

Intelligence Design Concept Method Utilizing Customer Science

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Abstract: The authors will deploy the “scientific approach to customers’ tastes” by means of “Customer Science” aiming to achieve “Intelligence Design Concept Method.” This model means implementing Customer Science for turning the design process into an explicit knowledge as more creative activities from the implicit knowledge of designing utilizing statistical science. As an example of the application of this research, the authors applied this model to the product design process and obtained the results shown.

Keywords: Customer Science, Automobile, CS-IDCM.

1. INTRODUCTION

Product development in automotive manufacturing is undergoing a transitional phase from functional quality and product-oriented development, which views the product as a means of transportation, to a kind of development that inspires or makes an impression on the customer. In order to respond to such a trend, it is essential to conduct a “scientific approach to customers’ tastes” whereby the customers’ tastes are accurately grasped and reflected in the product [1]. This task is to be undertaken by the product planning and designing department. It is deemed important for the product planning department to determine the customers’ desires in a precise manner, and to provide the designers with a clear-cut product concept.

A study is being conducted on “Customer Science” (implicit knowledge - lingual knowledge - explicit knowledge) [2] which takes a scientific approach to the customers’ tastes, (implicit knowledge) by means of statistical science. As a study case for this, the authors created the “A Conception Support Method for Developing Strategic Product” and reflected it in the automotive styling (profile design) [2]. Then a specific commercialization study was conducted through academic-industrial cooperation, and substantial results have been obtained in the “innovation of the design business process” for 4-wheel vehicles [1].

Based on the above study results, the authors will deploy the “scientific approach to customers’ tastes” by means of “Customer Science” aiming to achieve “Intelligence Design Concept Method.” This method signifies implementing Customer Science for turning the design process into an explicit knowledge as more creative activities from the implicit knowledge of designing utilizing statistical science. The authors will attempt to carry on the “bridging” portion in the course of realization of strategic product designing from the mainly research-oriented analysis as the event analysis ac-

ording to the business process. This model contains SQC (Statistical Quality Control), collages, text mining, profile design, Package Design. As an example of the application of this research, the authors applied this model to the product design process and obtained the results shown.

2. ISSUE IN MARKETING, PRODUCT PLANNING AND DESIGN

Today, growing companies both in Japan and abroad try to grasp the unprejudiced desires of their customers from the viewpoint of customer-oriented business management [3] and to reflect these desires in future product development. However, the actual behavioral patterns (conception methods) of designers (new product planners and designers) in trying to grasp latent customer desires depend heavily on the designers’ empirical skills. Designers often proceed with product development using implicit business processes.

Accordingly, their performance is measured by sales results and their efforts to improve business processes for future jobs may be insufficient as implicit prescriptions. Designers often worry that their current business approaches are likely to depend on job performing capabilities and on the sensitivity (intuition or knack) of individual persons [4-8], which will not improve the probability of success in the future, regardless of whether or not they have “lucky success” or “unlucky failure”. It is, therefore, important to establish a scientific approach that improves powers of product conception sight and foresight or a “new model for assisting the conception of strategic product development” and to test its validity [9].

3. CUSTOMER SCIENCE PRINCIPLE - SCIENTIFIC CUSTOMER ANALYSIS

Supplying products that satisfy consumers (customers) is the ultimate goal of companies that desire continuous growth. In this new century in which the global marketing of products is the basis of management, it is necessary to manufacture products that bring increased value to customers in addition to matching the life stage and lifestyle of each customer. In order to develop and provide attractive customer-oriented products to attain this purpose [10-12], the current

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problems are researching customer needs and establishing visionary strategic product design methods [1].

Customers generally evaluate existing products as good or poor, but they do not generally have concrete images of products they will desire in the future. For new product development in the future, it is especially important to “supply desirable products before customers desire them”. For that purpose, it is important to precisely understand the vague desires of customers. Proposal of *Customer Science* principle [1], shown in Fig. (1), makes it possible to concretize customer desires. It is intended to indicate the desirable state of new business processes for creating “wants” indispensable to the development of attractive products.

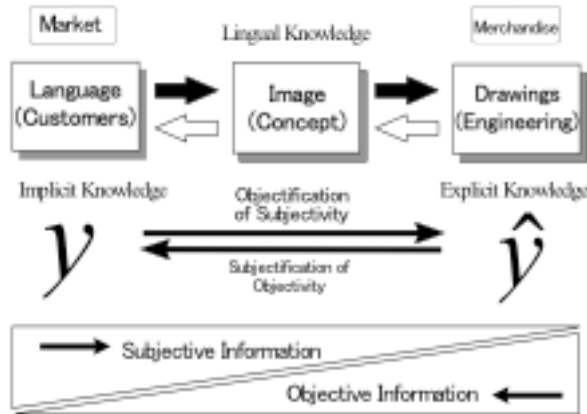


Fig. (1). Schematic Drawing of *Customer Science* principle.

