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Managing quality attributes using customer satisfaction coefficient

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Abstract

The two-way quality theory has been widely used as a method for classifying quality attributes for several decades. In particular, the Kano model that classifies attributes into not just conventional one-dimensional but must-be and attractive has gained popularity due to its applicability and ease of use. However, the wordings of the five alternatives in the Kano's questionnaire has been criticised for unclear meanings. This study proposes a new two-way model to classify attributes using 5-point Likert scale alternatives. For this, the current paper investigated a case of TV sets to examine how the proposed model works in comparison with the Kano model. The application results of the proposed model are different from the original one. The two-way model classifies quality attributes in more detail such as the "one-dimensional with an attractive tendency" attribute, which has a greater influence on satisfaction than dissatisfaction, the opposite "one-dimensional with a must-be tendency" attribute, and "highly one-dimensional" and "less one-dimensional" attributes. In this study, a potential satisfaction coefficient (PSC), a potential dissatisfaction coefficient (PDC), and an average potential coefficient (APC) to manage quality attributes are proposed and discussed for their utilization.
Key Words: The Kano model, 5-point Likert scale questions, Potential Satisfaction Coefficient (PSC), Potential Dissatisfaction Coefficient (PDC)

1. Introduction

For business firms to survive and thrive in a competitive market, customer defection should be reduced by solving customers' complaints immediately, and customer retention should be increased by undertaking proactive efforts to satisfy consumers' future needs. According to Anderson and Mittal (2000), the "satisfaction-profit chain" proves that an improvement in attribute performance increases customer satisfaction, and increased satisfaction leads to a greater customer retention, resulting in greater profits.

Since Kano et al. (1984) introduced the asymmetric relationship between the performance of an attribute and the customer satisfaction of that attribute, it has been used in various fields for about three decades. This model classifies quality attributes as follows:

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• One-dimensional attribute-an attribute that increases satisfaction when presented and decreases satisfaction linearly when not presented.

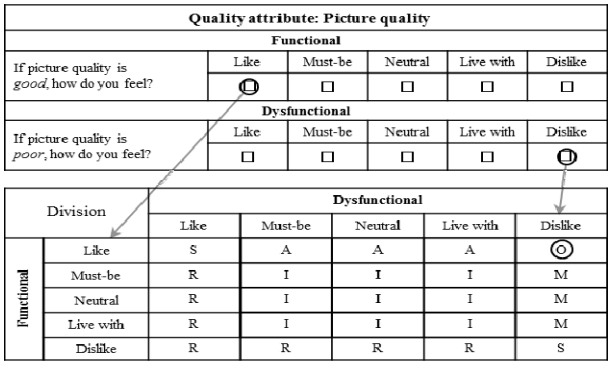
• Attractive attribute-an attribute that provides satisfaction when presented, but does not cause dissatisfaction if it is not provided.

• Must-be attribute-an attribute that does not increase satisfaction even if presented because it is taken for granted, but incurs dissatisfaction when not presented.

• Indifferent attribute-an attribute that customers are neither satisfied nor dissatisfied whether it is provided or not because this attribute does not attract consumers' interest or attention.

• Reverse attribute-the opposite of a "one-dimensional" attribute.

The Kano model identifies quality attribute types through pairs of functional and dysfunctional questions. For example, regarding 'picture quality' for a TV set, the quality type is determined through following two questions: "if the picture quality is good, how do you feel?" and "if the picture is poor, how do you feel?" From Figure 1, the attribute of 'picture quality' is classified as "one-dimensional" if a respondent chose "like" for the functional question and "dislike" for the dysfunctional question. Because the classification results are not the same between the respondents, the Kano model determines the attribute type which was chosen the most.



Quality attribute: Picture quality					
Functional					
If picture quality is *good*, how do you feel?	Like	Must-be	Neutral	Live with	Dislike
	◉	□	□	□	□
Dysfunctional					
If picture quality is *poor*, how do you feel?	Like	Must-be	Neutral	Live with	Dislike
	□	□	□	□	◉

Division		Dysfunctional				
		Like	Must-be	Neutral	Live with	Dislike
Functional	Like	S	A	A	A	◎
	Must-be	R	I	I	I	M
	Neutral	R	I	I	I	M
	Live with	R	I	I	I	M
	Dislike	R	R	R	R	S

[Figure 1] Kano's questionnaire and evaluation table

The evaluation table as in <Figure 1> consists of 25 cells in accordance with the combination of five alternatives of functional and dysfunctional questions. In the cells of the table, "S (sceptical)" means that it is questionable whether the respondent understood the questions correctly because he/she chose like or dislike for both of them.

