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# What design can bring to the food industry

## ABSTRACT

*Even though designers are specifically trained to create and build new products, their contribution to innovation in the food industry is relatively small. The industry seems unfamiliar with the ways in which designers operate and may be unaware of the added value they may provide. Therefore, this article identifies the potential roles that designers could fulfil within large food companies. The development of new consumer products requires knowledge of target consumers, production technology and the business environment. These three types of expertise are often concentrated in different departments. Although highly experienced product experts such as culinary chefs may be able to integrate this knowledge, involving designers may be a more fruitful strategy. First of all, designers tend to approach design challenges holistically, which broadens the scope of the project. As a consequence, designers will provide more innovative solutions, which can guide multiple project aspects simultaneously (production, packaging, marketing). Second, designers shape their own tools, which will engage the others involved. Third, designers are equipped to manage the product development process and can facilitate cooperation between the disciplinary experts. Fourth, designers can play a role in bringing together and integrating the knowledge from the different disciplines. By strengthening these roles, large food companies can deliver innovations that address actual consumer needs, provide a positive contribution to society and consolidate long-term profitability and growth.*

*For designers, foods represent interesting prototyping materials, which are firmly rooted in daily, cultural practices and can be enjoyed through all the senses. Their regional, seasonal and perishable character challenges designers to connect consumers with agriculture, trading and processing methods.*



## KEYWORDS

innovation
food industry
designer
chef
holistic approach
tools
facilitation
sustainability

## INTRODUCTION

At a recent meeting in New Zealand, I decided to try a scone with my afternoon tea during the break. Because I am relatively unfamiliar with scones, I was eager to study its taste and to explore its texture. But I had to be very careful with my exploration, because the scone could crumble easily. Since it was covered with powdered sugar and the scone contains quite a lot of fat, I was afraid to spoil my clothes with stains. I immediately saw the design challenge here: enable consumers to spontaneously explore and enjoy scones, without becoming embarrassed by dirty clothes.

I talked about this challenge to one of the other guests, and he suggested that the food industry could solve my problem by adding an ingredient to the dough, which would make the crumbs stick together so that the scone would not fall apart on my clothes. I can imagine that many innovation projects in the food industry may start off like this: identifying a consumer problem and trying to solve the problem by finding a technological solution. However, adding new ingredients to the scone recipe might also alter its crunchiness and overall texture, and this type of solution could possibly deteriorate the sensory qualities of the product. Furthermore, if changes are made in the scone recipe, it might break with the culinary conventions, and we may wonder whether the new product is still a scone.

I realized that if I would tell this anecdote to a designer, he or she would probably tackle the issue differently and might come up with totally different solutions. Typically, design projects start out from ill-defined problems (Cross 1984, 2000), and the first stage of a project involves an exploration of the available design space, while attempting to define the limits of the design task (Dorst and Cross 2001). Although in the case of the crumbling scone the problem seems well-defined, the consumer problem is not directly related to the food product itself: the essence is that the consumer feels uncomfortable in a social setting if his clothes get stained! Therefore, possible design solutions might also involve a scone package that can retain all the crumbs that fall off the scone, a piece of cutlery that facilitates the eating of scones, or a coating that can be sprayed on clothes to prevent them from getting stained. Some of these solution directions can be picked up by the food industry; others could be developed through cooperation with external partners, while another category does not fit with food companies and might be picked up by other entrepreneurs.

Even though designers may carry a great potential to increase the innovative and competitive powers of the food industry, they seem to have played only a limited role in food development processes thus far. In this respect, it is exemplary that a group of food scientists who edited a book entitled *Food product design: An integrated approach* described food product design as 'a technological activity based on science, engineering and social sciences' (van Boekel and Linnemann 2011: 19) without dedicating any role to designers. In the current article it is my aim to convince food company managers of the added value designers can have for the food industry. My appeal is mainly directed towards the larger food companies, because they play an important role in providing people with foods in major parts of the world and they are likely to have the resources to hire specialized professionals to develop new products. In addition, the amount of people that depend on large food companies for the majority of their diet is likely to increase, given that more and more people live in cities all around the world (Fresco 2012).

As part of the current study, I have interviewed seven professionals who are involved in food design and innovation: three independent designers who work with the food industry, three academic researchers who study food innovation and one senior employee from a major food company. All interview participants were female and ranged in age from 30 to 50 years. Their cultural backgrounds were Dutch (five), Finnish (one) and Turkish (one). Five were trained as designers, and among the other two, one was trained as a food scientist and the second as a nutritionist. The interviews focused on determining the added value that designers may have for product development in large food companies, and the conditions that determine whether this potential can be unleashed. Over the course of these interviews I developed the current framework. Parts of this framework were discussed in the later interviews, in order to check whether the interviewees supported my conclusions. Quotes from the interviews are shown below with respondent numbers between parentheses.

In the present article, when I mention food products I refer to products for human consumption as they are typically sold in stores and in markets. This may concern the physical food product, with or without its commercial packaging. Food design projects, however, may often concern more than designing the food product itself, such as changes in the production system, a consumption ritual, a product display, a website or a marketing campaign.

Below, you find a summary of the topics discussed in the interviews, supplemented with links to the relevant literature. I start out by discussing the challenges faced by product developers in the current food industry, followed by an overview of the current and potential roles of designers in large food companies. Also, I try to identify reasons why companies may hesitate to hire designers. Subsequently, I take the opposite perspective by discussing topics that make the food sector interesting for designers.

## CHALLENGES IN CURRENT PRODUCT DEVELOPMENT PRACTICE IN THE FOOD INDUSTRY

For the development of new consumer products, at least three types of knowledge are essential and need to come together: (1) knowledge of the technologies needed to produce the product; (2) knowledge of the business, such as the company strengths and weaknesses, the brand portfolio, the product assortment, company strategy, competitors, distribution channels and the market environment; and (3) knowledge of the consumer or – more precisely – the future customer; this may involve knowledge of current consumer needs, but also understanding of the latent needs, which are not yet fulfilled by current offerings, and consumers' expected responses to societal trends and developments. The potential for the success of future innovations is likely to increase with the development of expertise in each of these areas (Figure 1).

Several challenges can be identified, which will affect the success of the product development process.

### *Challenge 1: Develop products for the future*

Any product that companies develop now will be introduced in the market at some later point in time. Therefore, the product should be developed for a market that is still partly unknown: future customers who live in a world that

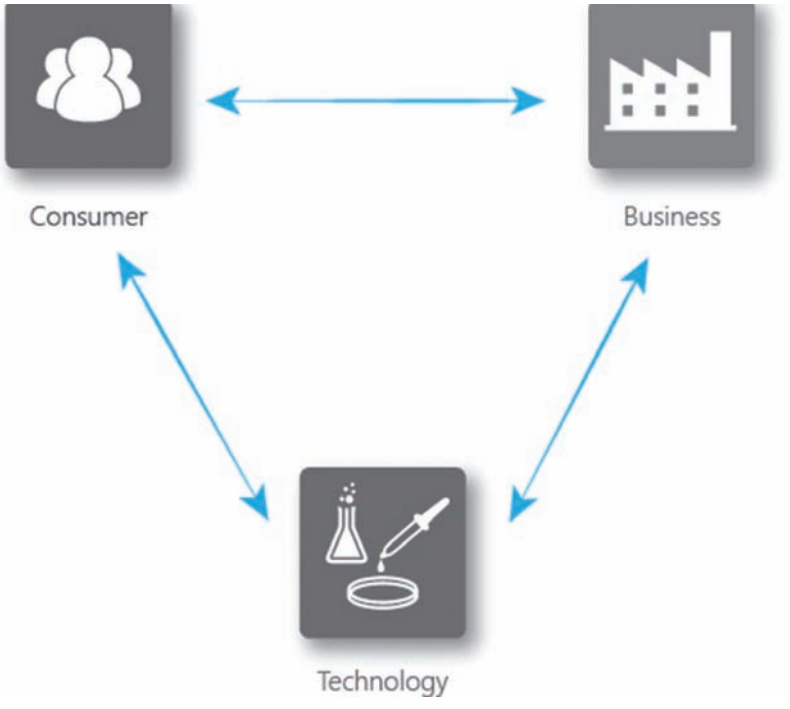


*Figure 1: Essential fields of expertise for new product development.*

will probably look like the present one, but may nevertheless be quite different in some important respects. Hence, it is important to develop sensitivity for current trends and developments and to have a thorough knowledge of universal human needs in order to develop successful innovations (Hekkert and van Dijk 2011).