As shown in the figure, the image of customer’s words (implicit knowledge) is translated first into common language (lingual knowledge) and then into engineering language (design drawings as explicit knowledge) by means of appropriate correlation. In other words, objectification of subjective information is important for future product development. It is also important to transform objective into subjective information through correlation to check that engineering successfully reflects customer requirements. An approach based on customer science methodology will make product planning and uncertain business processes more accurate, possibly increasing success rates and decreasing failure rates.

4. INTELLIGENCE DESIGN CONCEPT METHOD “CS-IDCM”

The authors [9] think that the analysis process itself that turns implicit knowledge named designing into explicit knowledge constitutes the secret to the conception. In this connection, the authors propose Intelligence Design Concept Method “CS-IDCM”, the conception support method for developing strategic product quoting the “*Customer Science*”. This diagram signifies implementing *Customer Science* for turning the design process into an explicit knowledge as more creative activities from the implicit knowledge of designing.

The author will attempt to carry on the “bridging” portion in the course of realization of strategic product designing from the mainly research-oriented analysis as the event analysis according to the business process (method 1 to

method 2 to method 3 in the diagram) shown in Fig. (2). This methodology is intended to establish a new methodology for supporting conception, which will ascertain the field covered by conception adapted to the times and contribute to enhancing the proposal capability of designers. Each method unfolds as follows.

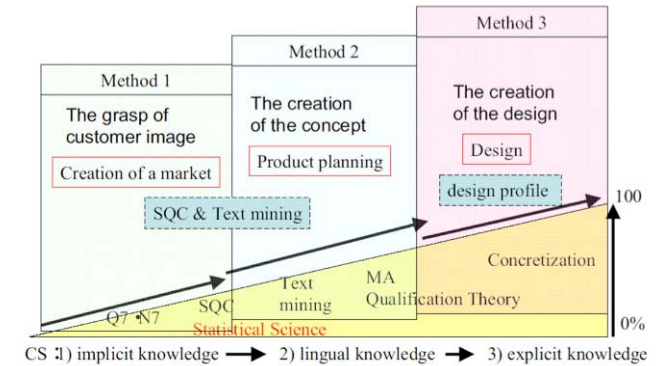


Fig. (2). CS-IDCM.

1) The grasp of the customer image

Method 1 is clear grasp which utilizes quantification of the sense of values and sensitivity of the customer. The designers analyze the collection of Customer Data utilizing statistical science. In this method, Q7 (7 QC Tools), N7 (New 7 QC Tools), SQC, collage, qualification theory, etc. are effective.

2) The creation of the concept

Method 2 is to understand what the customer wants and to offer a clear concept to the designer. Analyst and designers objectively analyzes customer’s value of product and create a product concept. In this method text mining, qualification theory, etc. are effective.

3) The creation of the design

Method 3 improves generation of new ideas which affects development process of profile design. This method support idea generation by analysis process used statistical science. In this method, multivariate statistical analysis, qualification theory, etc. are effective.

This formulation is intended to convert designing as implicit knowledge into the designing process that can be expressed explicitly. In other words, it is aimed at creating a special useful solution instead of a general solution that can be obtained by analysis-oriented teleology in the automotive design engineering field.

5. APPLICATION OF CS-IDCM

A contemporary issue today surrounding the topic of “design” as a merchandizing technique for creating attractive vehicles is the establishment of a “Concept Support Method for Designers” [13] which contributes to the innovation of the design process. This is especially clear in the case of vehicle package design and satisfying the demands for both the “exterior” and “interior space” of a vehicle is one of the especially troubling problems facing the present design proc-

