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COMPREHENSIVE STUDY OF DESIGN ATTRIBUTES FOR SUSTAINABLE PACKAGING DESIGN: ANALYTICAL TECHNIQUES AND EXPERT VALIDATION

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Abstract

A significant shift toward incorporating sustainable practices into packaging design with the increasing concerns about environmental sustainability. Sophisticated frameworks or tactics are necessary to lessen the increasing environmental impact of packaging waste. However, there are numerous opportunities to reduce waste and use more sustainable packaging design (SPD) techniques despite these initiatives. To address the need for a holistic strategy, this study introduces a comprehensive approach to sustainable packaging design. This technique covers packaging systems and packaged goods across the entire supply chain starting from the producer to the final consumer. This is presented as a strategic blueprint that aims to achieve not only more efficient but also more sustainable. It will provide a holistic perspective based on identified attributes on what constitutes a sustainable packaging solution. The approach incorporates several distinct analytical methods that ensure cost-effectiveness. The methodology is intended to be a practical tool for the packaging Industry and designers who seek to enhance sustainability within their packaging systems. Experts were selected from industry, academia and entrepreneurial background to enhance robustness of the proposed methodology. Moreover, attributes of this framework were validated on the Kano model that analysed whether its strength and relevance possessed significant impacts towards sustainable packaging design. The findings of this research will contribute to the development of a comprehensive framework for sustainable packaging design. These attributes will offer valuable guidance to manufacturers, designers, and companies seeking to prioritize sustainability in their operations. By providing a structured approach to decision-making, it aims to empower stakeholders to make well-informed choices that align with environmental goals and improve the overall sustainability of packaging systems.

Keywords: Sustainable Packaging design (SPD), environment, sustainability, attributes and Kano model

1. Introduction

India generated 17 million tonnes of plastic in 2019, and throughout the past 30 years, the country's plastic consumption has increased by more than 20 times (India Plastics, 2019). It is anticipated that India's packaging market would expand by 18% a year, with rigid packaging rising at 15% and flexible packaging at 25%. Packaging is the economy of India's fifth-largest industry and one of its fastest-growing industries. The Packaging Industry Association of India (PIAI) estimates that the industry is expanding between 22%-25% annually. According to a

research by the global consulting company EY and the trade and commerce trade association ASSOCHAM, India's packaging market is expected to rise to $73.6 billion by the 2020 fiscal year (FY2020) as a result of the country's rising income levels and population. It's regarded as one of the crucial Ps in the marketing mix. It is regarded as a "Five Second Commercial" and a "Silent Salesman." One of the key components of marketing is said to be packaging. While it was viewed as indifferent in the 1950s, it is now gaining a lot of relevance. It becomes much more significant in the modern day as it offers a variety of dimensions, including functional, technological, instructive, and visual. Customers are looking for better options/solutions to their issues. Therefore, packaging need to be viewed as one of the key components of the marketing mix rather than just a simple container. According to the data, shoppers often make a purchasing choice in a matter of seconds. Thus, it functions as a "Silent Salesman." Packaging often indicates the quality of the goods. Packing needs to be good from a technical, functional, instructive, and aesthetic standpoint. Therefore, the need for recyclable, reusable and environmentally friendly packaging options is becoming a key driver of innovation in many sectors (Byggeth and Hochschorner, 2006; Beitzen-Heineke et al., 2015). Packaging affects customer pleasure and loyalty, it plays a crucial role in consumer buying behaviour. In this regard, a number of researchers stress the need to study the connection between the packaging's quality attribute and how it influences consumers' purchasing decisions (Oliver, 1997; Lofgren and Witell, 2005). While some studies try to look at every possible aspect of packaging and how it affects consumers' decisions to buy (Butkeviciene, Stravinskiene, & Rutelione, 2008), others concentrate on specific aspects of packaging and how they affect consumers' decisions to buy (Ampuero & Vila, 2006; Madden, Hewett, & Roth, M, 2000; Underwood, Klein, & Burke, 2001; Bloch, 1995). As sustainability becomes an increasingly important focus in packaging design, businesses are under significant pressure to move away from the traditional, linear models of production and consumption. There is a strong push for adopting more sustainable, circular practices that minimize waste, reduce environmental impact, and promote resource efficiency. Data suggests that consumers are not only aware of these issues but are also willing to invest in products with sustainable packaging. The perceived major hurdle when implementing SPD in product development and the design process is cost. The main reason why the majority of users did not utilize SPD tools is because they assumed that their customers would not be willing to pay the additional cost (Ma, X., & Moultrie, J. 2018). Many consumers now recognize that sustainable packaging solutions contribute to environmental conservation and broader sustainability efforts, further driving demand for eco-friendly options. In response to these changing consumer expectations and environmental challenges, packaging companies are reassessing their approaches to product packaging. Rather than merely focusing on the functional aspects of packaging, such as protection and convenience, industries are increasingly incorporating sustainability into the design and production processes. This shift is a reflection of the growing recognition that sustainable packaging is not just a trend, but a vital part of doing business responsibly in today’s environmentally conscious market (Singhal and Malik, 2018). A thorough grasp of consumer preferences is essential to creating packaging that works as well as possible. It is crucial to certify your understanding of how package features and traits affect overall sustainable growth. To promote sustainable development, the packages must meet the social, economic, and environmental standards of the community. (T. Singh et at., 2023).

