Developing a wafer with customer amenity—an application of Kansei engineering

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Abstract

New food product development is so often confronted with failure in the market. One of the significant reasons is, nowadays, the customer preference is no longer simply only determined by a few factors rather a combination of various needs. This article presents an affective engineering methodology “Kansei Engineering” which can tailor the product by the customer need. This methodology is able to assist the food product developer to connect the consumer affection with the product properties in order to develop the food product with the most affective influence deep in customer’s mind associated with product. Using this systematic affective methodology “Kansei engineering” approach would help the company to develop the food with consumer amenity.
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Introduction

The new product development is believed to be an indispensible strategy that could assist the company to build the competitive advantage and achieve the sustainable profit in today’s fast moving consumer product industry. The food product innovation is advocated to help maintaining the growth of the company, control the market risk, and increase the competitiveness in the market (Lord, 2000). Nonetheless, being proactive in the food market is not an easy task. Despite the large amount of research, improvement in the product development and its process, most of the new food product developments end up with failure. Hollingsworth (1994) expresses the view that almost every year thousands of food products are introduced to the retail market and almost certainly extinct. This opinion has been confirmed by many other researches, even the most conservative estimates indicate that 40% to 50% of new products are encountered with the failure after introduced to the market place and this data does not include the product development failure before the market launch (Ernst & Young Global Client consulting, 1999). Moreover, if we define the new product as “the new to the world”, only 3-14% percent of the new product are successfully stayed on the shelves of the retailer for more than one year after market launch (Lord, 2000).

It is often debated by some researchers that the high rate of failure is mainly caused by slow rate of change in eating habit and preference and customer resistance to the novel food. However, is that the truth? In fact, the climate of the food market is changing faster nowadays than ever. The low fat food, sugar free, functional food, these new food concepts emerged in the market with the rapid proceeding pace of the people’s life quality. Even the environmental and sustainability policies may also bring the need to influence consumer’s food choice. Therefore, nowadays, the new food product development should take more concern on what the food could bring to the consumers rather than only fulfilling basic physiological need. The new food development, innovation, becomes more than a necessity (M.D. Earle 1997).

What are the factors most associated with a successful product development? From the studies
of Hoban (1998) in the USA, Kristensen and colleagues (1998) in Denmark, two common factors were found, market and consumer knowledge and retailer involvement. Moreover, they also indicate that the appropriate degree of senior management involvement will be useful for development process. And their research results as well imply a need for more research investigating the relevance of various in house and external sources of expertise for food product outcome. In another recent research papers of Barbara and Peter published at 2003, he argued that three out of six dominant factors associated with product success related to product concept or product idea while another three related to the communication with outside sources of expertise, including retailers, suppliers, food research centre. The expertise would assist to prevent and solve different problems that inevitably arise in food product development.

Some of the researchers believe that the customer led product development approach is able to assist the food company to reduce the risk to the lowest extent (Lord 2000, A.I.A Costa & W. M.F. Jongen 2006). Although a positive relationship between market-orientation and business performance has been established for several types of industries many years (Slater & Narver, 2000), not much is known about the level of application of market-orientation method in the food companies. In practice, most food companies rely on retailers to obtain information about their end-users. This leads to deduction that truly market-oriented food companies are still rare (Avermaete et al., 2004). Meanwhile, though the customer led product development process has been repeatedly advocated by many marketing and food technology experts, there is no concrete methodology established under this theory to guide the practical implementation (A.I.A Costa & W. M.F. Jongen 2006).

**Purpose of this study**

Based on these researches in food development realm, it is not difficult to find that for the food company, how to obtain the information and support from various sources internally and externally at the beginning stage of the food development and how to organize and analyze these information in order to serve for the generation of the new product fulfilling the need of
customer are two significant but not specifically solved problems. The first purpose of this study is that we will introduce a relatively new product development methodology in the food industry--Kansei engineering. Kansei engineering has already been employed in many other industries, such as automotive industry, home appliance industry, since the eightieth of twentieth century. However, no English literature or evidence in the food company has any record of its application in the food product development process. We believe, when comes to the food industry, that the Kansei engineering methodology could achieve the task by taking advantage of its capacity in collecting, organizing and analyzing massive information from various sources and its ability in terms of the effective interaction with consumers. Furthermore, how to apply the Kansei engineering for the food development will be demonstrated by an experimental study. The experimental study will take the food “wafer” as the object. The target customers and companies possessing the leading wafer brand will be involved in the information collection in order to make the result more reliable. Thus, the second purpose of our study would be the indication to the wafer developer what the most appropriate design properties would be.

**Background Information**

1. **The food development process**

Before we explore the food development processes, it is necessary to define what the new food product is. Some people may think that new food product should be the completely innovative and new product in the market. However, the new food product has a more broad definition in the real business world. Kotler and Armstrong (1991) conducted a longitudinal study about the new food development amongst a number of companies and, from the data collected, concluded that the majority of products launched by manufacturers could be aligned within one of the six categories shown below:

(1) New to the world products (10 per cent).

(2) New product lines: new products that for the first time, allow a company to enter an established market (20 per cent of the total).
(3) Additions to existing product lines: new products that supplement a company's established product lines (26 per cent of the total).

(4) Improvements in revisions to existing products: new products that provide improved performance or greater perceived value, and replaced existing products (26 per cent of total).

(5) Repositioning of existing products that are targeted to new markets or market segments (7 per cent of the total).

(6) Cost reduction: new products that provide similar performance at lower cost (11 per cent of the total)

According to the definition of the new food product, the new food development should be able to generate a new food product platform, derivatives of existing product platforms, incremental improvements to existing products or fundamentally new products. Considering different features of various new food product developments, there are many researchers trying to find one model suitable for all purposes and eventually, several models have been developed for the food industry.

Here, the model developed by MacFie will be illustrated as an overview how the food development process looks like. MacFie (1994) emphasizes the importance of time-scale in the new development time and proposed a seven-point development model:

a) concept generation;
b) concept screening;
c) product development;
d) product testing;
e) packaging development (including advertising material);
f) first production run; and
g) market launch.

The product development process introduced by MacFie (1994) is a fairly straightforward process. The first stage of the process is that of concept generation. This stage will involve a number of activities such as market trend analysis, brainstorming, competitor analysis etc. The second stage is concept screening which is carried out by both the development team and
the consumers. The consumers will participate at the estimation of the product concept or the actual product. Their input will assist the development team to do some statistical analysis so as to obtain the most proper product attributes or product concept. MacFie (1994) identifies the third stage as product development which he believes is fairly straightforward if all the preceding steps have been undertaken correctly and should entail simply completing the formulation parameters of the food product. Moreover, for food product, this stage should also encompass some form of sensory analysis, which may be undertaken by skilled members of the product development team. Product testing is the fourth stage and there are a range of activities including further sensory assessments, consumer assessment and instrumental testing. Packaging development, production run and market launch are the next three stages should be counted into the product development process. MacFie (1994) express the view that in the future the phases of product development will involve less practical work and make more use of computers with the use of databases and mathematical modeling, especially for the customer data collection and analysis, sensory analysis and the packaging development.

