How to make product development projects more successful by integrating Kano's model of customer satisfaction into quality function deployment

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Abstract

Despite all efforts, many product development projects fail and lead to the introduction of products that do not meet customers' expectations. A high level of customer satisfaction cannot be obtained. On the other hand, in many product development projects the process of product development is conducted very unsystematically and resources are wasted because of a lack of communication between the different functions involved in product development. Time especially is a critical factor within product development as time to market is becoming increasingly more important.

Managers need a set of practical step-by-step tools and methods which ensure a better understanding of customers' needs and requirements, as well as procedures and processes to enhance communication by focusing on the voice of the customer within a product development project.

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The authors propose a methodology, based on Kano's model of customer satisfaction, to explore customers' stated needs and unstated desires and to resolve them into different categories which have different impacts on customer satisfaction. It is shown how this categorization can be used as a basis for product development, especially for quality function deployment. The paper begins with a brief discussion of the strategic importance of customer satisfaction, then Kano's model and its combination with quality function deployment is demonstrated, using a case study from the ski industry. The paper closes with a brief discussion of the managerial implications and the consequences of the application of these tools.

1. CUSTOMER SATISFACTION AS A SOURCE OF COMPETITIVE ADVANTAGE

Customer satisfaction is a growing concern to many leading companies throughout the world. More and more firms use satisfaction ratings as an indicator of the performance of products and services and as an indicator of the company's future. Several consulting firms are now promoting strategies for customer satisfaction instead of some form of market share strategy (Business Week, 1990). This shift in strategic thinking is based on the assumption that customer satisfaction is the best indicator for the company's future as a high level of customer satisfaction leads to a high level of customer loyalty. A high level of loyalty in turn leads to a steady stream of future cash flow, transaction costs should decrease and the costs of attracting new customers should be lower for firms that achieve a high level of customer satisfaction and loyalty. Customer satisfaction reduces price elasticities, as satisfied customers are willing to pay more for high quality products and services (for a detailed discussion see Hinterhuber *et al.*, 1997b). Reichheld and Sasser (1990) state that satisfied customers are likely to buy more frequently and in greater volume and to purchase other goods and services offered by the firm. Hanan and Karp (1989) summed it up and state: "Customer satisfaction is the ultimate objective of every business: not to supply, not to sell, not to service, but to satisfy the needs that drive customers to do business."

1.1 Customer satisfaction and market share

Traditionally, market share was seen as the key part of each market strategy. The maximization of market share should lead to the maximization of return on investment (ROI) (Fornell, 1992). This assumption is based on the effects of economies of scale and a considerable number of empirical studies (e.g. PIMS), which confirm the impact of market share on profitability (Buzzel and Gale, 1987). Market share in turn is seen as a result of offensive market strategies whose primary goal is to acquire new customers. But increasing competition, low market growth rates and saturated markets make it much more difficult to grow on the basis of offensive strategies. In this context the costs of attracting new customers are much higher than the costs of keeping the present customers through an increased level of loyalty. The American Marketing Association estimates that it costs five or six times more to acquire a new customer than to keep one. Customer retention strategies are becoming increasingly important. But paradoxically, both types of strategy — market share and customer satisfaction strategies — are often used under the same market conditions (Fornell, 1992).

Capturing market share through the attraction of new customers is an offensive strategy, the focal point is competition; whereas for defensive customer satisfaction strategies in a low growth or saturated market it is the customer. The measure of success is the share of market relative to competition for market share strategies and the customer retention rate for customer satisfaction strategies; their behavioural objective is buyer loyalty. The kind of market share also differs for both types of strategy. While for offensive strategies market share is of a quantitative nature, for defensive strategies it is of a qualitative nature; this means it is composed of customers with a high loyalty, low price sensitivity, low transaction costs, cross-selling effects and who are more likely engaged in positive word of mouth (Fig. 1).

With increasing competition, customer retention or customer satisfaction strategies are becoming more important. The strategic intent is not to capture higher market shares than competitors but to gain sustainable competitive advantages within certain market segments where the core competences of the firm can be exploited, and to create a high level of customer satisfaction and loyalty.

	Market Share	Customer Satisfaction
Typically in ...	Low growth or saturated markets	Low growth or saturated markets
Strategy type ...	Offense	Defense
Focal point ...	Competitor	Customers
Measure of success ...	Share of market relative to competition	Customer retention rate
Behavioral objective ...	Buyer switching	Buyer loyalty
Nature of market share ...	Rather quantitative	Rather qualitative

Fig. 1.   Market share versus customer satisfaction (Hinterhuber *et al.*, 1997b; Fornell, 1992).

1.2 Customer satisfaction and loyalty

Growth opportunities in highly competitive and saturated markets can be gained through a better exploitation of the customer's lifetime value. In the ski industry, for instance, the average customer in the high-price segment spends about $700 on each purchase and buys a new pair of skis every three years. So he buys between 15 and 20 pairs of skis in his life and his lifetime value is therefore about $10,500–14,000.

Fig. 2 shows the retention rates of two major competitors in a certain market segment and its impact on their future market shares.

Salomon has a market share of 5.7% in the analysed market and a retention rate of 68.6%. The market leader Atomic has a market share of 14.1% and a retention rate of only 45.5%. As one can see, Atomic needs much more effort to hold the present market share as, due to the low retention rate, the gap has to be recovered by attracting new customers; this can cost about five times more than keeping the present customers.

Finkelman and Goland (1990) and Heskett *et al.* (1994) analysed the impact of customer satisfaction

on loyalty. They revealed that the actual loyalty differs substantially depending on whether the customers are 'very satisfied' or 'satisfied'. Customers giving 5s (very satisfied) on a five-point scale are six times more likely to repurchase a product than those giving 4s (satisfied). In our study of the ski industry we were able to confirm this causal relationship (Fig. 3).

