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Aimo Tiilikainen

# Integrating Consumer Understanding into New Product Development

## Practical Approach for Integrating Consumer Understanding into Technology Push-originated NPD Processes

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Abstract

In this paper, we wish to contribute to technology push -originated NPD process development by introducing an approach to increase consumer orientation in practice in NPD processes. We propose a five-step approach for this purpose. The NPD stage-specific steps in our approach are as follows:

1) cross-functional workshops in early NPD phases to generate end user-oriented product ideas from technological opportunities,
2) cross-functional workshops to develop end user-oriented product concepts from product ideas,
3) qualitative end user studies to develop more consumer-oriented cross-functional product concepts,
4) specific phase for food products: development of the sensory parameters of product prototypes in order to better meet the criteria of consumers, and
5) semi-quantitative consumer studies to validate consumers' **positive** buying intentions and evaluations of the subjective quality and price perceptions of the developed prototypes.

We made the decision to use a comparative methodology in the quantitative consumer studies; the reference product is from the same product category as the one in which the prototype is intended to be launched.

Currently, new products fail more often than they succeed on the market, especially in the case of groceries; our reasoning is that this problem is due to the overly limited understanding of end users in the NPD process. In aiming to increase this orientation, one should be ready to invest in this issue as to technology or economics and take action to understand end users earlier in the process, allocating a greater budget and know-how to this effort with a view to achieving deeper understanding.

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# Foreword

I have worked for several years in innovation commercialization positions in industry, both in a domestic and international context, and have gained experience of the dominant practices in innovation development. For the most part, products are created in R&D departments and are then commercialized by the marketing or sales departments. I have often wondered how this process could be developed.

Improving success in NPD has been a topic of great interest both in industry and among scholars. For example, researchers have examined how the process should be developed because the dominant stage-gate process in NPD dates back to the 1970s. The world has changed greatly since then, but innovations are still managed in stages in line with that 40-year-old model. A few months ago, I heard an interesting reflection about the success rate of the current process: in a public presentation, the director of a Finnish major retailer said that only two per cent of the new grocery products his chain introduced to the market could still be found on store shelves three months after launch. In this paper, we aim to introduce an approach to integrating better end user understanding into the NPD process, and thereby facilitate the success of new products on the market. We believe that a situation in which a new product is launched but the end users do not buy it means that the company has not understood the consumers well enough.

I appreciate Tekes for offering us the possibility to develop our approach in a real NPD project; we sought to find ways to commercialize two food production technologies. Furthermore, VTT offered funding for not only this project, but also two separate projects that were carried out at a later date. Both of these later two projects involved managing cross-functional workshops with the aim of developing market-oriented product concepts from technological opportunities. I wish to thank Johanna Buchert and Tuomas Mustonen from VTT for making this all possible.

This project was led by an active management team whose members engaged in lively discussions. The team consisted of Anu Kaukovirta-Norja (chair), Tapio Koivu, Mika Naumanen, Pekka Lehtinen, Raija Lantto and Aimo Tiilikainen (secretary).

Several researchers at VTT contributed to this project. I would like to thank all 45 of the experts who participated in our workshops. Several other researchers also lent their support to this large project. Pekka Lehtinen and Raija Lantto assisted us in project plan writing and prototype development, Kaisu Honkapää in meat product prototype development and Juhani Sibakov and Tuija Kössö in fibre drink prototype development, and Raija-Liisa Heiniö in sensory profiling. Kyösti Pennanen helped us with the quantitative consumer study and Maarit Heikkinen assisted in drafting it.

I wish to express my warm thanks to all those who funded and contributed to this multidisciplinary project.

Espoo, 10 Oct. 2011

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# 1. Introduction

These days, innovations are in the heart of both the micro- and macro-economy. For example, at the micro level, when market competition heats up, companies need to launch new products and services to hold on to their existing sales and profits. When companies aim to increase sales or profits, they have an even stronger need to engage in new product development (NPD).

In 1997, the Journal of Marketing Research, one of the key academic marketing journals, published a special issue on New Product Development (NPD). Fifteen years ago, researchers said that the business environment is changing so dramatically that NPD activities and the way the NPD process is managed should be reformulated. They stated that rapid growth in telecommunications, globalization, mergers and acquisitions, as well as changes in consumer behaviour dynamics are the reasons why NPD should be further developed (Wind & Mahajan 1997). In spite of these ongoing changes, researchers observed that NPD had not changed much and the process is being managed in the same way as it was done in the 1970s: as a stage-gate (and one paradigm dominating) process (Wind & Mahajan 1997).

For 40 years now, the basic idea in new product development processes is to manage them as sequential phases starting from strategic planning and continuing to concept development, technical evaluation and development, prototype development and finally to market transfer (Crawford 1991). Typically, the concepts are evaluated early in the process from the perspective of market opportunities and customer needs (Veryzer 1998; Crawford 1991; Ulrich & Eppinger 1995; Urban & Hauser 1995). If the concept is given a positive evaluation in these tests, it is transferred to technical feasibility studies. These stages are then followed by the product design phases.

In this paper, we wish to contribute to technology-oriented NPD processes in order to improve the low success rate of NPD. Currently, new launches fail more often than they succeed.

Our hypothesis is that the success rate is low because the process does not focus enough on the end users. This is certainly not the only reason, but may be one of the major ones. We believe that the needs of the end user, subjective perceptions of the

quality of the products, subjective price perception, unstated and changing preferences, existing product framing effects and other such factors are not understood early enough or sufficient deeply and broadly. We think that the end user-orientation in the NPD process is currently overly simplified. That is, although end user studies are carried out, they are performed with too limited expertise, too mechanistically ("we will do a small survey") and with too much of a focus on cost efficiency ("we will spend a few thousands Euros to collect consumer feedback"), as well as too late and without enough input from other disciplines. In our view, this leads to a situation where studies do not yield real insight into consumer behavioural dynamics. And we believe this is one of the key reasons why new products fail too often on the markets.

In this paper, we aim to introduce a practical approach to increasing and integrating an understanding of end users, in our case consumers, into the NPD process. We wish to introduce a five-step procedure proposing in what stages of the NPD process, and by which methodology, one can increase end user-orientation. In other words, we aim to introduce an approach that identifies in which phases it is relevant to pay attention to end user orientation, and how this could be done. Furthermore, we come to the broader conclusion that end user dynamics comprise such a complicated phenomenon that, when aiming to increase end user-orientation in practice in the NPD process, this discipline should be present in a well-defined way in each NPD phase.

We focus on so-called technology-oriented NPD. In this type of NPD, the process starts from deep and thorough technological expertise, which can be referred to as a technology push. In this case, technological expertise is the source of innovations, new products and services. In this paper, we focus on the technology push-originated NPD process by presenting an approach to steering this process to produce more end user-/consumer-oriented applications, thereby improving success rates.

In our paper, we wish to pay attention to the stages of the NPD process in which one can achieve a deeper and broader understanding of end users, in our case consumers, and determine which methodology should be used in each phase. From that perspective, our case is different from market-led NPD processes in which the original opportunities or ideas are identified from the markets (see e.g. Costa & Jongen 2006). In a market-led process, the aim is to find ideas from the markets, and then take action to realize these ideas through the NPD process (Urban & Hauser 1995). In our case, the inputs and ideas driving the NPD process do not originate from the markets, but rather from technological possibilities, e.g. from scientific or technological findings that the NPD process seeks to develop into new products and businesses.

The idea of increasing consumer orientation in the innovation development process is not new. In the 1970s, von Hippel (1976; 1978) noticed that some customers, especially in the business-to-business sector, did not expect manufacturers to be able to introduce new features in their products, but instead made them on their own. Industrial customers were not satisfied with the quickness, trustworthiness or innovativeness of producers,

and realized that they had to get involved in product development. This led researchers to start thinking that there is a need for greater consumer orientation in NPD.

Customer orientation – that is, consumers or end users as customers – has several meanings in the innovation area. It can refer to 1) a situation where an initiative to develop new products originates from customer markets (see earlier), or 2) a situation where users participate in the innovation development process but where the innovations originate from the company's internal expertise (Grunert & Jensen 2008). Early customer involvement and/or early market research actions have been found to comprise one of the key success factors in the NPD process. Some scholars argue that if a company does not consult customers in its NPD, or does so either too late in the process or too superficially, the success of NPD is influenced negatively (Ernst 2002; Cooper & Kleinschmidt 1993a; Cooper & Kleinschmidt 1995a). We took this as a key point in the development of our approach. If it is true that listening to customers is vital, in what phases and how should it be done? In this paper, we wish to discuss how a deeper and more thorough understanding of the end user can be achieved in the NPD process – in which NPD process phases and by means of which methodology in each phase.

Grunert and Jensen (2008) have defined three research streams that are relevant for increasing consumer orientation in innovation development (in the food sector). These research areas are as follows:

1) End user quality perception and preference formation of products and services. One example of this area is to study the tradeoffs made by consumers concerning what they get (quality) and what they need to give (price), and try to develop innovations offering the best possible tradeoffs (see e.g. Monroe & Krishnan 1985; Tiilikainen 1998).

2) Management of the user-oriented innovation process: how the process should be managed in order to achieve user-orientation in innovation development. This area includes questions such as how to create cross-functional cooperation among functions participating in innovation development.

3) Network approach, meaning how two or more partners, e.g. companies, can jointly create innovations.

We take two of these ideas as our starting points in approach development. We agree with the previously mentioned researchers: increased end user-orientation requires a deeper and broader understanding of end user perceptions and decision-making dynamics; furthermore, it is necessary to have a well-managed process that is capable of creating a balanced development orientation for the various disciplines involved in the NPD process. By this we mean that no single discipline should dominate the NPD

process, and one must pay great attention to consumer understanding (in the market, where consumers make the final decision on whether to buy new products).

We will introduce an approach whereby one can gain an understanding of consumers in the product idea and concept development phases as well as validate consumers' buying intentions in the prototype development phase. These methodologies pay attention to consumers' subjective thinking at both the single item (attribute) and summative levels (perceived quality and price, buying intention).

We base our thinking on traditional consumer quality and value perception theories. In these theories, researchers are interested in the cues that consumers use in evaluating the quality attributes of the products or overall quality of the products (e.g. reviews of Olson 1977; Steenkamp 1989; Tiilikainen 1998). These cues are, for example, price, brand, colour, harshness, tastiness, package, etc. These cues are relevant for us because they take into account the subjectivity of the consumers' thoughts and the fact that the consumers' knowledge of products is incomplete. In forming their impressions, consumers rely on their personal experiences, in other words on their subjective world.

More relevant for us than these cue evaluation theories are models that seek to understand which offerings consumers find valuable and worth buying. These theories can be called quality and value perception models (see e.g. Olson 1972; Olson, 1978; Steenkamp 1989; Monroe & Chapman 1987; Zeithaml 1988; Dodds et al. 1991; Chang & Wild 1994; Tiilikainen 1998; Sweeney & Soutar 2001). These models aim to understand the cognitive processes of consumers when they form perceptions of the quality or the value of products and form their buying intentions. One of the major conclusions derived from these models is that consumers form their buying intentions on the basis of their subjective evaluations of the quality and price of the product. These models have later been broadened to encompass emotions and social aspects, arguing that these also have an effect on consumers' buying intentions, a view that we believe is true (Sweeney & Soutar 2001). Perceived quality and value theories thus offer a suitable basis for developing the NPD process in a more end user-oriented direction, thereby ensuring greater success.

In our thinking, the focus in a consumer-oriented NPD process should be on ensuring that the consumers form high subjective quality evaluations of the products (focus group of consumers) and also a strong subjective buying intention. If consumer studies are done in the proper way (and not with a view to keeping costs down to "a few thousand euros"), and the consumers give the overall quality of the new product a very high subjective rating in their evaluations and their buying intention is likewise strong, we believe that the NPD process has good chances of success.

In the previous sentences, "subjective" has a specific meaning. End user-orientation needs to have a perspective that pays attention to the subjective world of consumer thinking. In this context, "subjective" refers to consumers' perceptions of product features and their summative quality and value evaluations. In the area of consumer

behaviour, subjective quality is different from objective quality. In this context, it is worthwhile to think about an old and well-known conflict: sometimes, consumers might give a poor rating to a product even though it is scientifically or technically good. When adapting this logic to the NPD process, if something is evaluated as poor, it is not very probable that somebody would be willing to make sacrifices to acquire it. We believe that this logic is very relevant to operationalizing the NPD process. Even when starting from new product development opportunities that are scientifically or technically relevant, one should be able to develop these opportunities into a form that the end users would evaluate as being valuable and worth buying.

The second relevant issue in our NPD model is cross-functionality. In our thinking, focusing too heavily on any single discipline decreases the potential for success. Instead of focusing on one discipline, our approach supports the idea of integrating disciplines. That is why we adopted cross-functionality as a tool to operationalize end user-orientation in NPD, especially in the early phases of technology push-originated NPD processes.