Though these new product development models differ in the number of stages and definition of stages, these models are still quite similar to each other. These differences are just the manner in which they have been named and how it appeared with the same contents (Alison Rudder, 2001). In addition, it is argued by many other researchers, such as Kotler and Armstrong (1991), that numerous iterations should occur at each step of the processes. And processes are not operated sequentially and instead, most of the operations are concurrent. The loop feedback mechanisms are among related stages in order to move the entire development forward together with shortened time and lowered risk.

**Literature Review**

1. **Methods Used**

For the purpose of studying customer eating and drinking behaviour and delivering what customer really wants, there are so many methods have been created and optimized in the
food industry. Here is the brief review of several commonly used methods in the food product development.

1.1. 9 point hedonic and unstructured line Scale

The 9 point hedonic method was formally introduced by Peryman, and Pilgrim (1957). They use the 9 points scaling to measure the customer acceptance towards certain food from “dislike extremely” to “like extremely”. Laying aside some negative concerns, such as unequal interval spacing, lack of freedom to elicit responses because of defined response category, central tendency, the 9 point hedonic method is still an important tool in customer testing (Lawless & Heymann, 1999). Unstructured line Scale is the extension of the 9 point hedonic scale. The difference between the unstructured and structured scale is whether all the specified descriptors are labeled on the scale. The unstructured line scale is more flexible in the situation that the descriptors on the scale are not easy to be specified in words accurately. Then we just to need to define the two ends of the scale with two descriptors, commonly with similar meaning as “most” and “least”.

1.2. Labeled affective magnitude

The Labeled affective magnitude (appendix one) is designed aiming at incorporate the advantage of magnitude estimation, visual-analogue scale and labeled category scale. It has the similar vas-liked scale where intensity descriptor labels. Meanwhile, the labeled descriptors are not located in the fixed interval, and instead their positions are experimentally determined by the respondents (Cardello & Schutz, 2004). On the one hand, as claimed by Karen and Sara (2008), in separated studies, the labeled affective magnitude has been reported to have better discriminative ability, compared with the 9 point hedonic method. On the other hand, it requires more input from the respondents and is more complicated to conduct.

1.3. Just about right

JAR is the method for product optimization and development. The aim of such activity is to
find the ideal point for certain attribute of food and deliver food products to the market place that are optimally aligned with consumer preferences. The core assumption of JAR method is consumer disliking of the product is a weighted linear combination of the absolute attribute level deviations from the ideal product (Engel, Blackwell & Miniard, 1995). JAR use the 5 point scaling to estimate the degree of the overall liking towards certain food. Its improved versions have the conventional methods with 9 points scaling and variant thereof methods which need to ask the ideal point as a reference plus to the eventually calculated idea point. There is no evidence shows that its improved versions have far better performance in assessing the customer preference. (Hans, Pieter, Femke & Lotje, 2007)

1.4. Best worst scaling

The Best worst scaling method is to use a few samples and combination of different sample groups(normally three to five different samples per group) to find out which one owns the best customer preference and which one is the worst(Finn & Louviere,1992). It is believed to own a good discriminatory power especially under the circumstance with limited number of samples. With its principle similar to the commonly used pair wise comparison method, best worst scaling method has been perceived more effective for food product than par wise comparison method which requires much more input from respondents. (Karen, Sara, Carr Conor, 2008).

1.5. Sensory evaluation

The sensory evaluation is a set of techniques to use the human senses to measure and interpret flavor and sensory characteristics of foods, beverages, or other materials. The methods introduced above with many other methods that can provide analytical information of the sensory attribute of food products are usually incorporated in the sensory evaluation system. It is able to define technical specification of the product and the hedonic perception of that product as defined by the user/ consumer (Lawless & Heymann, 1998). Benefiting from its application in the food industry for many years, the sensory evaluation system is relatively mature and complete in evaluating the consumer preference and acceptance. It consecutively
absorbed so many new techniques which could assist it to achieve the purpose. Nonetheless, it mainly focused on the direct sensory characteristics of food and beverage, i.e. taste, smell, though its original initiative is to take all kinds of human senses into consideration.

**Despite of the methods illustrated above focusing on the direct human senses, there are also some tools and techniques have been applied to find the meaning behind the product attributes and try to connect the affection with the attributes of the product.**

1.6. **Laddering technique**

Laddering Technique (appendix two) is useful for understanding the meaning behind important product attributes (Grunert, 1995). A ladder is defined as one participant’s sequence of responses from attribute to a higher level of abstraction. The abstraction usually will be pertained to four levels: attributes; physical consequences; psychosocial consequences and values. Ladders are decomposed into their direct components and then reconstructed into aggregate data from chains (Russell, Busson, Flight, Bryan & Lawick, 2006). Hence, using laddering technique, the correlations among the attributes, consequences and values will be found with the significance level of how they influence each other. The most commonly used two laddering techniques nowadays are soft laddering based on personal interview and hard laddering based on paper or computerized presented questionnaire. It has been argued that employing them combined would get more reliable results (Russell, Busson, Flight, Bryan & Lawick, 2006).

1.7. **Preference mapping**

Preference mapping is a commonly used tool in understanding the descriptive sensory attributes that drive consumer preferences. Identifying the segments of consumers with similar preference patterns is one of the main interests of the food companies, and a number of techniques have been proposed for this purpose, based on various types of cluster analysis (Lawlor & Delahunty, 1999). Preference mapping is relating the sensory profile data to individual consumer preference data with the method of statistical regression such as principal
component regression, partial least squares regression and then plotting the results in maps (Schlich & McEwan, 1992). The procedure of preference mapping requires an objective characterization of product sensory attributes using descriptive analysis. Then it will relate the sensory attributes to the preference rating obtained from the sensory panel. Internal preference mapping uses only consumer data to determine consumer preference patterns, whereas external preference mapping relates consumer preference data to descriptive sensory information and/or instrumental data (Lawlor & Delahunty, 1999). Both internal and external preference mapping techniques have been implemented in a number of studies with a variety of products.

