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Applying Refined Kano Model to Classify and Rank Customer Requirements, Case Study: Automotive Industry in Portugal

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Abstract - **Companies aim to increase the quality of products and competitiveness to gain and retain more customers. This study proposes a novel approach to identifying and prioritizing customer requirements (CRs) to improve black uniformity as a characteristic that refers to luminance differences on the surface of a display by evaluating the CRs. The refined Kano model was applied to find the significant CRs to develop the product. Firstly, 112 CRs were identified in 5 main categories (1) technical, (2) quality, (3) delivery, (4) sustainability, and (5) cost. Then, the refined Kano questionnaire was designed to categorize the CRs.**

An example is performed to validate the method on the automotive display' CRs. The findings showed that mechanical and delivery needs are critical CRs. Today, climate change is a significant challenge and a severe customer concern. Although sustainability's CRs not classed as essential items in the production process, suppliers must be diligent in providing them. The results help to improve the automotive industry and other production systems.

Keywords - **Customer Requirements (CRs), Refined Kano model, Sustainability, Automotive industry.**

1. INTRODUCTION

Nowadays, it is significant for companies to retain current customers, share in profitability and improve profit margins. Companies must meet customers' requirements and even go beyond that [1]. Customer satisfaction can be considered one of the aspects that play an essential role in the success or failure of a business [2]. Therefore, companies strive to meet customer expectations and go beyond them to gain loyalty. A dissatisfied customer is a challenging problem that can negatively affect the business. Dissatisfying customers can lead to escape the customer and result in business failure. Retaining current customers and keeping them satisfied is more important than gaining new customers [3]. Therefore, the real goal of any business is not to offer, sell or provide services, but to meet customer satisfaction needs. Organizations that can recognize customer requirements (CRs) rapidly and have up-to-date mechanisms to understand and meet them are more profitable than organizations that those that lag in meeting them [4]. Understanding the mental image and perception of customers towards the goods and services provided has a particular significance, while revealing the strengths and weaknesses of an organization, provides an infrastructure for adopting good strategies and improving performance. Therefore, customer satisfaction has become the operational goal of many organizations. Not surprisingly, companies invest significant resources in increasing customer satisfaction, and the customer satisfaction assigned budget is almost the majority of the annual marketing budget. In addition, Business marketing costs about 50% of total yearly costs [5]. Identifying and measuring customer satisfaction is not enough. Meanwhile, the processes that have caused dissatisfaction must recognize and modify. Therefore, implementing a system that can measure customer satisfaction seems vital [6].

The Kano model helps determine the characteristics that should be included in a product or service to improve customer satisfaction. This model focuses on highlighting the most relevant features of a product or service along with customers' estimation of how to use the existence of these features to predict satisfaction with specific services or products [3]. Kano's model accurately identifies customer needs such as attractive, performance, basic, indifferent, or reverse [7].

Kano emerged in the 1980s, distinguishing three types of product requirements that affect customer satisfaction differently. These three types of needs are [9]:

(1) Must-be needs (M): These needs are typically "unspoken." If these needs are not fulfilled, the customer will be highly dissatisfied. However, they must be identified because they are essential to customers. For instance, the wheels are a primary requirement for a car. Customers do not mention wheels as necessary, as this feature belongs to the machine's existential concept.

(2) Performance or One-dimensional (O) needs: The more these requirements are met, the more a client is satisfied by improving performance. Better performance leads to happier customers. The customer usually articulates these needs. For instance, gasoline consumption at a certain distance in the car is a performance need. One-dimensional features are often identified by scrolling.

(3) Attractive Needs (A): These are customers' wishes, so they are not stated. The absence of this feature does not cause dissatisfaction because they are unaware of these needs. The product/service will delight the customer if

these needs are met. Satisfying attractive needs provides a competitive advantage for the organization as an opportunity to differentiate itself from competitors. Forinstance, customers will not be dissatisfied if the cars do not use solar energy. Satisfying theseneeds makes the organization a market leader.