### *Challenge 2: Cooperation between disciplines and departments*

An important challenge of the development process is to bring together and integrate the knowledge from the different expertise areas in order to obtain a cross-fertilization effect. In larger food companies the expertise areas that are needed to create new food products (Figure 1) are typically distributed over multiple departments. The technological expertise is typically concentrated in the R&D department, whereas business expertise is concentrated in the Marketing and Finance departments. Consumer expertise may be part of the Marketing department, but it can also be concentrated in a separate Consumer Insights department.

The cooperation of the different expertise areas is one of the major challenges in the food development process, because the experts from different areas have been educated in different scientific disciplines, which follow different rules, have different customs, use different terminologies and may prioritize different values. People from different departments may have specific, stereotypical ideas about each other, which block cooperation (Dougherty 1992). Typically, marketing has the lead in innovation, but R&D

has to provide the technology to produce the final products. If the departments do not cooperate optimally, potentially interesting ideas will not be developed further because they are not supported by the whole team. This topic has been identified as the R&D-Marketing gap, and has yielded substantial interest in the management literature (e.g., Griffin and Hauser 1996; Song et al. 1996), including the food development literature (e.g., van Trijp and Schifferstein 1995; Viaene and Januszewska 1999; Grunert 2015).

### *Challenge 3: The integration of expertise*

In order to create new products, insights from different fields of expertise need to come together. In some product areas, specific employees or external experts may play a central role in the development process, because they are able to integrate the different expertise areas. These people should have sufficient expert knowledge of all the relevant areas – technical expertise, consumer insights, company processes and the business environment – and they should be able to take these all into account when developing new concepts. This role may be fulfilled by the company owner in a small company, or by a trained technical expert with feeling for commercial opportunities, such as a culinary chef, or a coffee, tea or beer expert.

> The chef knows his target markets very well: the consumers, their local culture and its usage rituals. He can come up with innovative ideas for changes that consumers are likely to appreciate.
>
> (R7)

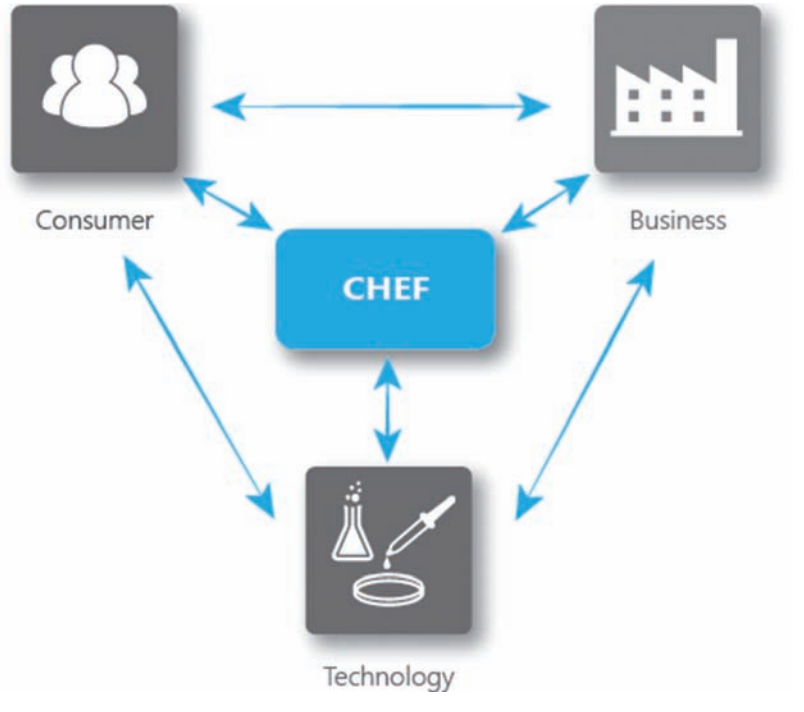


*Figure 2: The integrative role of chefs in the development of culinary products in the food industry.*

For the development of new culinary products, food companies can make use of trained chefs (Knorr 2015) who have sensitivity for picking up developments in local cuisines and can develop new recipes, which will appeal to a significant consumer segment (Figure 2). These dishes are then transformed into tasty products, which can be preserved, shipped and stored for a longer time, produced on a large scale and can be easily prepared and consumed. The chef's working experience inside the company will enable him to judge which types of recipes and products can be manufactured in the company, and which types of products will fit into the product portfolio.

### *Challenge 4: Making the right decisions along the way*

Because developing and bringing a new product to market is a costly process, with costs increasing exponentially along the way, another challenge for managers is to make the right decisions during the development process, determining which projects to continue and which to stop. To enable company management to make informed go/no go decisions for innovation projects, food companies often perform consumer tests in various stages of the process (Moskowitz and Saguy 2012).

## CURRENT ROLES OF DESIGNERS IN THE FOOD INDUSTRY

Up to now, the role of designers in the food industry has been fairly limited. Nonetheless, some large food companies have hired external design agencies on a project basis. Especially now that companies have started to expand their focus from the quality of the physical product to the usage context, the consumption experience and the meaning of the product in everyday rituals (Schifferstein 2010), food companies have started to develop products that improve the way in which their foods are prepared, served and experienced.

For instance, the beer company Heineken has hired design agencies NPK and dBOD to not only develop a new bottle but also to design a new glass 'Ellipse' in line with the restyled Heineken identity for the Dutch hospitality sector (DBOD 2010). In addition, Heineken has cooperated with Krups – a producer of domestic appliances – and design agency NPK to develop an apparatus to tap fresh draught beer in the consumer's home: the BeerTender (NPK 2015). More recently, Heineken and Krups worked with designer Marc Newson to develop this product's follow-up: the Sub (Heineken 2014).

Comparable examples from the coffee sector include the Dutch coffee brewer Douwe Egberts, who worked with domestic appliance producer Philips and the design agency WAACS to develop the Senseo coffeemaker with its characteristic coffee pads (WAACS 2015). Likewise, Nestlé developed new coffee-brewing technologies for their Nespresso machines with the accompanying coffee capsules. In addition, Nespresso appointed Austrian glassmaker Riedel to develop their 'Reveal Collection' glasses (Figure 3) to further improve their sensory coffee experience (Nestle 2014).

In cases where food companies have hired designers as internal staff, the designers have mostly joined the packaging design department. Packaging protects food products from external influences such as insects, microorganisms, moisture, air and light during transportation and storage (Robertson 2013; Dekker 2011). In addition, it provides information about the product, its origin, how to use it, its ultimate consumption date and so on. Furthermore, the packaging provides brand information, which is generally

*Figure 3: One of the glasses in Nespresso's Reveal Collection designed by Riedel (courtesy of Nestlé Nespresso S.A.).*

combined with an attractive image trying to attract potential customers (Rundh 2009; Klimchuk and Krasovec 2012). Therefore, food packaging forms an essential part of the food product in a retail environment. Besides doing 3D packaging design, these internal designers may be involved in graphic design for the package or in the communication design of verbal messages.