1.8. Chain information model

The chain information model (appendix three) is newly developed model for the food industry by Benner, Linnemann, Jongen, Folstar and Cnossen in 2003. This model constructs a production chain based on the QFD model. This chain starts with the quality characteristics and is mapped out with the options for the chain to realize an intended product. The approaches have been divided into three phases: 1) gathering information concerning the quality characteristics, the current production process and any other information related to quality characteristics change; 2) Determine the influence of the production chain on the consumer wishes and on the new product features; 3) Establish the chain targets, distribute the necessary information and make the change. This model can help a production chain to assure adherence to product specification and customer wishes. Moreover, it is able to speed up the NPD process and reduces cost (Benner, Linnemann, Jongen & Folstar, 2006). This model has a very positive initiative, fulfilling the customer wishes throughout the whole production chain. However, apparently, this model focused on the production more rather than covering the whole product development processes. Hence, the disadvantage of this model is the lack of substantial support to the early stage of the product development (Benner, Linnemann, Jongen & Folstar, 2006).
1.9. Quality function deployment

The QFD (appendix four) is originally developed in Japan during the 1970s for use in the automobile industry. This model brings generally defined quality, as demanded by a consumer market segment, to the early stages in the product development process. QFD is subsequently developed during 1980s by so many experts in both academic and industrial arena and recently, this model has been applied to food industry by Trijp and Steenkamp (1998). QFD advocates a structured food product development process and this process will integrate different disciplines, expertise, consumer acceptance and preference together so as to establish the optimized strategy from the very start to as far as possible in all aspects of the process (Benner, lineman, Jongen, & Folstar, 2003). The emphasis of this approach is heavily laid upon communication. Requirements are plotted on a product-planning matrix against the likelihood of achieving these goals through technological means, taking into account any trade-offs between requirements. When comes to the food development process, another advantage of this model is that it could take account of the sensory attributes due to its flexibility.

2. Kansei Engineering

2.1. Introduction of Kansei engineering

Kansei Engineering was founded by M. Nagamachi at Hiroshima University about 30 years ago and it is a powerful ergonomic consumer-oriented technology for product development. Kansei is Japanese term which encompasses the total concept of senses, consciousness, and feeling that relate to human behavior in social living which a consumer will have in mind when purchasing something (Shiizuka & Watada, 2006). It operates in all people at all times. For instance, when someone entering a restaurant, he or she would get the first impression by appearance of the door (vision) and then when eating something, would perceive the skill of the chef by the taste of the food (cognition). The good service, comfortable chair and table, everything would influence the feeling of the customer towards the restaurant. This combined feeling is Kansei and will affect consumer’s buying behavior seriously. When a consumer
wants to buy something, he or she has an image of the product such as "luxurious, gorgeous and high standard" for a watch, "speedy, easy control and good styling" for a passenger car etc.. Kansei Engineering is able to embed his or her image and feeling into the new product and produce the product fitting to the customer wanted image or feeling. The Kansei engineering is a method able to translate the knowledge of a consumer’s senses, consciousness, and feeling of the product into the physical design elements.

The customer feeling is the intangible information. How does the Kansei engineering convert the intangible feeling into tangible feeling? There a two-dimensional space developed by Shiizuka and Watada (2006), explains how we can seize the human nature Kansei and convert it into artificial Kansei. Figure one is two-dimensional space into which elements required for Kansei dialogue are mapped is discussed. The nature Kansei could be understood as the feeling about the existing object or concept and in contrast, the artificial Kansei means the feeling towards the newly created object or concept. As shown in figure one, it is easier to understand the vertical axis using the “natural Kansei” of real human beings and “artificial Kansei”, which realizes or expresses artificially natural Kansei. Hence, our main task is to grasp the nature Kansei and convert it into artificial Kansei which we could create by ourselves. The left part of the space represent the “measurement”, which means measurement
of the perception and cognition from people corresponding to the objects or concepts, both natural or artificial. The right first quadrant of the space can be understood as how we could use the design or product specification to express and achieve the Kansei we collocated. And the right fourth quadrant means building a nature Kansei express system or building a mathematical model of natural Kansei so as to support the collection and understanding of the nature Kansei.

Figure Two Disciplines and methods incorporated in Kansei method Shiizuka & Watada, 2006

The disciplines and methods employed to achieve the purpose in different quadrants of the pace has been shown in figure two. We could see that the Kansei engineering is not built as a new tool for the customer-oriented product development approach. It is a concept that needs several other tools and systems to support its implementation. “In fact, Kansei Engineering does not develop new theories or tools in the different areas at all. Rather, it is an all-embracing methodology containing rules for how different tools can interact with each other in order to quantify the impact a certain product trait has on the users’ perception.”(Simon, 2002)
2.2. Kansei engineering methods

The Kansei engineering methods has been proposed by so many researchers with different approaches. Basically, there are four kinds of approaches (Nagamachi, 2002).

2.2.1. Type one: category classification

The Category Classification is a method by which a kansei category of a planned target is broken down in a tree structure to determine the physical design details. The product development team will start with so called zero-level concept specifying their product strategy and then, they need to break the concept down into a tree structure with different product feeling collected from various sources until it is clear enough to be translated into the product design details.

2.2.2. Type two: computer-aided system concerning Kansei engineering.

The method replies on the large and accurate database containing the data about both the Kansei and the relationship between the Kansei and the physical product attributes. We will use the system to help the developer to translate the consumer’s feeling and image into the product design elements. Normally, the database consists of the Kansei database, image database, knowledge database, shape and color database etc.

2.2.3. Type three: Kansei engineering modeling

This type utilizes a mathematical modeling constructed in the computerized system. The mathematical model works as if it is a kind of logic like the rule-base. This logic could help to sort out the best attributes with the input of Kansei.
2.2.4. Type four: hybrid Kansei engineering system

This type of Kansei Engineering system basically can help the designer to take not only the forward and but also the backward Kansei Engineering approach. The forward means translating the consumer Kansei into product design while the backward means transform the product design into consumer Kansei.

2.2.5. Type five: virtual Kansei engineering

Kansei Engineering Type V is a new technique combining Kansei Engineering and Virtual Reality Technology. In this technique, we could create a Kansei environment including the new product constructed in the system. The customer will be invited to the physical virtual Kansei environment. This virtual environment and the product in it are decided by Kansei engineering. And the Kansei we acquired from the customer could help us to deliver what the customer want.

2.3. Application of Kansei engineering

Since it has been established by the Japanese researcher on nineteen seventies, Kansei Engineering has been applied to the industries of automobile, construction machine, home electric appliance, housing, costume etc. and it has spread out in Japan, Korea, England, Sweden, Netherlands etc. (Nagamachi,2002).