Kano proposes an effective tool for classifying the requirements and understanding their nature [8]. In addition to these three main quality dimensions of the Kano model, the consequences below can also appear [9]:

(1) *Indifferent (I):* The customer is not worried about this product feature and is not very interested in its existence or non-existence.
(2) *Questionable or Skeptical (Q):* This situation occurs when there is a discrepancy in thecustomer's answers to the positive and negative questions. The skeptical rating indicates an incorrect question *phrase*, misunderstanding of a question, or incorrect answer.
(3) *Reverse (R):* It means that the respondents' satisfaction decreases despite this requirement, but the opposite is also expected.

To expand the basic Kano model, a refined Kano model has been proposed and extended the four main quality features to eight (Fig. 1): High attractive, Low attractive, High value-added, Low value-added, Critical, Necessary, Potential, and Care-free.

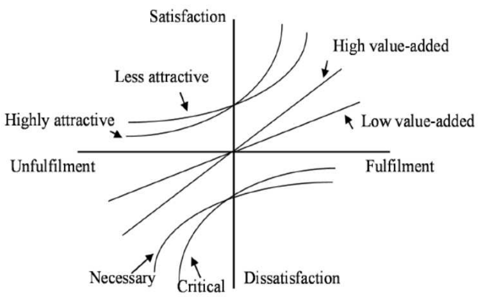

Fig. 1. Refined Kano model.

The refined Kano model refers to the mean importance as the cut-off point for classification. If a feature in the basic Kano is considered an attractive quality in case the importance value is higher than the mean value of all attractive features, it will classify by the refined Kano as a highly attractive quality; otherwise, it is considered a Low attractive quality feature. Table I is shown the different classifications of the features in the basic and refined Kano.

Table I. The classification of the Kano attributes and refined Kano attributes [10].

Kano model	**Refined Kano Model**	
Quality Attribute	**High Important Attributes**	**Low Important Attributes**
Attractive quality	High attractive quality	Low attractive quality
One-dimensional quality	High value-added quality	Low value-added quality
Must-be quality	Critical quality	Necessary quality
Indifferent quality	Potential quality	Care-free quality

Xu et al. [11] incorporated quantitative measures into customer satisfaction by focusing on customer need analysis. Accordingly, they presented two alternative mechanisms to provide decision support to product design. The Kano model was applied to improve customer satisfaction in the home appliance industry and introduced significant factors in customer satisfaction, including sales environment, price, user attributes, design features, and technical characteristics [12]. An analytical vehicle KANO model, called V-KANO Model, was proposed to improve vehicle technical characteristics and performance target setting more precisely at the early stage of design and development [13]. Al Rabaiei et al. [3] integrated the Kano model with data mining to predict customer satisfaction. The study aimed to develop a method for integrating the Kano model and data mining approaches to select related features that increase customer satisfaction. Montenegro et al. [14] combined the Kano model into the business model canvas in Bogota, Colombia’s aviation and metalworking industry. Shen et al. [15] also adapted the Kano model to assess perceived importance and customer satisfaction in sailing tourism experiences. Then, based on the Kano model, features were classified into must-be, one-dimensional, attractive, and different groups. Bhardwaj et al. [16] studied the Kano analysis to increase customer satisfaction with automotive products for the Indian market. The objective is to examine the features available in the current Indian automotive sector for the targeted hatchback market to classify the attributes into priority groups based on customer perception. Feedback on twenty features of a hatchback car was obtained from customers and analyzed by the Kano model.

Please refer to the review paper presented by Mikulić and Prebežac [17] for more information regarding the Kano model. Lo [18] aimed to present a new method by introducing the model of sustainable product development to facilitate industry’s sustainable development and proposed the modified Kano model to examine the characteristics of the air-cushioned casual shoe that improves customer satisfaction. The Kano model proposed to analyze the influence of gamification's elements on user satisfaction in health and fitness applications. Authors categorized General Electric into various qualitative classifications using questionnaires based on the Kano model [19]. The effect of matching owners’ preferences was investigated on satisfaction in different types of adopted dogs using the Kano model alongside more traditional methods on 392 dogs [20]. A modified Kano model and decision trees were applied in another study to explore learners' needs for instructional videos, multimedia tools, and applications [21].