As more scholars and practitioners used the Kano model, it's wording, especially the five alternatives of each question, has been criticized for confusable meaning from several literatures. In particular, the result of pilot test undertook by Song and Park(2012) shows that the respondents are confused with the alternatives for several reasons: First, 'must be(当然; Touzen)' sounds stronger than 'like(気に入る; Kininaru)' and it is difficult to distinguish between them. Second, 'live-with(しかたない; Shikatanai)' requires to think several times. Third, the alternatives look like a 5-point Likert scale. Finally, the Japanese version and English version of Kano's wording are generally confusing.

To relieve the wording problem of the Kano model, the current study proposes a two-way model using 5-point Likert scale that classifies quality attributes according to the degree of influence on customer satisfaction (very satisfied, satisfied, neutral, dissatisfied, very dissatisfied). To examine the applicability of the proposed model, this study examines a case study of TV sets' 23 quality attributes obtained from Jang.

2. A two-way model using 5-point Likert scale

2.1 Classification of quality attributes

By applying a five point Likert scale for satisfaction degrees ("1" for "very satisfied" to "5" for "very dissatisfied") for the Kano's functional and dysfunctional questions, the two differentials(the size of satisfiaction and dissatisfaction) can be obtained through the proposed two-way model and the

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sub-categorization of quality attributes is possible as follows :

2.1.1 One-dimensional attributes

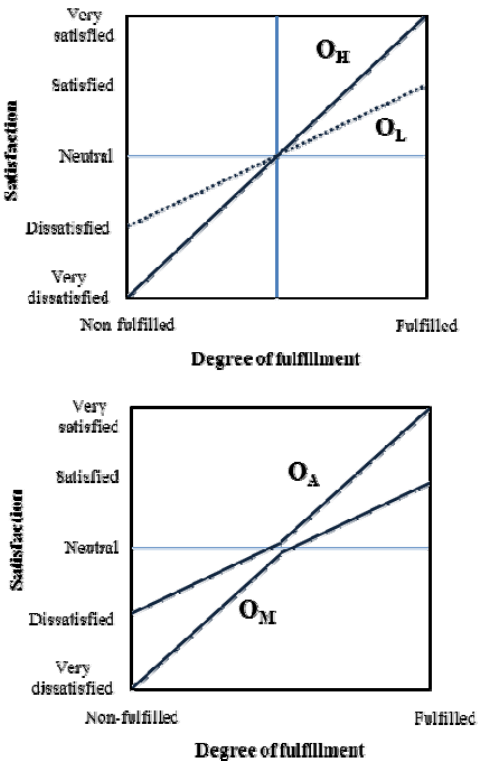
"One-dimensional" quality attributes can be divided into the four types as shown in [Figure 2].

(OH)Highly one-dimensional attribute: "One-dimensional" attribute that increase the customer satisfaction greatly when it is fulfilled and decrease the customer dissatisfaction greatly when it is not fulfilled.

(OL)Less one-dimensional attribute: "One-dimensional" attribute that influence customer satisfaction less than OHattribute does.

(OA)One-dimensional with an attractive tendency attribute: An attribute that has a greater effect on the level of satisfaction when they are fulfilled than when they are not fulfilled.

(OM)One-dimensional with a must-be tendency attributes: An attribute that has a greater effect on the level of satisfaction when they are not fulfilled than when they are fulfilled.



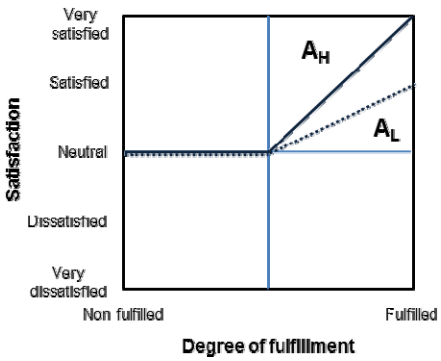
[Figure 2] One-dimensional attributes in the two-way model

2.1.2 Attractive attributes

"Attractive" quality attributes can be classified into the two types.

(AH)Highly attractive attribute: "Attractive" attribute that increases customer satisfaction greatly when it is fulfilled, while non-fulfillment of the attribute does not influence customer dissatisfaction.

(AL)Less attractive attribute: "Attractive" attribute that increases customer satisfaction less than AH does when it is fulfilled.