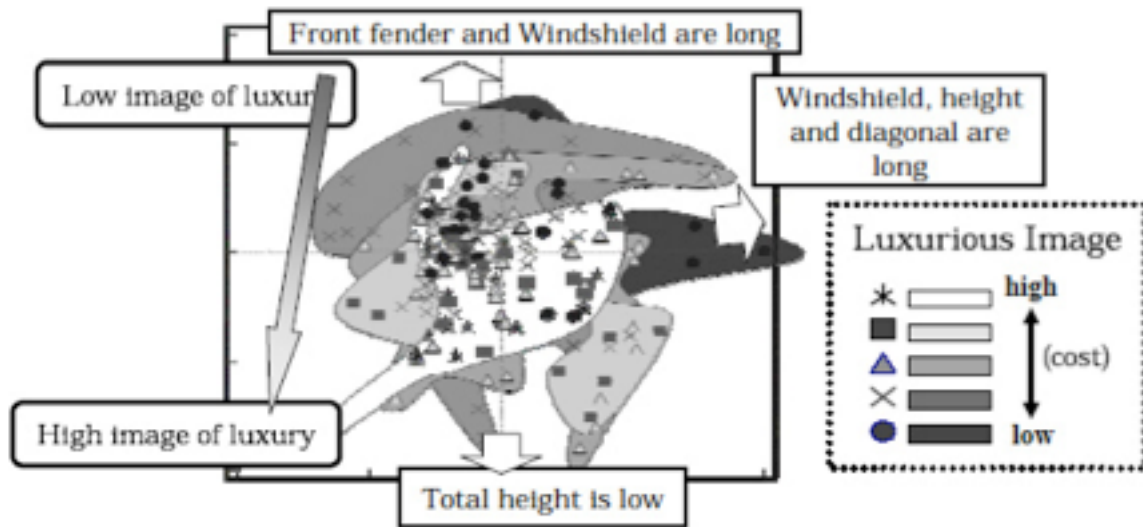


Fig. (3). Model classification by degree of luxury.

ess. The establishment of a “package design concept support method” is urgently needed to help tackle this problem [14].

This research focuses on the “designing of medium-sized sedans” that have both a “high class, innovative exterior and a comfortable interior,” a combination which has troubled experienced designers most during their careers. In the following, the application process of CS-IDCM for the product development of a new model is presented.

5.1. The grasp of the Customer Image: Optimizing the Exterior Shape “Design Profile” and Grasping its Relationship to the Interior Space

In method 1 the authors employ a statistical analysis (multivariate analysis) which has proved effective in our preliminary study Concrete Design Concept Support Methods, as the authors search for the “high-class, innovative exterior”. Concretely, the authors searched for the exterior proportion ratio that expressed the “high-class, innovative exterior” and gave priority to customer’s preferences when developing our exterior “design profile”. Next, the authors changed the ratio of the exterior proportion in various ways to examine the correlation (relative change in dimensions) between each of the exterior proportion items and each of the interior space items. This allowed us to clarify the degree of influence the changes in the exterior shape have on the interior space in more detail.

Fig. (3) shows the results from using method 1 to classify domestic and foreign automobiles by the degree of luxury they present based on the measurement data from the front area of their exteriors. The figure shows quantitatively that when an automobile is viewed from the front, a luxurious image can be presented by “the low level of its total height” and the “length of the front fender and windshield”. In this way, by closely examining the exterior proportion from 3 different directions, side, front, and rear, it should be possible to determine the exterior proportion ratio that satisfies customer preferences by expressing a sense of “luxury and innovation”.

Next, the authors concretely and clearly determined the degree of influence that a change in the exterior shape would have on the interior space. The authors clarified the degree of influence of the change of exterior profile on interior space from the mutual relationship (relative size change) between the exterior proportion item (each section of exterior) and interior space item by changing the exterior proportion in various ways.

Based on the results of these investigational analyses, it was confirmed that designing which gives highest priority to the exterior shape makes it very difficult to simultaneously achieve a satisfying level of comfort for the internal space. Therefore, the significance of this research into “package design that simultaneously satisfies the demands of both the exterior and interior space”, was verified.

5.2. The Creation of the Concept: Optimizing the Interior Space “Package Design”

In method 2, the authors searched for the optimal interior space “package design”, which would satisfy the demands for a comfortable interior, by investigating the dimensions of each of the component parts that make up the interior and their ratio. Concretely, the authors investigated customer’s aesthetics and open opinions towards interior parts they ordered by administering an aesthetic evaluation survey. Analysis of the survey results allowed us to grasp the relationship between “people’s aesthetics” and “dimensions” based on the various dimensions of each of the component parts of the interior and their ratio.

In addition, a text mining method was applied to the customer’s free opinion comment data to extract customer’s exact requirements for the interior parts they ordered, so that the authors can satisfy their demand for a “comfortable interior space”. At the same time this method allowed us to verify the analysis results.

