approx. 4%	Compare 30% mayo	Less than 30% mayo	Existing recipe	Similar to Kavli mayonnaise	Similar to regular mayo	Max allowed	Between sour cream & Swedish mayo	80% mayonnaise	Existing recipe	Similar regular mayo	3 months	Saturation of ALA, DHA and EHA	+3 C	+10 C recommended	250 bacteria/g	0 yeasts or moulds/g	No separation	PP	Plastic cup	Existing recipe	6.50 kr	200 ml	Existing recipe		

Appendix D – Activities and Resource consumption at Pôltsamaa Felix

To develop products similar to the ones presented in the three fictitious concepts, multiple tasks and activities needs to be performed to secure that the product meets the requirements of the consumers. These tasks can be grouped into more comprehensive groups or steps. These steps will commonly be referred to as activities in this report. Activities may sometimes involve people with different competences and experiences. They may require different amounts of time and resources depending on various factors like level of complexity. An attempt to map activities and estimate time requirement for the three fictitious concepts is presented in the tables below.

Activity Based Calculation of the Development Phase
Company: **Pôltsamaa Felix, Estonia**
Fictitious development project: **Chilli dip**

Activity	Tasks	Estimation of resource consumption	Comments
Research	-Identifying raw material -Production eq. -Mayonnaise characteristic -Chemical & Physical interaction -Contact with suppliers -Order raw material -Basic recipe -Construction of test plan -Control of test plan	Project manager: 2.5 days 100% No others: 1 1 day 25% Total: 22	2 weeks waiting time
Assessment of raw material	-Order raw material from storage -Collect raw material -Wash machines -Weight raw material -Test different chilli powders/extracts -Test different paprika/carrot pieces -Taste samples	Project Manager: 2 days 100% No. Others: 1 1 day 30% Total: 18.4 hours	10 samples
Recipe development	-Construction of test plan -Order raw material from storage -Collect raw material -Production of mayonnaise base -Wash machines -Weight raw material -Combine ingredients according to test plan -Prepare 12 samples -Clean of equipment	Project Manager: 2 days 100% No. Others: 1 Total:1	Production time: 4h Material: 25 kg
Taste evaluation	-Tasting samples (off-flavours and chilli pepper) -Direction for future development established	Project Manager: 1 day, 50% No. Others: 6 Total: 12 h	

Recipe development	-Construction of test plan -Order raw material from storage -Collect raw material -Wash machines -Weight raw material -Combine ingredients according to test plan -Prepare 12 samples -Clean of equipment	Project Manager: 1 day 100% Total: 8 hours	10 samples
Taste evaluation	-Tasting samples -Direction for future development established	Project Manager: 1 day 25% Total: 2 hours	
Innovation meeting	-Writing, printing documents -Preparing conference room -Cleaning -E-mail to participants -Protocol -Evaluation-taste -Evaluation-colour -Evaluation-consistency etc.	Product manager: 1 day 62.5% No. others: 7 1 day 25% No. others:2 1 day 50% Total: 27 hours	
Test production	-Test production meeting -Planning -Cleaning equipment -Order, collect and weigh raw material -Order and collect packages -Test production -Critical characteristics-carrot pieces during filling and pumping -Evaluation	Product manager: 1 day 50% No. Others 7 1 day 18,75% No. Others 7 1 day 25 % + 2 hours Total: 40.5 hours	Production time: 5 h Material: 300 kg
Shelf life test	-Test microbiological count day 1 -Test microb. count day 60 -3 test/sample	Microbiologist: 1 day 100% Total: 8 hours	
Prepare launch decision	-Detailed specifications of recipe -other information specified	Product manager:1 day 100% No. others 1 3 days 100% Total: 32 hours	

Activity Based Calculation of the Development Phase
Company: Põltsamaa Felix, Estonia
Fictitious development project: Mayonnaise enriched with omega-3

Activity	Tasks	Estimation of resource consumption	Comments
Research	-Thinking about the complexity with the product -Identifying raw material -Assessment & production equipment -Assessment mayonnaise characteristic -Chemical & Physical interaction -Contact with suppliers -Basic recipe -Construction of test plan -Control of test plan? - research about legislation on content, label etcetera	Product manager: 7 days, 100% No. others: 2 2 days 100%+ 1 day 100% Total: 80 hours	2 weeks waiting time
Assessment of raw material	-Production of test base -Testing raw material -Order raw material from storage -Collect raw material -Wash machines -Weight raw material for first test -Load machine -First sample prepared. -Cleaning of equipment -Test drive -Taste - off flavours -Taste – fish taste	Production manager: 2 days 100% No others: 1 1 day 12.5 % Total: 17 hours	Test production 25 kg 20 samples
Recipe development	-Cleaning equipment -Bring raw material -Production -Cleaning equipment -Construction of test plan -Clean equipment -Weigh material -Load machine -Prepare first sample -Test drives -Combining ingredients according to test plan -Tasting samples	Production manager: 2 day 100% No others: 1 1 day 12.5 % Total: 17 hours	20 samples
Taste evaluation	-Taste samples -Decide direction for future development	Product manager: 1 day 50% No. Others 2 1 day 25% + 1 day 12.5% Total: 7 hours	