The Kano Model was used when conducting an empirical study. The findings from Kano model demonstrate that, although boosting customer happiness is vital, preventing disappointment among consumers is much more crucial. However, how can buyers feel satisfied with a product or assistance? Customer satisfaction is correlated with customer satisfaction. Certain consumer requirements must be met by the product or service in order for those demands to be fulfilled. Different customer needs have varying effects on customer satisfaction over time because consumers become accustomed to them, because alternatives are offered, or because rivals seek to enhance their already-existing items. Then, in a market that is competitive, knowing the significance of the various product features and included them in the product is insufficient. It's also critical to monitor shifts in consumer demands and continuously assess how competitive the product is. Packaging industry should create premium packaging by considering the needs of their target audience. Given the paucity of research in the field of packaging, it is imperative and necessary to investigate the quality attributes of packaging design. Traditionally, packaging has been regarded as a key element of the physical product (Brown 1950). However, with changing customer expectations and increasing demands, the role of packaging has grown in importance, as it now provides additional information and functionality. This evolution may lead to modifications or enhancements in packaging functions beyond merely protecting products and aiding storage and transportation. The inclusion of new features or services in packaging can be seen as a shift along the goods-to-services continuum. Industry considers packaging to be a crucial component of product strategy and consider it to be the fifth P in the marketing mix, along with the other four Ps of product, price, promotion, and place (Philip Kotler K. L., 2008). As customers perceive goods and services differently, this transition emphasizes the need for companies to reconsider their definitions of quality and how it ties to customer satisfaction. An important part of packaging industry is sustainability. However, there are numerous obstacles for adapting sustainable development in packaging because of its high visibility and significance as a crucial enabler for the cost, marketing, distribution, and safe use of consumer and other products. Examples of factors driving the development of new package designs and technologies that frequently run counter to the ideas of sustainable development include changes in distribution, market segmentation, and consumer behaviour and spending patterns (James et al. 2005). Therefore, organizations must focus on developing, designing, and delivering packaging that ensures high levels of perceived quality.

A pressing question arises: how do improved or enhanced packaging designs contribute to a better sustainable solution? In other words, how should packaging be designed to enhance product competitiveness while also promoting associations with sustainability? The authors set out to identify the most important design attributes of packaging design that contribute to sustainability. Using the Delphi approach, 30 experts were selected from various design fields like academia’s, entrepreneurs & industry. Drawing inspiration from Herzberg's Motivation-Hygiene Theory (M-H Theory), Professor Kano and his associates formulated the Theory of Attractive Quality (Kano et al., 1984). This theory is designed to enhance the understanding of how customers assess and perceive the key features or the attributes. According to the Theory of Attractive Quality, the relationship between the extent of fulfilment and customer satisfaction with a quality attribute can be categorized into five distinct types of perceived

quality : I) attractive attributes; 2) must-be attributes; 3) reverse attributes; 4) one-dimensional attributes; and 5) indifferent attributes.
Experts were subsequently administered a structured questionnaire designed to assess their experiences with the functioning and dysfunction of 13 distinct attributes in context of SPD. The Kano model of excitement and basic quality (Kano et al., 1984; Berger et al., 1993; Mattler et al., 1996) provides a distinctive framework for analysing opportunities for product and service improvement. The Kano model considers the asymmetric and non-linear relationship between key features and customer satisfaction. It categorizes consumer needs into three types: basic attributes, performance attributes, and excitement attributes. (refer to Figure 1). This categorization facilitates a deeper understanding of how different attributes affects overall customer satisfaction and identifies areas where enhancements could lead to significant improvement.