Statement of the Problem

1. Different Methods Used to Understand the Food Choice

People’s choice of food is a seemingly simple, but in fact very complex behaviour that is determined by many inter-correlated factors. Moreover, these influencing factors each belong to one of many scientific disciplines and as a result, each of the factors could provide a partial answer to the central questions mentioned in so many researches in food choice: “Why does
In order to know what people really need and take the approach of customer led product development, there are plenty of science disciplines have been involved into the food choice research, including biology, physiology, motivation and decision psychology which deal with the “why” question; sociology, biology and differential psychology claiming the answer to the question “who”; the sensory, consumer and food science, marketing, perception and memory psychology which is studying the sensory issues representing the “what” question; at last, all these science disciplines mentioned above together solving the question “where” and “when”. Furthermore, as Mela (1999) pointed out in his paper on the human factor in food choice and intake, these single-disciplinary biases have often frustrated food development progress. However, despite of the importance of interdisciplinary research, there is no concrete and practical methodology is able to incorporate such many science disciplines together to serve for the food product development. Koster (2009) claimed that this problem was recognized by Jos Mojet (2001), in a proposal for the development of a European network for sensory and food consumer research (appendix five). Mojet commented on the overview of many factors and disciplines involved in food choice behaviour: “Although aspects of eating and drinking behaviour have been the subject of studies in many separate disciplines such as food chemistry, nutrition science, intestinal and brain physiology, dentistry, perceptual and motivational psychology and sociology, an integrated approach directed at understanding and predicting eating and drinking behaviour and the development of consumption patterns is lacking”. This fact is not a surprise because individual or even small group could hardly master all these disciplines, not to mention the integration of them. For instance, knowledge about consumer behaviour was investigated by the marketing departments who, being trained in general marketing techniques, usually had very little knowledge about the sensory and nutritional aspects of the products. Actually, when looking back upon the food development methods, this problem has caused the development of these customer approach methods limiting to the improvement of the use of “the human measuring instrument” and to the development of better scaling techniques and better methods to exclude “subjective” influences. At the beginning, the standardized procedures for the “objective” description of
sensory product properties or the measurement of hedonic appreciation were developed so as to test the preference of customer taste, such as the 9 point hedonic method or labeled affective magnitude. Then explicit attention was paid on the distinction between liking and wanting (Berridge, 2004). Although liking and wanting are often closely related, there are also instances in which they diverge and in such cases the behaviour consequences are not predicted by liking alone. In order to avoid taking “liking” automatically as an indication of “wanting” and directly gain the information of people’s need rather than transferring the liking into wanting, methods such as just about right, best worst scaling are developed. Nonetheless, despite of the issue of the measuring accuracy, one certain shortcoming of these methods is that they oversimplified the factors influencing the consumer’s food choice. Thus, the sensory evaluation methodology occurred to combine all kinds of senses testing methods for the evaluation of diverse customer senses. It is argued that although the initiative of the sensory evaluation is positive and these methods involved contributed much to the improvement of the translation of perceived sensory properties into physical product properties, to product development, it still can not be considered as completely developed customer led approach because of its over-weighted focus on direct sensory characteristics, such as taste, olfactory etc. rather than all kinds of human senses, including the perception, motivation, emotion etc.

In the food industry, most of the similar foods don’t have too much differentiation in its taste, it means you could easily find a substitution for the food with your preferred taste or odor. Under this circumstance, to win the customer requires the company to put much more effort in other human senses rather than simply creating delicious taste or odor.

Perception, in descriptive sensory analysis, is defined as a passive and receptive process that reorganizes and memorizes all the information of the product in a specific way. For a long time the idea of unconscious processes that regulates behaviour had been more or less banned from serious scientific research. Perception of the food has been put forward because people start to ask themselves, why, in sensory research, they devote so much effort to the precise definition of the sensory properties rather than to the question what the food bring to their life.
There are a number of arguments in terms of such a suggestion. It has been shown that the loss of olfactory capabilities in many elderly people does not lead to shifts in their preference for well known foods (Mojet, Christ-Hazelhof, & Heidema, 2005). Besides the perception, the emotion, motivation are also the significant factors which will influence the consumer food choice (Koster, 2009). The emotion and motivation are the unconscious behaviour actions and they operate constantly in your decision making process, nevertheless, difficult to be tested.

In order to measure these affects to the consumer’s food choice, over the last two decades, efforts have been made to overcome these problems by extending the sensory work in the direction of consumer insight and development of new methods to investigate these factors such perception, emotion, expectation etc (Meiselman, 1996). The laddering technique and customer preference mapping introduced above are basically two kinds of methods developed to achieve this purpose. However, these methods each are still only able to deal with single aspect of this problem. Under this context, the Quality Function Deployment has been applied in the food product development. It is an all inclusive methodology which could combine nearly all factors in the food development process and deliver the convincible results based on the trade-off of different factors. However, the application of this method, which might help to increase the product successful rate, is still limited due to the higher cost and long development time involved. Moreover, the implementation of QFD relies on the large scale of multidisciplinary communication which is difficult for the developer to achieve.

Therefore, on one hand, the food development scientists become aware of the serious limitations they impose on themselves by sticking to their traditional, explicit and conscious methods and try to find more indirect ways to tap the unconscious processes and to study the expression of these processes in behaviour. On the other hand, an effective and efficient method with the ability to translate subjective needs (e.g. healthy or convenient) into objective product specifications is essential for the realization of this purpose. It is thought that such a consumer-led approach to product development can greatly increase the likelihood of success of innovation processes (Costa & Jongen, 2006). In the Kansei engineering methodology, the specific Kansei words which one of the way to help the consumer to express their feeling,
collected from various sources could be a bridge for connecting the subjective and intangible senses, consciousness to the product properties. And the results obtained from the mathematical analysis are able to give the designer a direct indication what the customer affective perception is towards different designs. Based on that, it can assist the developer to be conscious of whether their product properties are delivering the customer wanted feeling and how well the feeling has been delivered.

2. Kansei Engineering Approach and Framework

A Kansei Engineering procedure framework has been proposed by the Schutte and Eklund on 2004, figure three.

![Diagram of Kansei engineering method]

2.1. Choice of domain

The choice of domain contains the selection of the target customer group and the definition of the niche market of the new product. Finding the representatives of the product, concepts and
even unknown design solution is another task in this step so as to understand the chosen
domain as much as possible.

There are no too many tools provided to execute the choice of domain. However, it is argued by
us that the choice of domain should take account of the company’s status quo and product
strategy.

2.2. Span the semantic spaces

The principle behind this part is that the set of Kansei word could be understood as semantic
space.