This paper uses the refined Kano model to classify the DMCS (Designed Mirror Camera System) display characteristics based on the customer's point of view. This model can comprehensively analyze the customers' requirements and obtain the specific model of the needs to design the product according to the CRs.

The rest of the paper is organized as follows: In Section 2, the application of refined Kano is discussed concerning their practical applications. Finding remarks are presented in Section 3, which is included data gathering results and results from applied approaches. Finally, Conclusion and directions for future research are given in Section 4.

2. METHODOLOGY

This study aimed to determine the momentous CRs for DMCS display. In addition, we intend to distinguish between the identified CRs according to customer satisfaction. The objective is to categorize the needs of customers using the refined Kano model and to calculate the weight of requirements by this method. The research questions are as follows:

• What are the CRs and needs of the DMCS display?
• Requirements should be placed in the must-be, one-dimensional, attractive, or indifferent category?
• What is the weight of each requirement?

2.1. Case Study

The DMCS display is a raw display of the final product, which is outsourced for a type of heavy vehicle manufactured by an original equipment manufacturer (OEM) company in Portugal. The production phases show how to satisfy CRs in each step and which gaps might be covered by the supplier during the processes. This product goes through various stages as follows:

Step 1: The display components are received from the supplier; the main part is the DMCS which is the focus of this study.
Step2: The bonding process is performed on a display to bind a single display, and another part called cover glass.
Step3: In the gluing step, the main frame is glued with special glues. Also, the plasma process and several tests are done to check if the materials are correctly applied and aligned with the patterns. All these sequences are briefly mentioned as the gluing step.
Step 4: The screwing process is performed on the electronic chip called a Printed Circuit Board (PCB) attached to the product by different types of screws.
Step 5: The supplier supplies the rear cover behind the display and assembles the whole product in the last step.

The Black Uniformity (BU) feature represents the ability of a display to have a solid black appearance across the entire screen. This characteristic refers to luminance differences on the surface of a display. A display with perfect BU does not produce white spots or clouding areas that represent defects on the screen, which in extreme cases can affect the transmission of information from the display to the user [22]. BU is one of the image features that are significant for the customer of the desired product, and many defects have been caused by rejection due to not considering the desired BU rate. It is worth mentioning that the acceptable BU index for product acceptance by the customer is 50%. According to Fig. 2, the rate of BU index shows a significant deviation in the BU due to the large gap observed in the display DMCS from the supplier in the tests performed on the display delivered to the OEM company. This reduction in the rate led to customer dissatisfaction. Also, the rate of BU decreased in the subsequent steps, including bonding, gluing, screwing, and rear cover assembly. The product line has been activated continuously for the last two years; thereupon, some problems have been solved simultaneously by experts in the internal processes of the OEM, and some defects have improved. Therefore, the study focuses on the needs of OEM, automakers' requirements, and final customers' latent needs from the display DMCS delivered from the supplier. Since the scope was limited to semi-product provided by the supplier, several tests and inspections were performed to validate the processes in each step, which are not mentioned in detail. The needs of the bonding process (the first step of manufacturing the final product) are addressed by experts as principal requirements to perform the operations and meet the technical needs. To obtain the CRs, the main categories of these needs have been extracted from the literature review. To explore the sub-categories, specifications list, and manufacturing requirement documents investigated and considering the production lunch, experts face many deviations from the customer expectations. Many tickets opened for claims, and comments have been sent to suppliers by various experts to improve the product. The customer's voice is adapted to study the feedback and reactions of suppliers to translate them to the engineering characteristics of the product.

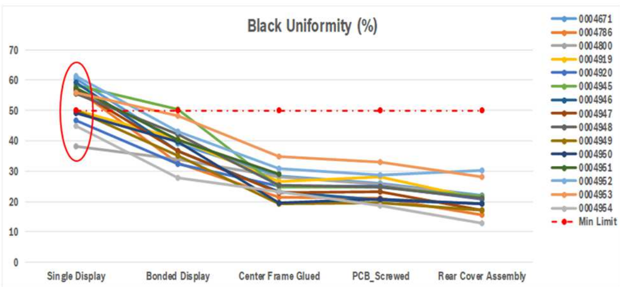

Fig. 2. The rate of BU index in different stages of DMCS production.

