

# Development of hierarchies of customer needs and impressions for passenger car interiors based on a survey of car reviews on internet

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The interior design of passenger cars has been emphasized as an important factor determining their competitiveness in the market. The quality of an interior design can be effectively improved by using information of customer needs and impressions. The present study is intended to develop hierarchies of customer needs and impressions for auto interiors and identify their relative weight in a systematic manner. Three models of different vehicle types (compact, full-size, and recreational vehicle) were selected and corresponding 350 car reviews were collected at 38 internet sites. Then, from the collected reviews, about 2000 customer statements related with needs and impressions were drawn. Then, by interpreting the statements, customer needs and impressions were identified. Next, the needs were grouped by affinity diagram method, resulting in a hierarchy which consists of five categories (aesthetic design, material, functionality, finish, and comfort). In parallel, the impressions were summarized by interior part. Lastly, customer needs and impressions that were addressed by customers with relatively high frequencies were presented.

## Introduction

As the competition of passenger cars in the world-wide market becomes increasing, automobile manufacturers place efforts to improve the quality of interiors as well as exteriors, horsepower and speed. Japanese and European auto makers keep competitive in the US market with superior interior designs incorporating high-quality materials and high-tech equipment; thus, US auto makers devote more efforts than before to improve their interior designs (White, 2001).

Information of customer needs and impressions of vehicle interiors should be used to improve the quality of the interior designs. In recent days, the interiors of compact cars have been introduced to the market with splendid colors and fashionable styles to appeal to the young, and those of full-size cars with high-tech convenience equipment and expensive materials of wood and leather (Welch, 2002).

With a rapid spread of internet communication, customer needs and impressions about the interiors of passenger cars can be easily surveyed at the internet sites of car reviews, in which customers evaluate the quality of their cars, share their experiences and opinions, and propose designs for improvement. Therefore, it is an efficient method

to identify customer needs and impressions on car designs by mining customer statements on the internet.

The present study developed a hierarchy of customer needs for interiors of three types of cars (full-size, compact and RV (recreational vehicle)) and a hierarchy of impressions for car interiors through a survey on the internet review sites of passenger cars.

## Methods

### Collecting car reviews

Car reviews of a particular model selected for each vehicle type were collected on the internet. The reviews were provided by customers and professional review writers (at car magazines and buyers' guides for cars) in various countries. A total of 350 reviews from 38 internet sites in 5 countries (South Korea, USA, UK, Canada, and Australia) were collected.

### Collecting customer statements

Of the collected car reviews for each vehicle type, 2,000 customer statements indicating customer needs and impressions on the interior were identified. A customer

statement with information of likes/dislikes and expectations for interior parts was classified as one indicating customer needs; a customer statement expressing his/her impression on interior parts with adjectives was classified as one indicating customer impressions. Half of the statements corresponded to customer needs and the other half related to customer impressions.

In addition, the collected customer statements were organized according to the structure of interior (4 parts, 22 assemblies, and 81 sub-parts). The customer statements were categorized into four interior parts (overall interior, crash pad part, cabin room, and luggage compartment), then further divided into corresponding assemblies and subparts in sequence.

### Developing a hierarchy of customer needs

The customer needs identified from the customer statements were organized into a hierarchy for each vehicle type. The needs hierarchy was developed by using the affinity diagram method, in which individual needs were grouped according to their semantic similarity along with group naming and then the needs groups were grouped again to form the next high level of the hierarchy along with group naming.

### Developing a hierarchy of customer impressions

A hierarchy of customer impressions was developed and the frequencies of impressions stated by customers were analyzed. Customer impressions were defined by using the adjectives identified from the customer statements. The dimensions of impression (Han et al., 2000) were referred to transform the adjectives into impressions. For example, the adjectives *circular* and *rectangular* were transformed to the impression *shape*. Then, the customer impressions were organized according to the structure of interior. Lastly, the frequency distribution of customer statements along with the impressions was summarized.

## Results and Discussion

### Hierarchy of customer needs

The customer needs of the interior were commonly classified into five categories (aesthetic design, material, functionality, finish, and comfort), but the weights of the needs categories and corresponding details varied among the three vehicle types. First, for the full-size vehicle type, needs of aesthetic design are most frequent followed by ones of functionality, finish, comfort, and material in order (see

Table 1). Of the needs of aesthetic design, ones for stylish interiors are dominant. Of the needs of functionality, ones for convenient equipment (such as CD/DVD player and navigation system) are major; and those for the equipment's superior performance and function and safety devices are unique in comparison with those of the other vehicle types. The frequency of needs for finish is similar to those of the other vehicle types, but, of the needs of finish, ones for the good refinement quality of interior parts are more than those of the others and needs for silence are unique feature of needs for finish of full-size type. Finally, the frequency of needs for materials is smaller than those of the others. Therefore, the interiors of full-size vehicle type should be made of high-quality materials basically, completed with good quality of refinement and silence, and emphasized with superior convenience equipment and aesthetic designs.