Fig. (4) shows the comparative charts obtained from performing a principle component analysis of the interior dimension data and test drive evaluation data. The relationship

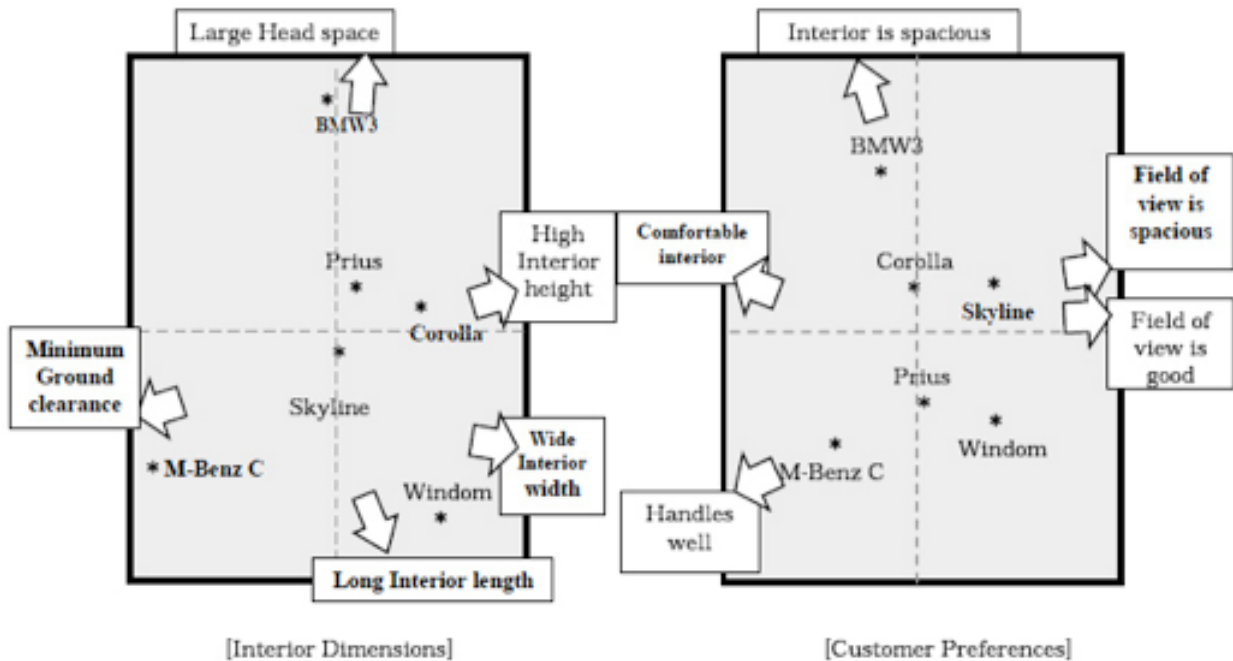


Fig. (4). Correlation between “interior dimensions” and “customer preferences”.

between “interior dimensions” and “customer preferences” can be seen clearly in the charts. Next an investigational analysis was made of the “lingual data gathered through the free opinion method (straightforward comments from customers), which are the basis of the aesthetic evaluations submitted by the test drivers. For example, comments like, “the foot space should preferably be simply designed and roomy”, helped to clarify the design concepts for interior parts which received a lot of attention from the test drivers. These honest comments straight from the customers also verified the analysis results. As a result, the “interior space dimensions and their ratio for realizing a comfortable interior space” were clarified as well.

Concretely, it was found that in car models that had a high number of characteristics that matched “customer preferences”, that a satisfying and comfortable interior space had needed an interior height to interior width ratio of 0.811 (1185 mm/1460 mm) or more, and an interior height to interior length ratio of 0.621 (1150 mm/1850 mm) or more. The ideal ratios were found to be, an interior height to interior width ratio of 0.821 (1150 mm/1400 mm) or more, and an interior height to interior length ratio of 0.699 (1185 mm/1695 mm) or more.

5.3. The Creation of the Design: Compatibility of the Exterior Shape and the Interior Space

In method 3, an attempt was made to combine the “exterior design - design profile” and the “interior space - package design” which would satisfy the customers, based on the knowledge obtained through the two steps listed above. Concretely, a specific guide was developed that should allow compatibility between the two by visualizing the parts which interfere in the design guide of each, and visualizing the distribution of space around the interfering axis.

In method 3 an attempt was made to combine the “exterior design - design profile” and the “interior space - package design” which would satisfy the customers, based on the knowledge obtained through the two steps listed above. First, from the “exterior proportion ratio”, to satisfy customer preferences, found from the analysis in method 1, and the “interior space dimensions and their ratio” found from the analysis in method 2, the customer demand ratio for each automobile exterior and interior part was determined. When the “visualization of the automobile package plan” (Fig. 5) was carried out and checked, knowledge that “the exterior design and interior design both interfere with each other” was gained.

