

Research on the Design of Heavy Truck Kitchen Appliances Based on User Needs

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Abstract:

The kitchen electrical equipment in the heavy truck cabin has an important impact on the quality of life of the driver during long-distance driving. The article obtains the actual needs of heavy truck users through background research and offline interviews. On this basis, combined with the Kano model standard questionnaire, the user needs are quantitatively analyzed to match the types of electrical appliances. Finally, the weight analysis is used to summarize the key needs of the heavy truck user group and make a combined design.

Keywords:

Heavy Truck Living Cabin, On-Board Electrical Appliances, Kano Model, Combined Design

1. Introduction

In recent years, the Internet has driven the rapid growth of the overall economy, and the new business model represented by e-commerce has greatly driven the development of the domestic logistics industry. As an important means of transportation for logistics, the demand for heavy trucks has also increased year by year. However, domestic on-board electrical products for heavy truck living cabins are less designed, lacking suitable design concepts and methods, and cannot meet the actual needs of users. This paper discusses a combined design method for electrical products in limited space, and proposes a combined design method based on user demand weight analysis combined with usability testing based on the above situation, and under the guidance of this method, the heavy truck on-board kitchen appliances are completed. innovative design.

The design of the cockpit of a heavy truck is different from that of an ordinary passenger car. It not only needs to meet the basic driving needs of "travel", but also needs to meet the long-term "food" needs of the people in the car. Domestic heavy truck users are mainly non-employment self-employed, so their driving routes are not fixed, and restaurants or shops that provide catering services near the road have problems such as high prices, uneven quality, and lack of standardized management. In the face of such a situation, the driver needs to be in charge of the driver's food and beverage needs, and it has become a common phenomenon for the "sister-in-law" to

follow the car. The purpose is to reduce food expenses and transportation costs as much as possible [1]. At present, there are few researches on vehicle-mounted kitchen appliances in China, and the existing vehicle-mounted kitchen appliances on the market cannot meet the long-term living needs of multi-person vehicles. In order to reduce expenses, heavy truck users can only simply install household appliances in the car, such as refrigerators, kettles, and induction cookers. These changes not only reduce the limited use space in the car and increase the difficulty of use, but also need to change the circuit in the car, causing a great safety hazard. How to improve the safety and ease of use of heavy-duty truck on-board appliances in a limited space, and reduce user learning costs, these urgent problems put forward new requirements for heavy-duty truck on-board kitchen appliances.

2. User Requirement Extraction

Wuhan has always been known as the “Nine Provinces Link” and is the largest water, land and air transportation hub in China’s inland [2]. In order to have a better understanding of the actual living conditions of heavy-duty truck drivers and find out the current problems existing in the life of heavy-duty truck users, an offline field investigation was conducted on Wujiashan, Dongxihu District, the largest logistics distribution center in Wuhan. A total of 28 heavy-duty truck drivers with more than 5 years of driving experience were asked in the survey. The combination of guided narratives and interviews was used to conduct research around the “food” aspect, and obtained the specific details of the drivers’ life in the car. The corresponding “food” descriptions are “the food provided in the service area does not suit the taste”, “there are many uncertain factors on the road, and it is impossible to eat on time”, “the price is high, accounting for the most expenses”, “it is more hygienic to cook by yourself”, “can not eat.” “Fresh fruits and vegetable”, “It is inconvenient to cook in the car”, etc. Faced with the above problems, it can be concluded that the dietary expectations of heavy truck users are: they can cook at any time, the food can be kept fresh, and the storage and organization are convenient.

On this basis, it is necessary to consider the particularity of the living space in the car, various restrictive factors in the food processing process, and various safety and convenience restrictive conditions should be considered when designing electrical appliances. Therefore, the focus group discussed and concluded that “it is safer to choose electric heating for heating equipment”, “consider different usage scenarios in the cab and outdoors when cooking”, “folding design minimizes space occupation”, “kitchenware storage management system”, “kitchenware storage management system”, “kitchenware storage management system”, “Waste Recycling System” and so on.