2.2. A statistical Sample

The table II shows the expert's distribution in the survey:

Table II. The expert's distribution in different CR categories.

Area	Max (Person)	Min (Person)	Number of Samples

Technical	17	13	9
Quality	13	9	9
Cost	13	11	9
Delivery	13	9	9
Sustainability	20	15	9

The experts participating were Technical (Simultaneous Engineers, Process Specialists, Mechanical Developers, Hardware engineers, Product Line Responsible, Manufacturing Production, Optics, and Mechanics), Quality (Quality managers, Testing specialists, Production Test Engineer, Supplier Quality Engineer, PFMEA moderator, Display Developer, Supplier Quality Engineer, Purchasing Quality Assurance, Customer claim analysis), Cost (Project Managers, Program Manager, Process Managers, Project Manager Purchasing) Delivery (Logistic Engineers), Sustainability (various proficients above, Sustainability experts). Among the experts, nine people with the most work experience were able to answer the survey chosen considering the max and min availability in each category. The survey was carried out in 2 weeks, and 45 questionnaires were collected.

2.3. Survey with refined Kano Quality Model

The research identified 112 CRs classified into Technical, Quality, Cost, Sustainability, and Delivery. After identifying the CRs, the Kano questionnaire consisting of 5 sections corresponding to the mentioned dimensions was designed. Table III shows the distribution of CRs in each category. Consequently, requirements are asked in both negative and positive spectrums. Firstly, the positive question asks about a person's feelings and if there is a particular quality attribute. Secondly, the negative question asks in the absence of that quality attribute. Each section of the questionnaire consists of sentences that describe the requirements positively and negatively, which show the functional and non-functional forms of the requirements in general. The scale used was a 5-dimension scale that included 1 = Like it, 2 = Expect it, 3 = Indifferent, 4 = Tolerate it, and 5 = Unhappy [9].

Table III. The structure of CRs and number of questions of the survey.

Row	**Category**		**Number of CRs**
1	Technical	Mechanical	23
		Electrical	8
		Optical	6
2	Quality	Definition of standard conditions	7
		Measurements conditions	7
		Customer rejection rate	2
3	Cost		12
4	Sustainability	Globalization	3
		Pollution production	5
		Urbanization & Eco-design Energy	7
		Health & Safety	3
		Water	2
5	Delivery		27
6	Total		112

3. FINDINGS

To conduct this study, first, using expert opinion and interviews with statistical samples, the CRs determined, and the required data to form the Kano model was collected. The CRs are classified using the simple Kano and the Refined Kano models. Finally, The CRs weighted using the refined Kano approach in each category.

3.1. Data Gathering Results

First, the variety of requirements extracted from the literature review and dimensions of the case study. Product development is considered a Technical and Quality category, and Delivery is a necessary part of the production chain to deliver to the customer. The Cost category is one of the critical categories that impact customer satisfaction, company profit, and requirement classification. Afterward, the main categories discussed above were selected from literature and interview with experts of the organization. The empirical results, lessons learned from the project lunch, and products' technical info was surveyed to specify the CRs. Tools for data gathering include observation, expert interviews, literature reviews, questionnaires, and meetings with experts. The observation is used as the production line screening and better understanding to identify the deviations caused by supplier delivery to the company. The number of CRs include Technical (Mechanical, Electrical, Optical) 45 items, Cost 14 items, Quality (Definition of standard conditions, Measurements conditions, Customer rejection rate) 21 items, Delivery 30 items and Sustainability (Globalization, Pollution production, Urbanization and Eco-design energy, Health & Safety, Water) 22 items. The three experts from the company and two consultants from outside who cooperate with the organization participated in obtaining the final requirements to form the questionnaire. Some items were irrelevant and eliminated from the list. In this phase, the 112 final CRs have remained.