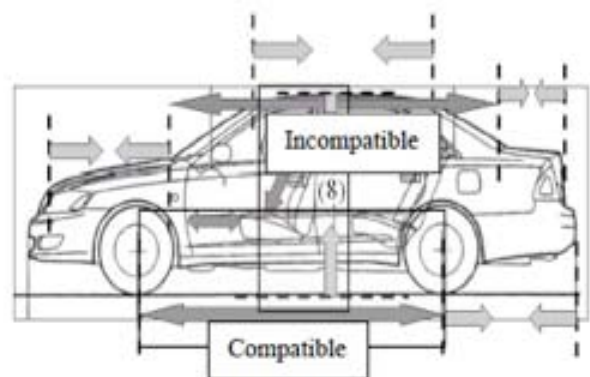


Fig. (5). Visualization of the automobile package plan.

For example, when it comes to the “exterior design”, the customer demand ratio indicates that the total height should be low compared to the total width. However, when it comes to the “interior space”, the customer demand ratio indicates that the total height should be high compared to the total

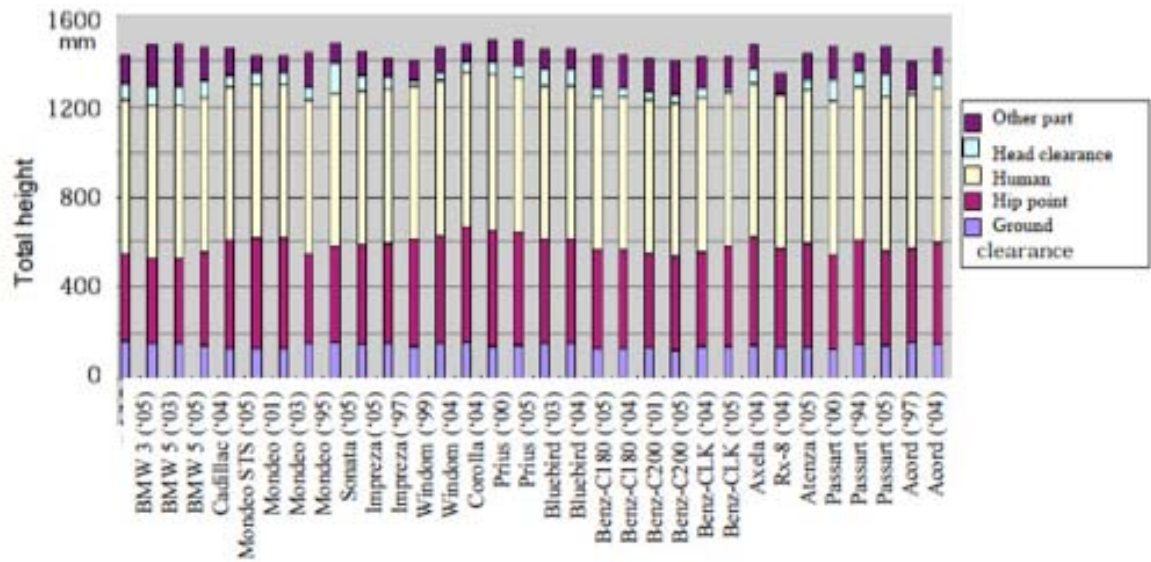


Fig. (6). Space distribution compared to total height.

width. Therefore, in order to cope with these interfering regions, the authors created Fig. (6) to visualize the interior space distribution compared to the total vehicle height for 32 domestic and foreign car models.

As a result, the authors discovered that the “nexus” between the “exterior design” and “interior space” of each model lay in the difference of the thicknesses of the roof and the floor. Consequently, once the issue of these thicknesses can be solved technically, it is clear that a package design that can cope with these interfering regions can be realized. In addition, as a part of the “designing – designer concept support method” it should be possible to create a “package design” guide that can generate concrete solutions to specific cases. For example, in response to a request to lower the vehicle’s total height, the roof and floor could be made thinner and the minimum ground clearance could also be lowered.

6. CONCLUSION

The authors deployed the “scientific approach to customers’ tastes” by means of “Customer Science” aiming to achieve “Intelligence Design Concept Method.” This model signifies implementing Customer Science for turning the design process into an explicit knowledge as more creative activities from the implicit knowledge of designing utilizing statistical science. As an example of the application of this research, the authors applied this model to the product design process and obtained the results shown.

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