Recipe development	-Cleaning equipment -Bring raw material -Production -Cleaning equipment -Construction of test plan -Clean equipment -Weigh material -Load machine -Prepare first sample -Test drives -Combining ingredients according to test plan -Tasting samples	Production manager: 2 day 100% No others: 1 1 day 12.5 % Total: 17 hours	10 samples
Taste evaluation	-Taste samples -Decide direction for future development	Product manager: 1 day 50% No. Others: 2 1 day 25% + 1 day 12.5% Total: 6 hours	
Innovation meeting	-Writing, printing documents -Preparing conference room -Cleaning -E-mail to participants -Protocol -Taste -Colour -Consistency etc.	Product manager: 1 day 62.5% No. others: 7 1 day 12.5% No. others:2 1 day 50% + 62.5% Total: 21 hours	
Recipe development	-Cleaning equipment -Bring raw material -Production -Cleaning equipment -Construction of test plan -Clean equipment -Weigh material -Load machine -Prepare first sample -Test drives -Combining ingredients according to test plan -Tasting samples	Production manager: 2 day 100% No others: 1 1 day 12.5 % Total: 17 hours	10 samples
Taste evaluation	-Taste samples -Decide direction for future development	Product manager: 1 day 50% No. Others 2 1 day 25% + 1 day 12.5% Total: 7 hours	
Test production	-Planning -Cleaning equipment -Order, collect and weigh raw material -Order and collect packages -Test production -Evaluation	Product manager: 1 day 100% No. Others 7 1 day 18,75% No. Others 7 1 day 25 % + 2 hours Total: 34.5 hours	Material: small scale 50 kg

Shelf life test	-Oxidation test -Test microbiological count day 1 -Test microb. count day 90 -3 test/sample -samples to research institute	Microbiologist 3 days 30% Total: 12 hours	-research institute
Preparing launch decision	-Refining of specifications etc	Product manager:1 day 100% No. others 1 3 days 100% Total: 32 hours	

Activity Based Calculation of the Development Phase
Company: Pôltsamaa Felix, Estonia
Fictitious development project: Instant mayonnaise

Activity	Tasks	Estimation of resource consumption	Comments
Research	-Identify possible challenges (Critical success factors) -Identify possible solutions -Contact with suppliers -Identify and order raw material -Make basic recipe for powder -Change oil/water content -Make adjustments to consumers -Construct test plan	Project manager: 4 days 100% No. others: 1 1 days 25% Total: 26 hours	2 weeks waiting time
Assessment of raw material	-Order raw material from storage -Collect raw material from storage -Wash machines -Weight raw material for first test -Taste citric acid at different concentrations to identify optimal concentration for mouth	Project manager: 1 day 100% No. others: 1 1 day 12.5% Total: 9 hours	Test production 25 kg
Recipe development	-Modifying recipe -Construct test plan -Order raw material -Collect raw material -Clean machines -Weight material -Combine ingredients according to test plan	Product manager: 1 day 100% + 1 day 50% No. Others: 1 1 day 12.5 % Total: 13 hours	12 samples
Taste evaluation	-Taste samples -Decide direction for future development	Product manager: 1 day 50% No. Others: 2 1 day 25% + 12.5% Total: 7 hours	
Recipe development	-Modifying recipe (different proportions oil/water) -Construct test plan -Order raw material -Collect raw material -Clean machines -Weight material -Combine ingredients according to test plan	Product manager: 1 day 100% No. Others: 1 1 day 12.5% Total: 9 hours	12 samples

Taste evaluation	-Taste samples -Decide direction for future development	Product manager: 1 day 50% No. Others: 2 1 day 25% + 12.5% Total:7 hours	
Innovation meeting	-Writing, memo writing and printing documents -Preparing conference room -Cleaning -E-mail to participants -Protocol -Taste -Colour -Consistency etc. -Test production day fixed	Product manager: 1 day 62.5% No. others: 7 1 day 12.5% No. others:2 1 day 50% + 62.5% Total: 21 hours	
Recipe development	-Modifying recipe -Construct test plan -Order raw material -Collect raw material -Clean machines -Weight material -Combine ingredients according to test plan	Product manager: 1 day 100% + 1 day 50% No. Others: 1 1 day 12.5% Total: 13 hours	12 samples
Taste evaluation	-Taste samples -Decide direction for future development	Product manager: 1 day 50% No. Others: 4 1 day 12.5% No. Others: 2 1 day 25% + 62.5% Total: 15 hours	
Test production	-Planning -Cleaning equipment -Order, collect and weigh raw material -Order and collect packages -Test production -Evaluation	Product manager: 1 day 100% No. Others 3 1 day 12.5 % No. Others 3 1 day 37.5% No. Others 1 1 day 100%+ 1 day 12.5% No. Others: 1 1 day 62.5% Total: 34	Material: 100 kg
Shelf life test	-Prepare samples for test production -Store in refrigerator 3 days -Test microbiological count day 2 k 3-3 tests/sample	Microbiologist 3 days 50% Total: 12 hours	-research institute
Preparing launch decision	-Detailed specification of recipe -Refining of specifications etc	Product manager:1 day 100% No. others 1 3 days 100% Total:32 hours	

Appendix E

The relationships market in the QFD chart as dots, must be transformed into numbers to be able to calculate importance and complexity ratings. The relationship weights are transformed into numerical factors so that:

Strong relation ship (black dot) = 3

Medium relationship (grey dot) = 2

Weak relationship (white dot) = 1

The calculation of importance rating is made by multiplying the weight factor for a specific customer desire (like Good taste = 10) with the relationship weights (like fat content = 3). Each relationship between customer desires and product characteristics is thus attached with a rating that is dependent upon both the importance of the customer desire and the importance of the relationship with the product characteristic.