3.2. Kano Results

At this stage, the CRs are classified using the model. In this study, we applied a refined Kano approach which uses the total satisfaction index (TSI) based on Kano responses which is the difference between better and worse values [23]. Using the following formula, this method calculates better and worse values to understand customer satisfaction and dissatisfaction with the features [24, 25].

$$better = \frac{A + O}{A + O + I + M} \tag{1}$$

$$worse = \frac{M + O}{(A + O + I + M) \times (-1)} \tag{2}$$

The CRs can be ranked based on the calculated values of the TSI. Negative values of the TSI indicate that the non-fulfillment of a specific requirement causes dissatisfaction, and positive values indicate that fulfilling a particular requirement causes satisfaction. In addition, higher values have more influence on the satisfaction rate. After calculating the weight and satisfaction index of the items, the average importance of the sub-criteria was obtained. Then, the refined Kano model classification was determined based on the average weight and classification of the simple Kano model, which is presented in table IV. Also, the average weight of the main categories of CRs and their classification is in table V. The reliability and validity for five categories of products have been done. The CRs' compatibility in the five main categories, the CRs verified correspondingly. The negative questions of the Kano questionnaire were not only negated by negative prefixes but also the questions understood in a negatively comprehensible. In Table IV, the CRs classified by the refined Kano model according to the classification shown in Table I. According to the refined Kano model, high value-added attributes cause a high level of customer satisfaction and thus reduce defective products. Among the sub-criteria, 20 CRs follow this feature. The 15 CRs are low value-added attributes. Although this feature does not play a significant role in satisfying customer demands, still the absence of it causes dissatisfaction and should be considered in the product. The high-attractive attributes include seven items. This feature is the best tool to attract customers to improve customer satisfaction. Therefore, it recommends fulfilling that kind of CRs. The Indifferent attribute is divided into two, which are significantly classified as potential. The Potential attributes' CRs become an attractive quality attribute, and suppliers should consider the potential needs of the product to attract the customer, and 3 CRs are in this category. The care-free features are scattered into four categories except for sustainability. Meeting the care-free requirements in the DMCS requires remarkable costs. Therefore, it is better not to apply these features to the product or simplify or superficially apply them. Even in some performance needs of the DMCS, care-free features can make improvements at a high cost which in the absence of these features does not disrupt the product's performance. Almost in every category, there are Must-Be attributes divided into two dimensions. Critical quality is the basis for the manufacturer to meet customer expectations. In the five categories of the CRs, some Critical attributes need to consider in the product to satisfy the consumer. Despite Critical features, there are Necessary items in each category except for sustainability. The Necessary items must provide from the customer's point of view. If we do not satisfy these features, the level of BU drops, which means customer dissatisfaction. Table V shows the main dimensions of CRs, Mechanical, and Delivery in the critical category; Electrical, Optical, Definition of standard conditions, Measurements conditions, and Cost are in the Care-free category. Customer rejection rate, Pollution production, Health & Safety, and Water are classed in the High Value-Added category. On the other hand, the items of Globalization and Urbanization and Eco-design Energy are in the Low Value-Added group.

Table IV. The refined Kano model classification, TSI, and weights of CRs for DMCS product.