Various studies have shown that cross-functionality is one of the key factors supporting success in NPD processes (Cooper & Kleinschmidt 1993a; Cooper & Kleinschmidt 1993b; Cooper 1994; Cooper & Kleinschmidt 1995b; Cooper & Kleinschmidt 1995c; Cooper & Kleinschmidt 1995d; Rothwell 1992). Companies have also taken note of the possibilities of cross-functionality and are relying on it because it yields better speed, quality, customer satisfaction and success in NPD processes (McDonough 2000).

Cross-functionality is achieved in NPD processes by a team that has expertise in several disciplines and whose expert members are able to make substantial contributions to the development of new products (Griffin 1997; Pinto & Pinto 1990). The key areas of expertise that should be represented in NPD teams are R&D, production and marketing (Song et al. 1997). In other words, both expertise and contributions are needed. In NPD processes, cross-functionality can foster interfunctional communication, sharing of information and cooperation, all of which support success (Balbontin et al. 1999; Yap & Souder 1994; Balachandra et al. 1996; Thamhain 1990).

That said, the results of cross-functionality studies show that its application can also have negative consequences. Negative results can be caused by contradictory goals, poor working cultures and the languages used by the various disciplines in the NPD process (Ancona & Caldwell 1992). These may lead to the opposite of what was intended: poor communication, shattered targets and dissonance. As a result, the outcome of cross-functionality may be negative (Cooper & Kleinschmidt 1993b; Henke et al. 1993). We took this seriously in our approach development and introduced systematically managed workshops as tools to operationalize cross-functionality in NPD processes. We wanted to pay attention to the contribution of each expert in the process and used methodologies that encouraged each expert to participate.

In addition to the operationalization of expert contributions, the following issues need to be addressed to ensure effective cross-functionality:

- Clear goals: these help to structure the task and facilitate cooperation in the team (Pinto et al. 1993).
- Empowerment: promotes individuals' participation in decision-making, which enhances commitment and can influence employee satisfaction (McDonough & Barcazak 1991).
- Project and team management skills and support from top management (McDonough 2000): paying attention to the motivation of team members and focusing on targets, timetables, responsibilities, balanced expertise and effective problem solving.

We considered these to be the critical points in operationalizing cross-functionality in our approach. We paid a great deal of attention to ensuring that the goals were clear to all the workshop participants. We used methods in which all workshop members contributed to product idea and concept development and tried to ensure that no single area of expertise dominated the work. During the project, we noticed just how critical these factors are for success.

To summarize our paper, we could say that our paper belongs in the NPD framework and aims to further develop the process whereby technology provides opportunities. In this paper, we observe that this development is achieved by means of increased end user-orientation, which in practice refers to the interest and expertise in reliably introducing subjective consumer evaluations into the NPD process. The other critical need is to introduce cross-functionality as a tool in the early phases of the process in order to shape technological opportunities into consumer-oriented product ideas and concepts.

# 2. Purpose

The purpose of this paper is to introduce an approach for integrating consumer understanding into the technology-originated NPD process. We aim to describe in which phases an understanding of consumers can be integrated into the process and which methodology should be used in each phase.

Our approach is based on three practical projects that were run in 2009-2011. These projects were the Weight Management Foods development project, which was funded by Tekes and VTT, the Food Concept development project, which was funded by VTT, and the Packaging Concept development project, likewise funded by VTT. We will not review these projects in their entirety. Instead, we take examples from these projects and present them in this paper. For example, we explain how we integrated consumer understanding into the NPD process in the product concept development phase, and what kinds of results we obtained from these activities in our approach phases. Finally we will discuss the conclusions and how we succeeded in this project.

# 3. Results

Our main project was the Weight Management Food development case. We will now describe some aspects of this project. In this project, we used two technologies as pilots in order to determine how we could develop them for greater consumer orientation. Next we will briefly introduce these technologies.

## 3.1 Food technologies

### 3.1.1 β glucan from oat bran for fibre-rich beverages

This technology has been patented by VTT and was developed in several projects in past years. The technology is aimed at developing a grain (oat) ingredient for producing fibre-rich functional beverages. With this technology, one can separate a fibre-enriched oat bran concentrate that can contain 25–30% β glucan and 45–50% total dietary fibre (Kaukovirta-Norja et al. 2008; Sibakov et al. 2011).

An illustration of the technology, in enzyme hydrolysis form, is presented in Figure 1 (the other form is an acid hydrolysis form).

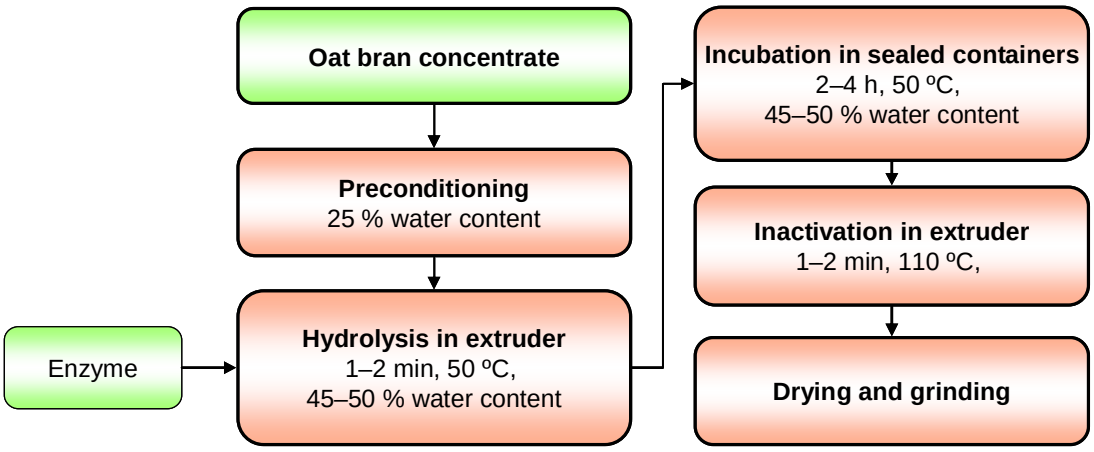


Figure 1. The hydrolysis of oat bran concentrate at low water content using a twin-screw extruder (Kaukovirta-Norja et al. 2009; Lehtomäki & Myllymäki 2009; Sibakov et al. 2010).

### 3.1.2 Producing light meat products by foaming meat mass

The other technology included in our project was also developed by VTT but was in an earlier development phase than the β-glucan technology, namely, in the invention announcement phase. This technology is intended for manufacturing low energy content meat products by foaming the meat mass (adding air to it).

With this foaming technology, sausage-type products can be made from light meat mass without losing the typical taste of sausage products. In the foaming process, air (nitrogen) is added to the meat mass, decreasing the density of the product. The amount of air in the product can be about 25–30 per cent of the volume of the product. It is commonly known that foaming yields a softer mouth-feel and increases the effectiveness of flavour absorption. Foaming technology is commonly used in baking, candy production and dairy product manufacturing, but not in the meat industry. The purpose of adding air to meat products is to decrease their energy content and improve the structure of the meat compared with normal products. (Lantto & Partanen 2011).

## 3.2 Approach for integrating consumer understanding into technology push-originated NPD processes

Our project case is a typical technology push-originated NPD process. In our project, we identified technological opportunities, and posed the question: in the case of which products can these technologies offer added value to consumers? Because we wanted to operationalize a consumer-oriented NPD process, we raised the question: what kind of product offering could we develop based on these technologies to ensure that consumers would subjectively evaluate them positively and be willing to spend money on them? Before addressing these questions, we will introduce our model.

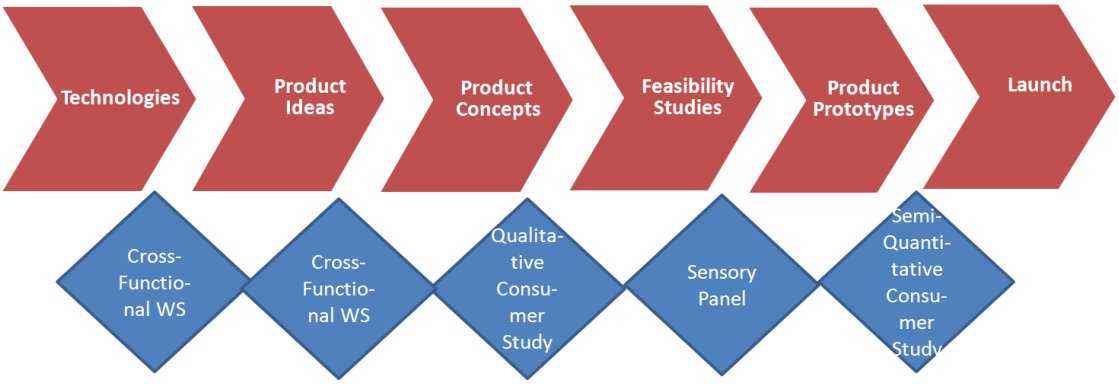


Figure 2. Approach for integrating an understanding of the end user, in our case the consumer, into technology-originated NPD processes. WS = Workshop.

Figure 2 is divided into two parts. The first part is the process, which is represented by six red symbols: 1) technologies (to be commercialized), 2) product ideas, 3) product concepts, 4) feasibility studies (for products and production processes), 5) product prototypes and 6) launch.

The second part is our approach, the integration of consumer understanding. It is shown in the figure with blue shapes. Our approach has five specific phases:

1) Cross-functional workshop to transfer technologies to end user-oriented product ideas,
2) Cross-functional workshop to develop product ideas for end user-oriented product concepts,
3) Qualitative consumer study to develop more end user-oriented product concepts,
4) Food product-specific phase: sensory panel to develop prototypes to meet end users' sensory criteria for products,
5) Semi-Quantitative Consumer Study to find out whether the end users feel that the subjective quality of the developed product prototypes is high enough and to ascertain their buying intentions. We recommend that a semi-quantitative study should have a comparative orientation: to compare how end users evaluate the quality and price of the prototype as well as their buying intentions against a reference product from the same product category.

The first phase in our approach is to develop product ideas from technologies. We propose to do this with cross-functional workshops. Our reason for using a cross-functional workshop for this purpose is to strengthen non-technological disciplines in the NPD project. Until this phase, technology expertise has been perhaps the only expertise area represented in the process. As we aim to offer something that caters to consumers' subjective perceptions, there is a need to round out technological expertise with other disciplines. We recommend the use of cross-functional workshop(s) as a tool for this purpose. In this phase, the aim of these workshops should be to develop end user-oriented product ideas from technological opportunities (e.g. patents).

The second phase in our model is to refine the product ideas, which may be broad and abstract, into more specific product concepts. The idea behind a product concept is to describe the key features or attributes of the product in an end user-oriented way. Again, we propose the use of cross-functional workshop(s) for this purpose. The workshop can already be supported with real consumer participation in this phase of the process. Product ideas can be posted on an internet discussion forum, for instance, to be discussed and developed further.

In our view, real consumer participation in an end user-oriented NPD process should be started no later than in the third stage. In this stage, we organized both traditional qualitative consumer focus groups and internet forum discussions concerning both the key attributes and suitable product groups to which the consumers felt that the attributes fit well. Our aim was to gain a deep and broad understanding of the perceptions and thoughts of consumers concerning the developed concepts. After studies, we further modified the concepts to be a better fit with the consumer feedback. In our understanding, this is a necessary part of the end user-oriented NPD process. One should not just study consumer reactions to concepts but also use the study results to develop the concepts further.

The fourth phase, which is specific to food product NPD, is prototype development to meet consumers' sensory criteria for prototypes. In the case of foods, sensory parameters are of crucial importance to consumers, and this is why it is necessary to develop products to meet consumers' sensory criteria. For this purpose, we used a sensory panel in the prototype development phase.

The last phase in our approach is the use of semi-quantitative consumer studies to validate how well the developed prototypes fit the end users' evaluations of subjective quality, price and buying intentions. We used a comparative approach in this study. We also included a reference product from the product category of the prototype to enable us to analyse how the consumers' evaluations of the prototypes diverged from a suitable reference product. We think that this is a necessary approach because most new products are launched in existing product categories, and consumers face a dilemma in choosing from a range of alternatives. In our approach, final launch decisions should be based on the results of consumer studies. We believe that positive consumer study results can increase the potential success of NPD processes.

Now we will present a more detailed description of each phase of our approach.

### 3.2.1 From technologies to end user-oriented product ideas

In our understanding, one of the early key challenges in the NPD process is how to turn technological opportunities into end-user-oriented product ideas. In an early phase, technological expertise can be expressed in mathematical forms, process pictures, chemical formulas, etc. From there, it can be a big step to start thinking about practical products and an even bigger jump to start thinking about end user-oriented, case-specific products offering high in subjective quality. Typically, in these early NPD phases there can be a large body of ideas, but there might be a lack of realistic market facts or end user-oriented priorities relevant to these ideas.