The calculated values are summed up in each column and row, giving an indication of which desires and product characteristics that are most complex and important to fulfil but also to get an indication on if the efforts required to meet established targets of product characteristics reflects the importance from the consumers' perspective.

The three most important customer desires in the QFD-model, the five most important product characteristics and the five most complex product characteristics are marked in the matrices below.

Company: **Procordia Food, Eslöv**

Fictitious development project: **Chilli mayonnaise**

Product-characteristics / Customer-desires / Weight	Fat content	Choice-chili	Content-chili	Content-sugar	Content-salt	Choice-mustard	Content-mustard	Choice-emulsifyer	Content-emulsifyer	Choice-thickeners	Content-thickeners	Viscosity	Glossyness	Choice-acid	Content-acid	Choice-spices	Content-spices	Choice-tomato purée	Content-tomato purée	Choice-taste enhancers	Content-taste enhancers	Choice-particles	Size-particles	Colouring extracts	Colour intensity	Oxidation rate	Package-design	Volume	Package-material	Preservatives-content	Prodction Process	Cold storage	Shelf life	Retail price	SUM	SUM %
Good taste Good taste 10	30	30	30	30	30	20	30	10	10	10	20	20		20	20	30	30	20	30	30	30	20	20	10		30			30		30	20	30	20	690	20,1%
Easy to use 9	9						9	27	27	18	27	27															27	9	27						207	6,0%
Suitable as cold sauce 9	18	27		9	9	9	18	27	27	18	27	27	27	18	27	27	27	18	27	18	18	18	27	18	18	27	27	18	18	18		27			639	18,6%
Spicy 8	8	24	24	16	8	8	24	8	8			16		8	8	24	24	8	8	16	16										16	8	24	8	312	9,1%
Appetizing colour 8	8	16	16			16	24	8	8	16		8	24			8	16	24	24					24	24				24		8	8	24		328	9,6%
Chunky texture 7						14	21			7			7									7	7		14									14	91	2,7%
Thickness 7	21					14	21	21	21	21	21	21	14	7	7										7						14			14	224	6,5%
Good value for money 7		21	21					7	7	7	7	14	14		14	14		14	7			21	21		14	7	14		21		14	14		21	294	8,6%
Fresh 7	14	14	14	7	7	7	7	7	7	7	7	14	14	14	14	21	21	7	14	7	7	21	21	7	21	21	21	21	21	14	14	21	21	21	476	13,9%
Fat content 6	18						6	18	12	12	6	12	18			12	12								6	18					12			6	168	4,9%
DIFFICULTY [1-5]	1	3	1	1	1	2	1	3	3	3	3	3	3	2	1	3	3	2	1	2	2	3	2	4	3	3	1	1	1	4	4	2	1	4	3429	100,0%
SUM	126	132	105	62	54	88	160	133	127	116	115	159	118	67	90	136	130	91	110	71	71	87	96	59	104	103	89	48	141	32	108	98	99	104	3429	
SUM %	3,7%	3,8%	3,1%	1,8%	1,6%	2,6%	4,7%	3,9%	3,7%	3,4%	3,4%	4,6%	3,4%	2,0%	2,6%	4,0%	3,8%	2,7%	3,2%	2,1%	2,1%	2,5%	2,8%	1,7%	3,0%	3,0%	2,6%	1,4%	4,1%	0,9%	3,1%	2,9%	2,9%	3,0%	100%	
Weight	126	396	105	62	54	176	160	399	381	348	345	477	354	134	90	408	390	182	110	142	142	261	192	236	312	309	89	48	141	128	432	196	99	416	7840	
Weight %	1,6%	5,1%	1,3%	0,8%	0,7%	2,2%	2,0%	5,1%	4,9%	4,4%	4,4%	6,1%	4,5%	1,7%	1,1%	5,2%	5,0%	2,3%	1,4%	1,8%	1,8%	3,3%	2,4%	3,0%	4,0%	3,9%	1,1%	0,6%	1,8%	1,6%	5,5%	2,5%	1,3%	5,3%	100%	