As one can see, a moderate satisfaction does not have a high impact on customer loyalty. What companies need is to exceed customers' expectations and delight them, as a Japanese manager said: "We don't want to simply satisfy our customers by meeting expectations, we want to delight them by exceeding their expectations." Only a very high level of satisfaction leads to loyalty.

Market share is a direct consequence of customer satisfaction and loyalty. The present or future market share of a company is composed of existing, loyal customers and switching, potentially new customers (Fig. 4). The higher the retention rate of a firm is, the higher the future market share will be. High levels of perceived quality and customer satisfaction have an additional effect on future market shares, due to the positive quality image and the positive word-of-mouth of satisfied customers.
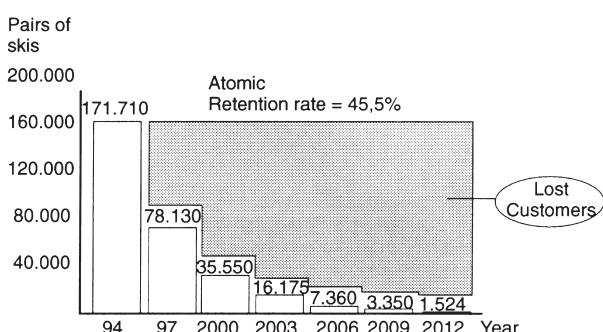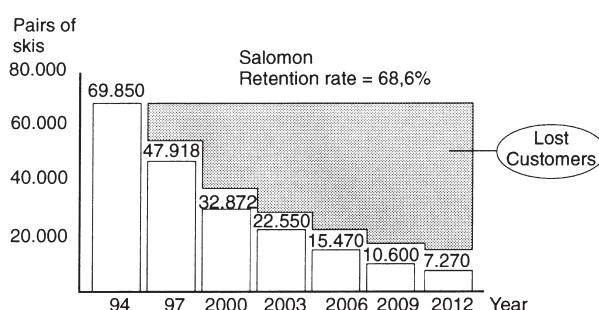
Fig. 2.   Market retention and market share for two different ski producers.
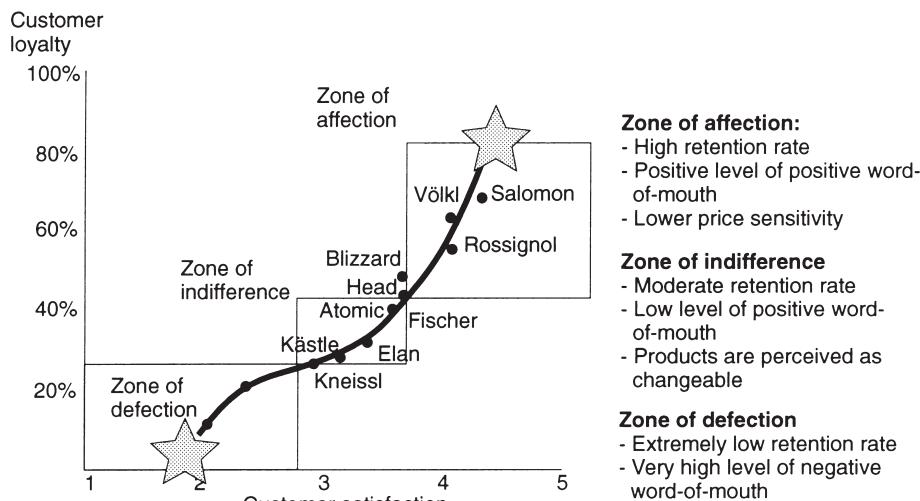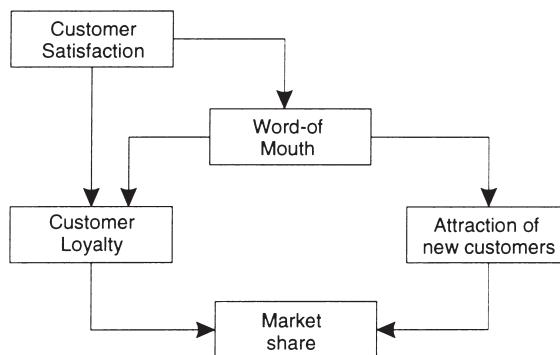
Fig. 3. Customer satisfaction and customer loyalty.

Fig. 4. Market share as a consequence of customer satisfaction (Kordupleski *et al.*, 1994).

As one can see in Fig. 5, companies with a high level of customer satisfaction will increase their market share by a larger extent than companies with lower satisfaction levels. The question is: Which products and services can be used to obtain a high level of customer satisfaction? Which product attributes have a more than proportional influence on satisfaction, and which attributes are an absolute must in the eyes of the customer?

So far, customer satisfaction has mostly been seen as one-dimensional — the higher the perceived product quality, the higher the customer's satisfaction, and vice versa. But fulfilling individual customer expectations to a great extent does not necessarily imply a high level of customer satisfaction. It is also the type of expectation that defines the perceived product quality and thus customer satisfaction (Matzler *et al.*, 1996). Departing from Kano's model of customer satisfaction, a methodology is introduced which determines what impact the attributes of products and services have on customer satisfaction.

2. KANO'S MODEL OF CUSTOMER SATISFACTION

In his model, Kano *et al.* (1984) distinguish three types of product requirements which influence customer satisfaction in different ways when met (Fig. 6).