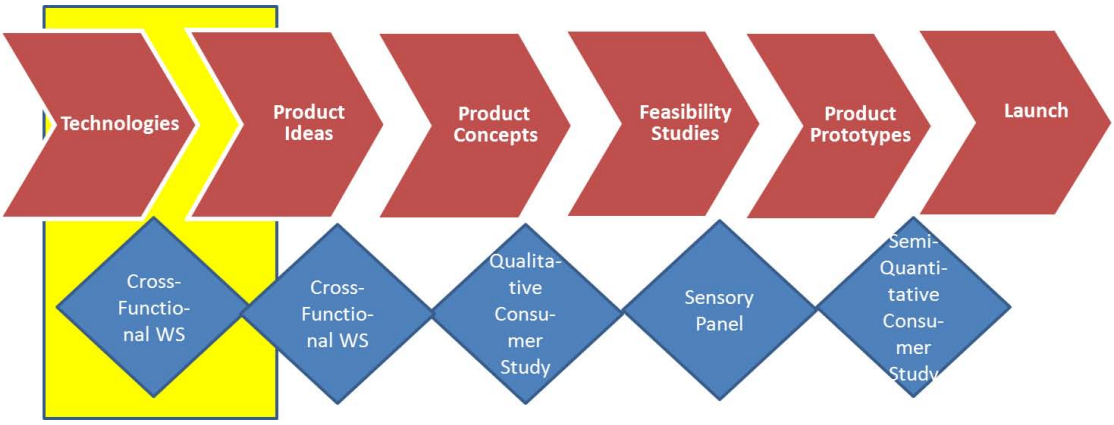


Figure 3. Cross-functional workshop focused on product idea generation as a tool to develop technological opportunities for end user-oriented product ideas.

We used a cross-functional workshop for this purpose (please see Figure 3), and paid attention to the issues mentioned earlier in this paper in order to produce end user-oriented ideas. First we paid attention to the issue of orientation in the workshops and devoted some time to describing it. We focused on end user-oriented product idea development and stated that our task is no longer to develop technologies as such but to focus on brainstorming what kinds of products one could make with these technologies.

Then we paid attention to the management of the workshops. We wanted the manager to not be a technologist but rather to have combined expertise in end user behaviour and innovation commercialization. We thought that this would help to make the workshops more neutral and end user-oriented. The writer of this paper managed the workshops.

In the workshops, we also paid attention to the balance of disciplines and the contributions of all participants, as suggested earlier in this paper. We wanted to make sure that all participants contributed to idea development. To this end, we utilized workshop methodologies that “forced” the experts to work first as individuals and then in small three-person groups. Furthermore, the participants changed groups several times.

The fourth issue we paid attention to was the types of expertise present in the workshops. Key areas of expertise were chosen on the basis of the literature and were technology, marketing, sales and consumer behaviour.

Next we will give a few examples of the product ideas we generated in the workshop (please see Table 1). Altogether, we generated about 25 product ideas based on technology for producing fibre-rich beverages with oat bran from β glucan and about 20 ideas based on producing light meat products by means of meat foaming technology.

Table 1. Examples of the product ideas created in the product idea generation workshop.

| **Product ideas** | |
|---|---|
| **Technology for producing fibre-rich beverages with β glucan from bran oat**<br>– fibre-rich sport drinks<br>– cholesterol management drinks<br>– fibre-rich mineral waters<br>– fibre-rich milk/yoghurt<br>– fibre ingredient to be added to coffee<br>– fibre-rich snack drinks | **Light meat products made with meat mass foaming technology**<br>– light sausages for men who want great flavour<br>– mousse type of meat product in cans for seniors<br>– combined meat and vegetable balls or patties<br>– light liver sausages<br>– light pâtés |

As one can see from Table 1, the product ideas are still quite broad but are also well aligned with the needs of end users. Focus groups are mentioned (seniors), as are product categories (sport drinks).

Next we wanted to take these ideas further in the workshop and make them more specific in terms of key features and prioritize these further. We set ourselves the target of choosing three to five ideas in both technologies for further concept development, and followed the proposal of Srinivasan et al. (1997) that, depending on the cost of developing each concept, it would be optimal to keep multiple product concepts in the prototyping and testing phase, and to select the best of those designs later in the process. In Table 2 are the final results of the product idea generation workshop, representing the best ideas as seen by the cross-functional team.

Table 2. Prioritized product ideas from the first cross-functional workshop.

| **Prioritized product ideas to be taken to product concept definition** | |
|---|---|
| **Technology for producing fibre-rich beverages with β glucan from bran oat**<br>– fibre-rich soft drinks. Healthier than normal sugar-rich soft drinks containing β glucan<br>– β glucan powder that the user can add to coffee or tea to turn them into healthy drinks<br>– fibre-rich milk products. Healthier milk product containing β glucan fibre<br>– healthier fibre-rich snack drink, e.g. smoothie containing β glucan fibre<br>– fibre-rich mashed potato powder containing β glucan. | **Light meat products made with meat mass foaming technology**<br>– tasty light sausage<br>– tasty light pâtés<br>– easy to chew meat paste products in tubes or small cans for seniors and children |

In the second part of the workshop we were able to elaborate product ideas to give clearer definitions of the added value we could develop for the product by means of technology. We also prioritized ideas. The cross-functional workshop evaluated β glucan-rich soft drinks as the best idea in the case of β glucan technology. Tasty light sausages were chosen as the best idea in the other technology group (see Table 2).

In our approach, the next stage is to develop the product ideas into product concepts. These should describe in greater detail what the product provides to the end user.

### 3.2.2 From product ideas to end user-oriented product concepts

In the second (transfer) phase in our NPD approach we face the challenge of how to develop end-user-oriented product concepts from product ideas. In this stage we should be able to describe what the end users get from consuming these products.

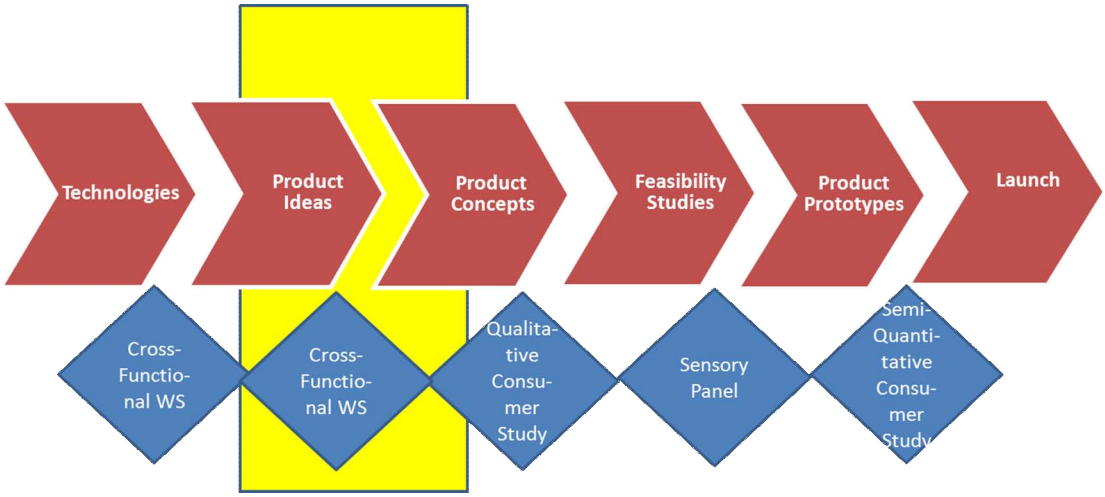


Figure 4. The cross-functional workshop focused on product concept development as a tool to develop end user-oriented product concepts from product ideas.

In this phase, we once again used a cross-functional workshop as a tool (please see Figure 4). We based our decision on the complexity of the product ideas we had. We thought that it would be too difficult for consumers to discuss β glucan fibre or foamed meat products if they were not provided with more practical product definitions, and we aimed to produce these definitions in the cross-functional workshop. In addition to the workshop, it might be a good idea to present the product ideas (when they are easy to understand) to consumers for discussion and review, such as over the internet. This would facilitate obtaining real consumer insight into the NPD process at an earlier stage, which we assume is essential for steering the process in a more consumer-oriented direction. However, since we thought that our ideas might be too strange for consumers to discuss, especially the foamed meat product idea, we made the decision to go ahead only with the cross-functional workshop.

The aim of this workshop was to further develop product descriptions in an end user-oriented way and choose two to three concepts per technology for later consumer (qualitative) study. We led this workshop in the same way as the workshop described earlier.

Table 3 presents product concepts developed in the second workshop.

Table 3. Product concepts developed in the second workshop.

| Product concepts | |
|---|---|
| **Technology for producing fibre-rich beverages with β glucan from bran oat** | **Light meat products made with meat mass foaming technology** |
| **Fibre-rich juice**<br>Drink that controls the increase in blood sugar levels and provides a longer-lasting feeling of satiety than normal snack drinks that contain sugar. Focus group: Busy young adults and parents of young children. | **Tasty light sausages**<br>Light sausages (energy content 20% lower than that of normal sausages) made by adding air to meat paste. Vegetable fats are not used in mass which means that the taste should be the same as that of normal products. Focus group: Consumers who prefer foods that are both healthy and tasty. |
| **Fibre-rich yoghurt**<br>Yoghurt containing β glucan fibre, either with sugar or sugar-free. Slower sugar absorption into blood, giving the user longer-lasting energy and feelings of satiety. Focus group: Health-conscious grown-ups and their families. | **Light tasty mass meat patties or balls**<br>Patties or balls manufactured from foamed meat mass that are as tasty as normal meat mass patties or balls and have 20% lower energy content. Focus group: Health- and taste-conscious consumers who eat convenience and semi-prepared foods. |
| **β glucan fibre powder**<br>β glucan fibre powder that can be added to coffee or tea, giving these drinks the positive health effects of fibre. Focus group: Busy young adults and health-conscious grown-ups | **Combined light meat and vegetable cold cuts for sandwiches**<br>Cold cuts made from foamed mixed meat and vegetable mass, providing consumers with both meat and vegetable proteins in the form of a light product (20% less energy than a normal similar product). Focus group: Consumers interested in lowering their meat consumption and consumers of lighter foods. |
| **Fibre-rich juice to enhance intestinal functioning**<br>Juice with β glucan fibre that enhances intestinal functioning. Focus group: Consumers with intestinal problems. | **Tasty and light pâtés**<br>Pâté made of foamed meat paste in tubes and cans. Lighter than normal pâté and tastier than traditional light pâtés. Focus group: Health- and taste-conscious consumers who eat pâtés. |
| **Fibre-rich cola drink**<br>Cola drink with β glucan fibre, providing longer-lasting energy than normal cola drinks. Focus group: Cola drinkers. | **Meat bar**<br>Easy to chew meat bar made of foamed meat mass. Focus groups: Seniors having chewing difficulties. |
| **Cholesterol management juice**<br>Drink with β glucan fibre, providing the same cholesterol-controlling benefits as margarines. Offers an alternative way to manage cholesterol. Focus group: Middle-aged and older consumers. | **Light tasty barbeque meatballs**<br>Barbeque meatballs produced of foamed meat mass. Lighter than normal products and tastier than traditional light products. Focus group: Health- and taste-conscious consumers who like to barbeque. |

As shown in the above table, the workshop was able to develop good product concepts from the product ideas. These concepts described what is unique about them from the consumer perspective.

After six product concepts were developed from both technologies, we wanted to prioritize them with the aim of taking the two to three most promising ones into the next phase. During the prioritization process, we also continued to develop the product concepts and integrated some of the features from the other concepts into those that had been evaluated as the best by the workshop members.

Table 4 below presents the three product concepts from both technologies that the workshop prioritized as being the most promising.