2.2.1. Semantic differential method

Semantic differential was developed by Snider and Osgood on 1969. It is a type of rating
scale designed to measure the connotative meaning of objects, events, and concepts. The
connotations are used to derive the attitude towards the given object, event or concept. The
respondent is asked to mark the position on a scale between two bipolar adjectives, such as
adequate-inadequate, good-bad, fast-slow etc. This tool is able to provide an insight into the
border area between linguistics and psychology. We can use the adjectives as the descriptor
reflecting their personal feeling. Some researchers have done many studies about how to
classify most adjectives into categories and use them within certain context to reduce the
number of adjectives to manageable subsets, suitable for factor analysis. The semantic
differential technique now is the foundation of the Kansei engineering. It is able to assist us to
collect the emotional reflection towards the object or concept. The result obtained from the
semantic differential could be analyzed by multivariate statistic method so as to find the
common patterns or factors. It has been discovered that this semantic differential space
comprised by the word pairs can be divided into a three dimensional orthogonal vector space
figure four, with the evaluation (good-bad, kind-cruel), potency (large-small, hard-soft) and
activity (fast-slow, hot-cold) as its three dimensions. Hence, it is going to be easier for us to
classify and select these words according to this rule.
2.2.2. Collection of Kansei words

Kansei word is a word describing the product domain. Often these words are adjectives, phrases or short sentences. A complete selection of the Kansei words, even translating from the nonexisting solutions or concepts, is the prerequisite to guarantee the reliable results without any information missing. Therefore, all available sources have to be searched even if the words emerging seem to be similar or the same.

Suitable sources can be (Simon, 2004):
- Magazines
- Pertinent literature
- Manuals
- Experts
- Experienced users
- Relating Kansei studies and
- Ideas, visions

2.2.3. Reduction of the Kansei words

Although theoretically, we should evaluate all the Kansei words in order to keep the completeness and prevent the information missing. Nevertheless, the quality of the results will not be acceptable if there are huge amount of data input needed from the consumer and we have relative too few participant consumers. Thus, it is critical to reduce the set Kansei words
into several significant ones and then we could focus on these words which weighted much more than others in consumer choices. The statistical methods could help us to fulfill this task. As propose by Arnold and Burkhard 2001, there are two possible ways to do that. One is a pilot study using Osgood’s semantic differentials and followed by the factor analysis or cluster analysis. Afterwards, we should choose the representatives of the Kansei words in each factor or cluster group and these will become the new set of Kansei words. The other one is to use a focus group and/or expert group to reorganize the words by the affinity methods and choose representatives for the group they sorted out. The validity of these words must be tested due to the possible data missing in this process. We could use the manual inspection to double check whether the selected words represent the semantic space sufficiently or execute a post-hoc factor analysis.

2.3. Span the space of product properties

The spanning of the space of product properties is similar to the spanning the Kansei word semantic space.

The task in this part is to collect all the attributes representing the domain chosen and select those which apparently have the largest impact on the user’s Kansei, and choose products representing the chosen product properties.

2.3.1. Collection of product properties:

First, we could solely rely on the designer or development team’s experience to find the product attributes which should be taken into account.

Second, we could use the focus group as we used in the Kansei words collection. Various sources should be investigated for product properties collection (Simon 2004):

- Technical documents
- Comparisons of competing products
- Magazines
- Pertinent literature
- Manuals
• Experts
• Experienced users and
• Related Kansei studies

Moreover, so as to think more innovatively, the idea, vision, concept studies etc., should also be scrutinized.

2.3.2. Reduction of product properties and choosing of the product representatives

A focus group consisting of the potential users and experts will be formed to choose the most important product properties from the list of the properties we collected. This could be done by any kind of frequency or percentage based methods, such as pareto diagram. Followed by that, the products have to be found possessing the important properties we have chosen. These products will be used in the synthesis step in order to represent the different product properties.

2.3.3. Compiling

Distributing the data in a standardized way will facilitate the choice of the evaluation tool in the synthesis phase. Moreover, multiple tools can be used on the same data in order to compare and validate the results.

2.4. Synthesis

In the synthesis step, the semantic space and the space of properties are linked together. For every Kansei word, a number of product properties are found, affecting the Kansei word. As stated by Simon in 2004, Nagamachi (2002) and his research group have developed a number of different statistical procedures using different mathematical implements to capture the user’s impression and make the synthesis. Those are:

• Linear regression (Ishihara 2001)
• General Linear Model (GLM) (Arnold and Burkhard 2001)
• QT1 (Komazawa and Hayashi 1976)
• Neural Networks (Ishihara et al. 1996)
• Genetic Algorithm (Nishino et al. 1999)
• Rough set analysis (Nishino et al. 2001)

2.5. Test of validity

The validity test of the Kansei engineer model is a pending question. So far no systematic tools could be applied to fulfill this task. However, using different methods mentioned above in each steps and comparing the results could be an approach to evaluate the validity of outcome.

2.6. Model building

When it comes to the end after the validity test, a model explaining the relationship between the Kansei word and product properties will be built as a function to support the product development.

K Kansei= f product properties

3. Distinction

One of the advantages of Kansei Engineering is that its methods and tools are collected from different disciplines. This enables the Kansei engineering to solve the problem or achieve the task with the most suitable methods and enhances its flexibility for various problems and tasks. Nevertheless, it does not mean that Kansei engineering is just a combination of different well-known methods. Thus, based our discussion above, here is our definition of Kansei Engineering: “Kansei engineering is a independent methodology which provides the system to integrate and complement known or unknown methods and tools in order to achieve the task converting the human nature Kansei into the product properties with the desired artificial Kansei.” Since Kansei engineering has been created, there are so many successful cases of Kansei engineering supported product development in different industry, such as Mazda new sport car model "Persona", Sanyo new intelligent color printer, Milbon new type of Shampoo. However, no English literature has addressed the application of the Kansei
engineering in the food development process. Hence, it is believed that our study will fill up the blank in this research area.

In Japan, the Kansei engineering has been considered as a completely independent methodology in practical application able to involve many different disciplines. However, there is no literature studying how to incorporate all these disciplines into Kansei engineering and how to do the multidisciplinary experimental design. In product development, Kansei engineering is sometimes employed as a method leading a whole process and sometimes, as a complementary method within a bigger process. When considered as a complementary method, the Kansei engineering has been used with other methods, such as QFD, Conjoint Analysis etc.

The clear definition and distinction made between the Kansei Engineering concept and the possible tools incorporated and could be incorporated into Kansei Engineering reveals the essence on which Kansei engineering is based and assists us to understand the Kansei Engineering approach better. In our study, instead of a complementary tool, the Kansei engineering will be appreciated as a complete methodology to lead the whole food product development process.