3. Collection and Analysis of User Evaluation Based on Kano Model

The Kano model is a method invented by Noriaki Kano to classify and sort user needs. The model divides user needs into five types in the form of questionnaires, namely basic type (M), expectation type (O), attractive type (A), indifference type (I), reverse type (R), transforming perceptual demands into specific functional demands [3]. Using the Kano model in product design can help designers quickly understand user intent and help determine product functionality based on this [4].

3.1. Survey design

The purpose of this questionnaire is to divide the functional requirements of kitchen electrical equipment given by the previous survey and discussion group. Therefore, it is necessary to collect information extensively and cover various opinions from researchers to users as much as possible. Before the questionnaire starts, a group of designers simulates the cooking behavior in the form of a body storm, and summarizes the required products including induction cookers, rice cookers, microwave ovens, etc. On this basis, a combination of online and offline questionnaires is used to conduct . Forums with high attention from truck drivers are selected online, such as “Truck Home”, “Love Truck Network”, “Truck Driver Bar”, etc. Offline, the form of interview questionnaire is adopted, and the inquirers include truck drivers in logistics distribution centers and product design. Relevant personnel ordinary consumers. The questionnaire design is shown in Table 1.

Table 1. Kano Survey Questionnaire.

Number	Design features	I love so much (A)	of course (M)	It doesn't matter (O)	Reluctantly accepted (I)	I am not satisfied (R)
Q1	How do you rate the kitchen appliances (cooking equipment) facilities provided in the heavy-duty cabin					
Q2	How do you rate the lack of kitchen appliances (cooking equipment) in the vehicle living compartment					
.....						
Q17	The vehicle-mounted kitchen and electric complex provides storage areas for frequently used items such as condiments, pots and					

	bowls (to make the interior of the vehicle more tidy, but it will take up a certain amount of space and increase the cost)					
Q18	The vehicle-mounted kitchen and electrical complex does not provide storage areas for frequently used items such as condiments, pots and bowls (which can save space for other equipment and reduce costs)					

3.2. Data analysis

After the questionnaire survey is completed, the recovered data is imported into Excel, and then the overall satisfaction ratio of the combination of the provision and the non-provision of each demand is calculated according to the Kano model evaluation method, and the demand level attribute of each question is obtained. A total of 130 valid questionnaires were collected in this survey, and the survey objects were: truck drivers or vehicle attendants (26.19%), design professionals related to this issue (34.13%), and ordinary consumers interested in this issue (39.68%). Among them, truck drivers mainly use long-distance transportation, accounting for 37.84% of the total number of truck drivers, and mainly short-distance transportation, accounting for 62.16%. Driving experience within 5 years accounted for 32.43%, 5-10 years accounted for 48.65%, and more than 10 years accounted for 18.92%. The population structure of truck drivers in this survey is basically consistent with the truck driver data given in the “Truck Drivers’ Employment Status Survey” completed by the early middle school IOT Road Freight Branch, together with Truck Home, Xinjie Logistics and many other enterprise units in 2016. The survey results have objectivity. The detailed questionnaire data processing results are shown in Table 2.

Table 2. Survey results of heavy truck users' needs.

Number	Design Characterization	A	O	M	I	R	Q	Kano classification	Better	Worse
1	How do you rate the provision of kitchen electric facilities in the living cabin of heavy trucks & how do you rate the lack of kitchen electric facilities in the living cabin of the vehicle	23.0 8%	28.4 6%	22.3 1%	20.7 7%	0.77 %	4.62 %	O	54.4 7%	- 53.6 6%
2	Kitchen Electric Complex Provides Induction Cooker & Kitchen Electric Complex Does Not Provide Induction Cooker	36.1 5%	21.5 4%	9.23 %	26.9 2%	0.77 %	5.38 %	A	61.4 8%	- 32.7 9%
3	Kitchen Electric Complex Provides Rice Cookers & Kitchen Electric Complex Does Not Provide Rice Cookers	23.0 8%	12.3 1%	6.92 %	50.7 7%	2.31 %	4.62 %	I	38.0 2%	- 20.6 6%
4	Kitchen Appliances Complex Provides Microwave & Kitchen Appliance Complex Does Not Provide	28.4 6%	10.7 7%	4.62 %	50.7 7%	2.31 %	3.08 %	I	41.4 6%	- 16.2 6%