Table 4. Three product concepts from both technologies that the workshop prioritized as being the most promising.

| **Prioritized product concepts** | |
|---|---|
| **Technology for producing fibre-rich beverages with β glucan from bran oat** | **Light meat products made with meat mass foaming technology** |
| **Fibre-rich juice**<br>Drink that controls (slows down the increase in) blood sugar levels and provides a longer-lasting feeling of satiety than normal juices that contain sugar. Focus group: Busy young adults, parents of young children. | **Tasty light sausages**<br>Tasty light sausages (energy content 20% lower than in normal sausages), made by foaming (adding air to) meat mass. Vegetable fats are not used in the mass, meaning that the taste should be the same as that of normal products.<br>Focus: Consumers who prefer foods that are both healthy and tasty. |
| **Fibre-rich yoghurt**<br>Yoghurt containing β glucan fibre, either with sugar or sugar-free. Slower sugar absorption into blood, giving the user longer-lasting energy and feelings of satiety. Focus group: Health-conscious grown-ups and their families. | **Combined light meat and vegetable cold cuts for sandwiches**<br>Cold cuts made from foamed mixed meat and vegetable mass, providing both meat and vegetable proteins in the form of a light product (20% less energy than a normal similar product). Focus group: Consumers interested in lowering their meat consumption and consumers of lighter foods. |
| **β glucan fibre powder**<br>β glucan fibre powder that can be added to coffee or tea, giving these drinks the positive health effects of fibre. Focus group: Busy young adults and health-conscious grown-ups. | **Tasty and light pâtés**<br>Pâté made of foamed meat mass in tubes and cans. Lighter than normal pâté and tastier than traditional light pâtés. Focus group: Health- and taste-conscious consumers who eat pâtés. |

The above table presents three product categories that were developed for both technologies. Cross-functional workshops evaluated that the most suitable products for β glucan technology are juices, yoghurts and powder. In the case of meat foaming technology, the prioritized product categories were sausages, cold cuts and pâtés. The key attributes (features) that the workshops developed for β glucan technology were: slows down sugar absorption into blood, provides a longer-lasting feeling of satiety, and helps in cholesterol management. The key attributes of the meat mass foaming technology were: tastier than normal light products, no added vegetable fats and softer mouth feel.

### 3.2.3 From cross-functional product concepts to consumer feedback-oriented product concepts

The next phase in our approach is to study consumers' perceptions and thoughts concerning the developed product concepts, and the further development of the concepts on the basis of the collected consumer information (please see Figure 5).

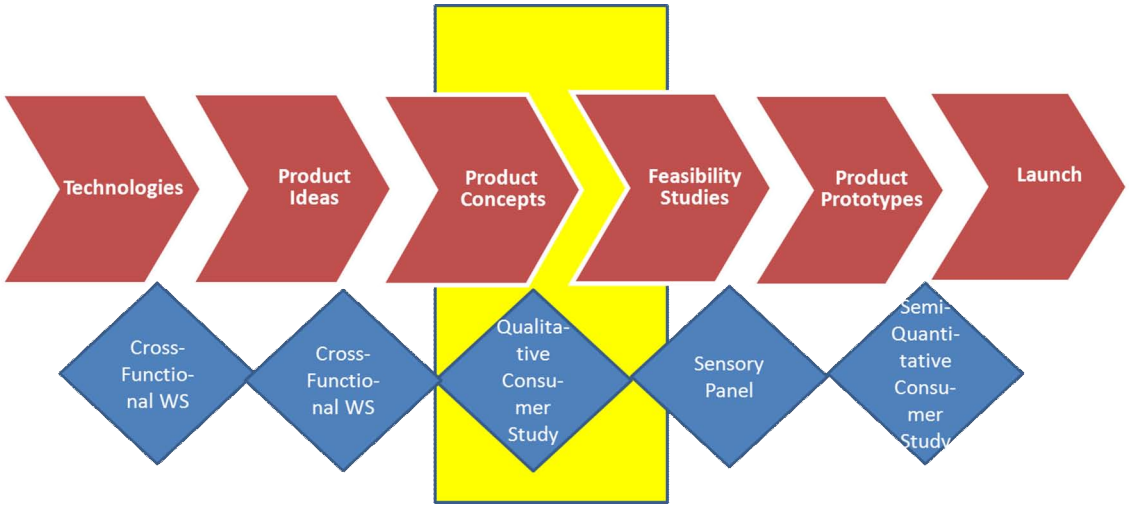


Figure 5. Qualitative consumer studies as a tool for the further development of more end user-oriented products.

It is our understanding that in this phase our research should focus on gathering the thoughts of consumers concerning the developed key attributes and suitable product categories (directions) in a deep, broad and wide-ranging manner. By this we mean that we should not just try to find out the immediate thoughts of the consumers regarding the concepts, but rather engage in more open discussions with them in order to identify further development possibilities for the concepts. If we narrow our study too tightly on product concepts we might not be able to engage in discussions at a level that can reveal consumers' unstated wishes and suspicions. We would propose the use of projective

methods as well in order to try to help consumers to describe their thoughts concerning ideas that might be very unfamiliar to them.

This phase of our approach is very challenging. We have seen cases where industry has made mistakes in this phase. Therefore, consumer studies should be keenly sensitive in order to reveal consumers' recurring feelings and implicit thoughts regarding the concepts. Here we also would like to express our concern over the drawbacks of focusing too much on the cost-efficiency of the studies. It seems that there is a tendency to think that consumer studies should be carried out with only a few thousand euros, but they are still expected to reveal the real thoughts of consumers. We are somewhat worried about this tendency and would like to ask how well such small projects can identify recurring and complex issues in consumer behaviour?

In our project, we organized two types of qualitative consumer studies. In the first part we organized four traditional focus groups and in the second part we had three moderated internet discussion groups. On the internet, consumers discussed the product concepts under the guidance of a moderator, who was a consumer researcher. Altogether, 28 consumers participated in the focus groups and 20 consumers participated in the internet discussions in March and April 2010. Participants for the internet discussions were recruited via Facebook. Both consumer groups completed a brief questionnaire asking them about their usage of the case product categories as well as their age, food allergies, education and family size. This enabled us to recruit consumers who use products from the product categories we included in our concept and did not have allergies that would have prevented them from consuming these products. We were nevertheless able to balance the groups in terms of age, education and family size. The participants of the normal groups were recruited by phone with the same criteria.

We had two focus groups for both technologies. One group comprised younger consumers aged 20–39 and the other group consisted of consumers aged 40–61.

We divided our discussions into two larger topics. The first concerned the attributes of our concepts and the second the product categories. Discussions always started from broader topics with very limited researcher stimuli (e.g. have you heard of dietary fibre? If somebody said yes, then we started to discuss what they had heard). The aim was to try to understand the cognitive structures of the consumers when thinking about the attributes and thereby make conclusions about how familiar the attributes are to them, and finally conclude how realistic it would be to introduce products having these attributes.

This same logic was applied in the internet discussions: we also split these into sections focusing on attributes and product categories. In the next table we present the attributes and product categories we discussed in the focus groups and on the internet forum.

Table 5. Attributes and product categories we discussed in the focus groups and on the internet forum.

| **Attributes and product categories in qualitative consumer studies** | |
|---|---|
| **Technology for producing fibre-rich beverages with β glucan from bran oat** | **Light meat products made with meat mass foaming technology** |
| **Attributes**<br>– capability to maintain cholesterol level<br>– maintains a feeling of satiety<br>– slower energy absorption into blood | **Attributes**<br>– tastier than existing light meat products<br>– softer mouth feel<br>– no added vegetable fats in the light meat product |
| **Product categories**<br>– milk products<br>– juices<br>– powder | **Product categories**<br>– pâté (spreads)<br>– sausages<br>– meatballs |

Discussions were led by an experienced consumer researcher. They were recorded and transcribed.

We utilized projective methods in the focus groups and asked the participants to assemble their preferred product from all the elements that had been discussed. Our aim was to get an idea of the consumers' ideal products.

Our data handling methodology was typical of qualitative studies; we transcribed the data, read it several times, grouped it into themes and then summarized the consumer perceptions of the attributes and product categories.

Figures 6 and 7 summarize the results of our qualitative consumer studies. The attributes are presented in the leftmost column of the table and the products in the top row. The colour green is used to show those attribute-product combinations that our study suggested were the best fit with the consumers' preferences and the colour red to show the worst combinations. We present the best alternatives with numbers.

| | Thick dairy product, like yoghurt | Thick juice product (including pulp) | Powder |
|---|---|---|---|
| Satiety | 1. | 1. | |
| Cholesterol management | 1. | | |
| Blood sugar level management | | | |

Figure 6. Attribute-product combinations that received support from qualitative consumer studies. Technology for producing fibre-rich beverages with β glucan from bran oat.

| | Light sausage | Combined meat and liver spreading | Meat balls ready to use in salads |
|---|---|---|---|
| **Better taste** | 2. | 1. | |
| No added vegetable fat | | | |
| Softer mounth feel | | | |

Figure 7. Attribute-product combinations that received support from qualitative consumer studies. Light meat products made with meat mass foaming technology.

The β glucan technology product concepts received support in the case of two attributes: satiety and cholesterol management. Satiety gained more support from (younger) women. Cholesterol management was supported mainly by middle-aged or older

consumers. The blood sugar level management attribute was too unfamiliar to the studied consumers and we thus eliminated it from later NPD phases.

The product category that received support was milk products; based on consumer feedback, we developed it further into thick milk products, such as yoghurts. This change was done because the thoughts expressed by the consumers supported adding fibre to milk products whose consistency is already thick. A similar change was done to the juice product category because consumer feedback did not support adding fibre to soft drinks; instead, consumers favoured adding it to drinks that already have a thick consistency.

In the case of meat mass foaming technology (Figure 7), the only attribute that was supported was better taste. The interviewed consumers were interested in the technology if it would make healthier meat products tastier. Softer mouth feel and no added vegetable attributes did not gain support. Some consumers even thought that it would be a pity to remove vegetable fats from light products.

The product category that received support was pâté/spreads. The consumers stated that air can be added to products that are made from a mixture, like spreads. Although sausages also gained some support, it was not as strong.

From the table above, we can see that our real consumer studies added value to the cross-functional workshops. In the case of β glucan technology, we needed to cut one product category (powder) from further NPD phases, and further modify the two that we included in later stages. We also needed to cut one of the attributes (sugar absorption into blood).

In the product concepts based on meat mass foaming technology, we needed to make greater changes when compared to the end results from the cross-functional workshops. We needed to cut two of the three attributes, keeping only better taste. The product category that received the most support was pâtés/spreads; sausages gained some support, too.

As we can see from the above mentioned case examples, real consumer participation is necessary in the NPD process. We would recommend involving real consumers in the process in earlier NPD phases by using cross-functional workshops representing multidisciplinary expertise. In our case, cross-functional workshops were able to develop good end user-oriented concepts. However, large changes were necessary after the qualitative consumer study. Consumer feedback on product concepts is always case-specific. That is why even marketing and market research experts find it very challenging to make predictions without case-specific consumer studies. We noticed this in our case study, too.

Next we moved on to feasibility studies and prototype development (we will summarize both here very briefly). However, we will pay more attention to the sensory parameter development of the prototypes, which is a vital phase in food NPD projects. This is because end user choices are highly influenced by the sensory aspects of foods.

Of the attribute-product category combinations, we chose to include the following concepts in the feasibility study:

- β glucan fibre-rich yoghurt product with satiety and cholesterol management attributes,
- β glucan fibre-rich thick juice with satiety attribute,
- Light combined meat and liver spread with better taste attribute,
- Light sausage with better taste attribute.

### 3.2.4 Food prototype development to fulfil consumers' sensory criteria

The next phase in NPD models is to carry out feasibility studies of the product concepts in order to determine realistic possibilities to produce the target products. Relevant actions in this phase include, for example, production methodology reviews, ingredient and material reviews, value chain reviews, legal and regulatory reviews and economical analysis. We performed these actions in our project, too: we defined pilot production machinery, made production planning and production tests, determined ingredient availabilities and prices, checked EFSA nutritional and health claim criteria (e.g. how much dietary fibre do foods need to include before they can be claimed to have various health effects, www.efsa.europa.eu) and so forth.

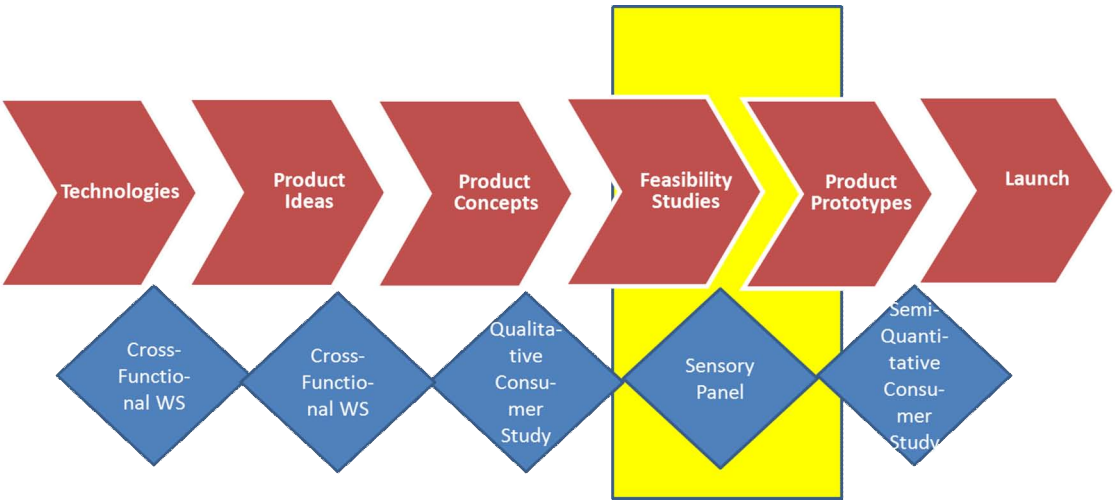


Figure 8. Sensory studies as a tool for developing food concepts for end user-oriented prototypes.