**Case Study**

1. **Define the product domain of Wafer**

   First, we need to specify our product domain. We have chosen the wafer as the carrier of our study, including all kinds of derivative of wafer products. And our target consumers are the youths aging from 16 up to 28. We choose the wafer product as the experimental product because it is a very typical western food and it is not very difficult to collect the data and present the results. And we have invited several experts working in the marketing, product development or other related departments from different companies possessing the leading brand of wafer product to support our research in order to ensure that the demonstration and result is reliable.
2. Span the Semantic Space of Wafer

The collection of Kansei word of wafer is a vital process because it could critically influence the final result even if there are only a few important Kansei words missing. Hence, we try to explore the semantic space as broad as we could. The possible Kansei words have been collected from various sources:

- Websites
- Magazines;
- Literature;
- Experts from the company
- Targeted Consumers
- Relating Kansei studies

All the adjective, short phrases or sentences have been collected until no new Kansei words could be found. And the process ends up with 316 different Kansei words. However, it is not scientific and practical to use all of them for our following up research because of the overwhelming data input needed for evaluating 316 Kansei words. Thus, to focus on the significant Kansei words which impose the most impact on the consumer, the reduction of the Kansei word is more than a necessity. We use the semantic scaling method to find the relative importance of these Kansei words according to the perception of our customers. 40 customers aging from 16 to 28, with nearly equal number of female and male (18 female and 22 male), has joined the survey. Then we identified 24 Kansei words with the highest scores as our refined Kansei word set. By the semantic space dimensional method, we chose 12 words with four words scored highest in each dimension of semantic space respectively, table one.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Selected Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation</td>
<td>Enjoyable, Delicate, Convenient, Lovely</td>
</tr>
<tr>
<td>Potency</td>
<td>Enjoyed on Trip, Tea or coffee time mate, Young, Cute</td>
</tr>
<tr>
<td>Activity</td>
<td>Crispy, Scrumptious, Tempting, Savory</td>
</tr>
</tbody>
</table>

Table One Kansei words selected according to three semantic space dimensions
After that, we will take the advantage of the cluster analysis to reduce the correlated similar words. For the reason of obtaining the suitable number of Kansei word, the similarity has been chosen as 70%. From the figure five, we could see that the Kansei words could be reorganized into five groups. The word with the highest score in previous consumer survey step will be selected as the representatives in each group. Hence, the Kansei words have been reduced to five words, delicate, enjoyed on trip, young, crispy and tempting. These five words will serve for the following study as the most critical Kansei words which would influence the consumer’s purchase.

![Cluster Analysis](image)

Figure Five Cluster analysis of important Kansei words

3. **Span the Space of Properties of Wafer**

Spanning the product properties space is basically the same as the Kansei words collection. We collected the product properties from various sources:

- Websites
- Magazines
- Literature
The all inclusive collection provides us 109 product properties. Afterwards, we took two approaches to select the most important wafer properties from both the expert’s point of view and the consumer’s point of view. We believe that the comparison of the difference between the consumer and the expert concerning the important wafer properties will make our research outcome more convincible. Theoretically, it could reduce the risk of the biased opinion from the trained experts. Thus, on the one hand, first, the affinity diagram has been employed to sort out the wafer properties and label them with several categories. Then we ask 30 consumers to choose the top three property categories which would influence their decision making mostly when purchasing the wafer. On the other hand, we ask four experts from four different food companies whose wafer brand is the leading brand in the market to select the top three wafer properties corresponding to their opinion. The variance in the choice regarding to the most important wafer properties between the experts and the consumers has been identified in this process.

Figure Six Pareto chart of the consumer selection of important wafer properties
According the data we collected from consumers figure six, the taste, shape, health and added function are the top three attributes concerned by the consumers when purchasing the wafer. However, the experts in the companies refer the taste, health and function, and coat or decorated feature as the top three attributes for the wafer. First, we don’t want to discuss too much in our study about this difference in terms of preference order of the important product attributes and the logical reason behind that. Otherwise, it would distract the emphasis of our study. But we could claim that the possible reason could be the inadequate updated knowledge of the consumer in the company etc. Second, in our study, we have to limit our focus to the most important attribute, the taste, which has been proposed by both consumers and experts. Moreover, the taste of the wafer is primarily determined by the ingredient. We, therefore, determined to confine our experimental design to the change of the ingredient. All available recipes have been searched and one of them has been chosen as our research recipe due to the generality of it. The sugar, butter and backing powder has been chosen as three product property variables. There should be more product properties to be evaluated, such as the flavor addictives, egg, etc., but in our study, we only focused on these three.

4. Synthesis

4.1. Experiment

The Kansei engineering software has been utilized to support our synthesis. The coding principle of the software is the full factorial analysis. We define different property variables with two levels, low and high based on the original proportion in the recipe we found. The low level is set as the 75% of the original recipe and the high level is set as the 125% of the original recipe. In this case, the lower level and higher level of the property variables has the difference by 50% of original recipe which is believed adequately big to measure the distinction. Hence, we get 6 property variables, low sugar, high sugar, low butter, high butter, low baking powder and high baking powder. According to the full factorial analysis theory, $2^3=8$, eight kinds of samples are required with different combination of the property variables (refer to table two).
<table>
<thead>
<tr>
<th>Ingredient Sample</th>
<th>SUGAR</th>
<th>BUTTER</th>
<th>BP</th>
<th>EGG</th>
<th>FLOUR</th>
<th>SALT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Recipe</td>
<td>120 g</td>
<td>80 g</td>
<td>4 g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>90 g</td>
<td>60 g</td>
<td>3 g</td>
<td></td>
<td></td>
<td>2 g</td>
</tr>
<tr>
<td>S2</td>
<td>150 g</td>
<td>60 g</td>
<td>3 g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td>150 g</td>
<td>60 g</td>
<td>5 g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4</td>
<td>90 g</td>
<td>60 g</td>
<td>5 g</td>
<td>2 whole</td>
<td>110 g</td>
<td>2 g</td>
</tr>
<tr>
<td>S5</td>
<td>90 g</td>
<td>100 g</td>
<td>5 g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S6</td>
<td>90 g</td>
<td>100 g</td>
<td>3 g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S7</td>
<td>150 g</td>
<td>100 g</td>
<td>3 g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S8</td>
<td>150 g</td>
<td>100 g</td>
<td>5 g</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Baking Parameters**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Baking Time</th>
<th>Quantity of Each Dough</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 centigardes</td>
<td>90 seconds</td>
<td>40 g</td>
</tr>
</tbody>
</table>

Table Two Experimental design information

The wafer maker has been used for us to prepare the samples and we maintain the same parameters for each sample making. All the samples has been reserved in a completely sealed plastic bag after 20 minutes cooling down and we serve the sample wafers to the suvery participants at a specific time period which is 24 and 48 hours after the sample wafer has been made.

The focus group consisting of twenty consumers (thirteen female and seven male) from the age twenty one to twenty six have participated in our survey on line. They are using the Kansei software to evaluate the five Kansei words according to each ample on the unstructured line scale with only two ends labeled with “0 equal to not at all” and “10 equal to extremely”. The participants need to evaluate five Kansei words one sample at a time and before they start to eat another piece of sample, the water has been served in order to fresh the aftertaste in their mouth.
4.2. Result

The results from the Kansei Software, following linear regression with QT1 are presented in figure seven. The MCC is the multiple correlation coefficient which is equal to the R value in regression analysis. The correlation whose MCC value is bigger than “0.50” will be considered as a valid multi-correlation according to the Kansei research of Nagumachi(2002). Another important value here is the partial correlation coefficient, PCC. It quantifies the relative importance of an item for the certain food property.