Company: **Procordia Food, Eslöv**

Fictitious development project: **Mayonnaise enriched with omega-3**

Customer-desires / Product-characteristics	Weight	Content-sugar	Concentration of salt	Choice of mustard	Content-mustard	Choice of oil	Content-oil	Choice-Omega 3	Content-omega 3	Choice of thickerness	Content-thickerness	Viscosity	Choice of emulsifyer	Content-emulsifying agent	Chocie of acid	Content-acid	Colouring extracts	Shinyness	Shelf life	Package material	Oxidation rate	Concentration of preservatives	Production Process	Distribution speed	Chilled product	Package design	Volume	Retail price	Flavour concentration	SUM	%
Good taste	10	20	20	20	30	30	30	30	30	20	20	10			20	30		10	30	30	30		10	30					20	470	16,1%
Low fat content	10					10	30			20	20																			80	2,7%
Healthy	10	20	20		20	30	30	20	30	20			10	20	10	10	10		10	20	30	30	20	10	30		10	30	20	460	15,7%
Fresch taste	10	20	20	10	10	20	30	20	30	20		20	10		10	10			30	30	30	20	10	20	30		10	10	30	450	15,4%
Freshness	9																								27	18		27	27	99	3,4%
No greasy mouthfeel	9				18	9	18	18	27	27	27	27		18		9					18									216	7,4%
Suitable for sallads	8	16	16		16	16	24	16	24	24	24	24	16	16	8	8		16		8	24	16			8				16	336	11,5%
Easy to use	7						21	14	14	21	14	21	7		7	7			14	21	21	14			7	21	14	21	7	266	9,1%
Colour	7						21	21		21		21	14		14	21	21	21	21	21			14	14	7	7	14			273	9,3%
Good value for money	7					21	21			7			21		7	14		21	21	14	21	14	7	21	14	21	7	21		273	9,3%
DIFFICULTY [1-5]		1	2	3	2	1	1	4	3	2	2	3	1	1	1	2	2	2	5	1	5	4	5	5	5	1	1	1	4	2923	100,0%
SUM		76	76	30	94	136	225	139	155	180	105	123	78	54	76	109	31	68	126	144	174	94	61	95	123	67	55	109	120	2923	
SUM %		2,6%	2,6%	1,0%	3,2%	4,7%	7,7%	4,8%	5,3%	6,2%	3,6%	4,2%	2,7%	1,8%	2,6%	3,7%	1,1%	2,3%	4,3%	4,9%	6,0%	3,2%	2,1%	3,3%	4,2%	2,3%	1,9%	3,7%	4,1%	100,0%	
Weight		76	152	90	188	136	225	556	465	360	210	369	78	54	76	218	62	136	630	144	870	376	305	475	615	67	55	109	480	7577	
Weight %		1,0%	2,0%	1,2%	2,5%	1,8%	3,0%	7,3%	6,1%	4,8%	2,8%	4,9%	1,0%	0,7%	1,0%	2,9%	0,8%	1,8%	8,3%	1,9%	11,5%	5,0%	4,0%	6,3%	8,1%	0,9%	0,7%	1,4%	6,3%	100,0%	

Company: **Procordia Food, Eslöv**

Fictitious development project: **Instant mayonnaise**

Product-characteristics / Customer-desires	Weight	Choice-emulsifyer	Content of emulsifier	Choice-thickeners	Content-thickeners	Choice-acid	Content-acid	Choice-mustard	Content-mustard	Choice of salt	Content-salt	Choice of sugar	Content of sugar	Volume	Package-material	Package-design	Retail price	Shelf life powder	Shelf life-prepared product	Time to prepare the product	Force to prepare the product	Oxidation rate (powder)	Modified atmosphere	Fat content	Viscosity	Choice of colouring	Shinyness	Mouth feel		SUM	
Good taste	10	10	10	10	20	20	20	20	30		30		30		30		20	30	30			30		30	20	10				400	19%
Freshness	10	10	10	10	10	20	20	10	10		10		10	30	30	30		30	30			30		20	20	10	20			370	17%
Flexibility	9																							27	27					54	3%
Convenient	9														27	27		27	18	27	27									153	7%
No preservatives	8									8		8			24		8	24	24			24								120	6%
Shelf life	8		16	16	8	16	8	16	8	16	8	16	8		24	16	8	24	16			24			16					264	12%
Easy to use	7					14	21	14	21	14	21		21											14	21		14	14		189	9%
Good value for money	7	7	7	7	7	7	7	7	7					21	21	21	21	14	14											168	8%
Package	7														21	21	21	21	21			14	14			14				147	7%
Easy to prepare	7	21	14	21	14	21	14	21	14	21	14	21	14	14						21	21			7	7					280	13%
DIFFICULTY [1-5]		1	4	1	3	1	3	3	3	1	1	1	1	2	2	2	2	3	2	2	2	4	3	3	3	1	3	3			
Importance rating		48	57	64	59	98	90	88	90	59	83	45	83	65	177	115	78	170	153	48	48	122	14	98	111	34	34	14		2145	
Importance rating %		**2,2%**	**2,7%**	**3,0%**	**2,8%**	**4,6%**	**4,2%**	**4,1%**	**4,2%**	**2,8%**	**3,9%**	**2,1%**	**3,9%**	**3,0%**	**8,3%**	**5,4%**	**3,6%**	**7,9%**	**7,1%**	**2,2%**	**2,2%**	**5,7%**	**0,7%**	**4,6%**	**5,2%**	**1,6%**	**1,6%**	**0,7%**		100%	
Complexity rating		48	228	64	177	98	270	264	270	59	83	45	83	130	354	230	156	510	306	96	96	488	42	294	333	34	102	42		4902	
Complexity rating %		**1,0%**	**4,7%**	**1,3%**	**3,6%**	**2,0%**	**5,5%**	**5,4%**	**5,5%**	**1,2%**	**1,7%**	**0,9%**	**1,7%**	**2,7%**	**7,2%**	**4,7%**	**3,2%**	**10,4%**	**6,2%**	**2,0%**	**2,0%**	**10,0%**	**0,9%**	**6,0%**	**6,8%**	**0,7%**	**2,1%**	**0,9%**		100%	