After or parallel to feasibility studies, one should start prototype manufacturing in the NPD process. In our case, we started prototype manufacturing parallel to feasibility studies. Our prototype manufacturing process was iterative (like it often is). We tested

machineries, ingredient varieties and recipes several times during prototype development and manufacturing.

In our project, we used several sensory panels as tools to develop food prototypes to fulfil consumers' criteria (please see Figure 8). A sensory panel evaluated the sensory parameters of the very first prototype versions. At the beginning, the panels were very small, consisting of three to six persons who tasted and evaluated a few key sensory dimensions of the prototypes (for more on sensory methodologies, see e.g. Moskowitz et al. 2006). After summarizing the results of these panels, we gave the feedback to the prototype developers, who then used it to guide further prototype development.

Sensory panels turned out to be a very good tool for developing the sensory parameters of the prototypes. The technology experts' evaluations of the prototypes tended to be a little too positive, and the panellists were able to balance out their views.

In Table 6 are examples of the results from the small (three to six members) sensory panels in the mid-development phase of the prototypes. Note that in the earlier stages of prototype development, we only used three major sensory profiles to make the tests easier, cheaper and quicker to conduct.

Table 6. Example results from sensory profile evaluations of the small sensory panel in the mid-prototype development phase.

| **Example of sensory profiling results from sensory panels in the mid-prototype development phase (scale 1–3, 1 = low)** | |
|---|---|
| **Technology for producing fibre-rich beverages with β glucan from bran oat** | **Light meat products made with meat mass foaming technology** |
| **β glucan-rich orange juice**<br>– Appearance: 2.8<br>– Combined smell and taste evaluation: 2.4<br>– Mouthfeel: 2.8 | **Foamed meat mass frankfurter (served cold)**<br>– Appearance: 2.4<br>– Combined smell and taste evaluation: 2.8<br>– Mouthfeel: 2.5 |
| **Reference orange juice without fibre (with pulp)**<br>– Appearance: 2.9<br>– Combined smell and taste evaluation: 2.9<br>– Mouthfeel: 3.0 | **Reference sausage, with no added air (served cold)**<br>– Appearance: 2.9<br>– Combined smell and taste evaluation: 2.8<br>– Mouthfeel: 3.0 |

From the table above (Table 6), one can see that the development of the prototypes had progressed nicely, and the small sensory panel evaluated them as being quite similar to the reference products. The biggest difference in this phase is still seen in the combined smell and taste dimension in the juice, and in mouth feel and appearance in frankfurter.

This was because both technologies tended to have side effects. We were able to decrease these side effects during the iterations and in the mid-development phase the differences were already quite small.

We continued prototype development with more iterations with the aim of ensuring that the prototypes would be very similar to the reference products in terms of their sensory profiles. Below, we present the final sensory results of the full double session panel of 13 members with more detailed sensory profiles. Next, we present pictures of the prototypes and reference products (Figures 9 and 11), the ingredients of the prototypes (Tables 7 and 8) as well as sensory profiling final results (Figures 10 and 12).

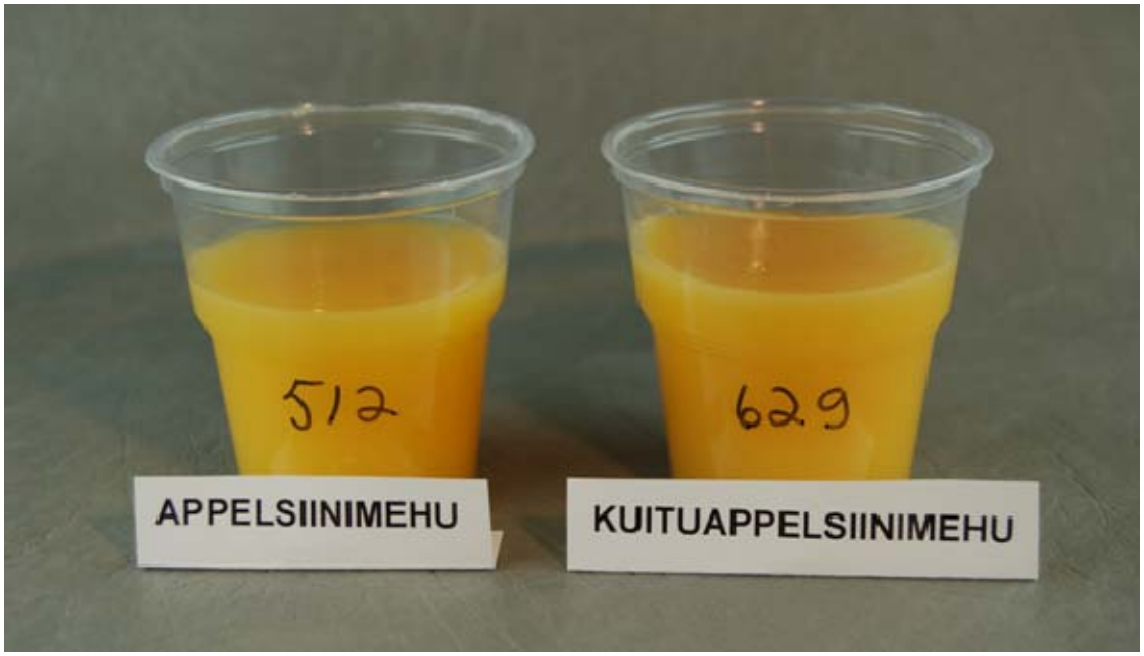


Figure 9. Picture of β glucan-rich orange juice prototype and the reference product, Bahi orange juice with pulp, a commercial product made by Valio Ltd. Translations of the terms in the picture: Appelsiinimehu (512) – Valio Bahi reference product. Kuituappelsiinimehu (629) – β glucan-rich orange juice prototype.

Table 7. Ingredients of β glucan-rich orange juice prototype.

| **Ingredients of the β glucan-rich orange juice** |
|---|
| **Technology for producing fibre-rich beverages with β glucan from bran oat** |
| β glucan-rich orange juice prototype<br>▪ oat bran extract (80%), orange juice concentrate (20%), percentages calculated from weight<br>▪ oat bran extract<br>  ▪ water, oat bran (12%), B glucanase (Depol 740L) |

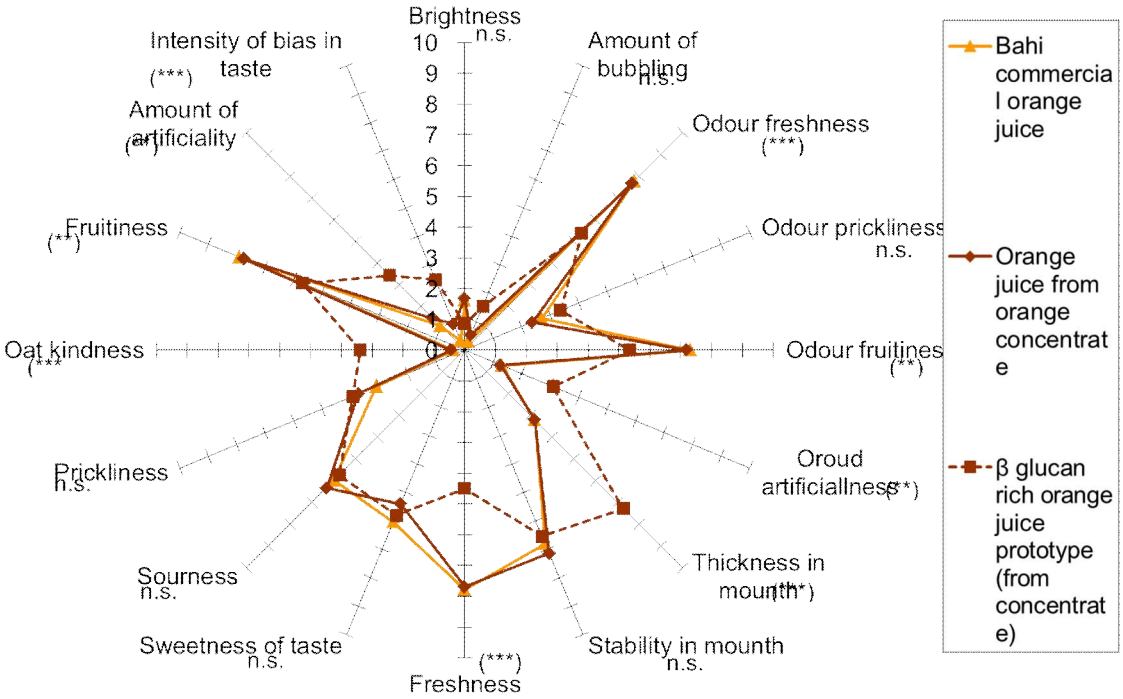


Figure 10. Final sensory profiling results of the prototype and reference orange juice from the sensory panel.

Figure 10 shows that we were able to develop a β glucan-rich orange juice prototype that was quite close to the premium reference product in several sensory profiles. In the evaluation of the panel of educated sensory specialists, the products were similar in terms of sweetness of taste, sourness, prickliness, brightness and bubbling. That said, some differences still existed. Differences were noted in freshness, thickness of mouth feel, fruitiness of smell, freshness of smell, amount of artificiality, fruitiness and oat flavours.

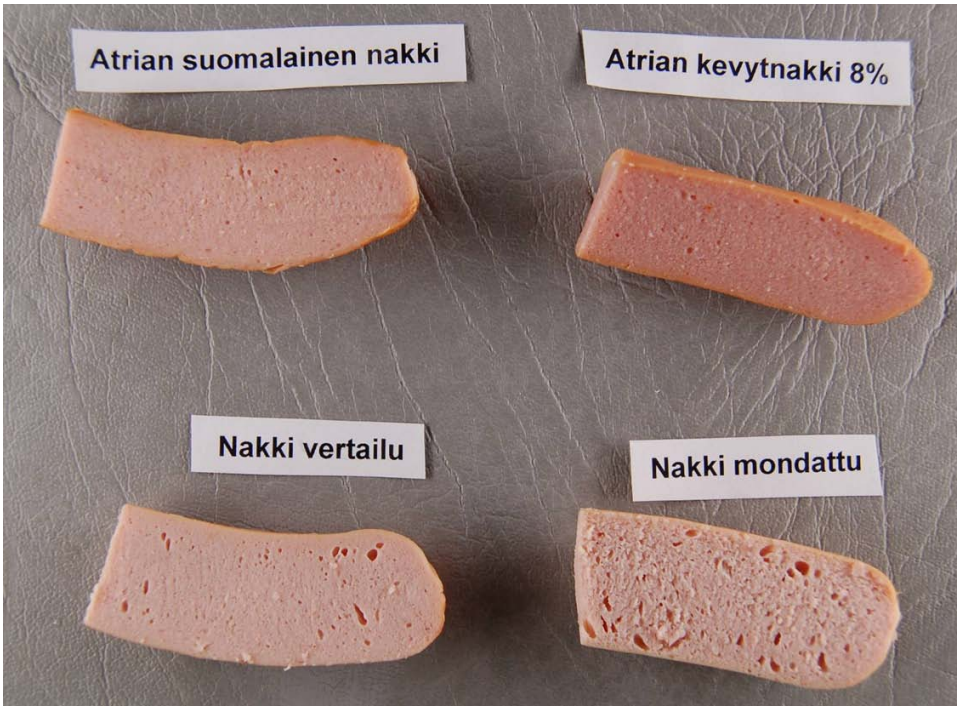


Figure 11. Pictures of the frankfurter prototype and commercial reference product. The picture includes additional products, too. Translations of terms in the picture: Nakki mondattu: Foamed meat paste frankfurter prototype; Nakki vertailu: prototype frankfurter made from the same meat mass as the foamed prototype but without added air; Atrian kevytnakki 8%: Atria Ltd light, 8% fat commercial frankfurter; Atrian suomalainen nakki: Atria Class A frankfurter (normal, not light product).