	Microwave									
5	Kitchen Appliances Complex Provides Refrigerator & Kitchen Appliance Complex Does Not Provide Refrigerator	30.0 0%	28.4 6%	6.92 %	29.2 3%	0.77 %	4.62 %	A	61.7 9%	- 37.4 0%
6	Kitchen Electric Complex Provides Water Purification Equipment & Kitchen Electric Complex Does Not Provide Water Purification Equipment	26.1 5%	20.0 0%	6.15 %	40.7 7%	4.62 %	2.31 %	I	49.5 9%	- 28.1 0%
8	Kitchen Electric Complex Provides Kitchen Waste Collection Equipment & Kitchen Electric Complex Does Not Provide Kitchen Waste Collection Equipment	18.4 6%	13.8 5%	3.08 %	58.4 6%	2.31 %	3.85 %	I	34.4 3%	- 18.0 3%
9	Kitchen Electric Complex Provides Sewage Collection Equipment & Kitchen Electric Complex Does Not Provide Sewage	6.15 %	5.38 %	2.31 %	40.0 0%	42.3 1%	3.85 %	R	21.4 3%	- 14.2 9%

	Collection Equipment									
10	The kitchen appliance complex provides storage areas for frequently used items such as condiments, pots and bowls & the kitchen appliance complex does not provide storage areas for frequently used items such as condiments, pots and bowls	13.0 8%	13.0 8%	1.54 %	64.6 2%	5.38 %	2.31 %	I	28.3 3%	- 15.8 3%

3.3. Weight ordering

According to the above data analysis results, kitchen appliances are expected needs for users in heavy truck living cabins. In order to further explore the data results fed back by the user, the method of calculating the weight by Better-Worse is used to draw the coordinate axis, as shown in Figure 1 below.

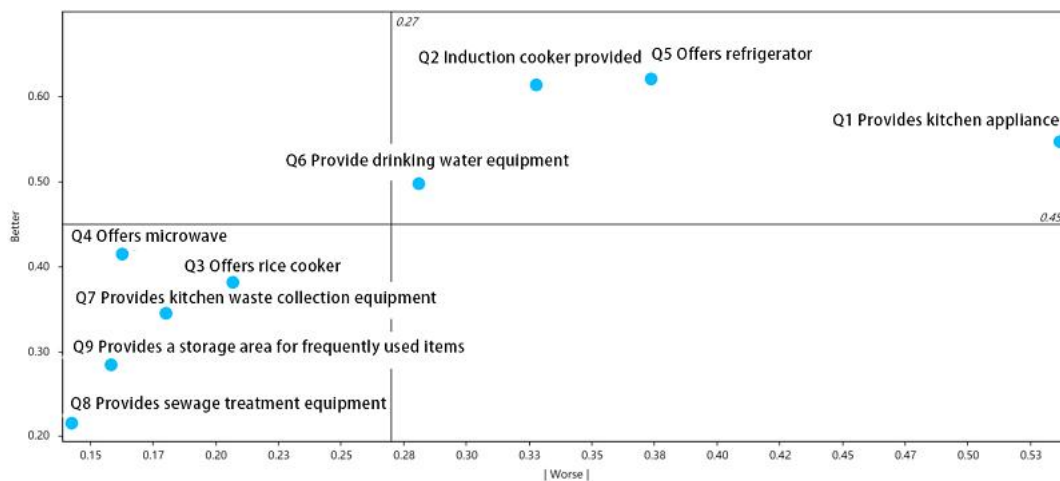


Figure 1. Better-Worse coefficient graph.

According to the Better-Worse evaluation standard, the first quadrant is the desired demand, the second quadrant is the attractive demand, the third quadrant is the undifferentiated demand, and the fourth quadrant is the necessary demand [5]. The above data analysis results show that kitchen appliances are expected needs for users in heavy truck living cabins. At the same time, vehicle-mounted kitchen appliances

should include induction cookers, refrigerators and drinking water equipment. The third quadrant is indifferent demand, which has little effect on improving user satisfaction, so it can not be provided.