Company: **Pôltsamaa Felix, Estonia**

Fictitious development project: **Chilli dip**

Customer-desires \ Product-characteristics	Weight	Retail price	Volume	Salt content	Sugar content	Choice of thickener	Thickener content	Chilli choice	Chilli content	Acid choice	Acid content	Oil choice	Oil content	pH	Choice of emulsifying agent	Egg powder-content	Milk powder content	Smothness	Shinyness	Viscosity	Stickiness	Particle size-carrots	Paprica extract content	Beetroot extract content	b-caroteen content	Preservative choice	Preservative content	No chemicals	Microb. Cont. in mayonnaise	Microb. Cont. In milkpowder	Microb. Cont. In egg yolk	Shelf life	Chilled distribution	Serving temperature	Packaging material	Package size	Easy to close	IMPORTANCE	%
Good value for money	7	21	21	7	7	14	14	14	14	7	7	21	21	7	14	14	7	14	14	14	14	14	7	7	7	7	7	14	14	7	7		14		21			329	17%
Good taste	10			30	30	30		30	30	30	30	30	30	30	30	30	30	10	10	10	10	10										20		30				390	20%
Good for dipping	10						30						30			30	30	30	30	30	30	30												30				240	12%
Attractive colour	9							27	27				9						9				27	27	27												126	6%
Generous volume	5		15																																15		30	2%
Suitable package	8																															24			24	24	24	96	5%
Cold storage	10	20									30			30						30						30			30			30	30	30	30			230	12%
Natural product	5					10		15				10														15		15										50	3%
Long shelf life	7			21	21						21		7	21	21	14	14									21	21		21	7	7	21	21		21			189	10%
Fresh	8						16			8		16	24	16	16								16	16	16	24		24	8	8		24	24	24	24	8	8	264	14%
DIFFICULTY [1-5]		3	0	1	1	5	4	5	5	2	2	1	1	3	2	2	2	2	2	2	2	2	4	4	4	1	1	3	3	1	1	3	3	1	1	1	1	1944	100%
Technical importance rating		41	36	58	58	54	60	86	71	45	88	77	121	104	81	88	81	54	63	84	54	44	23	50	50	82	28	53	73	22	14	119	89	114	120	47	32	2364	
Technical importance rating %		1,7%	1,5%	2,5%	2,5%	2,3%	2,5%	3,6%	3,0%	1,9%	3,7%	3,3%	5,1%	4,4%	3,4%	3,7%	3,4%	2,3%	2,7%	3,6%	2,3%	1,9%	1,0%	2,1%	2,1%	3,5%	1,2%	2,2%	3,1%	0,9%	0,6%	5,0%	3,8%	4,8%	5,1%	2,0%	1,4%	100,0%	
Complexity rating		123	0	58	58	270	240	430	355	90	176	77	121	312	162	176	162	108	126	168	108	88	92	200	200	82	28	159	219	22	14	357	267	114	120	47	32	5329	
Complexity rating %		2,3%	0,0%	1,1%	1,1%	5,1%	4,5%	8,1%	6,7%	1,7%	3,3%	1,4%	2,3%	5,9%	3,0%	3,3%	3,0%	2,0%	2,4%	3,2%	2,0%	1,7%	1,7%	3,8%	3,8%	1,5%	0,5%	3,0%	4,1%	0,4%	0,3%	6,7%	5,0%	2,1%	2,3%	0,9%	0,6%	100,0%	