Category		CRs	better	worse	Weight	TSI	Kano group	Refined kano group
Technical	Mechanical	Double side foam of the LCD	0.56	-0.56	0.56	0	O	Low Value-Added
		Enough DAM space	0.78	-0.56	0.78	0.22	M	Critical
		Rigidity of backlight Unit Housing	0.25	-0.75	0.75	-0.50	A	Low Attractive
		Optical alignment features definition	0.44	-0.56	0.56	-0.12	A	Low Attractive
		De-coupling of backlight unit & panel	0	-0.89	0.89	-0.89	A	High Attractive
		Sealant double side tape design	0.56	-0.56	0.56	0	O	Low Value-Added
		Propensity to leakage of foam tape	0.89	-0.44	0.89	0.45	M	Critical
		Dimension of the backlight frame	0.56	-0.44	0.56	0.12	M	Necessary
		GAP of Rear Glass & Black Housing	0	-0.89	0.89	-0.89	A	High Attractive
		Formation air bubbles on LCD	1	-0.44	1	0.56	M	Necessary
		Alignment features	0.44	-0.56	0.56	-0.12	A	Low Attractive
		Height difference between the frame and bonding surface	0.56	-0.22	0.56	0.34	M	Necessary
		Parallelism of display polarizer	0.44	-0.22	0.44	0.22	I	Care-free
		Gap of Backlight frame and LCD	0.22	-0.22	0.22	0	I	Care-free
		Light leakage on frame and back light	0.78	-0.22	0.78	0.56	M	Critical
		Thickness of the Inner glass	0.13	-0.25	0.25	-0.12	I	Care-free
		Thickness of the polarizer	0	-0.38	0.38	-0.38	I	Care-free
		Type of polarizer	0.78	-0.44	0.78	0.34	M	Critical
		Backlight reflection sheet shape	0.78	-0.33	0.78	0.45	M	Critical
		Shield film shape	0.25	0	0.25	0.25	I	Care-free
		Flatness of Backlight Housing	0.56	-0.56	0.56	0	O	Low Value-Added
		contamination of the display	1	-0.56	1	0.44	O	High Value-Added
		Thickness of TFT-/color filter glass	0.33	-0.22	0.33	0.11	I	Care-free
	Electrical	Foil banding material side of display	0.67	-0.33	0.67	0.34	M	Critical
		Foil banding width	0.13	-0.13	0.13	0	I	Care-free
		position of the LEDs	0.67	-0.22	0.67	0.45	M	Critical
		Thickness of the Driver IC	0.22	-0.22	0.22	0	I	Care-free