2. Kano model

The Kano model provides insight on how the different attributes actually affects customer satisfaction and helps in prioritizing improvements based on the expectations of the customer. With this knowledge on how the attributes are dynamic—where, for example, attractive attributes become basic over time—companies are better able to adapt their strategy and improve and maintain customer satisfaction effectively. The Kano model can effectively address financial limitations by pinpointing features that yield the highest benefits with the least investment For instance, when multiple service aspects require improvement but resources and time are limited, the Kano model helps identify which attributes most significantly impact customer satisfaction, thus prioritizing those needing immediate attention (Matzler K et al., 1996). Over time, attribute classifications can change: desirable attributes can turn into one-dimensional attributes, and one-dimensional attributes can become must-be attributes (Zacarias D. 2018) By monitoring the changes in attribute classifications between different time periods, a retailer can be ahead of competition because this analysis shows the shifting preference of customers and how the importance of the attributes changes.
Retailers must comprehend the significance of different attributes in influencing customer satisfaction (Matzler K et al., 1998). It has become much easier to assess such attributes since the Kano model was introduced by Professor Noriaki in 1984. The Kano model establishes a connection between customer satisfaction and product quality and functionality (Ek Fİ, Çıkış Ş. 2015 and Avikal S et al.; 2014). It also provides a graphical representation based on survey data to depict customer satisfaction and dissatisfaction. In this graph, the horizontal axis represents the extent to which a feature's functionality is fulfilled, while the vertical axis reflects the resulting customer satisfaction.
The Kano model classifies features into three primary categories based on their effect on customer satisfaction: must-be quality, one-dimensional quality, and attractive quality (Sauerwein E et al., 1996 and (Matzler K et al., 1996). These other dimensions of customer perception include Avikal et al. notions of indifferent quality and reverse quality. Overall, the five categories have given an effective insight to how various characteristics will impact on customer satisfaction (Ek Fİ, Çıkış Ş. 2015, Shahin A, et al., 2015, Salehzadeh R et al., 2015).

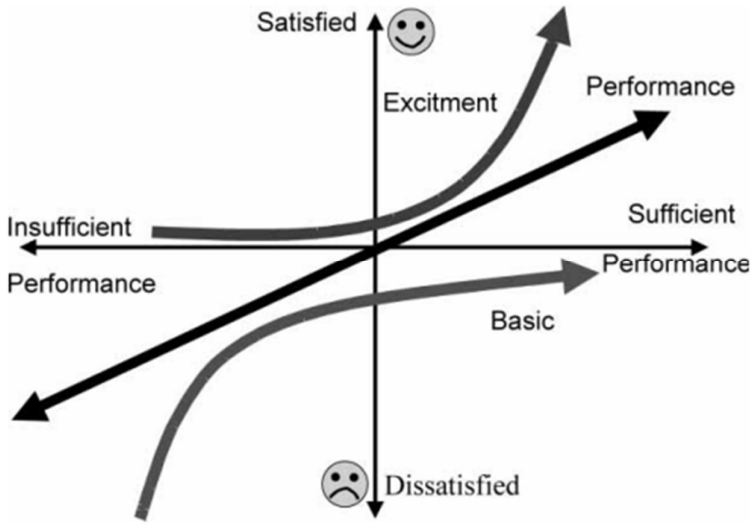

Figure 1. Kano model of excitement and basic quality (Matzler et al., 1996).