The examples of cases in which designers have been involved with the food industry thus far indicate that they have typically worked on products *associated* with the food (package, container, appliance) but not on the food itself. Because the food industry is in need of new and innovative products (Moskowitz and Saguy 2012) and designers are specifically trained to create new concepts and build new products, the role for designers in developing food products could be larger than it is at the present day. Current designers may be trained in many different areas within the design discipline, including graphic design, industrial design or interior design. However, given that the first food design educational programmes are of recent date, I assume that most designers are relatively unfamiliar with using foods as materials. If in the future more design students are explicitly trained in using foods as materials, their value for food product development will likely increase.

## THE POTENTIAL VALUE OF DESIGNERS FOR THE FOOD INDUSTRY

Designers can add important activities to traditional food development processes. I have grouped their possible contributions under four different headings, related to content, form and process:

1. Widen the scope of projects
2. Shape tools to engage others
3. Structure and facilitate cooperation among team partners
4. Expertise integration

## WIDEN THE SCOPE OF PROJECTS

> Often a company does not know exactly what they want when they approach a designer … so it needs to be tailored … It starts with this first stage. If you can get that clear, then it affects everything that follows … At the start you need to be so sharp.
>
> (R2)

Traditionally, the start of a design project is a brief provided by the company. However, the question described in the brief often does not cover the entire problem. The design problem generally needs to be reformulated, sharpened, redefined and reframed (Dorst 2015; Hekkert and van Dijk 2011). This elaborate process of problem setting is also partly instrumental in terms of coming up with a solution for the problem (Dorst and Cross 2001; Cross 2000). In many disciplines, people analyse the past in order to understand the underlying mechanisms, and they try to extrapolate their findings in order to say something sensible about the future. However, designers have learned to search for possibilities in different ways (Lawson and Dorst 2009).

> Their perspective was very much product-focused and that was the main challenge within this specific company. For designers it is not news that you shift your focus from a physical product to the interaction with the product and to the user … but for them this was already big news. To bring this news to the company in a way that they could adopt it, was also something that was our responsibility.
>
> (R4)

Whereas company employees tend to focus mainly on the products they make; designers generally take a more general, holistic view on the issues at stake and start analysing the whole system of factors and stakeholders that is relevant to the product. Designers tend to zoom out in order to see the bigger picture (Brown 2008). We saw this already in my anecdote on eating scones with which I started the article. In the case of food design projects, they may expand the design challenge from the physical food product to its packaging, or to the way in which people interact with the product, including the way they open the package, the actions they perform on the product, the gestures they make, how they put it in their mouth and how they chew and swallow it (e.g., Lemma et al. 2012).

Instead of focusing on one particular problem, designers develop different perspectives on the problem, and will look for underlying reasons in order to find inspiration for their design process (Brown 2009, 2008). They may adopt a historical perspective trying to determine why the product is eaten the way it is. They may look at the role the product fulfils in a culture, or they may try to determine the political consequences of changing the product. Designers are likely to identify a large number of stakeholders, and the intense discussions among people with very different viewpoints are likely to create additional insights. Furthermore, designers may dive into the production process, not only to evaluate technical and manufacturing issues but also to consider social interactions among workers who produce the product, and to determine the effects of waste streams on the local environment.

In order to come up with new ideas and solutions, designers tend to look for sources of inspiration instead of focusing on the past or the

current situation. In the area of food design, the search for inspiration and the attention for variety becomes evident – for instance, in the eight areas of inspiration that eating designer Marije Vogelzang (2009) describes: psychology, culture, senses, nature, action, science, technique and society. Alternatively, Stummerer and Hablesreiter (2013) provide insight in the diversity of actions, objects and customs that people involve in eating by studying and exaggerating the various aspects of eating situations. In search for definitions, Francesca Zampollo (2015) has specified different types of design activities related to food: design about food, design with food, design for food, food space design, food product design and eating design.

*Figure 4: Presentation of ice cream during the ICE-AID project (Fisker and Olsen 2008).*

The project ICE-AID (Fisker and Olsen 2008) was developed by Aalborg University in collaboration with local food manufacturers, external designers and Food College Denmark. It uses the combination of food and design to draw attention to and create a debate on global warming. The ICE-AID concept consists of high-quality ice cream served at festivals and events in a bowl-like cube of clear tap water ice, which is placed directly on the consumer's hand. The direct pain due to the melting ice covering your hand as you eat the ice cream is intended to generate a direct experience of the painful consequences of our contemporary energy-consuming lifestyle.

By showing variety in tools, situations, approaches and areas of inspiration, these authors widen designers' perspectives on food and eating as design topics.

> In food design, I think that … you combine multiple elements, so you get inspired by nature, culture, science … technology … It depends on what is important for a certain topic … I like to cross boundaries, I think. (R2)

What may help in increasing the diversity of aspects that will be considered is the fact that designers are trained to become good observers: they have an eye for details that others may overlook. These details may concern small aspects of user behaviour, or details of a particular product. Although these details may not seem of primary importance at the start of the project, these details may become important later on, during the design of the final product, and they may have an important impact on the final user experience (Valtonen 2005).

> Product designers, they can keep people sharp … [Their added value is to] connect, renew, and inspire. And with inspire I also mean that they keep on asking critical questions. (R3)

The broadened perspective designers bring into the food companies has consequences for the way in which data are gathered in user research. If the focus shifts from the product to its usage context, consumer insights can no longer be gathered at a central research facility, but should be gathered in people's homes in order to observe their everyday interactions in the context of their own living environment (e.g., Moskowitz and Saguy 2012; van Trijp and Schifferstein 1995). For instance, the availability of other types of chairs in the home may have consequences for how people sit, and their posture affects the way a food will be consumed. This also opens up the route for ethnographic research investigating the roles of particular foods in people's everyday lives, including symbolic meanings, personal memories, family traditions and rituals (e.g., Mintz and Du Bois 2002; Mennell et al. 1992).

> I developed insight for innovating the meaning and value of milk. One of the rituals that turned out to be very engaging … [It employs] a set of china cups to serve two different milks next to each other, from two different farms. They are shaped to drink in a kissing, tasting and comparing manner … The focus is aimed at the high quality finesse in the milk, brewed by the farmer, the cows and from the local ground and grasses … This ritual creates a new basis to perform R&D on dairy product development, the way to shape the chain from farmer to consumer, and a new story based on the product in marketing and communication. (R6)

The benefits of food design projects may not be limited to the introduction of innovative consumer products. The projects could also stir up discussion inside and outside the company about important business themes addressing the role of food production in society, including ethical issues, good wages and working conditions for employees in the developing countries, the world

food and water supply and so on. These discussions can inspire and ignite new innovation projects, which may be of strategic value to the company's future. As a consequence, products developed through this approach will not be anonymous commodity goods: designers create unique and coherent product identities, which distinguish them from competitive products.