Company: **Pôltsamaa Felix, Estonia**

Fictitious development project: **Mayonnaise enriched with omega-3**

Customer-desires / Product-characteristics	Weight	Content-oil	Choice-fish oil	Content-omega 3	Taste-fish	Choice-thickeners	Content-thickeners	Choice-acid	Content-acid	pH	Content-salt	Content-sugar	Content-milk powder	Content-egg powder	Choice-lemon flavour	Content-lemon flavour	Content-colour	Content-preservatives	Viscosity	Smoothness	Shinyness	Adhesiveness	Shelf life	Lipid oxidation rate	Chilled distribution	Serving temperature	Microb. count-bacteria	Microb. count-yeast, moulds	Stability	Package material	Convenien package	Label design	Price	Volume	Content-Asorbic acid			IMPORTANCE	%
Healthy	10	30	20	30		10			10	10	30	30	10	10			20	30					20	30	20	10	10		20			30			30			410	11,4%
Fresh	10	20	30		30	30	30	20	20	10	20	20				20	20	30			10	10	30	20	30	30			20									450	12,5%
Good taste	8	24	24	24	24	24	24	24	24		24	24	16	16		24							24	8	8	24												360	10,0%
No fatty mouthfeel	10	30	10			30	30	10								30			30	30	10	30				30												270	7,5%
Good as a spread	10	30				30	30						10	10					30	20	10	20				30			30									250	7,0%
Cold storage	10				30													30	20				30	30	30	30	30	30	20				20					300	8,4%
Good package	5																						15	15	10		15	15	15	15	15	15	15					145	4,0%
Good value for money	5		15	15		10	10	5	5	5	5	5	15	15	10	10	5		10				15	15	10		5		10	15	10	15	15	15	10			275	7,7%
Long shelf life	8	24	24					8	24	24	24	24						24					24	24	24	24	24	24	24	24			16		24			408	11,4%
No off-flavours	10		30	30	30	30		30	20	30	20	20	10	10		10	10	30	10	20	20	20	30	30	30	20	30	30	30	30	30	30	30	20			720	20,1%
DIFFICULTY [1-5]		1	5	3	5	4	4	2	2	2	1	1	1	1	5	5	1	1	2	2	2	2	2	5	2	1	2	2	1	1	1	2	4	1	4			3588	100,0%
Technical importance rating		128	153	99	114	164	124	97	103	79	123	123	61	61	10	94	55	144	100	70	50	80	188	172	162	198	75	99	169	84	55	90	96	35	64			3519	
Technical importance rating %		3,6%	4,3%	2,8%	3,2%	4,7%	3,5%	2,8%	2,9%	2,2%	3,5%	3,5%	1,7%	1,7%	0,3%	2,7%	1,6%	4,1%	2,8%	2,0%	1,4%	2,3%	5,3%	4,9%	4,6%	5,6%	2,1%	2,8%	4,8%	2,4%	1,6%	2,6%	2,7%	1,0%	1,8%			100%	
Complexity rating		128	765	297	570	656	496	194	206	158	123	123	61	61	50	470	55	144	200	140	100	160	376	860	324	198	150	198	169	84	55	180	384	35	256			8426	
Weigthing %		1,5%	9,1%	3,5%	6,8%	7,8%	5,9%	2,3%	2,4%	1,9%	1,5%	1,5%	0,7%	0,7%	0,6%	5,6%	0,7%	1,7%	2,4%	1,7%	1,2%	1,9%	4,5%	10,2%	3,8%	2,3%	1,8%	2,3%	2,0%	1,0%	0,7%	2,1%	4,6%	0,4%	3,0%			100%	

Company: **Pôltsamaa Felix, Estonia**

Fictitious development project: **Instant mayonnaise**

Customer-desires / Product-characteristics	Weight	Choice-acid	Content-acid	Choice-salt	Content-salt	Content-sugar	Content-mustard	Choice-egg powder	Content-egg powder	Content-milk powder	Choice-thickener	Content-thickener	Content-preservatives	Choice-colouring agent	Content-colouring agent	Choice-oil (recom)	Content-oil (recom.)	Content-water(recom.)	Smoothness	Shinyness	Viscosity	Adhesiveness	Retail price	Volume-prep. product	Volume-powder	Package material	Package size	Package-resealed	Convenient package	Preparation time	Preparation force	Shelf life-powder	Shelf life-prep. product	Moisture content-powder	Microbes-egg powder	Microbes-milk powder	Microbes-powder	IMPORTANCE	%
Good taste	10	30	30		30	30	30	10	30	30	30	30				20	30	30	10	10	10	10															400	18,1%
Creamy texture	10								30	30		30					20	20	30	30	30	30																250	11,3%
Good for salads	10								30	30		30					20	20	30	30	30	30																250	11,3%
Good as a spread	7								21	21		21					14	14	14	21	21	21																168	7,6%
Good value for money	10	10	10	10	10		10		10	10	20	20			10								30	30	30	30												240	10,9%
Easy to prepare	10							20	20			20					30	30								30	30	10	30	30	30	20		20				320	14,5%
Good package	10																									30	30	30	30									120	5,4%
Fresh product	7		7										21		7													14										49	2,2%
Natural product	7										14		21			14																						49	2,2%
Long shelf life	8	8	24	24	24	24	24	8	16	16			24	24		8										24		8				24	8	16	16	16	24	360	16,3%
DIFFICULTY [1-5]		2	1	1	1	1	1	1	1	1	2	2	1	1	1	1	5	5	1	1	2	1	3	1	1	1	1	1	1	1	4	2	3	1	1	4	2206	100,0%
Importance rating		48	71	34	64	54	64	38	157	137	64	151	66	24	17	42	114	114	84	91	91	91	30	30	30	114	60	62	60	30	30	44	8	36	16	16	24	2206	
Importance rating %		2,2%	3,2%	1,5%	2,9%	2,4%	2,9%	1,7%	7,1%	6,2%	2,9%	6,8%	3,0%	1,1%	0,8%	1,9%	5,2%	5,2%	3,8%	4,1%	4,1%	4,1%	1,4%	1,4%	1,4%	5,2%	2,7%	2,8%	2,7%	1,4%	1,4%	2,0%	0,4%	1,6%	0,7%	0,7%	1,1%	100,0%	
Complexity rating		96	71	34	64	54	64	38	157	137	128	302	66	24	17	42	570	570	84	91	182	91	90	30	30	114	60	62	60	30	30	176	16	108	16	16	96	3816	
Complexity rating %		2,5%	1,9%	0,9%	1,7%	1,4%	1,7%	1,0%	4,1%	3,6%	3,4%	7,9%	1,7%	0,6%	0,4%	1,1%	14,9%	14,9%	2,2%	2,4%	4,8%	2,4%	2,4%	0,8%	0,8%	3,0%	1,6%	1,6%	1,6%	0,8%	0,8%	4,6%	0,4%	2,8%	0,4%	0,4%	2,5%	100,0%	