In the Kano model, attributes are categorized into several distinct types:

a) **Attractive Attributes (Excitement Attributes)**: These are the attributes that exceed customer expectations and provide delight or surprise when present. Their absence does not lead to dissatisfaction, but their presence significantly enhances customer satisfaction and creates a sense of excitement.

b) **Must-Be Attributes (Basic Attributes)**: These are the essential features that customers expect to be included. The lack of these attributes causes significant dissatisfaction, while their presence is expected and does not necessarily boost satisfaction beyond a baseline level. They represent fundamental requirements for the product or service.

c) **Reverse Attributes**: These attributes elicit varying reactions from different customers; some may find them satisfying while others may find them dissatisfying. This duality makes them polarizing, as they can lead to opposite responses depending on individual preferences.

d) **One-Dimensional Attributes (Performance Attributes)**: These features have a direct and correlative relationship with customer satisfaction. The higher the level of performance of these attributes, the greater the customer satisfaction, and conversely, deficiencies in these areas lead to reduced satisfaction.

e) **Indifferent Attributes**: These attributes have minimal impact on customer satisfaction, regardless of their presence or absence. Customers generally do not have strong preferences or reactions to these features, and they do not significantly influence their overall perception of the product or service.

3. Methodology

An empirical study was conducted to evaluate the packaging's qualities. An expert panel from the field of design was chosen to conduct the research using the Delhi method. A survey was then conducted to determine the significance of various quality attributes and their ranking according to the Kano Model. The flow of the methodology is shown in Fig. 2.

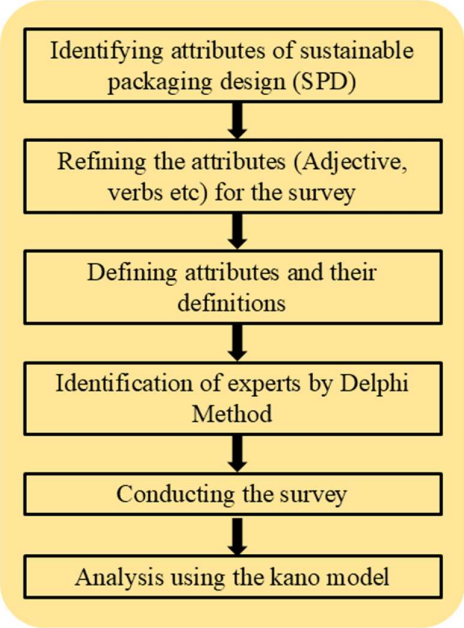

Figure 2. The flow of methodology

3.1 Studying the dimensions of attributes for sustainable packaging design

The current study intends to classify and rank these traits using approaches like the Kano Model, offering insightful information for user-centred product creation (Lo 2021; Yang, 2005; Wenninger, Rau, and Röglinger, 2022). The Kano model takes user emotions and product quality into account while identifying basic, performance, and excitement aspects (Lo 2021).

Identifying Attributes of Sustainable Packaging Design (SPD): In the initial phase, an extensive brainstorming session was conducted to compile a list of packaging design attributes, resulting in a total of 341 attributes. These attributes were subsequently validated for their relevance to sustainable packaging design through a comprehensive literature review, incorporating sources such as journals, books, online resources, catalogues, market surveys, and research papers. This validation process facilitated the refinement of the list, narrowing it down to 120 closely related attributes.

Refining the attributes for (Adjective, verbs etc) for the survey: A further refining procedure was carried out to get the qualities ready for efficient survey usage after an initial list of 341 features pertinent to sustainable package design was created and validated. This phase included examination of each property to determine its clarity, relevance, and conciseness so that it fits into the widely accepted descriptors that are often verbs, adjectives, and other simple phrases. The 17 attributes identified by this methodical refining were survey-ready, succinct, and comprehensive, allowing for more significant insights into the preferences and goals for sustainable package design as well as clearer replies.

Defining attributes and their definitions: In this phase, each sustainable packaging design (SPD) attribute was clearly defined to ensure a consistent understanding among survey respondents. To prevent misinterpretation, definitions were provided in plain, uncomplicated language. For instance, "biodegradable" was defined as "decomposes naturally without harming the environment, such as through composting or microbial breakdown," and "recyclable" as "capable of being reprocessed and reused in manufacturing." In order to

emphasise the qualities of the attributes, they were also characterised using comparable adjectives and verbs, such as "durable," which is connected to Material, Strong, Sturdy, robust, Long-lasting, Robust, etc. This process ensured that every attribute is identified, which would create an appropriate foundation for accurate and trustworthy survey results. Attribute and their definition are as shown in table 1.

Table 1. Definition of attributes.