> By visualizing it, by giving it identity, placing it in another context, you help creating discussion on the topic [of imperfectly shaped vegetables] … My statement is: Is this how nature grows? That is what you want to trigger.
>
> (R2)

## SHAPE TOOLS TO ENGAGE OTHERS

> Being embodied designers, we dare to step into a project naïve and uninformed, hence open for novel insights … We are eager to experience and to create unexpected angles. We work though experience and imagination, rather than cognition, thoughts and language. We involve the physical feel and influence of culture … We appeal to people's subconscious experience and pride, and simultaneously let them engage with that to open perspectives.
>
> (R6)

Designers bring creative energy to a project, because they have an open mind for learning new things; they want to become inspired and they want to be inspiring to others. They may bring some lightness to the seriousness of the project. In general, designers know how to engage people in the process. Designers are doers: through continuous cycles of planning, creation, reflection and decision-making they keep the project going and engage their co-workers on the way. Their creative skills support the design process throughout by creating multiple tools (Valencia et al. 2013).

In the problem definition stage of the process, designers may try to stimulate discussion by providing inspirational booklets with related information. Or they may decide to organize a lunch displaying recent food trends in cooperation with a chef, instead of giving a slide presentation. During the gathering of information, designers can construct and modify their own research tools. Hence, they are not restricted to the traditional verbal questionnaires and interviews, but can design sensitizing packages that stimulate users to document their personal stories, engaging apps that alert users at specific points in time to answer questions, appealing answer forms with pictograms that stimulate respondents to provide various types of information, and so on. In addition, they can develop tools (e.g., card sets) that stimulate discussion during focus group sessions (Sanders and Stappers 2012; Mattelmäki 2006). In the creative stages, designers may actively involve other team members in the creative process and turn meetings into a co-creation session, by bringing markers, post-its, pictures and various types of prototyping materials.

> For every single session, we made sure that we had nice visuals, we did drawings with them, sometimes co-creation … Designers take it in a serious way, but also a bit lightly … That really works out well

> in such a big, serious company setting. You always stand out as this crazy, energetic person, but still you deliver in the end and that is what matters, right?
>
> (R4)

Designers are also trained to present product concepts in a rich and engaging way. Besides communicating their idea verbally, they can create sketches, drawings, computer animations, videos and 3D models. This way of presenting makes a lot of abstract aspects more tangible and provides many details that otherwise would have been forgotten (de Vries 2015). Such a multimodal presentation is more likely to engage the staff members who work on the project and to inspire and persuade company management to invest in the project (Calabretta et al. 2014). To update and involve more company workers

Ozkaramanli et al. (2013) show how creative design research can generate rich new insights for food product development and the accompanying rituals. They developed Emotion Capture Cards, which worked as a two-stage experience-sampling tool. In the first stage, consumers reported their emotions that occurred while preparing and serving afternoon tea, while in the second stage participants were interviewed to deepen the understanding of the concerns underlying these emotions. The researchers looked for potential conflicts between different concerns as opportunities for product innovation. For instance, the conflict between 'I want to experiment with new recipes' and 'I want to serve food that expresses care and expertise' was resolved by developing a series of packaged products that the user could finalize herself through experimenting with different fillings, toppings and shapes, hence allowing for a personal touch with little room for failure.

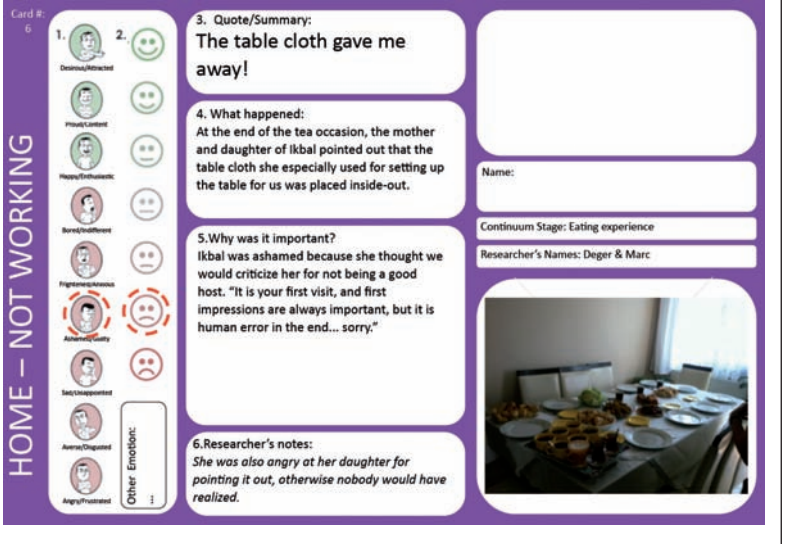


*Figure 5: Example of an Emotion Capture Card (Reprinted with permission from Ozkaramanli et al. 2013).*

with the project, designers may also create small items that are distributed in the entire company.

> In these final presentations, it always helps to have ideas or concepts already drawn … It really helps the presentation, to bring out why these insights are important … If you don't have people who can create those types of visualizations in a short time, you talk insights but not outcomes.
>
> (R4)

Companies can use the visualizations and 3D models in consumer tests, the results of which inform management decision-making in the different stages of the food development process (Moskowitz and Saguy 2012). However, using consumer evaluations to screen concepts is rather tricky from a methodological point of view, because ideas in this stage are not yet fully developed and respondents may not be able to form a good impression if concepts are not presented in a realistic way. Hence, interesting ideas may not be fully appreciated, because consumers are unable to imagine the product's future use. In addition, any uncontrollable changes in the physical, legal or social environment after the test will decrease its predictive power (Moore 1982; Dickinson and Wilby 1997).

After the preferred design direction has been chosen, the concept needs to be transformed into a physical manifestation. Designers are specifically trained to create physical objects, for which they may involve support from internal or external technical experts. By creating prototypes, designers not only contribute to defining what a product should offer consumer but also start shaping the way in which this benefit is offered to the consumer. In this stage, the company may want to conduct consumer studies that focus on the optimization of specific product aspects, such as a specific mouthfeel, colour contrast or shelf life. The first variants may be tested in a laboratory setting, while further developed prototypes can be evaluated in home use tests (Lawless and Heymann 1998) in a proof-of-concept study. In all these consumer tests, the validity of the outcomes largely depends on the quality of the prototypes that designers have made.

## STRUCTURE AND FACILITATE COOPERATION AMONG TEAM PARTNERS

In order to keep on track, it is important that project partners meet on a regular basis, and that the company gives direction to the innovation process. Designers provide added value here, because they have insight in the underlying design processes and are able to keep an overview of the whole project (Calabretta et al. 2014). They can recognize the general principles and systematics from other projects they have worked on. In addition, they may be able to determine who in the team is useful at which moment in time, because they know how different people can benefit the most from each other. In addition, designers can act as guardians of the qualities of the product concept (Walsh and Roy 1985): they should make sure that the original intentions and qualities of the product concept are maintained throughout the many iterations and changes in the design, and should take the design to the next level. When a project is passed onto another department, they need to make sure that the qualities one department has been working on with great effort are not lost along the way.

> The main role for me was to bring these insights together, because these people, on a daily basis, in that specific company, they didn't really talk to each other. And when they did talk to each other, there was a lot of friction, specifically between R&D and Consumer Insights … They wanted to focus on very different parts of the product development process, and it was really difficult for them to speak the same language and come to a common ground. The friction came mainly from who was going to get more of the budget for their activities.
>
> (R4)

Because each design project is different and requires different types of expertise, designers are used to communicating and cooperating with specialists from many different disciplines. In addition, if they develop their skills to facilitate creative and constructive processes in multidisciplinary groups, they can enhance interdisciplinary cooperation, and can help to bridge the gaps between the disciplinary boundaries, so that the qualities of each discipline can fully contribute to the final design (Valencia et al. 2013; Blaich and Blaich 1992; Kleinsmann and Valkenburg 2008; Calabretta et al. 2014). Technical product developers may not fully understand an idea from marketing, while marketers may not identify a technological idea as an opportunity. A designer may be able to pick up the ideas from either department and translate them into engaging concepts, which are supported by the whole company. Designers have enough knowledge of the different disciplines to speak the different languages (Valtonen 2005) and they can explicate the value of each contributor to the project, and thereby enhance mutual feelings of appreciation.