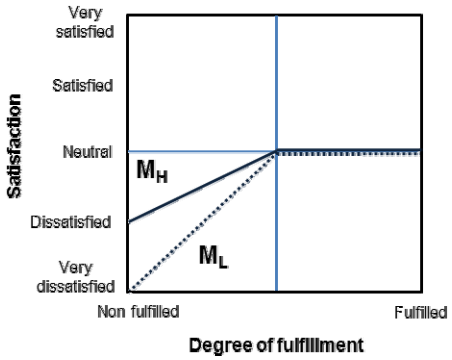
[Figure 3] Attractive attributes in the two-way model

2.1.3 Must-be attributes

"Must-be" quality attributes can be divided into the two types.

(MH)Highly must-be attributes: "Must-be" attribute that reduces the level of satisfaction greatly when it is not fulfilled, while fulfillment of the attribute does not influence satisfaction.

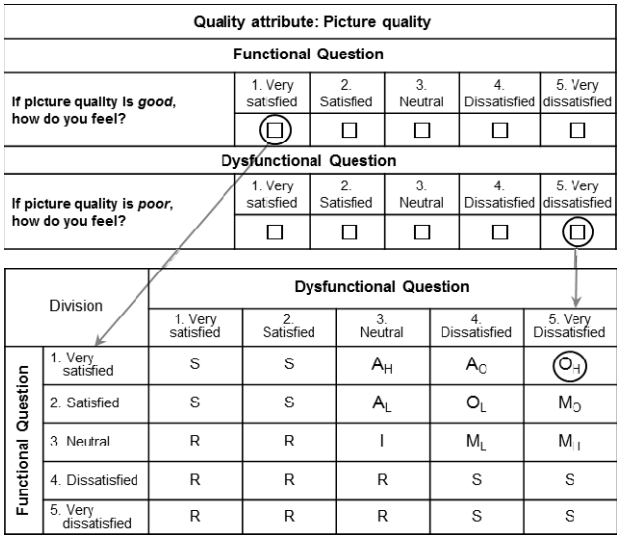
(ML)Less must-be attributes: "Must-be" attribute that reduces the level of satisfaction less than MH does when it is not fulfilled.



[Figure 4] Must-be attributes in the two-way

model

[Figure 5] shows how a quality attribute is determined in the proposed model. For example, if a respondent chooses "very satisfied" for functional question of TV's 'Picture quality' and "very dissatisfied" for dysfunctional question, it is classified as "highly one-dimensional (OH)" attribute by the evaluation table.



Quality attribute: Picture quality					
Functional Question					
If picture quality is *good*, how do you feel?	1. Very satisfied	2. Satisfied	3. Neutral	4. Dissatisfied	5. Very dissatisfied
	☑	☐	☐	☐	☐
Dysfunctional Question					
If picture quality is *poor*, how do you feel?	1. Very satisfied	2. Satisfied	3. Neutral	4. Dissatisfied	5. Very dissatisfied
	☐	☐	☐	☐	☑

Division		Dysfunctional Question				
		1. Very satisfied	2. Satisfied	3. Neutral	4. Dissatisfied	5. Very Dissatisfied
Functional Question	1. Very satisfied	S	S	A_H	A_O	O_H
	2. Satisfied	S	S	A_L	O_L	M_O
	3. Neutral	R	R	I	M_L	M_I
	4. Dissatisfied	R	R	R	S	S
	5. Very dissatisfied	R	R	R	S	S

[Figure 5] Classification of quality attribute in the two-way model

2.2 Managing quality attributes

The effect of the attributes' fulfillment or non-fulfillment on customer satisfaction can be monitored using the following three coefficients in the proposed model.

•Potential Satisfaction Coefficient (PSC)
The PSC denotes how much customer satisfaction will increase, on average, when an attribute is fulfilled.

$$PSC_j = \frac{\sum_{i=1}^{n}(3 - s_{ij})}{2n} \quad (;\ 0 \le \text{PSIj} \le 1) \qquad (1)$$

where,
i = respondent (; 1, ..., n)
j = quality attribute (; 1, ..., m)
sij = satisfaction level of respondent i when attribute j is fulfilled (; 1=very satisfied, 2=satisfied, 3=neutral).

"Dissatisfied" and "very dissatisfied" answers are not considered in the PSC calculation because the answer that fulfillment causes dissatisfaction is illogical. As PSCj becomes higher, the fulfilment of an attribute j increases satisfaction accordingly.