2.1 'Must-Be' requirements

The 'must-be' requirements are basic criteria of a product. If these requirements are not fulfilled, the customer will be extremely dissatisfied. On the other hand, as the customer takes these requirements for granted, their fulfilment will not increase his satisfaction. Fulfilling the must-be requirements will only lead to a state of 'not dissatisfied'. The customer regards the must-be requirements as prerequisites; he takes them for granted and therefore does not explicitly demand them. Must-be requirements are in any case a decisive competitive factor, and if they are not fulfilled, the customer will not be interested in the product at all.

For instance, British Rail found through extensive market research that when the average punctuality exceeds a certain level there is no increase in customer satisfaction. But if punctuality does not meet customers' expectations it causes a high level of dissatisfaction. Punctuality is a must-be requirement. For fulfilling this minimum requirement Bristish Rail does not get 'bonus points' (Silvestro and Johnston, 1990).

2.2 One-Dimensional requirements

With regard to these requirements, customer satisfaction is proportional to the level of fulfilment — the higher the level of fulfilment, the higher the cus-
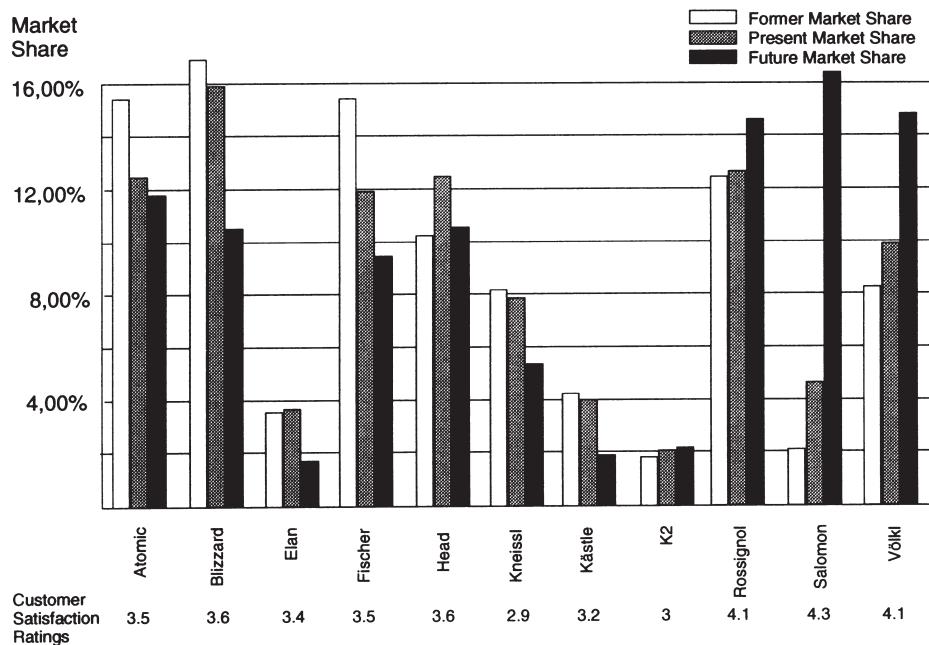
Market Share

Fig. 5. Present and future market shares in the ski industry.

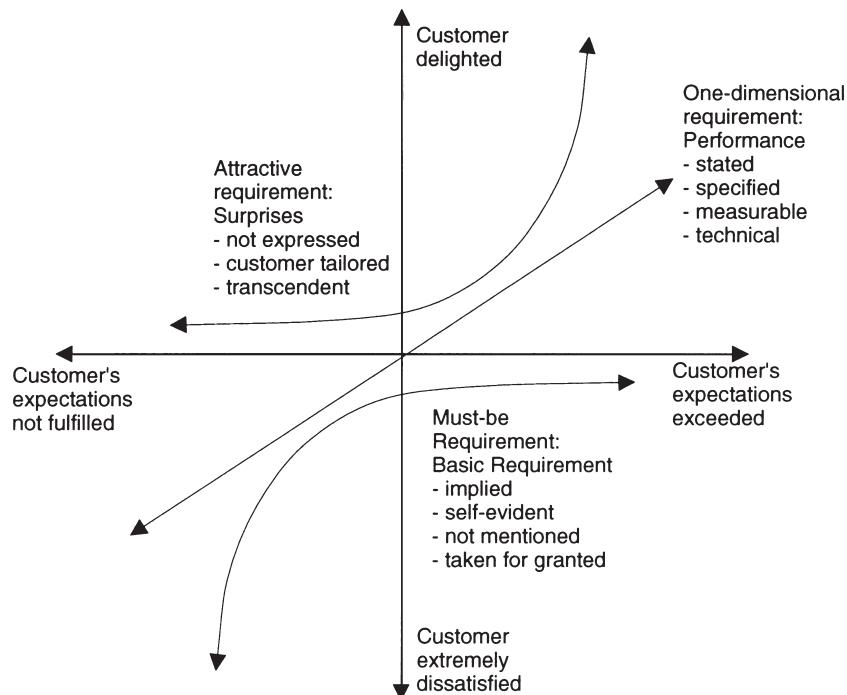Fig. 6. Kano's model of customer satisfaction (Berger *et al.*, 1993).

tomer's satisfaction, and vice versa. One-dimensional requirements are usually explicitly demanded by the customer.

A good example of a one-dimensional requirement is the gas mileage (petrol consumption) of a car. The better it is, the more satisfied the customer is, and vice verca.

2.3 Attractive requirements

These requirements are the product criteria which have the greatest influence on how satisfied a customer will be with a given product. Attractive requirements are neither explicitly expressed nor expected by the customer. Fulfilling these requirements leads to more than proportional satisfaction. If they are not met, however, there is no feeling of dissatisfaction.