Table 8. Ingredients of the frankfurter prototype.

| **Ingredients of the frankfurter prototype** |
|---|
| **Light meat products made with meat mass foaming technology**<br><br>Foamed meat mass frankfurter (served cold)<br>▪ pork meat, water, salt (1.6%), modified starch (E 1420), soy protein, glucose, spices (e.g. white pepper, black pepper, ginger), stabilizer (E450, E451), ascorbic acid, preservative (sodium nitrite). Meat content 72%.<br>▪ amount of air about 20% of the size of the product |

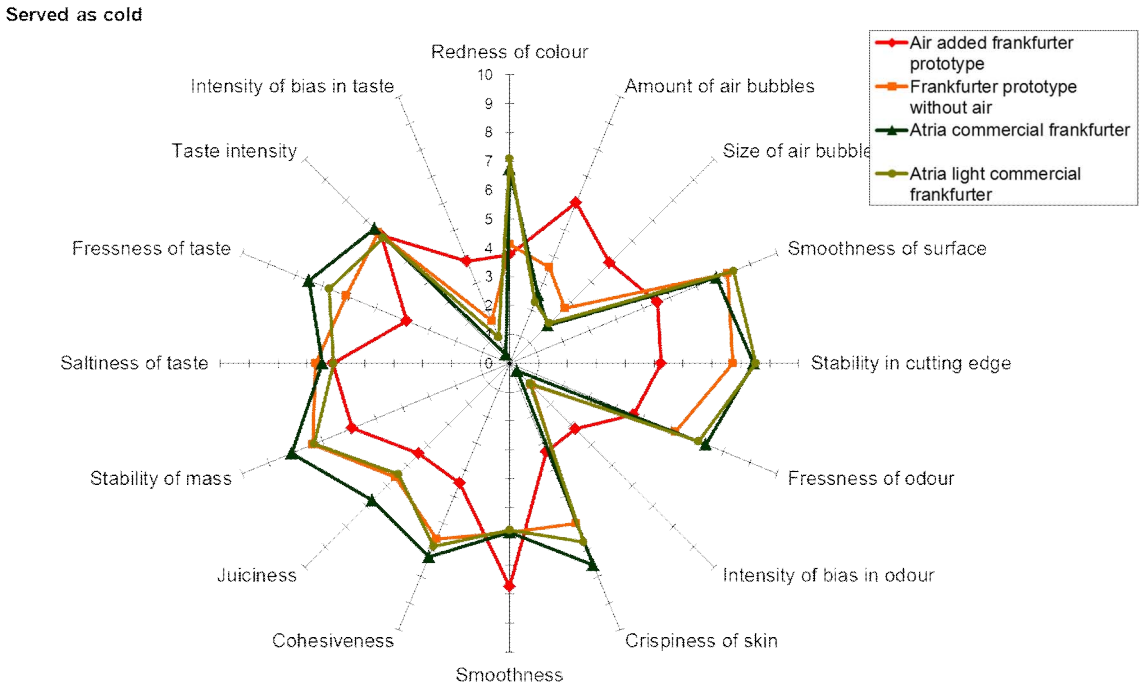


Figure 12. Sensory profiling results of the prototype and reference frankfurter from the sensory panel. The prototype is the foamed meat mass frankfurter shown in the picture. The reference product is the light commercial frankfurter made by Atria.

From Figure 12, we can see that the prototype and reference products were quite close to each other in terms of taste intensity and saltiness of taste. In the rest of the profiles, the prototype and reference products were different from each other. In view of these results, we had to proceed to the next phase in our NPD process too early. We should have been able to devote more time to prototype development in order to ensure that the sensory profile of the frankfurter prototype would be closer to that of the reference product before continuing to semi-quantitative consumer tests. However, because the aim of our project was to develop and pilot an approach to integrating an understanding of end users into technology-originated NPD processes, we made the decision to continue.

To summarize our experiences from sensory profiling, we note that sensory profiling is a very necessary part of our approach. These studies enabled us to develop sensory profiles of the prototypes at an early stage of the process. In addition, we gained out-of-the-box type of feedback on the feasibility phase of the NPD process, thanks to which we were able to balance the roles of the disciplines in prototype development.

In a real-life NPD situation, we would recommend continuing sensory profiling with real consumers. In our pilot project, we made the decision to combine consumer sensory tests of the prototypes with semi-quantitative consumer studies. We will present these studies next.

### 3.2.5 From cross-functional prototypes to prototypes validated with end user feedback

The last step in our approach to integrating end user understanding into a technology-originated NPD process is to validate the launch potential of the prototypes with a semi-quantitative end user study (please see Figure 13).

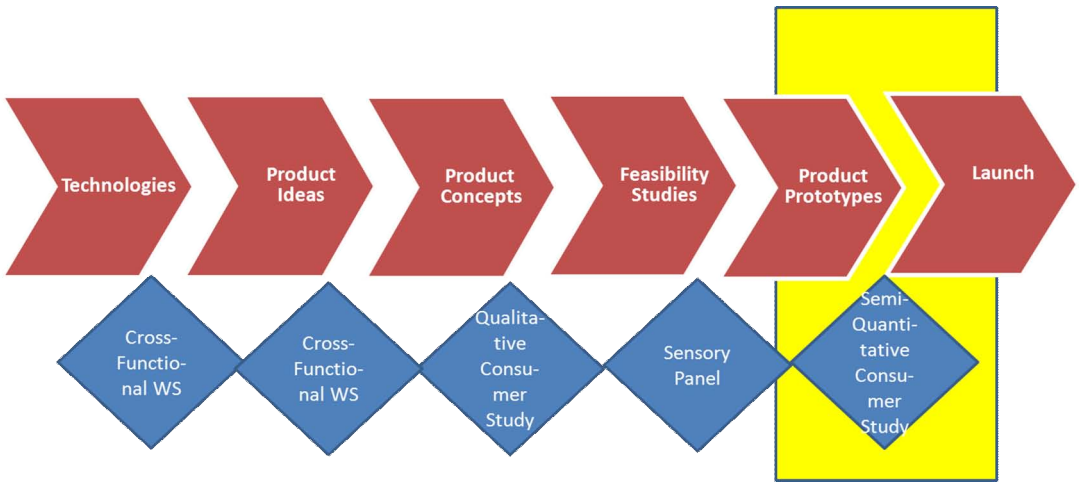


Figure 13. Semi-quantitative consumer studies as a tool to validate the end user launch potential of the prototypes.

We propose that the launch decision should be based on end user study results. These results should validate whether the prototypes can potentially fulfil the criteria of the end users before a decision is made to go ahead with market launch. If the end user study – done properly with sufficiently deep consumer research expertise – does not support the launch, the company should not go further in the process.

In our semi-quantitative end user study, we used a perceived quality and value framework in a comparative context to validate the launch potential of the developed prototypes. We will next describe our methodology and present some of the key results of this study.

#### 3.2.5.1 Study methodology

We based our study methodology on theoretical consumer decision-making models and thereby sought to rigorously put the concepts to the test before launch. By using this kind of approach, we wanted to challenge the prototypes and make sure that they do not gain support too easily (keep in mind that quite a number of new products fail in the market).

We decided to examine perceived quality, perceived value, perceived price and buying intentions in our end user studies. We reinforced our measurements with sensory profile evaluations. Furthermore, we adopted a comparative logic for the study in order

to be able to analyse how consumers evaluated our prototypes in comparison with suitable reference products in the product category.

We wanted our study to be quantitative in its orientation so that we would avoid problems associated with too small, skewed and unrepresentative sampling. Due to budgetary reasons, we limited our number of respondents to around 40 consumers per prototype. This is why we call our study a semi-quantitative consumer study.

We would like to say a few words about the quality of consumer studies. Some researchers say that consumer studies are affected by so-called common method variance, meaning that the results can be explained more by the research methodology (approach) than by real phenomena (e.g. the real interest of consumers in buying the product in question) (see, e.g. Podsakoff et al. 2003). If this is true, one should pay more attention to consumer study methodologies in order to gain an understanding of real consumer behaviour. We tried to operationalize this in three ways in our study: our study is based on relevant consumer behavioural theoretical concepts, we developed our instruments on the basis of scientific articles and we operationalized a comparative product category logic. In the case of the latter, we based our reasoning on a real consumer behavioural context; most of the time, consumers make their choices in product categories in which alternatives are available.

Here is a summary of our methodology.

Concepts and measures

**Sensory (so-called hedonic) measures** (see e.g. Stone & Sidel 1993)**:**

Please familiarize yourself with the smell, structure, appearance and taste of the product. Then please indicate the following aspects of the product:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Taste | Unpleasant | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Pleasant |

**Attribute evaluations:**

Please evaluate the following attributes and indicate how well these fit the product:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Unhealthy | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Healthy |
| Unsafe | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Safe |

**Perceived quality:**

Please evaluate the overall quality of the product:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Overall quality | Very Poor | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Very good |

**Perceived price (measured as reference price):**

Please indicate what in your opinion would be a suitable price for this product (a one-litre package of orange juice / 420 g package of frankfurters):

**€ 0**------0.5------1.00------1.50------2.00------2.50-----3.00------3.50-----4.00-----4.50-----**5.00 €**

**Buying intention**

Please indicate your willingness to buy this product:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| I would never buy this product | 1 | 2 | 3 | 4 | 5 | 6 | 7 | I would buy this product regularly |

Sampling

In the selection of consumers for the study, we ensured that they were real consumers of the product category in which we intended to introduce the prototypes. In other words, they consumed orange juices or frankfurters. We balanced our sampling with a personal information questionnaire (age, gender, occupation, etc.) that the participants filled out online before the real study.

Exposure

Each consumer evaluated two products during the study session. One of these was a prototype and the other was the reference product. Half of the respondents evaluated the prototype first and half of the respondents the reference product first. At the start of the studies, the respondents were given the first sample without any information and were requested to evaluate its sensory profiles. Therefore the sensory profile evaluations were based on sensory exposure alone.

After evaluating the sensory profiles of the product, the respondents were exposed to information and asked to answer questions regarding the attribute, perceived quality, perceived price and buying intention. Information exposures were as follows:

- β glucan-rich orange juice:
  - This is an orange juice with pulp and added oat fibre.
  - This juice is rich in fibre. Two decilitres of this juice contain three grams of oat dietary fibre. This amount of fibre equals one 25-gram slice of rye bread or a two-decilitre portion of oat porridge.
- Reference orange juice:
  - This is an orange juice with pulp, like Valio Bahi or Tropicana. The juice does not contain dietary fibre.
  - Foamed meat mass frankfurter:

- This is a new light frankfurter. A serving portion of this frankfurter includes the same amount of energy as normal light frankfurters. This portion has 30% less energy than normal Class A frankfurters.
- This product is made of pork meat and does not contain chicken meat or potato flour, unlike normal light frankfurters.

o Reference frankfurter without added air:

- This is a normal light frankfurter like Atria or HK light frankfurters. A serving portion of this frankfurter includes 30% less energy than the same portion of normal Class A frankfurters.

Next we will present our data (Table 9).

Table 9. Sample Demographics.

| | **Subgroup: β glucan-rich orange juice** | **Subgroup: Foamed meat mass frankfurter** | **Total** | |
|---|---|---|---|---|
| | **n** | **n** | **n** | **%** |
| **Gender** | | | | |
| Man | 18 | 19 | 37 | 43.5 |
| Woman | 24 | 24 | 48 | 56.5 |
| **Age group** | | | | |
| 18–35 | 17 | 17 | 34 | 40 |
| 36–50 | 15 | 14 | 29 | 34.1 |
| 51–65 | 10 | 12 | 22 | 25.9 |
| **Education** | | | | |
| Elementary school | – | 3 | 3 | 3.5 |
| High school | 9 | 8 | 17 | 20 |
| College degree | 9 | 9 | 18 | 21.2 |
| Lower university degree | 11 | 7 | 18 | 21.2 |
| Higher university degree | 13 | 16 | 29 | 34.1 |
| **Occupation** | | | | |
| Student | 6 | 2 | 8 | 9.4 |
| Worker | 11 | 9 | 20 | 23.5 |
| Lower clerk | 12 | 15 | 27 | 31.7 |
| Higher clerk | 11 | 12 | 23 | 27.1 |
| Director | – | – | – | – |
| Entrepreneur | 1 | – | 1 | 1.2 |
| Retired | – | – | – | – |
| Other | 1 | 5 | 6 | 7.1 |
| **Family type** | | | | |
| Single | 11 | 7 | 18 | 21.2 |
| Two adults | 19 | 17 | 36 | 42.3 |
| One adult and child(ren) | 3 | 2 | 5 | 5.9 |
| Two adults and child(ren) | 9 | 17 | 26 | 30.6 |

Next we will summarize our key results. First we will present the orange juice prototype results (Figures 14–16) and then the frankfurter results (Figures 17–19).