> Being a design thinker and a designer at the same time really helps to speak these different languages and know when somebody is useful. For example, the team leader he is very talented in bringing all these people together, but after they are in the same room … Who is going to pay attention to what and how you are going to manage different expertise, that is something a designer can really do well, how to benefit from each other … Being a glue, putting things together from different perspectives, that is what I could bring.
>
> (R4)

External designers may have an advantage over internal designers in fulfilling this role, because they are used to working with many different partners and have worked on innovation projects in a large variety of contexts. External designers constantly need to adapt their way of working to the companies they work with, which asks for considerable flexibility. External designers have the advantage that they are relatively naive with respect to previous company projects, and bring in a fresh, new perspective on daily matters. In addition, they may not feel restricted by any procedures and ways of working that have developed over time, or by the disciplinary boundaries that separate departments and that block creativity within the company.

## EXPERTISE INTEGRATION

In the previous sections, I have indicated that designers can play a central role in food innovation, by gathering information about a project from various perspectives and on multiple levels, by managing the innovation process and by

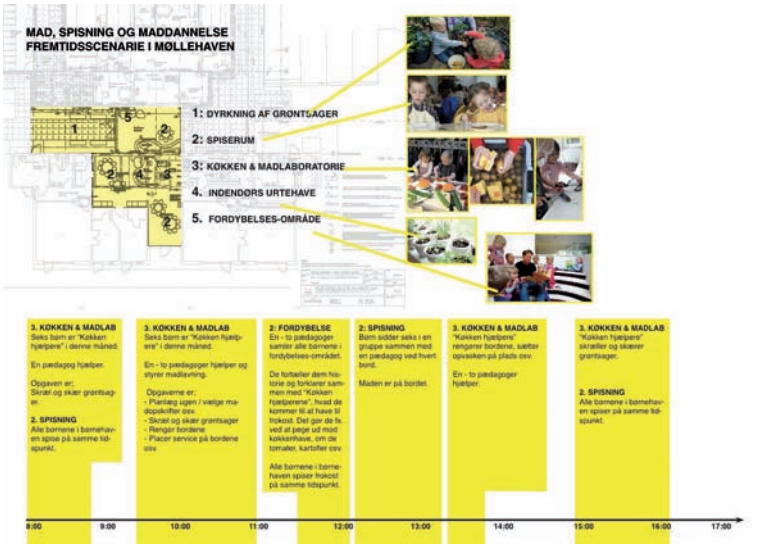


*Figure 6: Template illustrating how customer journey mapping, the kindergarten floor plan and inspirational images are brought together (Hermannsdottir et al. 2013).*

Hermannsdottir et al. (2013) performed a case study in Danish kindergartens, which was focused on transforming food and eating from a passive into an active activity. To understand how food and eating related to the pedagogical activities and the daily routines in the kindergarten, they introduced customer journey mapping. With this tool they developed a future scenario for the daily routines during one single day. The scenario was used as the basis of a design for a new building, by relating daily activities to the architectural floor plan, and by showing inspirational images for the different spaces on the template. This template served as an important tool to bring the views of kindergarten pedagogues, architects and design researchers together.

facilitating cooperation between the various project partners, and by developing tools that support information gathering, team creativity, team cooperation, communication and decision-making. Given this central role, I would like to propose that designers might take over the role of traditional chefs in integrating the different types of company expertise in food companies. This conclusion may not be surprising, given that the defined competencies for chefs and designers are in fact quite similar (Bruns Alonso et al. 2013). Indeed, designers tend to see themselves as gatherers and integrators of information (Bohemia 2002) and by continuously developing and updating proposals on the basis of the feedback received during meetings, they play a crucial role in integrating the demands of different stakeholders and in achieving balance between potentially conflicting demands (Valencia et al. 2013; Beardsley 1994; Calabretta et al. 2014).

> In the way I see it, the designer who works with food is a kind of connector between farmer and mother – a mother who feeds her

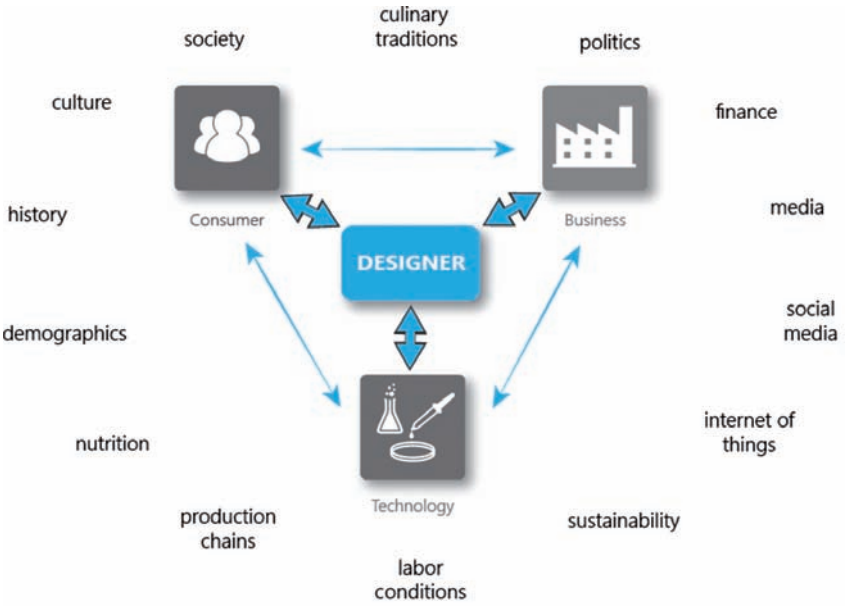


*Figure 7: Role of the designer in food innovation.*

> child –, or a politician and a transporter, or someone who owns a factory and [a quality inspector], and the designer stands in the middle, and he is none of these specialists, but he understands what all these people think and do. And he can make a creative step, so he uses his design thinking to transform this situation.
>
> (R1)

Figure 7 now depicts the designer as the main integrator between information from the different disciplines. Although the chef is no longer explicitly included in this representation, designers may work closely together with chefs as culinary experts in developing recipes for the foods that are part of the design. The broadened scope of the innovation project is visualized by including various fields of interest surrounding the focal topics related to consumer, business and technology. This collection of adjoining fields is by no means complete, and may be expanded in future versions. The arrows connecting the designer to the three focal topics have been thickened to emphasize that the designer is likely to be more dependent on the expertise from the different basic disciplines and is likely to work more closely together with these disciplines than a chef would do.

> The chefs have a much more applied focus in their work. Their briefing should be concrete and precise, without abstract, fuzzy language.
>
> (R7)

I think that designers are able to outperform a traditional chef in terms of food innovation, because designers bring in new expertise and knowledge from different disciplinary fields through their experience in previous projects. This allows for extra creativity, a wider view and more innovation. Designers are less immersed in one specific food culture than a culinary chef

and may feel connected to several other cultures. Also, it is important to realize that designers typically focus on optimizing the end user experience, whereas employees may become fixated on what is directly interesting for the company. Therefore, designers are likely to come up with ideas that provide more added value for the target consumers.