Table 1. Hierarchy of customer needs for full-size vehicle type

| Group (proportion)          | Details (frequency)   |
|-----------------------------|---|
| Aesthetic design<br>(35.3%) | Stylish interiors (116)<br>Harmony of interior parts (11)   |
| Materials<br>(4.7%)         | Luxurious materials (16)<br>Soft materials (1)  |
| Functionality<br>(22.8%)    | Various convenient equipment (24)<br>Usable arrangement and layout (18)<br>Readability/visibility (17)<br>Superior performance and function (11)<br>Manipulability (10)<br>Safety equipment (2) |
| Finish<br>(21.0%)           | Silence of interior (46)<br>Good quality of refinement (33)   |
| Comfort<br>(15.3%)          | Sufficient interior spaces (44)<br>Sufficient luggage spaces (11)   |

Next, for the compact vehicle type, needs for functionality are most frequent followed by ones of aesthetic design, finish, comfort and materials (Table 2) in order. Of the needs for functionality, ones for storage devices for convenience are dominant and ones for usability of interior equipment such as readability and visibility are major. Of the needs for aesthetic design, ones for fashionable colors are unique features of compact type in comparison of the others. Of the needs for finish, ones for soundproofing and elimination of noises are frequent, and ones for elimination of vibrations are unique characteristics of the compact type. Needs for sufficient spaces of interior are most frequent as the low-level needs in the hierarchy. Therefore, the interior of the compact vehicle type should be emphasized with a variety of storage devices for convenience, superior usability of interior equipment, and splendid and fashionable colors. Moreover, customers of the compact type expect basic

interior qualities of the full-size type such as soundproofing, elimination of noise and vibration, and sufficient interior spaces.

Table 2. Hierarchy of customer needs for the compact vehicle type

| Group (proportion)     | Details (frequency)  |
|------------------------|--|
| Aesthetic design (23%) | Stylish interior (71)<br>Preferable colors (9)<br>Color coordination (4)   |
| Materials (8%)         | Luxurious materials (14)<br>Preferable materials (8)<br>Soft materials (8)   |
| Functionality (29%)    | Convenient storage devices (43)<br>Readability/visibility (31)<br>Manipulability, simplicity (30)<br>Usable arrangement and layout (4) |
| Finish (21%)           | Soundproofing and noise elimination (53)<br>Refinement (17)<br>Vibration elimination (9)   |
| Comfort (19%)          | Sufficient space (72)  |

Lastly, for the RV type, needs for functionality are most frequent followed by ones of comfort, finish, aesthetic design, and materials (see Table 3). Of the needs for functionality, ones about usability of interior equipment, storage devices, and a variety of convenient equipment are frequent. Of the needs for comfort, ones for flexible luggage spaces are unique features of RV in comparison with those of the other vehicle types. Of the needs for finish, ones for soundproofing and elimination of noises are major like those of the compact type. Of the needs for materials, ones for coordination of materials are the unique features of the RV type. Therefore, the interiors of RV should be emphasized with plentiful spaces of interior and flexible luggage spaces, and be satisfactory with both the needs for functionality of the full-size type and needs for finish of the compact type. Moreover, they should be made of materials in harmony.

Table 3. Hierarchy of customer needs for RV type

| Group (proportion)       | Details (frequency)  |
|--------------------------|--|
| Aesthetic design (14.8%) | Stylish interiors (30)<br>Convenient design(14)  |
| Materials (9.8%)         | Luxurious materials (18)<br>Soft materials (9)<br>Harmony between materials (2)  |
| Functionality (37.2%)    | Manipulability (27)<br>Usable arrangement and layout (24)<br>Convenient storage devices (19)<br>Various convenient equipment (15)<br>Readability/visibility (15)<br>Usable information (9)<br>Convenience for cleaning (2) |

|                 |   |
|-----------------|---|
| Finish (15.4%)  | Soundproofing and noise elimination (32)<br>Refinement(14)        |
| Comfort (22.8%) | Sufficient interior spaces (47)<br>Sufficient luggage spaces (21) |

### Hierarchy of customer impressions

In the hierarchy of impressions for the interior, the most frequent impressions for each interior part were identified (see Table 4). For example, the major impression of interior parts that the user interacts with most frequently (such as center fascia, cluster gauge, display and controls) is convenience and those of crash pad, pillar and door are elaborateness and harmoniousness. For steering wheel, luxuriousness and convenience are most frequent, for interior space, impression of volume and comfort, and for console, convenience and elaborateness. Moreover, the most frequent impressions on overall interior which can affect purchasing decision on passenger cars are elaborateness, satisfaction, luxuriousness and comfort in order.