		Softness of FPC material	0.33	-0.56	0.56	-0.23	A	High Attractive
		Chip on Glass (COG)/Foil on Glass (FOG) bonding-Chip	0.11	-0.11	0.11	0	I	Care-free
		Resistance of the track material	0.33	-0.22	0.33	0.11	I	Care-free
		LED power consumption	0.22	-0.33	0.33	-0.11	I	Care-free
	Optical	contrast at higher temperatures	0.44	-0.44	0.44	0	I	Care-free
		Thermal reliability	0.56	-0.22	0.56	0.34	I	Potential
		DARK DOT rate	0.33	-0.33	0.33	0	I	Care-free
		BU percentage	0.78	-0.67	0.78	0.11	O	High Value-Added
		Type of LED material	0.44	-0.33	0.44	0.11	I	Care-free
		Nit of Brightness of Screen	0.33	0.56	0.56	0.89	I	Potential
Quality	Definition of standard conditions	Digital PWM rate	0.56	-0.22	0.56	0.34	I	Potential
		Repeatability of display sensitivity	0.67	-0.33	0.67	0.34	M	Critical
		Parameter settings of equipment	0.33	-0.22	0.33	0.11	I	Care-free
		Touch Mura Evaluation	0.67	-0.67	0.67	0	O	Low Value-Added
		Respect to PRE	0.78	-0.33	0.78	0.45	M	Critical
		Stability of the MSA	0.38	-0.13	0.38	0.25	I	Care-free
		Active Display Area measurement	0.44	-0.22	0.44	0.22	I	Care-free
	Measurements conditions	Water absorption rate	0.29	-0.29	0.29	0	I	Care-free
		Definition of the defects scale	0.78	-0.44	0.78	0.34	O	High Value-Added
		Difference between measurements LMK and TOPcon	0.44	-0.33	0.44	0.11	I	Care-free
		Reaching temperature for glass NTC during the measurement	0.67	-0.22	0.67	0.45	M	Critical
		part status measurement method	0.44	-0.11	0.44	0.33	I	Care-free
		High humidity storage condition	0.33	-0.22	0.33	0.11	I	Care-free
		Position of tracks on FPCs	0.67	-0.22	0.67	0.45	M	Critical
	Customer rejection rate	Sample size for measurement	0.56	-0.44	0.56	0.12	M	Necessary
		Material of the metal frame	0.89	-0.67	0.89	0.22	O	High Value-Added
Cost		Consignment contract	0	-0.14	0.14	-0.14	I	Care-free
		Cost Breakdown Sheet for tooling	0.17	-0.33	0.33	-0.16	I	Care-free
		Packaging Cost	0.25	-0.50	0.50	-0.25	I	Care-free
		Equipment set up requirements	0.33	-0.33	0.33	0	I	Care-free
		Tool strategy	0.33	-0.67	0.67	-0.34	A	High Attractive
		The optical measurement report	0.67	-0.33	0.67	0.34	M	Critical
		Timeline to sourcing decision	0.33	-0.22	0.33	0.11	I	Care-free
		The amount of volume scenario	0.67	-0.67	0.67	0	O	High Value-Added
		Availability of the whole component	0.13	-0.50	0.50	-0.37	I	Care-free
		Sampling Agreement	0.22	-0.11	0.22	0.11	I	Care-free
		Raw material definition	0.11	-0.22	0.22	-0.11	I	Care-free
		Target Price	0.13	-0.25	0.25	-0.12	I	Care-free
Sustainability	Globalization	Safe and sustainable transport systems	0.89	-1	1	-0.11	O	Low Value-Added
		Commitment to safety of employees	0.89	-0.78	0.89	0.11	O	High Value-Added
		Take responsibility of sustainability and create transparency	0.78	-0.67	0.78	0.11	O	High Value-Added
	Pollution production	CO_2 emissions	0.67	-0.89	0.89	-0.22	O	Low Value-Added
		Product environmental footprint	0.78	-0.67	0.78	0.11	O	High Value-Added
		Potential toxicity to human	0.89	-0.78	0.89	0.11	O	High Value-Added
		Climate pledge friendly products	0.56	-0.78	0.78	-0.22	O	Low Value-Added
		Quality of water discharges	0.78	-0.67	0.78	0.11	O	High Value-Added
	Urbanization & Eco-design Energy	Reduce operational water & energy	0.67	-1	1	-0.33	O	Low Value-Added
		New sustainable materials	0.56	-1	1	-0.44	O	Low Value-Added
		Reduce material through eco-design	0.56	-0.89	0.89	-0.33	O	Low Value-Added
		Water consumption	0.78	-0.89	0.89	-0.11	O	Low Value-Added
		Zero Waste to Landfill	0.56	-0.89	0.89	-0.33	O	Low Value-Added
		Strengthen the circular economy	0.67	-0.67	0.67	0	O	High Value-Added
		Energy supply from renewable source	0.56	-0.78	0.78	-0.22	O	Low Value-Added
	Health & Safety	Amount of hazardous material	0.78	-0.78	0.78	0	O	High Value-Added
		Road safety	0.56	-0.56	0.56	0	O	Low Value-Added
		Accident rate per hours of the work	0.89	-0.67	0.89	0.22	O	High Value-Added
	Water	Water Quality	0.89	-0.78	0.89	0.11	O	High Value-Added
		Water Scarcity	0.78	-0.89	0.89	-0.11	O	Low Value-Added
Delivery		Order lead-time	0.78	-0.78	0.78	0	O	High Value-Added
		Better delivery flexibility	0.11	-1	1	-0.89	A	High Attractive
		Communication, cooperation	0.56	-0.33	0.56	0.23	M	Necessary
		Standard cut-off time for release of the Transport Order (TO)	0.22	-0.44	0.44	-0.22	A	Low Attractive
		Special transports	0.38	-0.63	0.63	-0.25	A	High Attractive
		Minimum order quantity	0.89	-0.78	0.89	0.11	O	High Value-Added