*Figure 8: An analogue version of the Melkwegen tool: Integrating information on production, distribution and consumption of milk in the region (courtesy www.demelksalon.nl).*

The design project De MelkSalon (The MilkSalon) aims to develop a novel, sustainable culture for one of the most nutritious products in the Netherlands: milk. By offering new ways of handling milk at specialized events, various stakeholders can experience new future meanings and values of milk and dairy, arising through novel interactions with it. As part of this project, the design tool Melkwegen (Milkyways) (Klooster et al. 2015) was initiated to reconnect the city of Amsterdam with agricultural production in the grasslands of its region. For over 300 years, milk was transported on special boats (melkschuiten) from the villages to the city. Around 1900 Amsterdam had specialized cafes (melksalons) where people could drink local milk. These cultural, social and scenic connections with the villages were lost when centralized factories took over milk collection, processing and distribution. To re-establish these connections, the project initiated a social media platform where geolocation and user input were used to construct a map displaying milk farmers, transporters, consumption outlets, historic sites and so on. This map will form the starting point for a twenty-first-century-style dairy cooperative that stimulates direct routes (milkyways) between citizens, entrepreneurs and farmers.

## FACTORS THAT MAY HINDER THE EMPLOYMENT OF DESIGNERS IN FOOD INDUSTRY

In the previous sections I have sketched the remarkable potential that designers have for augmenting food innovation processes. This immediately prompts the question: Why did the large food companies not hire more designers thus far? Why did they not give designers a more challenging role? One reason may be that the food industry may be relatively unfamiliar with designers, the ways in which they operate and the added value they may provide to the company. Unfamiliarity might lead to the activation of stereotypical images of designers, for instance, of a person who uses mainly his own personal experiences as input for the design process and, thereby, disregards the wishes of target consumers, leading to unsuccessful products.

> The difficulty there is to really make them see that the designer is not someone who creates beautiful things with nice form and colour. They were really not prepared for this idea of a designer being a holistic thinker. And that, I think, is the real message.
>
> (R4)

The unfamiliarity of design in food companies is also exemplified by an anecdote from PepsiCo. Several years ago the CEO asked her staff to take pictures of anything that represented good design, but the result was very disappointing: many did nothing at all. When she started talking about design, people would typically refer to packaging features. Currently, design has a voice in nearly every important decision the company makes and teams are pushing design through the entire system, from product creation, to packaging and labelling, to how a product looks on the shelf, to how consumers interact with it. By increasing the role of design, the company has enjoyed steady revenue growth during the past nine years (Ignatius 2015).

Another reason for the limited role of designers in the food industry may be that the broadness of the problem exploration stage might make company management feel uncomfortable. In the first stages of the project, designers tend to talk about insights, interesting inspirational aspects, possibilities, but not about concrete outcomes. They need this freedom to be creative and innovative; otherwise their thoughts will become restricted. In contrast, the company tends to be outcome-focused, because employees have to deal with limited budgets and performance deadlines. In addition, it seems that some food companies have not yet fully embraced the values consumers find important, such as the subjective consumption experience, the product's role in cultural traditions and society at large, and issues of sustainability involving production, storage, transportation and waste disposal.

> I sensed that they were a bit scared of also using designers, because we are known as divergent thinkers … They were afraid that we were never going to be able to converge in two weeks … The company is very outcome-focused.
>
> (R4)

Hence, it is challenging for companies to keep an open mind for new possibilities and to grant designers the opportunity to exploit their freedom, while designers have to learn to deal with the restrictions of company culture. Designers may not fit in with the way product development is currently organized in many companies. For instance, the division of tasks over disciplinary

departments contrasts with the holistic approach designers tend to use. In addition, designers have to make sure that company collaborators fully support the product concepts they develop. Designers should provide information their company partners can continue with, so that the project does not stop as soon as the designer leaves the company building. In this way, the cooperation will be beneficial to both the company and the designer.

However, most of these aspects are valid for working with designers in general, and do not specifically apply to the food industry. Already in the 1980s, a substantive discussion started in the management literature on the strategic role that design can fulfil for manufacturing companies in general (Moody 1980; Kotler and Rath 1984; Lorenz 1990). This discussion seems to have grown consistently over the years, resulting in a more common use of design strategy in businesses nowadays (e.g., Nussbaum 2013; Martin 2009). However, this discussion seems to have had only limited effect in the food industry, even though some exceptions may be noted (e.g., Ignatius 2015). What could be the underlying reasons for the slow adoption of design processes in food product development specifically?

> A designer's nature is to be open-minded and curious to work with different sectors, domains and contexts. My experience is that the character of the food sector initially was rather closed: A highly complex sector with detailed expertises. Design comes in as a way to open perspectives or as a way to add aesthetics at the end of a development … However, having initiated works in the dairy sector for three years, the sector now starts to invite me as an expert in projects.
>
> (R6)

Lundahl (2012: 7) characterizes the food industry as 'historically slow to embrace change', suggesting that any changes will find their way into the food industry at a slower pace than in other industrial businesses. What may be relevant here is that many food companies evolved from family businesses in agricultural communities, in which the focus was on finding a market for products from local farmers, and not on innovation. Another aspect is that small changes in the production process of a food product may have large consequences for the company, because production volumes tend to be high, while profit margins may be low. Furthermore, production may be tied to strict government regulations ensuring food safety, implying large investments in new apparatuses and facilities with every small change. Therefore, experimenting with new product variants or fancy packages may be out of scope for many basic food brands.

> In our company you could say that about 85% of the projects is renovation, involving adaptations of existing recipes, whereas about 15% is innovation, where we work on a new product format or brand.
>
> (R7)

Moskowitz and Saguy (2012) also characterize product development in the food industry as a fairly slow process. These authors indicate that people's food habits do not change quickly and that food neophobia (Pliner and Hobden 1992) may affect their acceptance of new products. As a consequence, big innovations remain absent and development is quite relaxed. From time to time some new development emerges, such as microwave technology or another high potency sweetener, and the industry takes advantage of these new applications. This stands in sharp contrast to the computer industry,

where the size of chips decreases constantly, and new technologies such as Wifi and Bluetooth have opened up a range of new possibilities (Moskowitz and Saguy 2012).

Another reason why designers may have had limited impact in food product development may lie in the fact that the food product itself is perishable. Hence, any changes in the food itself or in the way people interact with it will mainly affect the moments where people consume the food, but will not be noticeable in the long term. On the other hand, when designers reshape associated objects like packages and tableware, buyers may continue to use them. Furthermore, if designers make changes in the food production and logistic system, such changes may also have a more long-term effect.

Although several authors have now suggested that a new approach to food innovation is needed, they have not explicitly filled in this role by recruiting more designers. For instance, Lundahl (2012) argues for an integrated and holistic approach to innovation, in which researchers use a mix of quantitative and qualitative techniques to gain insights in consumer experiences, and in which teams work in a multidisciplinary setting. He names his approach behaviour-driven innovation, without giving designers a central role. Moskowitz and Saguy (2012) see the need for an integrative, holistic, deeper thinking in food development and they argue for new organizational models in food business involving partnerships and strategic alignments with external parties. These authors do acknowledge that design should play a central role in new product development in the food industry, but they mainly focus on the roles that sensory, consumer and marketing research can fulfil in the new innovation process. Hence, I think that a re-examination of the role designers could play in food innovation is necessary to unleash their full potential.

According to Mauro Porcini, who is PepsiCo's Chief Design Officer (de Vries 2015), the new design function and its accompanying culture need to be protected by somebody at the executive level in order to be implemented successfully, because any organization tends to reject a new culture. The company needs to bring in design leaders with a holistic vision, who can manage all the different phases of design (including brand design, industrial design, interior design, experience design, strategy development) in a smart way. Furthermore, designers need to demonstrate quite fast that they have value for the organization: they need to find the internal projects that provide quick wins and endorsements from external parties to prove that things are moving in the right direction.