Appendix F – Verbal assessment vs. QFD

	Pôltsamaa Felix	QFD-Chilli	Verbal-Chilli	QFD-Omega-3	Verbal-Omega-3	QFD-Instant	Verbal-Instant
Desires	Attractive colour		√				
	Easy to prepare					√	√
	Fresh	√		√	√		
	Good taste	√	√		√	√	√
	Good value for money	√					
	Healthy			√	√		
	No off-flavours			√			
	Shelf life					√	√
	Suitable for dipping		√				
Importance Rating	Choice of acid						√
	Choice of omega-3				√		
	Choice of thickeners			√			
	Chunkiness		√				
	Colour		√				
	Content of chilli		√				
	Content of emulsifying agent					√	
	Content of thickeners					√	
	Oil content	√			√	√	√
	Oxidation rate			√	√		
	Packaging material	√				√	
	pH	√					
	Physical stability			√			√
	Serving temperature	√		√			
	Shelf life	√	√	√	√		√
	Viscosity		√		√	√	√
Complexity Rating	Choice of chilli	√	√				
	Choice of thickeners	√		√			
	Chunkiness		√				
	Colour		√				
	Content of emulsifying agent					√	
	Content of acid						√
	Content of chilli	√	√				
	Content of thickeners			√	√	√	
	Off-taste (fish)			√	√		
	Oil content					√	√
	Oxidation rate			√	√		
	pH	√					
	Production process						√
	Shelf life				√	√	√
	Source of omega-3			√	√		
	Viscosity		√			√	√

QFD vs. verbal analysis - chilli mayonnaise

A thorough analysis of coherence or inconsistency between QFD analysis and verbal description is presented for the Swedish chilli mayonnaise case. The results from the analysis of the different concepts in Sweden and Estonia are presented in two tables.

Important customer desires

The three customer desires that are most important, but also most complex, to meet are according to the QFD approach to secure that the product has a good taste, that it is suitable as cold sauce and that it is fresh.

It is not surprising to note that good taste receives the highest rating due to its fundamental importance and the complexity involved due to the many interactions with a variety of components. The challenge associated with securing that the product is suitable as a cold sauce is complicated as the it is related to rheological, visual and sensory characteristics as well as by the choice of package design and material. The freshness of the product is also a complex network of sensory, visual and rheological attributes, but is also dependent upon market communication, presence of preservatives, shelf life and distribution channels.

The same consumer desires are valued as most important in the verbal description. Coherence between QFD approach and verbal approach is thus noted and illustrated in the table below:

	QFD-Chilli	Verbal-Chilli
Fresh	√	√
Good taste	√	√
Suitable as cold sauce	√	√

Table 9 Customer desires - QFD vs. Verbal – Chilli, Procordia Food

Technical importance rating

The QFD analysis suggests that the following five characteristics should be prioritised to secure that consumer desires are met:

- Content of mustard
- Viscosity
- Package material
- Choice of spices
- Choice of emulsifying agent

According to the verbal description, the most important features, from the consumer perspective, of this product is the taste and colour. A fresh but spicy chilli flavour should be established and communicated. The colour and the package material are important characteristics that assist in the communication of this chilli mayonnaise. To be suitable as a cold sauce, it is important that the texture is adapted and to enhance the freshness, chilled distribution is likely to be perceived as important by the consumer. The most important product characteristics are therefore considered to be:

- Viscosity
- Choice of spices
- Package material
- Colour
- Chilled distribution

The product characteristics that are identified in the QFD approach and the verbal description as most important for the securing consumer satisfaction are thus:

	QFD-Chilli	Verbal-Chilli
Chilled distribution		√
Choice of emulsifier	√	
Choice of spices	√	√
Colour		√
Content of mustard	√	
Package material	√	√
Viscosity	√	√

Table 10 Technical importance rating – QFD vs. Verbal – Chilli, Procordia Food

Coherence

Coherence between the QFD and the verbal analysis is indicated for the following three product characteristics; viscosity, choice of spices and package material.

Inconsistency

Inconsistency between the QFD and the verbal analysis is indicated for the following product characteristics; content of mustard, choice of emulsifier, colour and chilled distribution.

Content of mustard

Although it is clear that taste is important for the success of the project, the QFD analysis and the description of the complexity indicate different opinions on critical components. The QFD analysis indicates a high technical importance of the mustard content, due to its effect on both sensory and rheological characteristics. These aspects may be important to consider in regular mayonnaise, but the verbal description concludes that mustard taste will not be important in this case as chilli flavour will dominate. Thickeners and emulsifiers mainly influence rheological characteristics.

Choice of emulsifying agent
The QFD analysis indicates that the choice of emulsifying agent exhibits high technical importance. Although it is a basic requirement that the emulsifier is working satisfactorily, its importance is perceived as less significant when developing this line-extension product as the choice of emulsifying agent is already established.