### 3.2.5.2 Semi-quantitative consumer study results for the prototypes and their reference products

**β glucan-rich orange juice**

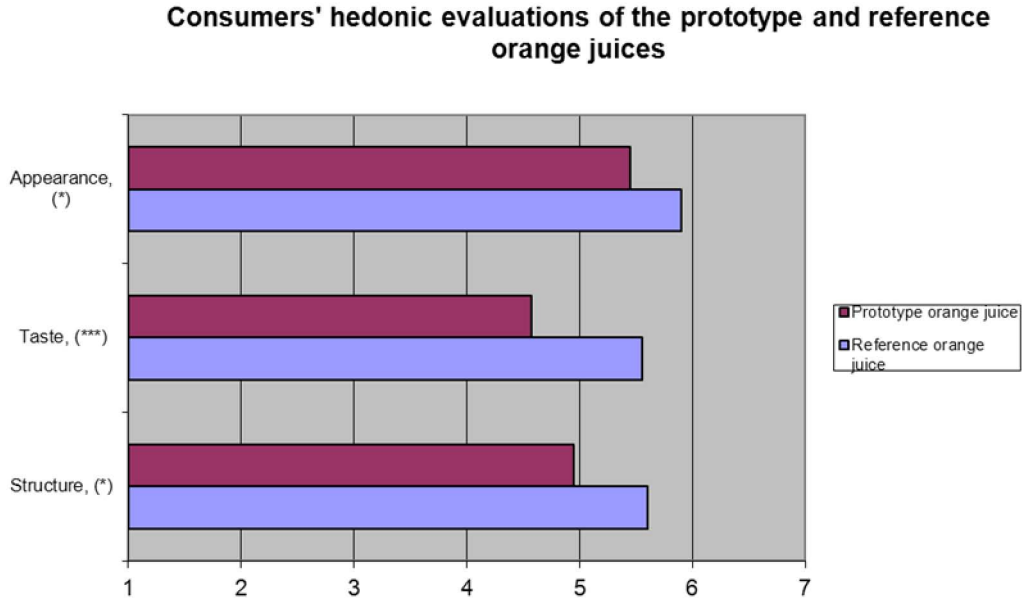


Figure 14. Consumers' hedonic evaluations of the prototype and reference products. Before information exposure. n = 42, ***; $p < 0.001$, **; $p < 0.01$, *; $p < 0.05$, ns not significant. 1–7 scale, where 1 is low.

By hedonic evaluations we refer in this case to a group of variables covering a wide range of information concerning how well the consumers like the product; sensory researchers sometimes call these the workhorse of sensory research (see Moscowitz et al. 2006).

From Figure 14, we can see that β glucan-rich orange juice received a score of around 5 on a scale of 1–7 in terms of its appearance, taste and structure, meaning that it got reasonably high scores. It received the best score for appearance and the lowest for taste. These scores are quite good, taking into account that we needed to complete prototype development a bit too early in our project (see earlier).

Comparing the results for the prototype with a premium product in this product category, in this case Valio Bahi, we can see that the evaluations are significantly lower in hedonic liking. Taste is particularly different, at a level of $p < 0.001$. The reference product received a mean score of 5.5 for taste and the prototype product 4.5. To conclude this section on the results for hedonic liking in our study, we could say that although the results are promising, the prototype might not currently be able to compete

with premium products in terms of its sensory profile. Therefore, we would recommend that the sensory profile of the prototype be developed further before proceeding to launch. Next we will analyse consumers' decision-making criteria more broadly, and see whether these cognitive measures provide more support for launch.

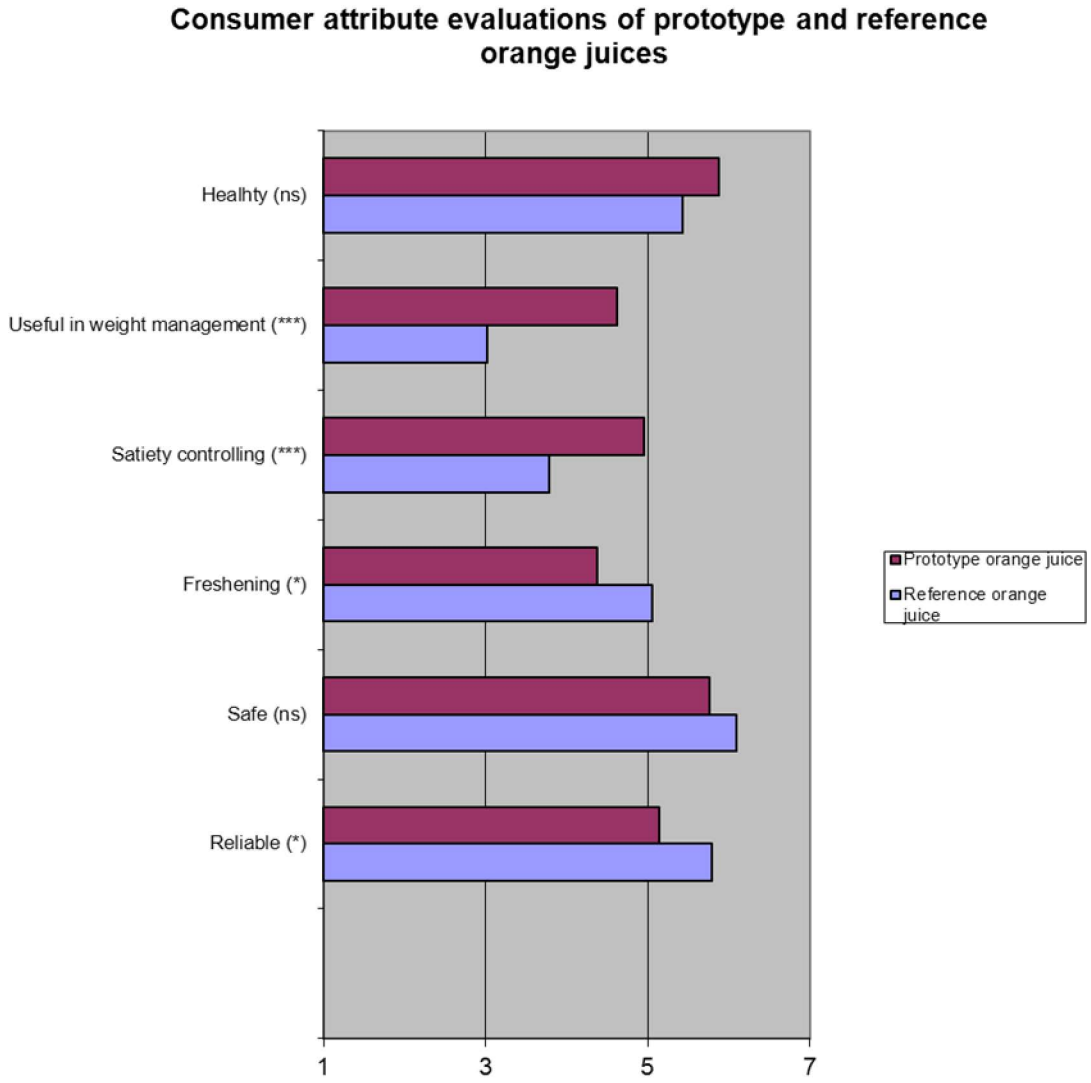


Figure 15. Consumers' attribute evaluations of the prototype and reference products. After tasting the product and information exposure. n = 42, ***; $p < 0.001$, **; $p < 0.01$, *; $p < 0.05$, ns not significant. 1–7 scale, where 1 is low.

In the attribute evaluations (Figure 15), the prototype received the highest scores for healthiness, safety, reliability and satiety. On these attributes, the prototype received scores between 5–6 on a scale of 1–7.

Fibre information exposure (together with sensory evaluation) influenced consumer evaluations positively and in the right direction because the consumers rated the prototype as being better than the reference product in controlling satiety and usefulness

in weight management. Evaluations of the healthiness of the product also improved, but the difference was not large enough to be statistically significant.

The prototype was evaluated as being poorer than the reference product in terms of refreshingness and reliability. Safety also received a lower score.

To summarize the attribute evaluation results, we can state that they indicate moderately positive market opportunities.

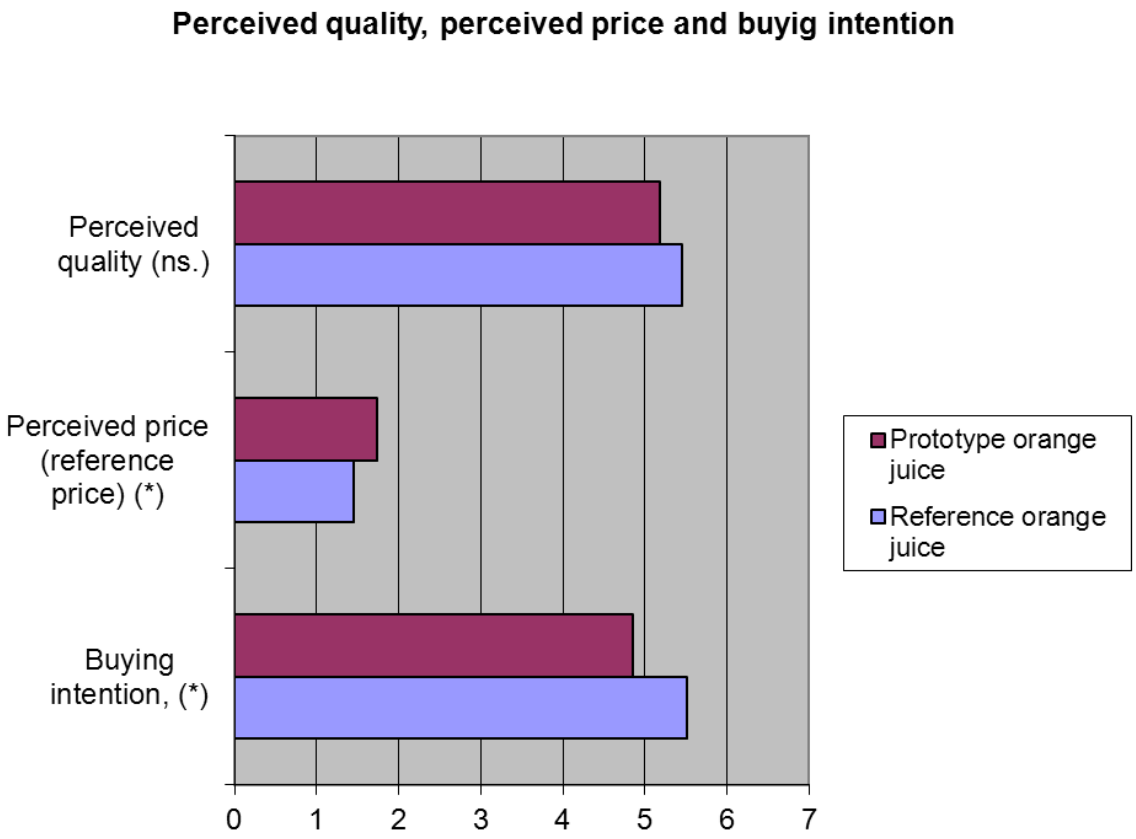


Figure 16. Consumers' key summative evaluations of the prototype and reference products. After tasting the product and information exposure. n = 42, ***; p < 0.001, **; p < 0.01, *; p < 0.05, ns not significant. 1–7 scale, where 1 is low. Reference price scale 0–5 € per litre.

When consumers evaluated the subjective quality of the prototype (Figure 16), it scored slightly lower than the reference product. They gave it a score of about 5.2 on a 1–7 scale. This indicates good potential, and the difference with the ppremium product in the product category was not significant, which is a very good achievement for a prototype. Considering that the results in sensory profiles were previously poorer and some of the results in the attribute evaluations were contradictory, one could say that this is a surprisingly good result. This means that consumers' first summative perception evaluation in the decision-making process is promising. Furthermore, this indicates the potential of the conceptual content of the prototype (fibre-rich content of thicker orange juice, please note information exposure).

Perceived price evaluation (Figure 16), measured as the reference price for the prototype, is slightly higher for the prototype than the reference product. The difference in reference prices is 13%. This result favours the launch of the prototype, too.

The final and most critical measurement in our approach, the measurement of buying intention, is 4.8 for the prototype (Figure 16). The reference product received a score of 5.5 for buying intention, which is a reasonably good figure and indicates sales potential. The difference in buying intention between the prototype and reference is significant. Buying intention, which theoretically correlates well with practical consumer behaviour, is most probably negatively impacted by the sensory and attribute profiles of the prototype.

To sum up the semi-quantitative consumer study results concerning the fibre-rich orange juice, we could say that the prototype has promising potential, but more prototype development is needed before one would be able to realize this potential in the market. Some attribute evaluations are promising, such as satiety, as well is perceived quality measurement. That said, some of the attribute evaluations, such as in the case of refreshingness, and especially the low sensory profile evaluations and lower buying intention measurements indicate that, in our view, further development of the prototype is necessary before going to launch.