• Potential Dissatisfaction Coefficient (PDC)
The PDC denotes how much customer dissatisfaction will increase, on average, when an attribute is not fulfilled.

$$PDC_j = \frac{\sum_{i=1}^{n}(d_{ij} - 3)}{2n} \quad (;\ 0 \le \text{PDIj} \le 1) \qquad (2)$$

where,
i = respondent (; 1, ..., n)
j = quality attribute (; 1, ..., m)
dij = dissatisfaction level of respondent i when attribute j is not fulfilled (; 3=neutral, 4=dissatisfied, 5=very dissatisfied).

"Satisfied" and "very satisfied" answers are not considered in the PDC calculation because the answer that non fulfillment of an attribute increases satisfaction is illogical. As PDCj increases, the non-fulfillment of attribute j causes more dissatisfaction accordingly.

• Average Potential Coefficient (APC)
The APC, the average value of PSC and PDC, indicates that the impact on both the customer satisfaction and dissatisfaction resulting from the change of the level of fulfillment.

$$APC_j = \frac{(PSC_j + PDC_j)}{2} \quad (;\ 0 \le \text{APIj} \le 1) \qquad (3)$$

where,
j = quality attribute (; 1, ..., m)

3. A case study of TV sets

This study performed a case study of TV sets to examine how the proposed model works and how it differs from the Kano model (1984).

3.1 Quality attributes

The quality attributes of TV sets were adopted from the study of Jang (2013). The derived attributes are listed in <Table 1>.

3.2 Data collection

The current study collected Kano data from 319 undergraduate students who are familiar with TV sets for the case study. Among these, 161 responded to the Kano questionnaire and 158 to the proposed questionnaire. This study used 23 quality attributes of TV sets for the purpose of data validity which is proven by Kim . <Table 2> summarizes the survey respondents (Jang, 2013). The sex ration and daily watching time of TV sets was similar between the two respondent groups.

In order to show the effectiveness of APC, the current study used additional data of 118 undergraduate students for the importance and priority for improvements of quality attributes.

<Table 1> The quality attributes of TV sets

Quality attributes	Description
Picture quality	The better the picture quality, the better the detail of each image viewed. Better picture quality also reduces eye strain and fatigue.
Screen size	The larger the screen, the more realistic the viewing experience becomes; much like watching a movie at the theatres.
Explosion proof	Electronic devices can cause fires and explosions.
Internet connectivity	Allows TV sets to connect to the internet to be used like a personal computer.
Fall deterrence	TV sets can be damaged or cause injuries when tipped over due to impacts.
3D View	Technology enabling 3D viewing of images.
Reception quality	If the reception is bad, TV viewing may be interrupted intermittently or disabled.
Connectivity with other media sources	The ability to plug and play movies or pictures from media sources such as cameras, camcorders, and cell-phones.
Energy efficiency	If the energy efficiency of a TV set is bad, it consumes more energy.
Olfactory function	Technology allowing TV sets to emit smells that link to the image being viewed on the screen.
Foldable/Rollable	For purposes of easy storage and mobility.
Virtual display	Does not require a physical screen or backdrop to display images. Images will be displayed in mid-air.
Sound quality	The better the sound quality, the more realistic the sound becomes.
Thickness	The thinner the screen, the less space it takes up, and can be mounted on a wall like a picture frame.
3D Sound	Sound is projected from various angles to make the viewing experience more realistic.
Weight	Less weight allows for easier installation and movement.
2D-3D conversion	The optional function to convert standard 2D into 3D images
Cell-phone remote	The ability to use your cell-phone as a TV remote.
Loading time between channels	The time between switching channels and actual images being displayed on the screen.
Twin view remote	The ability to watch what is being displayed on the TV screen on a small screen embedded in the remote.
Picture in picture	The ability to watch multiple programs on the same screen at the same time.
Video recorder	The ability to prerecord programs for later view.
Smart TV	The ability to access a TV app. store, like a smart phone.

<Table 2> Respondents of the survey

Types	No.	Male	Female	TV watching time		
				Less than 1 hour	1-2 hours	2-3 hours
The Kano	161	126 (78%)	35 (22%)	108 (67%)	42 (27%)	11(6%)
The Proposed	158	122 (77%)	36 (23%)	107 (68%)	43 (27%)	8(5%)

3.3 Data analysis

While Kano et al. determined quality attributes using a statistical mode and ignored the rest of the responses, Lee and Newcomb took into account the statistical significance of the difference between the highest and the second highest frequencies among the five quality elements in the Kano model. Applying Lee and Newcomb's rule, the current study classified an attribute as a "combination(C)" if the difference between the highest and the second highest answers is less than 6%.