S.No	Attribute	Definition	Other parameters
1	Accessibility	In the state of being always available	Accessible Availability Attainability Acquirable Within reach Easy to reach
2	Adaptable	Referring the ability of an identity to adapt it-self efficiently and fast to changed circumstances.	Adjustable Convertible Flexible Modifiable Scalability Compatible
3	Aesthetic	Being interested in how something looks, feels and seems pleasing to the senses and especially to the sight	Pleasing Beautiful Attractive Eye catchy High visibility Appreciable Desirable
4	Affordable	The state of being cost-effective enough for mass to be able to buy.	Cost-effective Inexpensive Low-cost Cost Accepted by mass
5	Contextual	A diversified solution that is convenient to use, generous and impactful in most situations in various demographic situations	Achievable Awareness Convenient Generous Impactful Adequate Feasible Dependable Loyal
6	Durable	Made up of good quality material that can last for long	Material Strong Sturdy

			Resilient Long-lasting, Robust
7	Emotional	Consumers experience a feeling or attachment with a product.	Affectionate Caring Cultural Nostalgic Attachment Belongingness
8	Sustainable	Created to develop eco-friendly solutions that address immediate needs while integrating a long-term outlook that "Returns to its roots". Not or less harmful to the environment.	Biodegradable Sustainable development Natural Eco-friendly Recyclable Minimal damage Eco-system Green Non-polluting Low carbon-footprint Energy-Efficient
9	Ergonomic	Product to improve people's working/operating conditions and help them work more effortlessly.	Easy to use User friendly Flexibility in use Low pain points Used by mass
10	Functional	Relating to the way in which product can serve for longer time than intended, or relating to how useful it is.	Useful Easy to use Re-usability After-use Shelf-life
11	Inclusive	Should be easily used by as many people as possible of all backgrounds and abilities	Comprehensive For all
12	Informative	A component of design that uses visuals, text or content that strategically convey a message or express information.	Branding Readability Promotional Communicative Information
13	Intuitive	With an intuitively designed product, customers will understand how to use it without much effort.	Understandable Perceived value

			Perceived information Status
14	Materials	A substance that can be used for making a sustainable solution	Easily available Robust Long lasting Procurable Eco-friendly Production – friendly transportable Durable Hygienic Re-growing
15	Portability	Should provide a ease factor in transportation / distribution of packaging or its material	Light weight Cost effective Manageable Convenient Compact
16	Protection	The state of being shielded from harm and being hygienic.	Shelf-life Hygienic Harm-less Low / Zero contamination
17	Social		Behavioural Attachment Awareness Diverse Responsible Empowering Collaborative Social Values & Responsibilities

Identification of experts by Delphi Method: The identification of experts for this study was conducted using the Delphi method, a structured approach that aims to gather insights from a panel of knowledgeable individuals through multiple rounds of questioning (Linstone & Turloff, 1975). The Delphi method (Dalkey & Helmer, 1963) is particularly useful for achieving consensus on complex issues where there may not be a single clear answer. Experts from this list were selected on their basis of experience in sustainable packaging design, environmental sustainability, and related fields. Based on the expertise, industry experience, and familiarity with the latest trends and challenges in packaging design, these experts were chosen for this study. For that, the selection was carried out by identifying academics,

professionals, and practitioners. After the elicitation of experts, questionnaires from the Delphi method were then sent out among them in a series of rounds. Responses were analysed, refine and improve the next set of questions, allowing the group to converge toward a consensus on key attributes and considerations in sustainable packaging design. This iterative process helped ensure the reliability and validity of the findings, capturing a broad range of expert opinions and leading to a more comprehensive understanding of the subject.

Conducting the survey: In this research study, the questionnaire was formulated for gathering opinions of experts concerning the attributes of sustainable packaging design. It comprised functional as well as dysfunctional questions on the Kano model, measuring the way the absence or presence of the concerned attributes was influencing experts' perceptions. In this study, sustainable packaging attributes are categorized into six Kano quality types: **A (Attractive Quality)**, **M (Must-be Quality)**, **O (One-dimensional Quality)**, **I (Indifferent Quality)**, **Q (Questionable/Doubtful Quality)**, and **R (Reverse Quality)**. Experts rated their responses on a five-point scale: "I like it," "I expect it," "I am neutral," "I can tolerate it," and "I dislike it." This allowed for a detailed understanding of each attribute's significance. The questionnaire was distributed to experts either in person or via Google Forms, enabling easy access and completion. Since no pilot survey was conducted with the experts, the initial responses were directly used to refine the findings and conclusions.