Product or service elements that exceed customers' expectations and are classified as attractive requirements enhance customers' perceived value and their satisfaction. For instance, an airline that offers an in-flight telephone service may provide a value enhancement to business travelers who otherwise lose opportunities to communicate with their respective customers and/or home offices. Yet the absence of this service will not necessarily result in customer dissatisfaction or loss of passengers (Brandt, 1988).

The advantages of classifying customer requirements by means of the Kano method are very clear (Hinterhuber *et al.*, 1997a):

- Product requirements are better understood. The product criteria which have the greatest influence on the customer's satisfaction can be identified. Classifying product requirements into must-be, one-dimensional and attractive dimensions can be used to focus on priorities for product development. It is, for example, not very useful to invest in improving must-be requirements which are already at a satisfactory level, but better to improve one-dimensional or attractive requirements as they have a greater influence on perceived product quality and consequently on the customer's level of satisfaction.
- Kano's method provides valuable help in trade-off situations in the product development stage. If two product requirements cannot be met simultaneously due to technical or financial reasons, the criterion which has the greatest influence on customer satisfaction can be identified.
- Must-be, one-dimensional and attractive requirements differ, as a rule, in the utility expectations of different customer segments. From this starting point, customer-tailored solutions for special problems can be elaborated, which guarantees an optimal level of satisfaction in the different customer segments.
- Discovering and fulfilling attractive requirements creates a wide range of possibilities for differentiation. A product which merely satisfies the must-be and one-dimensional requirements is perceived as average and therefore interchangeable (Hinterhuber *et al.*, 1994).
- Kano's model of customer satisfaction can be optimally combined with quality function deployment. A prerequisite is to identify customer needs, their hierarchy and priorities (Griffin and Hauser, 1993). Kano's model is used to establish the importance of individual product features for the customer's satisfaction, and thus it creates the optimal prerequisite for process-oriented product development activities.

3. A METHODOLGY TO ASSESS AND EVALUATE CUSTOMER REQUIREMENTS

In the following we will explain how product requirements can be classified by means of a questionnaire. The ski industry, where more than 1500 customers were interviewed, is used to demonstrate how product requirements are ascertained, how a questionnaire is constructed, how the results are evaluated and interpreted and used as the basis for product development (Fig. 7).

3.1 Step 1: identification of product requirements — "Walk in your customer's shoes"

The starting point for constructing the Kano questionnaire is the product requirements which have been determined in explorative investigations. Griffin and Hauser (1993) found that only 20–30 customer interviews in homogeneous segments suffice to determine approximately 90–95% of all possible product requirements. Many market research institutes use focus group interviews to determine product requirements, assuming that group dynamic effects enable a greater number of more diversified customer needs to be discovered. Compared with the expense, individual interviews seem to be more favourable. Customer interviews are useful for registering visible product requirements and customer problems, but when investigating potential *new* and *latent* product requirements they usually do not suffice. In particular, attractive requirements are not expressed by the customer, as these are the features he does not expect.

3.2 Analysing customer problems instead of customer desires

If customers are asked only about their desires and purchasing motives in the exploratory phase, the results are usually disappointing and the answers
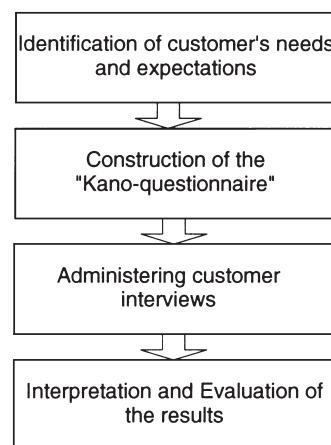

Fig. 7. Individual steps of the 'Kano project'.

- Good edge grip on hard pistes
- Great ease of turn
- Good powder snow features
- Very light skis
- Integrated anti-theft device
- Scratch-resistant surface
- Design matches bindings and ski boots
- Trade-in offer for old skis
- Regular up-to-date information concerning test results, maintenance of skis and safety measures
- stable gliding, when skiing fast

Fig. 8.   Customer requirements for skis.

already known. The product expectations mentioned by the customer are only the tip of the iceberg. It is necessary to ascertain the 'hidden' needs and problems. A detailed analysis of the problems to be solved, of the conditions of application and the product environment can lead to instructive information on promising product developments (Fig. 8).

3.3 Step 2: construction of the Kano questionnaire

Must-be, one-dimensional and attractive requirements as well as product requirements towards which the customer is indifferent can be classified by means of a questionnaire. For each product feature a pair of questions is formulated to which the customer can answer in one of five different ways (see also Kano *et al.*, 1984). The first question concerns the reaction of the customer if the product has that feature (functional form of the question); the second concerns his reaction if the product does not have that feature (dysfunctional form of the question; see Fig. 9).

When formulating the questions, the "voice of the customer" (Hauser and Clausing, 1988) is of prime importance. The voice of the customer is a description of the problem to be solved from the customer's viewpoint. If one asks about the technical solutions of a

product, it can easily happen that the question is not correctly understood. The customer is not interested in *how* but *which* of his problems will be solved. In addition, if the solution to the technical problem is already provided in the formulation of the question, the engineer's creativity might well be restricted in the field of product development at a later date.