However, it is also important to acknowledge here that most designers are relatively unfamiliar with the food industry. Many design education programmes do not yet acknowledge food design as a discipline and do not provide the multidisciplinary curriculum that is necessary to work intelligently with food. Hence, designers who want to work with the food industry still need to acquire this specific expertise. They need to get to know the companies better and they could be more proactive in marketing their skills to provide solutions to the food industry. I will address the skills designers need to work with the food industry in a separate article (Schifferstein, submitted for publication).

## WHAT FOOD CONTRIBUTES TO DESIGN: POSSIBILITIES AND CHALLENGES

Although the present article has focused mainly on what designers can contribute to the food industry, it would be a pity not to look also at the opposite

perspective: to what extent can designers grow from working with the food industry? In this section, I discuss several ways in which working with food products or working with the food industry can enrich the design profession.

### *Prototyping material*

First of all, foods give designers access to an incredible amount of interesting prototyping materials. In many countries an abundance of food products is available at a relatively low cost. Hence, they provide an enormous wealth in textures, consistencies, shapes, colours and materials that show interesting transformations when they are cut, heated and moulded. Some designers have suggested adding foods as materials to existing material libraries (Lemma et al. 2012). Foods are interesting materials for designers in order to learn how to sculpt, build and shape objects, and to develop their sensory sensitivity (Ayala Garcia, 2015). Foods have many different properties, which present different challenges and provide different opportunities. Just try to compare the properties of fats and oils, dairy products, bakery products, meat, vegetables and fruits, or imagine what happens when you combine them.

Foods allow for a rapid, iterative process of developing concepts through preparing, cooking, testing, evaluating and adjusting. The familiarity of the material, the widespread availability and the possibility to adjust its properties through shaping, processing and cooking help to stimulate an embodied, hands-on approach in experimenting. In addition, by evaluating the sensory qualities of the end products, designers receive direct feedback on their manipulations. For instance, the shape of bread depends on the way the dough is shaped, following the baker's movements. Hence, this food product offers the possibility to relate movements of making to movements of eating. Furthermore, food offers designers the possibility to explore processes that are only partly under the designer's control. For instance, when making bread, the shape and texture of the end result is influenced by the rising process, which is dependent on gas production by living yeast cells (Bruns Alonso et al. 2013).

The familiarity of food as an everyday product allows designers to connect easily to their momentary and remembered personal experiences and to relate personally to the design topic at hand (Bruns Alonso et al. 2013). Because food preparation is always embedded in specific cultural practices, foods help in developing designers' sociocultural awareness, both of the designer's own culture and of unfamiliar cultures. It makes designers realize that designing in a specific context yields more concrete results than designing on a drawing table (Bruns Alonso et al. 2013).

### *Do-it-yourself materials*

Food products and their waste can also be the basis for new materials that designers can create themselves (Rognoli et al. 2015). These DIY materials allow designers to go beyond industrial and mass-customized materials in creating new materials with unique experiential qualities. They allow designers to experiment with material production techniques through hands-on material interactions and to create the recipes for their own materials. Such autonomous and independent production of materials enables designers to develop their own personal fabrication strategies, resulting in unique, custom-made products. In addition, these new material production strategies may enhance innovation in conventional material production companies, because

*Figure 9: Examples of 3D printed sugar cubes (courtesy 3D Systems).*

they provide opportunities for reconsidering the existing manufacturing processes (Rognoli et al. 2015).

### *3D printing*

Fast innovations occur mainly in the digital sector, where it is hard to make connections with food (Moskowitz and Saguy 2012), but some experts see a role for designers in the food industry with the introduction of 3D printing. It is already possible to print 3D food structures using basic materials, such as sugar, chocolate or pasta (Kytannen 2015; Sugar-Lab 2015, see Figure 9), but this production method seems inefficient for large-scale production in terms of material and energy use. However, that might change in the future, with the advancement of the technology. In addition, the characteristics of 3D printing techniques may hold promises for the creation of specific food structures that are hard to produce with other methods, such as the layered filament structures, which are characteristic of meat (Sher and Tuto 2015).

Although 3D food printing holds many promises that require further explorations, its role in the future food chain and its impact on the food industry are largely unknown. The 3D printer may develop in the direction of the food replicator, which we have seen aboard spaceships in the science fiction series Star Trek: an apparatus that can generate a food product tailored exactly to the individual consumer's needs and wishes (Sun et al. 2015; Sher and Tuto 2015). Currently, the first affordable food printers are already appearing on the market. This development holds promises for patients with very specific dietary needs, for people preparing foods in remote areas or under extreme conditions (e.g., the ISS space station, a polar expedition, a war zone), or for culinary chefs who would like to create very complex or unique food structures. The introduction of such a device will have major implications for the way in which the food production chain is organized and how food quality is assured.

### *Food aesthetics*

What makes foods remarkable as aesthetic objects is that people use all the different sensory modalities in the interaction with food products (Schifferstein 2006). Each sensory modality employs a different perceptual mechanism and


*Figure 10: HAPIforks in different colours (courtesy HAPILABS Inc.).*

responds to a different type of stimulus (Schifferstein and Cleiren 2005), but each modality also has its own mode of aesthetic experience. The laws that govern these aesthetic responses may be partly shared over modalities and are partly modality-specific (Schifferstein and Hekkert 2011), but they all contribute to the overall product evaluation. Hence, food products offer the unique possibility to engage with all the senses in creating aesthetic responses. And the more senses are involved in creating a unified impression, the more engaging that experience is likely to be (Bahrick and Lickliter 2000).

Up to now, the aesthetics of food has been mainly appreciated in the culinary arts: here we have 'haute cuisine', restaurant grading systems (Michelin, Gault & Millau), cooking and baking contests and so on. Recently, the fashion magazine Elle has also declared an interest in food by launching its new magazine 'Elle Eten' in the Netherlands (Elle 2015). Perhaps this indicates that the appreciation for the aesthetics of food is also likely to develop further within the design discipline.

### *Promoting behavioural change*

Current food and eating designers more and more also support behavioural changes among consumers, to improve a healthy lifestyle. For instance, designer Boguslaw Sliwinski created plates with drawings in order to motivate children to eat vegetables (Dezeen 2012). The HAPIfork (Figure 10) helps people to slow down during eating by monitoring how fast they eat and warning them if they eat too fast (Hapi 2015). Researcher Brian Wansink (2014) has published a book that provides checklists with which you can redesign eating environments in order to support weight loss. Each of these examples can inspire designers to provide solutions that promote healthy eating behaviour.

### *Seasonality and regionality*

Many food products are originally seasonal and regional products. Because plant growth depends on factors such as temperature, amount of sunlight, soil conditions and amount of precipitation, products of vegetal origin used to be available in a specific time of the year only within a certain geographical region. Likewise, many products of animal origin were seasonal. The availability of various products from domestic animals (e.g., milk, eggs) depended on the reproductive cycle and young animals were mainly born in spring. Furthermore, the presence of wild animals was dependent on seasonal migration processes.