The research data was analyzed in three steps. First, the Kano's results were analyzed and interpreted at each 23 TV quality attributes. Second, the comparison analysis of the Kano model and the proposed model was carried out to see the difference between the two. Finally, for the validity of the proposed model, the magnitude of potential satisfaction coefficient (PSC) if an attribute is fulfilled and the magnitude of potential dissatisfaction coefficient (PDC) if the attribute is not fulfilled are calculated and compared with the results of the improvement priority of quality attributes.

4. Results and discussions

4.1 Application results of the Kano model

The classification results of the Kano model are summarized in <Table 3> and the following observations are withdrawn:

•Basic attribute such as reception quality and the safety attributes such as the 'explosion proof' and 'fall deterrence' are classified as must-be attributes.

•Performance attributes such as 'picture quality', 'energy efficiency', 'sound quality', and 'loading time between channels' are classified as one-dimensional.

•High-tech functions of TV sets such as 'Internet connectivity', '3D view', 'foldable TV', 'virtual display', '3D sound,' '2D-3D conversion', 'cell-phone remote', 'twin view remote', 'picture in picture', and 'smart TV' are classified as attractive attributes, and 'screen size' and 'thickness' were grouped into the combination of attractive and one-dimensional attributes. In addition, 'connectivity with other media sources', 'weight', and 'video recorder' are also classified as attractive attributes. If these functions are presented, customer satisfaction will be raised at the time of survey.

•'Olfactory function' was classified as an indifferent attribute. From the perspective of the dynamics of quality attributes (Kano, 2001; Nilsson-Witell and Fundin, 2005), there is a possibility that this high-tech functions may become attractive in the future.

4.2 Comparison of the two models

As shown in <Table 3>, the proposed model can classify quality attribute in more detail such as attractive (AH and AL) and one-dimensional (OH and OL). The proposed model differs from the Kano model as follows:

•The attributes classified as one-dimensional or combination with one-dimensional in the Kano model are divided into OH, OL in the proposed model. If an attribute is grouped as OH (accordingly higher APC than other quality attributes) is more sensitive to the change of products or services' quality levels (fulfillment or non-fulfillment) and it can be regarded as

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more important in this manner. Therefore, picture quality among the four one-dimensional attributes in the Kano model is more important than the others because they were classified as highly one-dimensional attribute.

•The two Must-be attributes in the Kano model grouped into OH attributes in the proposed model. Thus, 'explosion proof' and 'reception quality' attributes can be regarded as relatively more important. The reason that 'fall deterrence (must-be in the Kano model)' is classified as OL in the proposed model is probably that because the incident that TV falls off the desk (or wall) is hardly happening in reality and it is not conceived as important. According to Matzler and Sauerwein(2002)'s study of IT attributes of a hospitcal, when must-be attribute performs well, the importance of that attribute is decreased.

•Attractive or combination with attractive attributes were OL or AL attributes in the proposed model. These attributes are therefore relatively less important.

•Indifferent attribute in the Kano model remained indifferent in the proposed model.

4.3 Managing quality attributes using APC

To determine "which quality attribute takes precedence over others to be improved" or "which quality attribute should be preferentially managed", it is crucial to measure the impact of quality attributes on customer satisfaction. In this perspective, the PSC, PDC, and APC of the proposed model can be useful for managing quality attributes.

In the proposed two-way model, the two differentials (PSC and PDC) can be obtained through the paired questions and 5-point Likert scale and APC (average potential coefficient) can be used as the importance of quality attributes. From <Table 3>, the correlation coefficient with APC and the consumers' perceived importance is very high ($r=0.957$; p-value<0.000), showing the validity of the APC as an importance measure. can make an efficient decision: APC is for determining importance of quality attributes among many quality attributes, PSC is for improvement priority, and PDC is for prevention of customer dissatisfaction.