By combining the two answers in the Kano evaluation table (Fig. 10), the product features can be classified. If the customer answers, for example, "I like it that way" as regards "If the edges of your skis grip well on hard snow, how do you feel?" — the functional form of the question — and answers "I am neutral" or "I can live with it that way" as regards "If the edges of your skis don't grip well on hard snow, how do you feel?" — the dysfunctional form of the question — the combination of the questions in the evaluation table produces category A, indicating that edge grip is an attractive customer requirement from the customer's viewpoint. If combining the answers yields category I, this means that the customer is indifferent to this product feature. He does not care whether it is present or not. He is, moreover, not willing to spend more on this feature. Category Q stands for a questionable result. Normally, the answers do not fall into this category. Questionable scores signify that the question was phrased incorrectly, or that the person interviewed misunderstood the question or crossed out a wrong answer by mistake. In the study quoted here, no product criterion received a Q-rate higher than 2%. If looking up the answer in the evaluation table yields category R, this product feature is not only not wanted by the customer but he even expects the reverse. For instance, when holiday tours are offered it might well be that a specific customer segment wants pre-planned events every day, while another would dislike it (see Berger *et al.*, 1993).

Functional form of the question

| If the edges of your skis grip well on hard snow, how do you feel? | ❑ I like it that way
❑ It must be that way
❑ I am neutral
❑ I can live with it that way
❑ I dislike it that way |

| If the edges of your skis do not grip well on hard snow, how do you feel? | ❑ I like it that way
❑ It must be that way
❑ I am neutral
❑ I can live with it that way
❑ I dislike it that way |

Dysfunctional form of the question

Fig. 9.   Functional and dysfunctional questions in the Kano questionnaire.

Product requirement →		Dysfunctional form of the question				
		1. I like it that way	2. It must be that way	3. I am neutral	4. I can live with it that way	5. I dislike it that way
Functional form of the question ↓	1. I like it that way	Q	A	A	A	O
	2. It must be that way	R	I	I	I	M
	3. I am neutral	R	I	I	I	M
	4. I can live with it that way	R	I	I	I	M
	5. I dislike it that way	R	R	R	R	Q

Fig. 10. Kano evaluation table.

In addition to the Kano questionnaire, it may be helpful to have the customer rank the individual product criteria of the current product on a rating scale and to determine the relative importance of the individual product criteria (self-stated importance). This will help you to establish your priorities for product development and to make improvements wherever necessary (Fig. 11).

3.4 Step 3: administering customer interviews

Decide which method you want to use for carrying out the customer interviews. In principle, the most favourable method for ascertaining customer expectations and satisfaction is by mail. The advantages are the relatively low costs and the high level of objectivity of the results; one disadvantage is, however, the frequently low return rate.

Our experience has shown that standardized, oral interviews are the most suitable method for Kano surveys. A standardized questionnaire reduces the influence of the interviewer, the return rate is very high and, in case of comprehension difficulties, the interviewer can explain. Usually the questionnaire must be explained because of its new and unfamiliar nature.

3.5 Step 4: evaluation and interpretation

The questionnaire is evaluated in three steps. After having combined the answers to the functional and dysfunctional question in the evaluation table, the results of the individual product criteria are listed in the table of results (Table 1) which shows the overall distribution of the requirement categories. The next step is to analyse and interpret the results.

The following possibilities are available for processing the results of a Kano survey.

3.6 Evaluation according to frequencies

An overview of the requirement categories of the individual product requirements is gained from the table of results. The simplest method is evaluation and interpretation according to the frequency of answers. Thus, from Table 1, edge grip would be a must-be requirement (49.3%), ease of turn a one-dimensional requirement (45.1%) and service of edges and base an attractive requirement (63.8%).

As a rule, a more differentiated interpretation is required, as the answers to a product requirement are

Fig. 11. Self-stated importance and satisfaction scale.

TABLE 1. Table of results

Product requirement	A	O	M	I	R	Q	Total	Category
Edge grip	7	32.3	**49.3**	9.5	0.3	1.5	100%	M
Ease of turn	10.4	**45.1**	30.5	11.5	1.2	1.2	100%	O
Service	**63.8**	21.6	2.9	8.5	0.7	2.5	100%	A

often spread out over more than one category. In this case we believe that this distribution can be explained by the fact that customers in different segments have different product expectations. For instance, we found that the significance of edge grip varies depending on the skill of the skier. While expert skiers presuppose edge grip as a must-be requirement, novices see it as a one-dimensional requirement.

If the questionnaire includes sufficient customer-oriented variables, the results can be used as the ideal basis for market segmentation and thus differentiation of products and services according to utility expectations of the different customer segments.

3.7 Customer satisfaction coefficient

The customer satisfaction (CS) coefficient states whether satisfaction can be increased by meeting a product requirement, or whether fulfilling this product requirement merely prevents the customer from being dissatisfied (Berger *et al.*, 1993). Different market segments usually have different needs and expectations, so sometimes it is not clear whether a certain product feature can be assigned to the various categories; it is especially important to know the average impact of a product requirement on the satisfaction of all the customers. The CS coefficient is indicative of how strongly a product feature may influence satisfaction or, in the case of its non-fulfilment, customer dissatisfaction. To calculate the average impact on satisfaction it is necessary to add the attractive and one-dimensional columns and divide by the total number of attractive, one-dimensional, must-be and indifferent responses. For the calculation of the average impact on dissatisfaction, add the must-be and one-dimensional columns and divide by the same normalizing factor (see Berger *et al.*, 1993).

Extent of satisfaction:

$$\frac{A + O}{A + O + M + I}$$

Extent of dissatisfaction:

$$\frac{O + M}{(A + O + M + I) \times (-1)}$$

A minus sign is put in front of the CS coefficient of customer dissatisfaction in order to emphasize its negative influence on customer satisfaction if this product quality is not fulfilled. The positive CS coefficient ranges from 0 to 1; the closer the value is to 1, the higher the influence on customer satisfaction. A positive CS coefficient which approaches 0 signifies that there is very little influence. At the same time, however, one must also take the negative CS coefficient into consideration. If it approaches -1, the influence on customer dissatisfaction is especially strong if the analysed product feature is not fulfilled. A value of about 0 signifies that this feature does not cause dissatisfaction if it is not met. For instance, a bad edge grip with a negative CS coefficient of -0.83 leads to more than proportional dissatisfaction; good edge grip with a positive CS coefficient of 0.40 can only slightly increase satisfaction (see Table 2 and Fig. 12).