> Did you ever realize that milk used to be a seasonal product, because calves were only born in spring? And did you know that the system of milk production is almost entirely separated from the production of meat, although dairy production naturally comes with meat production? … You can imagine that it creates quite some challenges to change that system and the infrastructure of production.
>
> (R6)

To extend the period of availability, the agricultural sector developed processing methods to preserve foods, such as heating and drying, fermentation or adding salt, sugar or acid. This resulted in canned and dried fruits and vegetables, beer and wine, cheese and yogurt, dried sausages and so on, which enabled transport and allowed consumption in other parts of the year. More recently, the agricultural sector and the food industry have tried to reduce the perishability of food even further and to make products available all year round. The agricultural sector has not only managed to optimize growing conditions, but has also been able to extend the growing period by employing different plant breeds and using greenhouses. Furthermore, it has increased availability through the improvement of storage facilities, by artificially controlling ripening processes, and by transporting foods over large distances. In addition, advanced heating treatments, cooling and freezing methods, irradiation treatments and packaging under modified atmospheres help to reduce the growth of micro-organisms and enzymatic changes (e.g., Zeuthen and Bogh-Sorensen 2003; Shafiur Rahman 1999). Supermarkets make use of the new technological possibilities by developing contracts with agricultural suppliers that specify the parameters their products should meet.

But have these changes in production, storage, transport and retail also improved the sensory and nutritional quality of the available food? My own experience is that in some cases the system has failed drastically. For instance, in my childhood in the 1970s, oranges and mandarins were only available in the Netherlands in wintertime, but they were juicy and tasty, and I really enjoyed eating them. Nowadays, I can buy these fruits all year round, but most of the time they are dry and tasteless, probably because they have been stored in climate-controlled cells for months before they reach the Dutch supermarkets. Also, the improved emphasis on production cleanliness and hygiene can have negative consequences for the processing of traditional agricultural products. For instance, the fact that the number of holes of Emmentaler cheese has decreased over the years seems to be caused by a more sophisticated milking process, which results in cleaner milk, whereas the formation of holes in the cheese during ripening is dependent on the presence of microscopically small hay particles (Guggisberg et al. 2015; Martley and Crow 1996).

Governments typically have developed rules defining the minimal standards that all products need to meet, and supermarkets may develop their own production standards for the fresh produce they buy and sell. However, because selling in a retail situation is largely dependent on visual impressions (Fenko et al. 2010), the supermarket criteria may be largely based on what makes products visually appealing and may compromise on criteria that are more important during food consumption, such as a rich flavour and an interesting texture. Hence, the increased emphasis on specific quality control variables has not always resulted in products that are better from a consumption point of view (tastier, healthier). This provides a number of interesting design challenges, which the food sector itself has not been able to tackle effectively.

### *Perishability*

If you start using food as design material, you will immediately notice that it is extremely perishable. Food quality literally deteriorates while you are working with it. Attracting (or losing) moisture, heat or oxygen can quickly ruin a tasty product. Hence, designers who work for the food industry need close cooperation with chefs, food chemists, microbiologists, physicists and other specialists to create new products that are relatively stable and easy to prepare. In addition, designers need to be aware that any mistakes they make can directly harm people, if foods become infected or polluted. This provides an interesting, new environment in which designers can sharpen their capabilities.

> Why not treat the vulnerability of food as a possible strength? The vulnerability of the product asks for a short chain from production to consumption. This requires consumers to become more connected to the way in which the food is produced, and provides them with direct evidence for the authenticity of the product.
>
> (R6)

### *Connecting production to consumption*

In the 1960s, many fresh products were delivered at people's homes. This created personal contact between consumers and farmers or grocers, who had expert knowledge on the products they sold. Nowadays, food distribution in western societies has largely been taken over by supermarkets, where there is less contact with the staff, and product communication is often restricted to package labelling. Hence, we have developed an efficient logistical system that may be good in handling and preserving the physical food product, but has also created a larger distance between the producer and the consumer.

The abundance of available food products in supermarkets in the western world has created the illusion that the presence of food is evident, and that there is no reason to be concerned about our food supply. Nonetheless, recent food scares (e.g., BSE, swine fever) and scandals (e.g., melamine in Chinese infant formula) make clear how vulnerable our food supply actually is, and that the availability of good food is a necessity that is by no means self-evident. Due to the large distance between food production and consumption, many consumers have only very limited knowledge of the products they consume. In contrast, modern media make it easy to obtain such knowledge in an instant, and to connect to people all over the world, who may be involved

in the production, processing and trading of the various products. Hence, the chances that producers can get away with bad circumstances under which products are produced are getting smaller and smaller. Therefore, it has become a necessity for food companies to take up their societal responsibility all over the world, to produce good quality products under good environmental and social conditions.

> Packaging designers could be more critical about what is being claimed in the packaging, if it gives false impressions about the product … There are rules about [what you can say in text], but if you communicate something with images, you can do quite a lot of things … Even though there are cows that are outside, that is not the reality where this milk is coming from … Maybe 100 years ago that was the case.
>
> (R5)

The traditional and authentic character of food products is often used as a main asset in food marketing campaigns (Autio et al. 2013), by presenting food in a natural environment, thereby implicitly referring to an unspoilt paradise (Fresco 2012). We can see this, for instance, in the vision of the popular Slow Food movement, which links the access to good, clean and fair food to the preservation of local food cultures and traditions (SlowFood 2015). However, even though a renewed interest in handmade, local products and small-scale production may be desirable and achievable for some of the relatively wealthy consumers in western countries, it is unlikely to yield enough affordable foods to nourish the majority of the world population. In addition, going back to small-scale production would ignore all technological developments that have made food production more efficient and have made food available to many people at low cost (Fresco 2012).

> It becomes some kind of romantic ideal, that your food can only be ok if you have your own vegetable garden. That is why I think science and technology are very important, because there are also solutions somewhere in between. Solutions that have respect for animal, plant, human and environment, but that are also appropriate for our current time period.
>
> (R1)

The increase in the worldwide travel seems to enhance consumers' interest in local cooking cultures, with restaurant visits, food fairs and cooking courses as new pastimes during holidays abroad (Harrington and Ottenbacher 2010; Hjalager and Corigliano 2000; Long 2004). In the line of these developments, we can see more television cooking shows that do not focus solely on food preparation but also on the production of ingredients and the local conditions under which they are produced. This asks for a design approach that is no longer solely focused on creating a particular physical product, but also on developing a system of production, processing and trading, which provides good environmental and working conditions for everyone involved, and on creating good and reliable customer service, which can provide all relevant information. Here lies a design challenge to create more transparency in the food chain, so that each consumer can find out where the product she buys was produced, and thereby re-establish the connections between production, processing, trading and consumption.

> We are working to make our products healthier and more sustainable, but we do not always communicate that on the package, because it may have a negative effect on consumer appreciation. It has become an integral part of our product development, but if you say that a product is healthier or good for them, consumers may think it is less tasty. Currently, we mainly put this type of information on the website.
>
> (R7)

## CONCLUSION

Although designers' current roles in large food companies are limited, they carry a considerable potential to improve food innovation processes. I have identified and discussed four major roles for which designers have trained specific abilities, which have added value for the food industry: to widen the scope of innovation projects, to shape tools in order to engage others, to structure and facilitate cooperation among team partners and to integrate the knowledge from these different areas. By strengthening these roles, food companies are more likely to deliver innovations that satisfy actual consumer needs, that contribute positively to society at large and that consolidate long-term company profitability and growth. By engaging more designers in food development, companies will not only improve company performance on objective variables, such as their return on investment, but more importantly on subjective variables, such as the degree of consumer engagement and brand equity, which enhance the viability of the company (de Vries 2015).

Conversely, working with foods offers multiple ways to enrich the design discipline by offering a rich set of prototyping materials, discovering a unique multisensory aesthetic and connecting designers with local cultures and social contexts. In addition, foods provide interesting design challenges to help consumers implement beneficial behavioural changes, to find engaging ways to deal with food perishability and to enable people to connect with the origins of their food: plants, animals, farmers, traders and so on.

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