	Information transmission between the supplier and OEM	0.67	-0.22	0.67	0.45	M	Critical
	KANBAN call offs (JIT calls)	0.22	-0.67	0.67	-0.45	A	High Attractive
	Start-up and phase-out control	0	-0.56	0.56	-0.56	A	Low Attractive
	Delivery of Sub-suppliers to supplier	0.78	-0.33	0.78	0.45	M	Critical
	Maximum storage time	0.44	-0.11	0.44	0.33	M	Necessary
	Transportation time	0.44	-0.33	0.44	0.11	M	Necessary
	Production progress information	0.67	0	0.67	0.67	M	Critical
	Number of parts in package	0.78	-0.56	0.78	0.22	M	Critical
	Easy handling packaging	0.78	-0.78	0.78	0	O	High Value-Added
	Stack ability of the package	0.78	-0.56	0.78	0.22	O	High Value-Added
	Traceability of the product	0.78	-0.56	0.78	0.22	O	High Value-Added
	Corrosion and moisture control	0.56	-0.11	0.56	0.45	M	Necessary
	Security in goods transportation	0.56	-0.33	0.56	0.23	I	Care-free
	Risk and crisis management	0.22	-0.22	0.22	0	I	Care-free
	Logistics failures	0.33	-0.33	0.33	0	I	Care-free
	Digitalization of the supply chain	0	-0.33	0.33	-0.33	I	Care-free
	The LCD bag material	0.56	-0.33	0.56	0.23	I	Care-free
	Max handling weight of the box	0.38	0	0.38	0.38	I	Care-free
	Pallet size	0.67	-0.11	0.67	0.56	M	Critical
	Clean returnable packaging	0.75	-0.75	0.75	0	O	High Value-Added
	Intermediate layers elements	1	-0.25	1	0.75	M	Critical

Table V. The DMCS main categories classification by the refined Kano model.

Category		Weight	Kano	Refined Kano
Technical	Mechanical	0.623	M	Critical
	Electrical	0.378	I	Care-free
	Optical	0.518	I	Care-free
Quality	Definition of standard conditions	0.547	I	Care-free
	Measurements conditions	0.517	I	Care-free
	Customer rejection rate	0.725	M or O	High Value-Added or Necessary
Cost		0.403	I	Care-free
Sustainability	Globalization	0.89	O	Low Value-Added
	Pollution production	0.824	O	High Value-Added
	Urbanization and Eco-design Energy	0.874	O	Low Value-Added
	Health & Safety	0.743	O	High Value-Added
	Water	0.89	O	High Value-Added
Delivery		0.63	M	Critical

4. CONCLUSION

This paper provides a scientific and engineered framework for features that may help manufacturing companies re-evaluate their services and reach efficient technological features in the automotive area. This paper aimed to apply the refined Kano approach to categorize and prioritize CRs. First, 112 CRs of the DMCS display were identified in 5 different categories Technical, Cost, Delivery, Sustainability, and Quality. Then, CRs were categorized using the refined Kano model, and the Kano's importance weights were obtained. According to the results, mechanical and delivery are in the critical group. Therefore, suppliers should pay more attention to these requirements to customers who do not feel these features are not considered (these requirements are essential from the customers' point of view, and if not met their expectations, may lead to losing the market). Electrical, Optical, Definition of standard conditions, Measurement conditions, and Cost are in the carefree category. The supplier can spend the budget and time on other needs if necessary. The Customer's rejection rate, Pollution production, Health and Safety, and Water are in high value-added classification. Not only do they increase satisfaction but also increase profitability and competitiveness of the organization as it requires efforts to improve these requirements and the customer's emphasis on them. Therefore, the supplier must improve these needs, which are significant CRs from the point of view of OEM, which ultimately reduces the defects or at least decreases the deviation range of BU. On the other hand, Globalization, Urbanization, and Eco-design Energy should be considered by the supplier. However, it does not significantly impact customer satisfaction to prevent dissatisfaction and produce a consistent product. As can be seen, the needs of Pollution production, Health and Safety, and Water are among the sustainability needs and are in the high value-added group. Today, everyone knows the importance of social, humanitarian, and environmental goals. All worldwide, namely the automotive industry, must maintain sustainable customers and attract new customers to create sustainable development. One of the points in this article is to consider the CRs concerning the dimensions of sustainability, which distinguishes this paper from others. This paper provides a scientific and engineered framework for features that may help manufacturers re-evaluate their services and achieve efficient technological features in the automotive field.

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