3.8 Quality improvement index

The quality of one's own products perceived in comparison to that of the strongest competitors is of prime importance for product development strategies and improvement measures. Thus it is useful not only to have the customers evaluate one's own products but also to get customers' opinion of the competitors' products.

The quality improvement index (QI) is the ratio calculated by multiplying the relative importance of a product requirement for the customer by the gap value of the perceived product quality (own product versus competitor's product) gained from the rating scale in the questionnaire (Fig. 13; see also Griffin and Hauser, 1993):

QI = relative importance
× (evaluation of own product
− evaluation of competitor's product)

The value is indicative of how important the product

TABLE 2. CS coefficient

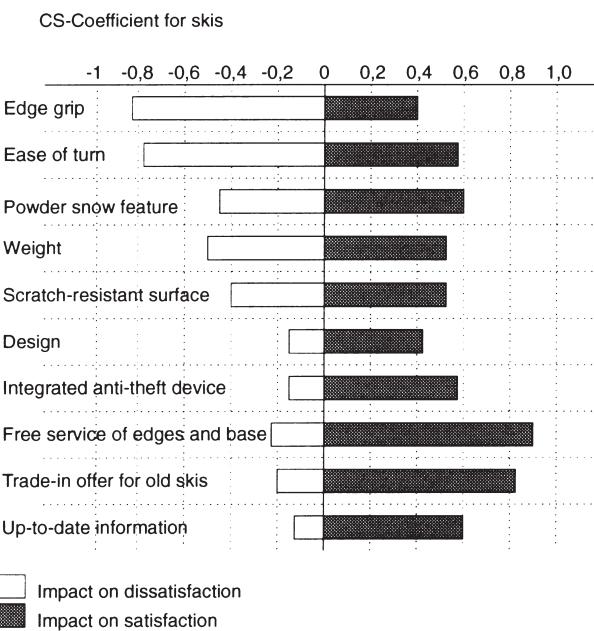| Product requirement	A	O	M	I	Total	Category	$\dfrac{A + O}{A + O + M + I}$	$\dfrac{O + M}{A + O + M + I}$
Edge grip	7	33	**50**	10	100%	M	0.40	− 0.83
Ease of turn	11	**46**	31	12	100%	O	0.57	− 0.78
Service	**66**	22	3	9	100%	A	0.89	− 0.25

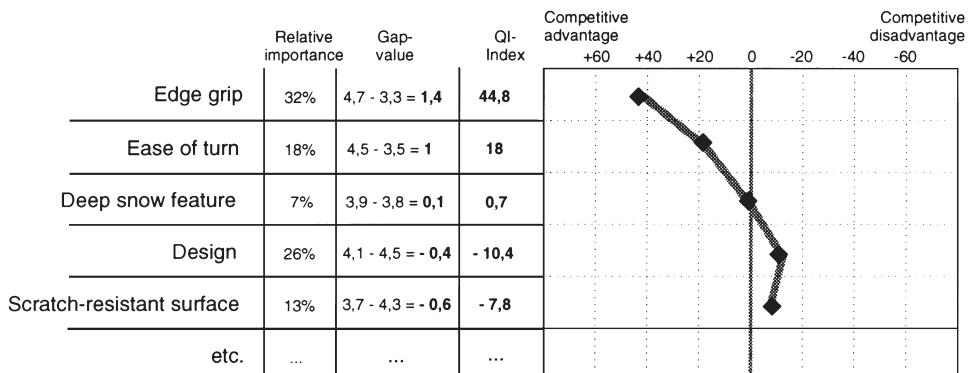Fig. 12.   Impact of product features on satisfaction or dissatisfaction.

Fig. 13.   Quality improvement index.

requirement is in terms of competition. The higher the value in the positive range, the higher the relative competitive advantage in the perceived product quality from the customer's viewpoint. However, the higher the negative value of this index, the higher the relative competitive disadantage. Therefore it is far more important to improve this product requirement.

4. QUALITY FUNCTION DEPLOYMENT

Quality function deployment (QFD) was first used successfully by Japanese manufacturers of consumer electronics, home appliances, clothing, integrated circuits, synthetic rubber, construction equipment and agricultural engines, before American and European

manufacturers started to use it within product development projects (Akao, 1992). Fig. 14 compares the number of design changes at a Japanese auto manufacturer using QFD with changes at a US auto manufacturer. As one can see, QFD leads to fewer changes in product development projects, the consequence being much lower startup costs.

Quality function deployment is a customer-oriented approach to product development. It supports design teams in developing new products in a structured way, based on an assessment of customers' needs.

An organized QFD approach follows all the rules for project management, beginning with project definition and team selection, and is not restricted to one single department in a company. Cross-functional teams should work together on the whole process (Govers, 1994). QFD helps a company to make key trade-offs between what the customers want and what the company can afford to build.

The product development project can be outlined in a step-by-step approach. Usually seven steps can be discerned (Hauser and Clausing, 1988; Hauser, 1993). The first four steps in the construction of the 'house of quality' (Fig. 15) are covered by the above illustrated methodology based on Kano's model of customer satisfaction to explore and evaluate customer needs.

To illustrate the application of quality function deployment based on Kano's model of customer satisfaction it is necessary, due to lack of space, to simplify the process. Please note that this case study is intended to be used as a basis for an illustration of the methods rather than to illustrate either effective or ineffective handling of technical problems within product development. We base our illustration on a

limited number of product requirements and a limited number of design attributes.