4. Design Elements of Kitchen Appliances for Heavy Trucks

By excavating and analyzing the needs of heavy truck users, a vehicle-mounted kitchen and electrical equipment consisting of an induction cooker, a refrigerator and a water dispenser is obtained. The design of this scheme is based on the Dongfeng Tianlong heavy truck cabin. After physical research, it is concluded that the co-pilot can be adjusted to the front and rear without affecting the sitting posture and comfort. The available space from the seat to the bed behind the cabin is 600mm×450mm. The storage space under the bed is 1950mm x 850mm x 450mm in length, width and height. Therefore, the team decided to place the kitchen and electric complex in the available space from the passenger seat to the rear bed, and the water tank was placed under the bed. The length, width and height of the kitchen electric complex is limited to 600mm×450mm×450mm. The water tank needs to be taken into consideration to facilitate taking out and adding water, so the length, width and height are limited to less than 500mm×450mm×450mm. The design scheme is shown in Figure 2.



Figure 2. Product display of kitchen appliances for heavy trucks.

4.1. Induction Cooker Module

In the design, the different use environments inside and outside the car are considered, and the bottom folding bracket design is added on the basis of the traditional induction cooker function. It can be used in the car when the stand is not unfolded, and when the outdoor conditions permit, the stand can be unfolded to facilitate outdoor cooking. At the same time, the storage is magnetically attached to the side of the vehicle-mounted kitchen and electrical complex, with a length, width and height of 400mm × 400mm × 140mm, making the most of the lateral space in the car.

4.2. Refrigerator module

Due to the limited use of space in the car, the car refrigerator adopts a horizontal top-opening method to facilitate access to items. The top cover of the refrigerator has a flat design and is coated with an anti-scratch coating, which can be temporarily used as a cutting board when cooking in the car. The overall length, width and height of the refrigerator module combined with the induction cooker is 540mm×420mm×420mm. Considering that the kitchen-electrical complex is placed next to the bed, the refrigeration module adopts semiconductor refrigeration technology, which can

achieve the functions of mute and power saving, and reduce the noise impact on the occupants of the car when they are resting.

4.3. Water dispenser module

The combined design of the water dispenser and the water tank, the refrigerator-made semiconductor and the power management system and the water pump use the same space, which helps to increase the occupancy rate of the internal storage space of the refrigerator and reduces the volume of the kitchen appliance complex. The water source storage area can be replaced by different containers (here, the blue plastic water storage tank is used as an example, and bottled water can also be used instead). The water faucet is combined with a shrinkable hose. When using water, the water faucet can be pulled out to open the cover to take water. When not in use, the hose can be retracted and stored on the side of the refrigerator module. The length, width and height of the drinking water module are 420mm×420mm×50mm.

5. Conclusions

To sum up, as a special means of transportation, heavy trucks need to take into account the functions of the driver and accompanying persons while having the transportation function. This paper takes the concept of heavy truck living warehouse as the background, takes heavy truck user needs as the core, and obtains user needs through interviews and research. This paper discusses a combined design method of electrical products in limited space based on kano model to obtain user needs. This method can help enterprises or designers to effectively integrate product functions, reduce product development risks, improve user satisfaction, and enhance the market competitiveness of products and brands. However, dietary preferences vary from place to place, and there are many localization factors that affect on-board kitchen appliances. In the future, the functions of on-board kitchen appliances can be expanded according to the eating habits of different regions.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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References

- [1] Li, J.Y. “Investigation Report on Chinese Truck Drivers No. 2”: Pay attention to his hired drivers and card sisters. *China Storage and Transportation*, 2019, 6, 62-63.
- [2] Liu, E. Research on the current situation and countermeasures of Wuhan Internet business development. Central China Normal University, 2009.
- [3] Kano, N.; Seraku, N.; Takahashi, F. Attractive quality and must-be quality. *Journal of the Japanese Society for Quality Control*, 1984, 14(2), 39-48.
- [4] Meng, W.; Han, Y.Q.; He, L. Classification method of customer service needs based on fuzzy Kano model. *Technology and Economics*, 2014, 33(6), 54-58.

- [5] Yu, H.L.; Hou, L.M.; Song, M.L. Service Demand Analysis of Maternity and Infant Room Based on KANO Model. *Design*, 2020, 33(7), 141-143.



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