5. Concluding Remarks

To maintain and increase the market competitiveness of products or services, it is important to identify the attributes that need to be controlled tightly and those that need to be improved first. For the purpose of strategic management of quality attributes, this study proposed the two-way model that uses 5-point Likert scale alternatives. From the correlation results in <Table 3>, it is possible to hold the view that the larger is the APC of an attribute, the more attention should be given to it. Likewise, the larger is the PSC (such as new product development) or PDC (such as safety related must-be attributes), the more important is to improve the attribute. Accordingly, one of the advantages of the proposed model is that, by asking the respondents the paired question, maintaining quality attributes is possible without conducting additional surveys for importance or improvement priority of quality attributes. In addition, the proposed model has the following benefits: With regard to prioritizing quality attributes for improvement, PSC can be used if attractive quality is important in case of new product development (Matzler and Hinterhuber, 1998; Fundin and Nilson, 2003). The correlation result with PSC and the consumers' perceived priority for improvement is the highest ($r=0.760$; p-value<0.000) among the other potential coefficients. In addition, PDC can also be used to prevent customer dissatisfaction when especially must-be attribute is important.

In summary, by using of the potential (dis)satisfaction coefficients, quality managers

First, the proposed model classifies quality attributes in more detail than the Kano model, subdividing "one-dimensional" attributes into

"highly one-dimensional(OH)", "less one-dimensional(OL)", "one-dimensional with attractive tendency(OA; PSC > PDC)", and "one-dimensional with a must-be tendency (OM; PSC < PDC)" attributes. It also distinguishes between "highly attractive(AH)" and "less attractive(AL)" attributes, as well as "highly must-be(MH)" and "less must-be (ML)" attributes.

Second, as Goldenberg and Mazursky mentioned that consumers' ability to provide reliable information beyond their personal experience is doubtful; it can be a demanding task to obtain accurate information of ideas for a new product or a service. However, through the Kano's paired questions, we can obtain information about non-existing products or services effectively by asking respondents the pairwise question: "If a new attribute is presented, how do you feel?" and "If that attribute is not provided, how do you feel?", which is the provision-based question.

Finally, while the meaning of the five alternatives (like, must-be, neutral, live with, dislike) in the Kano model are ambiguous , the 5-point Kano model uses straightforward expressions (very satisfied, satisfied, neutral, dissatisfied, very dissatisfied) and therefore the multiple choice answers of the proposed model are clear and easy to understand.

<Table 3> Application results of the two models

No.	Quality attributes	The Kano model	The proposed two-way model				Direct Importance	Priority for improvement
			Classification	PSC	PDC	APC		
1	Picture quality	O	OH	0.77	0.79	0.78	0.88	0.85
2	Screen size	C(A/O)	OL	0.65	0.52	0.59	0.77	0.62
3	Explosion proof	M	OH	0.60	0.87	0.73	0.88	0.17
4	Internet connectivity	A	AL	0.45	0.07	0.26	0.47	0.31
5	Fall deterrence	M	OL	0.55	0.60	0.57	0.79	0.13
6	3D view	A	AL	0.46	0.07	0.27	0.42	0.26
7	Reception quality	M	OH	0.61	0.90	0.75	0.93	0.41
8	Connectivity with other media sources	A	OL	0.48	0.27	0.38	0.65	0.41
9	Energy efficiency	O	OL	0.68	0.61	0.64	0.79	0.61
10	Olfactory function	I	I	0.28	0.04	0.16	0.31	0.05
11	Foldable/Rollable TV	A	AL	0.41	0.04	0.23	0.41	0.12
12	Virtual display	A	AL	0.51	0.07	0.29	0.54	0.07
13	Sound quality	O	OL	0.75	0.68	0.72	0.83	0.58
14	Thickness	C(A/O)	OL	0.68	0.46	0.57	0.74	0.45
15	3D Sound	A	AL	0.69	0.22	0.45	0.69	0.26
16	Weight	A	OL	0.62	0.34	0.48	0.61	0.31
17	2D-3D conversion	A	AL	0.54	0.10	0.32	0.47	0.17
18	Cell-phone remote	A	AL	0.48	0.19	0.33	0.64	0.14
19	Loading time between channels	O	OL	0.69	0.68	0.68	0.79	0.41
20	Twin view remote	A	AL	0.41	0.11	0.26	0.47	0.07
21	Picture in picture	A	AL	0.42	0.12	0.27	0.54	0.18
22	Video recorder	A	AL	0.54	0.26	0.40	0.52	0.14
23	Smart TV	A	AL	0.58	0.12	0.35	0.57	0.29
Correlations with direct importance		–	–	–	–	r = 0.957 (p < 0.001)	–	–
Correlation with the priority for improvement		–	–	r = 0.760 (p < 0.001)	r = 0.619 (p < 0.001)	r = 0.709 (p < 0.001)	–	–

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