Figure Seven Three analyzed results Female and Male, Female, Male (from left to right)

4.2.1. Result of Female and Male

In the result analyzed by input of both female and male, first of all, for the Kansei tempting, delicate, enjoyed on trip, young, the level of MMC between the properties and Kansei words is around 0.60 to 0.70. This means these three properties, butter, sugar, baking powder has a moderately strong correlation with these four Kansei feeling. Second, the MMC level between
the “crispy” and these three properties is 0.92 which represents a very strong correlation. In addition, when comes to the PCC, we could find that sugar, compared with other two properties, has a relatively strong correlation to four among five words, only excluding the crispy. And the level of butter and baking powder has rather strong correlation with the crispy feeling.

In terms of single property’s influence towards each Kansei, we could also find largely differentiated characteristics. To begin with, the high level of butter will restrain more tempting, enjoyed on trip, and young feeling. Nonetheless, it is positive at increasing the feeling of delicate. Second, the low level of sugar is positive at enhancing all five kinds of feelings. The last property baking powder, low level of it is positive but relatively weak at contributing to these feelings except for the crispy feeling and concerning feeling young, it is even neutral.

4.2.2. Result of Female
From the data of female, the Kansei words “Tempting” and “Delicate” has relatively low correlation with these three properties, possessing the MCC “0.68” and “0.71” respectively. The Kansei word “crispy” has the strongest correlation with three properties holding a MCC value “0.86”. When looking upon the PCC, we could find that the butter has the biggest correlation with these feelings compare with other two properties, except for the feeling “delicate” which is correlated with baking powder the most.

In terms of the single property’s influence, the low level of butter has a positive correlation with all the feelings apart from the “delicate” feeling. And the low level of sugar has positively correlated to all five feelings, strong in “delicate”, “enjoyed on trip”, “young”, but rather weak in “tempting” and “crispy”. These five feelings, meanwhile, are positively correlated with the low level of baking powder, but relatively weak compared with their correlation to sugar and butter.

4.2.3. Result of Male
The result of male shows that only the feeling young is not correlated well with these three properties, holding an MCC value “0.61”. The feeling tempting (MCC=0.95) and enjoyed on the trip (MCC=0.87) is strongly correlated with these three properties. The butter has a significant correlation with all the feelings according to the PCC value, except for the feeling tempting in which its PCC value is 0.02 less than factor sugar(PCC=0.92). Except butter, sugar is the second significantly correlated factors to all these feelings.

When considering the single factor, the high level of butter has a positive correlation to all five feelings while the high level of sugar holds a negative correlation to all five feelings. The feeling tempting, delicate, enjoyed on trip is positively correlated to the high level of baking power yet crispy feeling is negatively correlated and young is neutral.

Here is the demonstration of the significant correlations according to the research result (table three).

<table>
<thead>
<tr>
<th>Highest MCC Kansei</th>
<th>Female and Male</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tempting</td>
<td>Crispy</td>
<td>Crispy</td>
<td>Tempting</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Highest PCC Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tempting</td>
</tr>
<tr>
<td>Delicate</td>
</tr>
<tr>
<td>Crispy</td>
</tr>
<tr>
<td>Enjoyed on Trip</td>
</tr>
<tr>
<td>Young</td>
</tr>
</tbody>
</table>

Table Three Demonstration of Significant Correlations
Discussion

1. Appropriate Properties

1.1. Sugar, butter and baking powder

1.1.1. Sugar

To begin with, according to the data we obtained from the experiment, it is undoubtedly that the sugar has the most significant impact on people's feeling, excluding the crispy, when eating wafer. And it shows that the influence of the sugar to both female and male maintains the consistency which means that it influence their feeling in almost the same way and the same direction. It gives the indication to the designer that they should pay much attention to the sugar content when they want to deliver certain feeling to consumers. Moreover, when analyzing the data more detailed, it indicates that the lower the sugar is, the better feeling the consumer can gain.

1.1.2. Butter

Only taking account of the female or male, the butter is the most heavily weighted factor among all three properties in terms of affecting the Kansei feelings. Nonetheless, there are big difference between female and male when evaluating the impact of the butter in the Kansei feeling. Except for the feeling delicate, the high level of butter would bring better feeling to the male while worse feeling to the female and the influence to both of them are considerable though in inverse direction. The possible explanation for the fact could be that male has more acceptance capacity to oily food. It is hard to explain all the reasons behind that but the implication we could get is that the designer should consider what their primary target gender is for the wafer when setting the amount of the butter in it.

1.1.3. Baking Powder

Except for the crispy feeling, the baking powder doesn't influence the consumer's feeling very substantially. And the lower level of baking powder brings more crispy feeling to both male and
female. Despite of the consistency regarding the crispy feeling, the influence of the baking powder to the female and male still owns slight dissimilarity. Basically, more baking powder can bring better feeling to male but not female.

It seems that we could conclude that lower or higher level of certain food property will bring more certain feeling to consumer when eating wafer. However, it is argued that there are several conditions we need to be aware of before we draw such conclusion. First, we chose the recipe's ingredient proportion as the optimized sugar, butter and baking powder level which is very important to the experiment. We will explain later why this optimized ingredient level is important this experiment. Second, there should be an upper and lower limit to confine this conclusion because when the level of sugar is higher or lower than an extreme limit all the feeling will be critically influenced.

1.2. Appropriate properties to different feelings

1.2.1. Tempting

When reviewing the Kansei word tempting, these three properties don't considerably influence people. And the sugar is the dominant influencing properties among these three and the lower level of sugar will bring more tempting feeling to people. However, it is easy to find that the influence of these three properties towards the feeling tempting between female and male is differentiated significantly. The male's tempting feeling are influenced much more by these three properties than female. Furthermore, examining the data more carefully, apart from the difference in butter discussed before, it is able to find that the difference is caused by their dissimilarity in sugar. Male's tempting feeling decreases largely with the increase of sugar level while female's tempting feeling decreases slightly. One possible reason we explained here could be that the male are more sensitive to the sweet taste and their acceptance in terms of the level of the sweet is rather lower than female. Thus, when delivering the tempting feeling, the designer should be cautious about their target gender and the sugar level difference.

1.2.2. Delicate
The feeling delicate is highly influenced by the factor sugar and the less sugar it was, the more delicate the consumer would feel. And the high level of butter contributes positively to the feeling delicate as well. Comparing with other two, the influence of baking powder is relatively weak but still lower level of baking powder will bring more delicate feeling. There two differences between the female and male in this feeling. First, the influence brought by the butter is counted more important to the male and the influence brought by the baking powder counted more important to the female. Second, the lower level of baking powder will bring more delicate feeling to female but less to the male.