3.2 Analysis using the kano model

The Kano Model is utilized to evaluate the attributes that influence designers' decision-making and to categorize customer requirements. It helps aiming to improve the service's performance of a product or service. The following steps were implemented to apply the Kano Model in assessing and categorizing the attributes of packaging.

A questionnaire in which the experts indicates whether they are satisfied with a hypothetical scenario serves as the basis for the Kano model's identification of excitement and fundamental criteria (Figure 3). Each product need is followed by two questions. The consumer has five options for responding to each inquiry (Kano et al., 1984). The first question, sometimes known as the functional question, asks the client how they would respond if the product met the demand or if it meets the requirement with appropriate performance. The response is indicated by the second question, often known as the dysfunctional question, if the product fails to meet those criteria or performs inadequately. The criterion may change based on how consumers respond to functional and dysfunctional inquiries.

Functional form of the question

What if the Packaging is aesthetically pleasing?	1. I like it 2. Must be 3. I am neutral 4. I can live with it 5. I dislike it
What if the Packaging is NOT aesthetically pleasing?	1. I like it 2. Must be 3. I am neutral 4. I can live with it

	5. I dislike it

Dysfunctional form of the question

Figure 3. Kano model questionnaires.

The most important decision in the Kano approach is which of the alternatives to choose. The wording of the options, which were taken from (Berger et al. 1993), is comparable to the Japanese version proposed by (Kano et al. 1984). These choices include "I like it that way," "It must be that way," "I am neutral," "I can live with it that way," and "I dislike it that way." The wording employed by (Berger et al. 1993) was determined to be the most appropriate by the authors for their analysis of Swedish customers. However, they think that the phrasing should be adjusted based on the respondents that are being worked with. The expert can respond to each section of the research by selecting one of the five options shown in Figure 3. claims that the phrasing. The expert can respond to each section of the research by selecting one of the five options shown in Figure 4. Berger et al. (1993) claims that the phrasing one should take into account the subtle differences in vocabulary between Japanese, English, and Swedish language.

Table 2. Kano evaluation table.

		Dysfunctional				
		I LIKE IT	**MUST BE**	**I AM NEUTRAL**	**I CAN LIVE WITH IT**	**I DISLIKE IT**
Functional	**I LIKE IT**	Questionable	Attractive	Attractive	Attractive	One-Dimensional
	MUST HAVE	Reverse	Indifferent	Indifferent	Indifferent	Must-have
	I AM NEUTRAL	Reverse	Indifferent	Indifferent	Indifferent	Must-have
	I CAN LIVE WITH IT	Reverse	Indifferent	Indifferent	Indifferent	Must-have
	I DISLIKE IT	Reverse	Reverse	Reverse	Reverse	Questionable

A = Attractive
O = One-Dimensional
M = Must have
I = Indifferent
R = Reverse
Q = Questionable

The classification of attributes based on the responses from participants was carried out using three distinct methods:

1. **Frequency-based attribute classification method:** This approach involves categorizing each attribute based on the response category with the highest frequency (M, O, A, I, R, Q). The attribute is classified according to the category that received the most responses.
2. **Comparison-based attribute classification method:** In this method, attributes are classified by comparing the total frequencies of two response groups. If the combined frequency of categories M, O, and A is higher than that of I, R, and Q, the attribute is classified under the category with the highest frequency within M, O, or A. If the total frequency of I, R, and Q is higher than M, O, and A, the attribute is assigned to the highest frequency category among I, R, or Q. If the sums are equal, the classification follows a priority order established by (Matzler et al. 1996), specifically M > O > A > I.
3. **Index-Based Attribute Classification Method:** This method introduces two indices: the Satisfaction Index (SI) and the Dissatisfaction Index (DI).

   The Satisfaction Index is calculated as $SI = \frac{(A+O)}{(A+O+M+I)}$ with a range from 0 to 1, while the Dissatisfaction Index is determined as $DI = \frac{(M+O)}{(A+O+M+I)} * (-1)$, which ranges from -1 to 0.

   A diagram is used to plot the Satisfaction and Dissatisfaction Indices for the 12 attributes to give an overall perspective.