(1) *Identifying customer needs.* The first step is to identify customer needs, which usually are determined by personal interviews and/or focus groups. It is very important to discover not only articulated needs but also exciting needs or unarticulated needs which, if they are fulfilled, delight and surprise the customer.

(2) *Structuring the needs and prioritizing them.* Customer needs should be structured into a hierarchy of basic requirements, one-dimensional requirements and attractive requirements, which means assessing their strategic importance. Basic requirements have to be fulfilled, a product should be competitive with one-dimensional requirements and stand out regarding attractive requirements. As can be seen, 'good edge grip on hard pistes' is a must-be requirement as it causes very high dissatisfaction if it is not fulfilled but is not able to lead to a high level of satisfaction if it is fulfilled. To increase customer satisfaction, those product attributes should be improved which have a more than proportional effect on customer satisfaction, i.e. attractive requirements. To make effective improvements in terms of increasing the level of customer satisfaction it is necessary to know how the quality of competitive products is perceived by the customers.

(3) *Comparing customers' perceptions.* In order to know whether an improvement of certain product attributes leads to a competitive advantage it is necessary to compare the customers' perceived product quality with that of products of competitors. This evaluation should be based on scientific market research. It can be seen that an improvement of the edge grip on hard pistes has priority for Atomic, because the competitor's product is perceived to be better.

(4) *Identifying design attributes.* In this step the product development team translates customer needs into engineering concerns. The question is: How can we change the product? The team has to identify those design attributes which fulfil customers' needs. Typical design attributes for skis are the weight, the shape (carving = narrow middle part and broad end parts of the skis), torsional stiffness and longitudinal stiffness.

(5) *Developing the relationship matrix.* The product development team has to judge how strongly the different design attributes influence individual customer needs. The influence should be measured for the following reasons (Govers, 1994): first, to determine priorities and directions for improvements to the design attributes; second, to
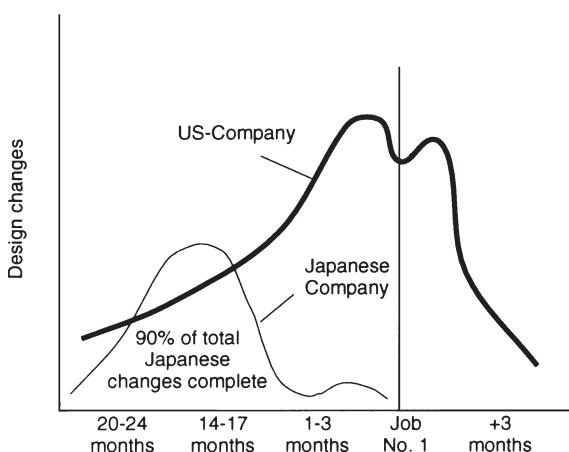

Fig. 14. Japanese auto maker with QFD versus US auto maker without QFD (Sullivan, 1986).
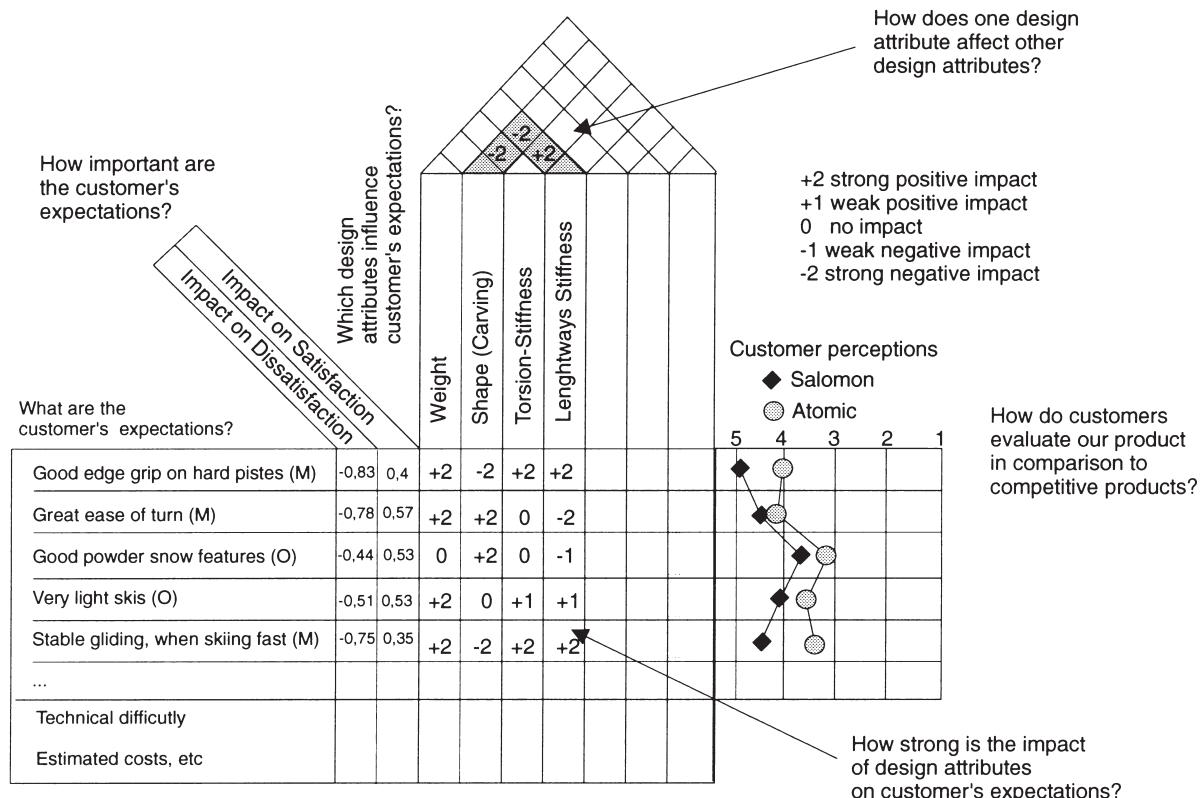
Fig. 15. The house of quality.

provide an objective means of ensuring that customer requirements have been met; and third, to provide targets for further detailed development. It can be seen, for instance, that 'carving' leads to a deterioration of the gliding stability, whereas it facilitates the ease of turn.