1.2.3. Crispy
The feeling crispy is related to these three properties the most significantly and the butter and baking powder weighted more in influencing it. Thus, when dealing the crispy feeling, the designer should pay more attention to the level of butter and baking powder. In fact, from the result, we could find the crispy feeling will decrease with the increase of the amount of butter and baking powder in the wafer. Nevertheless, as we discussed before, two conditions should be aware of before we draw the final conclusion.

1.2.4. Enjoyed on Trip
The lower level of the butter and baking powder only slightly increase the feeling of enjoyed on trip while the lower level of sugar take the leading influence. In addition, if examining the gender separately, significant difference between female and male could be found from the data presented. First, the lower level of butter brings more enjoyed on trip feeling to female meanwhile less to the male. Second, the female can get more of this feeling if the baking powder level is low whereas the male's feeling is inverse.

1.2.5. Young
These three properties do not contribute too much to the feeling young. But the lower level of sugar could lead to more young feeling. Concerning this feeling, the difference between male and female is mainly caused by the butter. The lower level of butter brings more young feeling to female while the high level of butter brings more young feeling to male.
1.3. Optimized level of ingredient and upper and lower limit

When using the QT1 to analyze the data we get from the consumer survey, the final result is presented in a way that the high level of low level has a positive or negative influence in the Kansei feeling. It is argued that for this positive and negative indication, an optimized level of ingredient should be found before the Kansei survey. The reason is that if the level of ingredient chose as the original level is too high, then probably the higher level you have set as the experimental level is higher than the upper accepted level of consumer towards such taste. In that case, the positive and negative indication would be invalid due to the overwhelming uncomfortable feeling brought by the unaccepted level of ingredient. In our study, the content of different ingredient, from the recipe which we used, has been assumed as the optimized level of ingredient. However, for a more reliable result, we should find the optimized level of ingredient first and test whether the higher level and lower level we set for the experiment have been out of the boundary of the degree which people could accept. Moreover, another way to solve this problem proposed here is to have several iterations of the validity test with different amount of ingredient as the parameters to test if the influence is the same or not.

In addition, for our study, several conclusions has been drawn from the presented result as the lower or higher certain ingredient will bring higher or lower certain Kansei feeling. However, in order to make the conclusions more reliable and practical, the upper and lower limit of the amount of ingredient should be found to more accurately define the conclusion because consumer's repulsion to the extreme taste would bring the uncomfortable feeling which will make the result not consistent with our conclusions. Thus, we need a confidence interval to refine the conclusion.

The widely used methods, such as hedonic scale, are able to assist us to achieve this task. However, finding the most appropriate way to measure the upper and lower limit requires the research in the future.
2. Kansei Methods Application in the Food Development Process

From our study, it is argued that the Kansei engineering is constructive at the beginning stage of the new food development. It can help to communicate and take the information from various sources as much as possible. Rather than lost in the overwhelming information, it is able to organize the information based on their importance from the perspective of both the consumers and the companies. Moreover, the Kansei words can assist us to detect not only the direct senses, like the taste, smell, vision but also other broader and deeper senses, like the perception, image, and psychological responses. It actually builds a bridge between the consumers and the expert in the companies and helps the companies to deliver what the customer want indeed. Another important advantage of the Kansei engineering can be easily found out is that it is not only able to translate the customer preference and perception into product properties but also indicate how much each property’s influence weights in achieving certain customer wanted feeling.

Beside its merit in the early stage of the new food development, it has been proven in many researches that the Kansei engineer method is really powerful in exterior design including the food package design. First, it is because the food package design needs to incorporate more customer vision experience which is the strength of Kansei engineering. Second, compared with other package design supporting methods, it is argued that due to the fact that the Kansei word collected for the food development could as well be used for the package design, the development of the food and food package could be more possible to maintain the consistency in terms of the product concept so as to better attract the target consumers.

3. Limitation of our Study

In our study, the Kansei engineering method has assisted us to find out the relation between the consumer feeling and the level of sugar, butter and baking powder. However, the development process is not complete yet. There are much more properties of the taste, i.e. flavors, additives, and property categories, i.e. the shape, health and function, should be investigated in the future research. Moreover, the parameter nationality should be taken into consideration as well
because the preference and acceptance level towards certain food properties in different countries is not the same. But, due to the limited amount of time and resources, we did not spread our study to that large extent. Nonetheless, the procedure required for these missing parts is basically the same as we did in our study. Concerning what we did, how to find optimized level of ingredient and how to define the upper and lower limit of the amount of ingredient is not discussed thoroughly. Thus, a further research should take account of these so as to complement our study result. Moreover, there is another advantage of Kansei engineering we did not present in our study for the food industry is to assist collecting the information and responses to support the package design. However, after all, this advantage of the Kansei engineering has been studied in many other researches already.

**Conclusion**

This study shows that the Kansei engineering has the ability to support the food product development. And its advantage in collecting, organizing and analyzing the massive data from various sources is able to complement the shortcoming of the methods used in the food industry nowadays. It is able to assist the product developer to find out the essential elements and even their individual weight of influence. In this way, the product can avoid being drowned in overwhelming data collected. Moreover, the Kansei engineering could connect the product properties with not only the direct sense of consumer, i.e. taste, shape, but also broader senses, i.e. image, perception which most of the methods already used is not able to. In addition, its strength in package design is able to contribute to the consistency of the whole food development process from the food design to the package design.

In addition, the wafer with lower level of butter and baking powder will be perceived crispier. And lower level of sugar will bring the most significant positive influence of the feeling tempting, delicate, enjoyed on trip and young. Moreover, concerning different feelings, the male and female don’t have the agreement on the influence from certain food properties. Generally, the male tend to like more butter, less sugar and more baking powder in the wafer whereas the female tend to like less butter, less sugar and less baking powder. As to these
feelings respectively, the female and male has some substantial dissimilarity as well. Thus, it is concluded that the developer should be aware of the difference of the feeling influenced by the ingredient between female and male. Furthermore, because of the possibly worse feeling brought by the amount of the ingredient exceeding the consumer acceptance, it is as well concluded that the optimized level of ingredient should be defined before conducting the research or alternatively, the iteration of the validity test should be done. Meanwhile, the lower and higher level of ingredient should not be extremely low or high. Thus, the upper and lower limit should be set as well in order to confine the results in certain confidence interval.
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Appendix

Appendix One  The labeled magnitude scale devised by Green et al. (1993) that was evaluated in the present study.
Appendix Two  A simplified laddering map made by Russel, Busson, Flight, J.Bryan 2004 for food choice
Appendix Three: Quality dependence diagram for the quality characteristic "convenience" made by Benner, Geerts, Linnenmann, Jongen, Foktar & Cnossen 2003
Appendix Four  House of quality for chocolate couverture made by Viaene, Januszewska

1999
Appendix Five  Essential factors that influence eating and drinking behaviour and food choice