Various attributes were categorized using the Satisfaction and Dissatisfaction Indices, as outlined in Table 3.

Table 3. Index based attribute classification

Satisfaction Index (SI)	Dissatisfaction Index (DI)	Classification
<0.5	≥ 0.5	Must-be (M)
≥ 0.5	≥0.5	One-Dimensional (O)
≥ 0.5	< 0.5	Attractive (A)
< 0.5	< 0.5	Indifferent (I)

Category Strength (CS) and Total Strength (TS), introduced by Lee and Newcomb in 1997, are two metrics used to assess attributes. Category Strength (CS) quantifies the difference in response percentages between the most frequently selected category and the second-most selected category. For example, if an attribute's highest response category is "O" with 40% of responses, and the second highest is "A" with 30%, then CS would be calculated as 40% - 30% = 10%. Total Strength (TS), on the other hand, represents the combined percentage of responses across the three categories: Must-be (M), One-dimensional (O), and Attractive (A). For example, if an attribute's responses are 20% for "M," 40% for "O," and 10% for "A," then TS would be the sum of these percentages, resulting in TS = 20% + 40% + 10% = 70%.

4. Results and discussions

The empirical study's results, detailed in Table 4, allowed for the definitive classification 12-quality attributes using the Kano model. It shows total number of ratings received from each

category i.e. A= Attractive, O=One Dimension, M=Must have, I-Indifferent, R-Reverse and Q=Questionable. This classification was achieved through an analysis of category strength, total strength, and the frequency of questionable responses, complemented by statistical testing as shown in table 4.

Table 4. Dimensions and attributes of packaging.

S.No	Attribute	A	O	M	I	R	Q	TOTAL
1	**Accessible**	4	5	10	8	0	0	27
2	**Adaptable**	3	5	10	9	0	0	27
3	**Aesthetics**	11	7	6	3	0	0	27
4	**Affordable**	3	10	12	1	1	0	27
5	**Contextual**	2	3	4	17	1	0	27
6	**Durable**	4	6	9	8	0	0	27
8	**Functional**	3	9	8	7	0	0	27
9	**Informative**	11	7	6	3	0	0	27
10	**Portable**	4	7	6	10	0	0	27
11	**Protection**	2	10	12	2	1	0	27
12	**Reusable**	3	10	12	1	1	0	27

The results of the study show high statistical significance, as 12 out of the measured attributes were shown to have a p-value of less than 0.01, which reflects very high confidence in the relationships found. The horizontal coordinate indicates the fulfilment of the quality attributes, while the vertical coordinate indicates consumer satisfaction; it also represents which product to be kept in a one-dimensional category of attributes, attractive attributes and must be attribute shown in Figure 4. Attributes like Protection, Reusable, affordable, accessible and energy efficient came out to be the must have design attributes for SPD. Durable and Functional were one-dimensional.

Table 5. Represents the customer satisfaction and customer dissatisfaction coefficient for the attributes along with attribute strength.

S.NO	ATTRIBUTES	SI=(A+O)/(A+O+M+I)	DI=(O+M)/(A+O+M+I) x (-1)	Total Satisfaction Index	Attribute Strength	
1	**Protection**	0.44	-0.81	-0.37	**4.81**	**MUST HAVE**
2	**Reusable**	0.48	-0.81	-0.33	**4.59**	
3	**Affordable**	0.48	-0.81	-0.33	**4.66**	
4	**Adaptable**	0.29	-0.55	-0.26	**4.33**	
5	**Accessible**	0.33	-0.55	-0.22	**4.23**	

6	**Durable**	0.36	-0.55	-0.19	**4.26**	**ONE-DIMENSIONAL**
7	**Functional**	0.36	-0.55	-0.19	**3.74**	
8	**Aesthetics**	0.66	-0.48	0.18	**3.59**	**Attractive**
9	**Informative**	0.66	-0.48	0.18	**3.41**	

Furthermore, the horizontal coordinate in the diagram represents the degree to which the quality attributes of the product are fulfilled, providing a measure of how well each attribute is addressed in the design or features of the product. On the other hand, the vertical coordinate reflects consumer satisfaction, illustrating how much consumer's value and are satisfied with each of these attributes in the product. This two-dimensional framework allows us to understand not only how well the product meets specific quality criteria but also how those criteria translate into consumer perceptions and satisfaction.