Also, the interior parts on which customers stated their impression mainly were identified by summing the frequencies of all impressions on each interior part. Those interior parts are overall interior (27.3%), center fascia (18.6%), space of interior (11%) and door (6.5%). Moreover, the most frequent impressions of interiors are convenience (19.5%), elaborateness (17.8%), satisfaction (15%) and impression of volume (10.4).

Table 4. Hierarchy of impressions for interior (sample of crash pad assembly)

| Assembly                   | Sub-part                  | Major impression elements(frequency)                                       |
|----------------------------|---------------------------|--|
| Overall Crash Pad Assembly | -                         | Satisfaction (18), convenience (12), elaborateness (11), luxuriousness (8) |
| Center Fascia              | Overall of center fascia  | Preference (32), convenience (10), metaphoric design image (6)             |
|                            | Center fascia panel       | Convenience (4)  |
|                            | Display                   | Convenience (3)  |
|                            | Control                   | Convenience (22), impression of volume (5), elegance (4)                   |
|                            | Audio                     | Convenience (23), satisfaction (6), impression of volume (5)               |
|                            | Cup holder                | Elaborateness (7), convenience (6)   |
| Cluster Gauge              | Overall of cluster Gauge  | Convenience (7), clearness (1)   |
|                            | Speedometer               | Convenience (2), attractiveness (2), harmoniousness (1)                    |
|                            | Tachometer                | Convenience (3), attractiveness (2)  |
| Crash Pad                  | Overall of crash pad      | Elaborateness (2) harmoniousness (1), impression of texture (1)            |
|                            | Crash pad main panel      | Luxuriousness (6), elaborateness (6), convenience (4), satisfaction (3)    |
| Steering Wheel             | Overall of steering wheel | Luxuriousness (3), convenience (3), impression of heaviness (2)            |
|                            | On-board control          | Convenience (5), elaborateness (4)   |

## Conclusion

This study developed a hierarchy of customer needs for each vehicle type and a hierarchy of impressions for the interior based on customer statements from car reviews on the internet. Three models were selected for three vehicle types (compact, full-size, and recreational vehicle) and 350 car reviews for the corresponding models were collected at 38 internet sites. Then, from the collected reviews, 2,000 customer statements indicating customer needs and impressions were identified and organized.

A hierarchy of customer needs for each vehicle type was developed by using the affinity diagram method and characteristics of customer needs were identified for the interior of each vehicle type by analyzing the frequency distribution of customer needs. The interior of the full-size vehicle type should be refined in an elaborate and neat manner with luxurious materials and emphasized with superior convenience equipment and aesthetic designs. The interiors of compact car should be emphasized with a variety of convenient storage devices, superior usability of interior equipment, and splendid and fashionable colors. Finally, the interior of the RV type should be satisfactory with both the functionality needs of the full-size type and finish needs of the compact type.

A hierarchy of impressions for interior was developed by organizing customer impressions according to the structure of the interior. The representative impressions of each interior part, major interior parts affecting impressions on interior and major impressions of interior were identified by analyzing frequencies of impressions. The major impressions for each interior may be highly related the characteristics of interior part. The impressions of interior parts which influence functionality were convenience and those of interior parts affecting the aesthetic design of the interior were elaborateness and harmoniousness. The most affective interior parts were overall interior, center fascia, and interior space. Finally, the most frequent impressions of the interior were convenience, elaborateness, satisfaction, and volume impression.

The customer needs hierarchy of each vehicle type and the impression hierarchy can provide effective information for improvement of an interior design for passenger car based on customer opinions.

For more reliable hierarchies of customer needs and impressions, it may be necessary to collect customer statements from car reviews about other models of the three vehicle types. In this study, car reviews of a particular model

selected for each vehicle type were collected, assuming that the customer needs and impressions identified from the reviews of the particular model are applicable to other models of the corresponding vehicle type. A further study is needed to investigate this assumption.

## References

- Han, S. H., Yun, M. H., Kim, K. Kwahk, J. 2000. Evaluation of product usability: development and validation of usability dimensions and design elements based on empirical models. *International Journal of Ergonomics*, 26, 477-488.
- Welch, D. 2002. Luxury gets more affordable. *BusinessWeek*, April 22, 60-61.
- White, G. L. 2001. Car makers battle inferior interiors in hopes of earning buyers' respect. *The Wall Street journal*, December 3, <http://online.wsj.com>.