(6) *Developing the roof matrix.* The roof matrix should quantify the physical relationships between the design attributes. Sometimes the improvement of one design attribute leads to a degradation of other design attributes. The roof matrix is very helpful when trade-offs have to be made. 'Carving' (narrow middle part and broad end parts) causes conflicts with both torsional and longitudinal stiffness. An improvement of torsional stiffness is always coupled with an improvement of longitudinal stiffness, because it can be reached through the use of certain materials.

(7) *Estimation of costs, feasibility and technical difficulty.* The product development team should try to quantify costs, feasibility and technical dif-

ficulty of each design attribute, which is necessary if reasonable choices are to be made.

Quality function deployment is becoming quite popular. By combining it with Kano's method for understanding customer-defined quality the following benefits can be gained (see also Govers, 1994):

● there is a deeper understanding of customer requirements and problems;
● trade-offs within product development can be managed more effectively;
● there are fewer start-up problems;
● competitive analysis is easier (improved market research);
● control points are clarified (reduced development time, better planning);
● effective communication between divisions (departments) is facilitated;
● design intent is carried through to manufacturing (quality is built in 'upstream').

5. CONCLUSION

If one knows to what extent a product feature influences the perceived product quality and in turn influences customer satisfaction (must-be, one-dimensional or attractive requirement), and if one is aware of the relative significance of this product feature and its assessment from the customer's viewpoint in comparison with the competitors, the satisfaction portfolio can be drawn up and suitable measures can be taken. Of utmost priority are those product requirements which the customer regards as important and which show disadvantages with respect to competitors' products. The long-term objective is to improve customer satisfaction with regard to important product features in order to establish sustainable competitive advantages. The following strategic implications emerge: fulfil all must-be requirements, be competitive with regard to one-dimensional requirements and stand out regarding attractive requirements!

In this article the authors have tried to show how Kano's model of customer satisfaction can be integrated into quality function deployment. In this way product development projects can be managed more systematically; the benefits are considerable.

REFERENCES

Akao, Y. (1992) *Quality Function Deployment*. Landsberg.

Berger, C. et al. (1993) Kano's methods for understanding customer-defined quality. *Center for Quality Management Journal* (Fall), 3–35.

Brandt, D. R. (1988) How service marketers can identify value-enhancing service elements. *Journal of Services Marketing* **2**, 35–41.

Business Week (1990) King customer (12 March), 88–94.

Buzzel, R.D. and Gale, T. (1987) *The PIMS Principles*. New York.

Finkelman, D.P. and Goland, A.R. (1990) How *not* to satisfy your customers. *McKinsey Quarterly* (Winter), 2–12.

Fornell, C. (1992) A national customer satisfaction barometer: the Swedish experience. *Journal of Marketing* (January), 6–21.

Govers, C.M.P. (1994) What and how of quality function deployment (QFD). *Proceedings of the Eighth International Working Seminar on Production Economics*, Igls/Innsbruck, February.

Griffin A. and Hauser, J.R. (1993) The voice of the customer. *Marketing Science* (Winter), 1–27.

Hanan, M. and Karp, P. (1989) *Customer Satisfaction, how to Maximise, Measure and Market your Company's Ultimate Product*. New York.

Hauser, J.R. (1993) How Puritan–Bennett used the House of Quality. *Sloan Management Review* (Spring), 61–70.

Hauser, J.R. and Clausing, D. (1988) The House of Quality. *Harvard Business Review* (May–June), 63–73.

Heskett, J.L. et al. (1994) Putting the service–profit chain to work. *Harvard Business Review* (March–April), 164–174.

Hinterhuber, H.H., Aichner, H. and Lobenwein, W. (1994) *Unternehmenswert und Lean Management*. Vienna.

Hinterhuber, H.H., Matzler, K., Bailom F. and Sauerwein, E. (1997a) Un modello semiqualitativo per la valutazione della soddisfazione del cliente. *Micro and Macro Marketing* (April), 127–143.

Hinterhuber, H.H., Handlbauer, G. and Matzler, K. (1997b) *Kundenzufriedenheit durch Kernkompetenzen*. Munich/Vienna.

Kano, N. *et al.* (1984) Attractive quality and must-be quality. *Hinshitsu: The Journal of the Japanese Society for Quality Control* (April), 39–48.

Kordupleski, R.E., Rust, R.T. and Zahorik, A.J. (1994) Marketing: the missing dimension in quality management. *California Management Review* (3).

Matzler, K., Hinterhuber, H. H., Bailom, F. and Sauerwein, E. (1996) How to delight your customers. *Journal of Product and Brand Management* **5**, 6–18.

Reichheld, F.F. and Sasser, W.E. (1990) Zero defections: quality comes to services. *Harvard Business Review* (September–October), 105–111.

Silvestro, R. and Johnston, R. (1990) The determinants of service quality: hygiene and enhancing factors. In: *Quality in Services II, Selected Papers*. Warwick Business School, UK.

Sullivan, L.P. (1986) Quality function deployment. *Quality Progress* (American Society for Quality Control) (June).

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