Colour
The colour of the product is perceived as very important from the consumer perspective. Identifying a suitable colour – tint, intensity, transparency, homogeneousness – requires both time and effort and is affected by other components such as oil content, choice of thickeners etcetera.

Chilled distribution
As mayonnaise is commonly perceived as unfresh and unhealthy, it is important to communicate enhanced freshness for this concept as it is competing with product like Crème Fraiche. Chilled distribution is perceived as an important characteristic for the perceived freshness.

Complexity rating

The QFD analysis indicated that when the degree of technical difficulty was considered, the development team should prioritise the following five characteristics:

- Viscosity
- Production process
- Retail price
- Choice of spices
- Choice of emulsifying agent

According to the verbal description, chilli mayonnaise is not perceived as a complex product to develop, and the most important technical challenges considered are mainly related to the taste of the product through the choice and content of spices, taste enhancers and colouring agents. The balance between these components is essential for development of a good and fresh taste, suitable for the intended situation of consumption. In addition, as the texture is thinner and the fat content lower than in regular mayonnaise, some effort has to be invested in adapting the choice and content of thickeners and emulsifying agents. Some time and resources also has to be invested in adapting production process to provide a preservative product. Knowledge regarding such processes and its effect on spices, colouring agents, shelf life, taste profile etcetera is available.

The verbal description thus highlight the following product characteristics as demanding and important for the success of the concept:

- Choice of spices
- Content of spices
- Colour
- Viscosity
- Production process

The product characteristics that are identified in the QFD approach and the verbal description as challenging and important for the securing consumer satisfaction are thus:

	QFD-Chilli	Verbal-Chilli
Choice of emulsifiers	√	
Choice of spices	√	√
Colour		√
Content of spices/flavours		√
Production process	√	√
Retail price	√	
Viscosity	√	√

Table 11 Complexity rating – QFD vs. Verbal – Chilli, Procordia Food

Coherence

Coherence between the QFD and the verbal analysis is indicated for the following three product characteristics; viscosity, choice of spices and production process.

Inconsistency

Inconsistency between the QFD and the verbal analysis is indicated for the following product characteristics; choice of emulsifier, retail price, colour and content of spices

Choice of emulsifying agent
The QFD analysis indicates that the choice of emulsifying agent exhibits high complexity rating and should thus be allowed to consume major resources. However, a choice of emulsifying agent is already established and should therefore not be perceived as challenging, indicating that the rating of technical difficulty is misleading.

Retail price
The retail price is perceived as an important quality attribute due to conflicting expectations of consumers wanting a high level of added value at a low retail price and the company wanting high profit margins. Establishing a suitable retail price that meets consumer desires while allowing high margins is thus a challenge that is influences by basically every aspect of the development process.

Colour
The colour of the product is perceived as very important from the consumer perspective. Identifying a suitable colour – tint, intensity, transparency, homogeneousness – requires both time and effort and is affected by other components such as oil content, choice of thickeners etcetera.

Content of spices
In order to provide a product with a good taste suitable spices – chilli, herbs, taste enhancers etcetera – must be identified and the quantities established. The content of spices is viewed as one of the most important challenges associated with development of this product.

Appendix G – Challenges and sources of knowledge

Chilli mayonnaise		Procordia Food	Pôltsamaa Felix	External source I	External source II
TASTE	Acidity		I		
	Choice of chilli	S	S	S	S
	Choice spices	S		S	
	Mustard content			I	
	Roundness	I	I	I	I
	Salt content		I	I	I
	Solubility of taste components				I
	Strength	I	I	S	I
	Sugar content		I	I	
	System – taste components			S	I
	Taste enhancers	S			
	Taste release	S			I
COLOUR	Colour intensity	I	I	S,I	I
	Colour transparency	S,I			I
	Colouring agents	S	S	S	I
	Solubility of colouring agents				I
	System – colouring agents				I
TEXT.	Adhesiveness		S		
	Choice particles	S	S		
	Chunkiness	I	S		
	Viscosity	I	S		I
STABILITY	Chemical stability – colour	S			
	Chemical stability – spices	S			
	Contamination rate – production		I		
	Production process	I			
	Package material	I			
	Preservatives		S		
	Shelf life	I	I		
Expected Time to Develop (Months)		2	1	1	6

Mayonnaise enriched with omega-3		Procordia Food	Pôltsamaa Felix	External source I	External source II
Taste	Choice of citrus flavour	I	S		I
	Choice of fish oil	S	S	S	S,E
	Intensity citrus flavour		I		I
	Lipid oxidation rate	S,E		S	I
	Purification process (oil)	S	S	S	S
Health	Concentration of omega-3	E	E		
	Fat content	I			
	Lipid oxidation rate	E	E	S,I	I
	Nutritional value	E	E	S,I	I
Text	Choice thickeners		S		I
	Content thickeners	I	I		I
	Mouthfeel		I		
Stability	Antioxidants			S	I
	Emulsion system				I
	Production process	I		I	
	Lipid oxidation rate	S,E		S	I
	Microbiological contamination		I		I
	Package design	I		I	
	Package material	I		I	
	Preservatives		I		
	Production Process	I		I	
Expected time to develop (months)		6	6	6-12	6-12

Appendix H

Expected time plan for product development phase

Company: **Pôltsamaa Felix**
Project: **Chili dip**