**Foamed meat mass frankfurter**

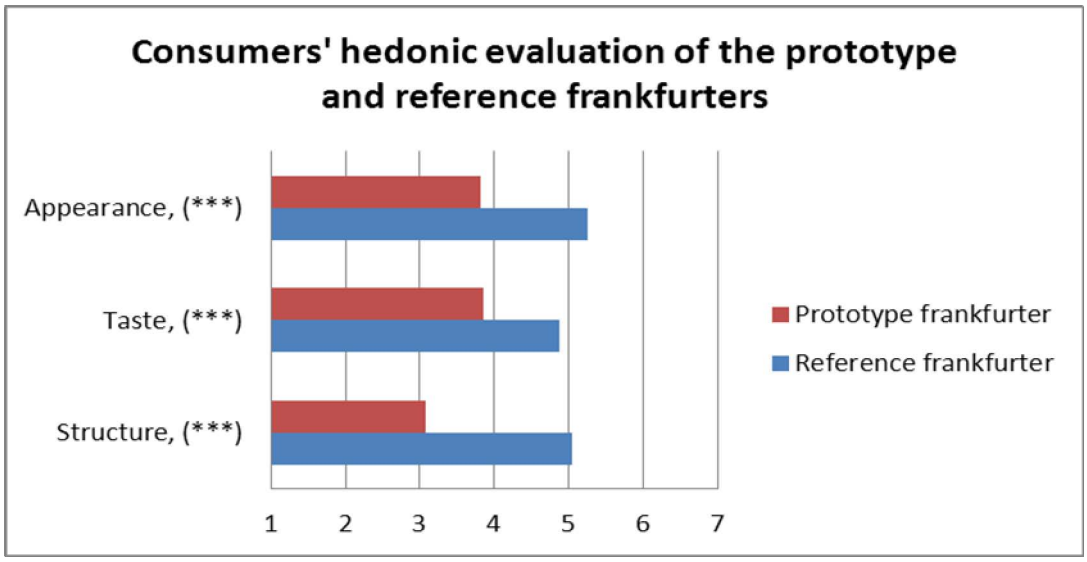


Figure 17. Consumers' hedonic evaluations of the prototype and reference frankfurters. Before information exposure. n = 43, ***; $p < 0.001$, **; $p < 0.01$, *; $p < 0.05$, ns not significant. 1–7 scale, where 1 is low.

In the case of the hedonic parameters (Figure 17), the prototype frankfurter received scores between 3–4 on a scale of 1–7, which meant that the evaluations were not satisfying. The low ratings indicate that the consumers did not like that much the sensory aspects of the prototype. The reference product (Atria Ltd light, 8% fat frankfurter) received a better score, with a mean score of 5 in each parameter on the same scale. All sensory profile differences between the prototype and reference products were significant on a level of $p < 0.001$. All these results indicate that the sensory parameters of the prototype should be developed before going to launch.

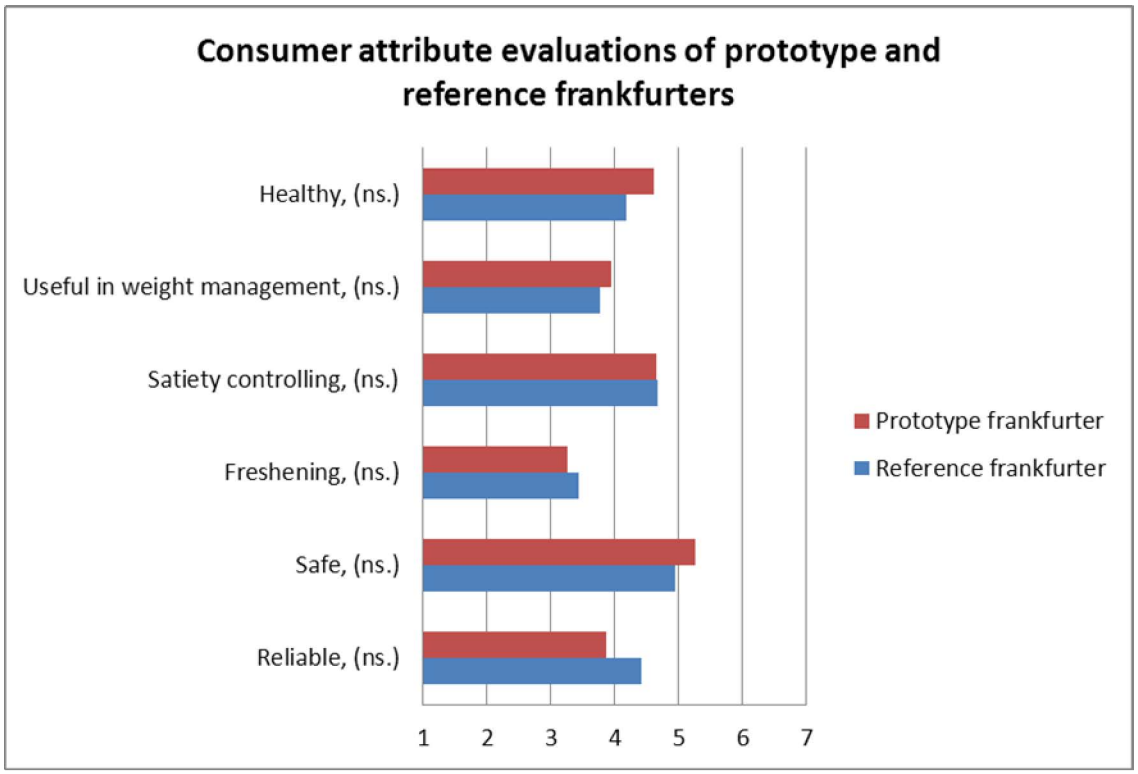


Figure 18. Consumers' attribute evaluations of the prototype and reference frankfurters. After tasting the product and information exposure. n = 43, ***; $p < 0.001$, **; $p < 0.01$, *; p 0 < 0.05, ns not significant. 1–7 scale, where 1 is low. (Please note that some attributes, such as refreshingness, are not very relevant for frankfurters, but were used to compare scales over product categories in the pilot project.)

Attribute evaluations do not differ between the prototype and reference product (please see Figure 18).

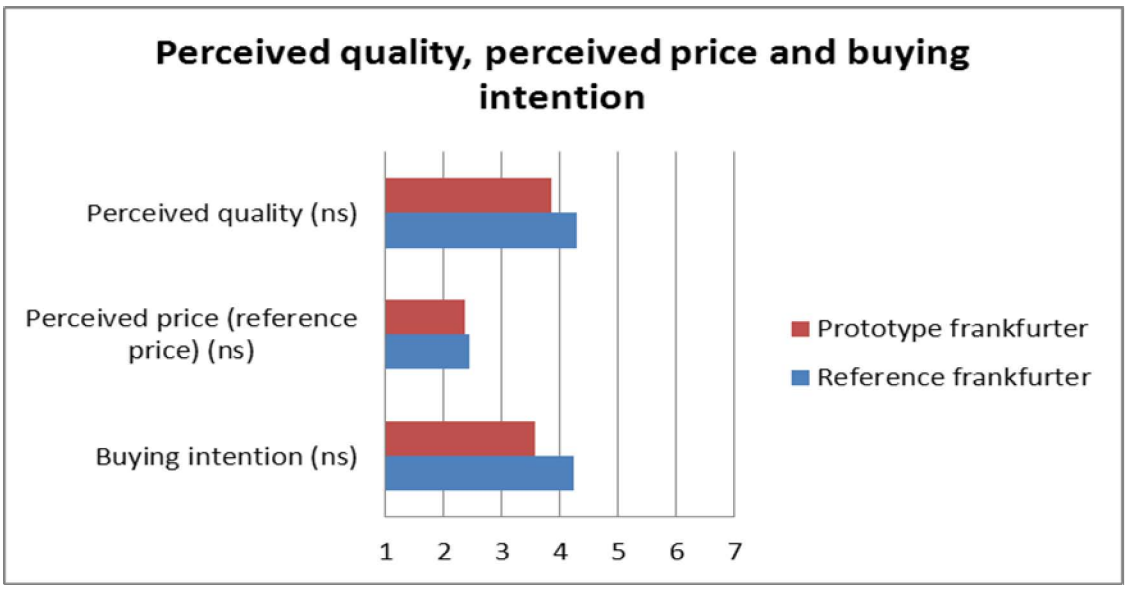


Figure 19. Consumers' key summative evaluations of the prototype and reference products. After tasting the product and information exposure. n = 43, ***; $p < 0.001$, **; $p < 0.01$, *; $p < 0.05$, ns not significant. 1–7 scale, where 1 is low. Preference price scale 0–5 € per kilo.

All summative evaluations (Figure 19) are slightly higher for the reference product than for the prototype. Perceived quality evaluations of both the prototype and reference products were around 4 on a scale of 1–7, indicating that both samples were evaluated as being merely satisfactory in terms of subjective quality perception. Reference prices did not differ from each other. Buying intention towards the reference product was slightly higher, but not significantly different from the prototype. Buying intention for both products is merely satisfactory.

To sum up the consumer evaluations of the prototype, we first have to acknowledge that the sensory parameters need to be developed before going to launch. All of the measured sensory profiles were significantly lower for the prototype than for the reference product. The rest of the measurements – attributes and summative measures – were roughly at the same level for both the prototype and the reference product, but prototype evaluations to the direction of lower values. These all together indicate that the prototypes should undergo further sensory parameter development and after that taken back to new quantitative consumer study to see would summative measurements be turned to higher level than reference product. Sensory parameters should be rated as 5 or better on a scale of 1–7, thereby decreasing the risk that the product would fail on the markets due to consumers' negative reaction to its sensory aspects.

# 4. Conclusions

The aim of this paper was to introduce an approach for integrating end user understanding into technology-originated NPD processes. In this paper, we focused on end user understanding due to the low success rate of NPD processes, meaning that new products fail more often than they succeed on the market. In our view, one of the major reasons behind the low success rate is that organizations do not understand end users deeply or broadly enough.

We introduced a five-step approach to integrate end-user (consumer) understanding into technology-originated NPD processes. Each of these phases is stage-specific in the NPD process.

We started our approach with a cross-functional workshop to generate product ideas from technological opportunities. When technologies have been developed to a certain stage, there is a need to broaden expertise to cover disciplines other than technology. According to international studies, the other key disciplines include marketing, sales and market research. We introduced cross-functional workshops as a tool to develop end user-oriented product ideas from technological opportunities. We noted that it would be necessary to operationalize several aspects in workshops. In addition to the areas of key expertise that should be represented in the workshops, there should be a clear focus on developing consumer-oriented product ideas, and good leadership. That said, the workshop practices should encourage all participants to contribute and prevent any specific area of expertise from dominating the work.

The second phase in our approach was end user-oriented product concept development. In our approach, we recommended the use of cross-functional workshops for this purpose, too. When the product concepts are easy enough for the end users to understand, this work could be supported with real consumer participation in the process, such as via internet forums. On these forums, consumers could discuss and develop product ideas. The major task in the second stage was to develop product concepts further so that the product descriptions could be honed to be more specific and elaborate and to ensure that they described the key attributes (added value) of the products in an end user-oriented way.

The third phase in our approach was to carry out qualitative consumer studies of the product concepts. In our view, if one aims to call the process end user-oriented, end user participation in the process should begin no later than in this stage. In this phase, end user studies should be very open, broad and deep in their orientation and should try to understand end users' existing cognitive structures with regards to the product attributes and suitable product categories. Studies should use discussions with the aim of gaining a deep and broad understanding of the end users with minimal exposure from researchers. Projective methods could be used to reveal unstated consumer preferences and thoughts. The study should be oriented to facilitating the further development of product concepts to better fulfil end user criteria's. In our pilot project, we supported the focus groups with internet discussions where consumers discussed the concepts, with a consumer researcher serving as a moderator.

The fourth phase in our approach, which is specific to food product development, was sensory profile development during the prototype phase. We used the traditional method employed in food product development: the professional panel approach. We received good results from the panel work, but would nevertheless recommend continuing sensory profiling with real consumers, as it can provide direct and real consumer feedback and thus increase validity and reinforce the panel results.

The last and critical phase in our approach was semi-quantitative consumer studies. Such studies should yield positive end user evaluations of the prototypes. One should proceed to launch only once the results are positive. We mentioned that if a product is launched without having received positive results from a consumer study, the product is geared more towards fulfilling the company's strategy or other disciplines rather than the needs of end users.

In this study, we recommended the use of well-balanced samples where demographics are in line with the population. In addition, we recommended paying attention to the usage of the right theoretical concepts and instruments in the study to ensure that the results will reflect consumer decision-making processes and behaviour. The concepts we used in our pilot were sensory profiles, product attributes, perceived quality, perceived price and buying intention evaluations.

In our approach, we adopted an orientation where the emphasis on end users should be increased the closer the project gets to launch. However, end users should also start participating in the NPD process at an early stage, preferably in the product idea development phase. If the product ideas are very complicated, consumer participation should start from product concept development.

In our view, increasing consumer understanding is a very promising means of seeking to improve the success rate of NPD processes. Currently, consumers more often hesitate not to buy new products, especially in the case of groceries. Our conclusion is that we do not understand consumers well enough. To improve our understanding of consumers, we should increase investments into consumer insight in the NPD process. In this paper, our aim was to introduce a practical method for doing this.

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