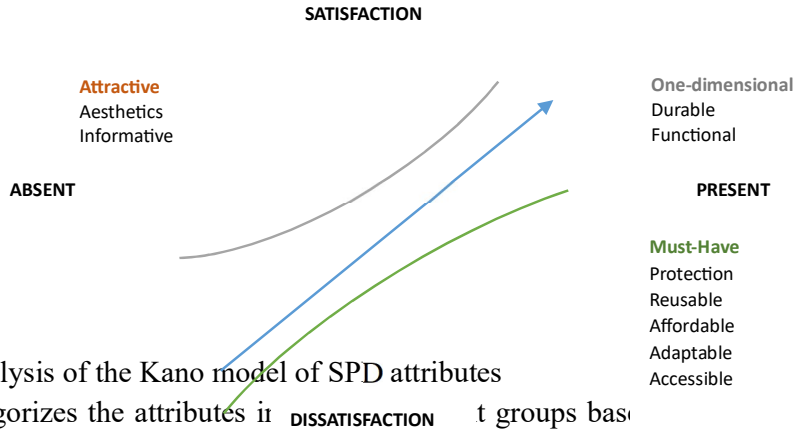

Figure 4. Analysis of the Kano model of SPD attributes

Analysis categorizes the attributes in t groups bas impact on consumer satisfaction, as shown in Figure 4. These categories include:

Must-have attributes: Those are the attributes necessary to satisfy the consumer. Without these attributes, the satisfaction of a consumer and his/her perception toward the product may be negative. In SPD (Sustainable Product Design), Protection, Reusable, Affordable, Accessible, and Energy Efficient are the must-have attributes. These attributes are the basis for the basic functional and sustainability requirements that a product should meet. In addition, these attributes are what form the foundation of consumer expectations. If any of these attributes are lacking, the product may not be considered viable or satisfactory by consumers.

One-dimensional attributes: One-dimensional attributes are attributes that build satisfaction with a product in direct proportion. When these attributes fulfilled, satisfaction is correspondingly higher. Durability and Functionality are two such one-dimensional attributes in the research that have been reported. Both of them, though essential for a product, work straightforwardly; in other words, when a product scores well on the dimensions, say, in durability or functionality, it goes hand-in-glove that satisfaction with that product increases correspondingly. However, simply gratifying these characteristics is insufficient for high

overall satisfaction because neglecting other more critical characteristic results in low overall satisfaction.

Attractive attributes: An attribute beyond the normal satisfaction with basic expectations may even give greater-than-normal pleasure to delight. While their absence doesn't create dissatisfaction, these may help consumers feel a form of pleasure or additional value from being present and done sufficiently. Aesthetics, for example, as well as the Informative features of this study, fall within this category of attractive characteristics. These elements enhance the appeal of the product by providing more layers of satisfaction, such as visual design or informative features that educate the consumer about the benefits and use of the product. The classification of attributes into 'must-have', 'one-dimensional', and 'attractive' helps to determine which attributes are most critical for meeting basic consumer expectations, which enhance overall satisfaction, and which are more likely to provide a delightful experience. The balance between these attributes is key to designing sustainable packaging that not only meets fundamental consumer needs but also offers extra value that can improve consumer satisfaction and loyalty. This expanded version offers more context to the categorization of attributes and their implications for product design, consumer expectations, and satisfaction.

Packaging has become a crucial component. Brand's overall sustainability strategy as environmental consciousness grows in importance among both consumers and Industries. Nowadays, Industries see packaging as a powerful tool to demonstrate their sustainable philosophy rather than just a means of transporting their goods. Brands can respond to the growing number of environmentally conscious consumers by projecting a very eco-friendly image with the use of creative packaging designs and materials obtained responsibly. A long-lasting or sustainable business is a good business. Sustainability is a modern business strategy that considers social, environmental, and economic factors to ensure a company's long-term viability (K. Haanaes 2016) "What is the role of designers with their designs so that a business can be sustainable?" is the next question to be taken into consideration. Implementing the idea of sustainable development into the design is one duty that a competent designer might complete. A designer bears moral and ethical responsibility for the design and its effects (O. Diegel 2001; and D. Nemerson, J. Rosenbeck 2009). This study offers a thorough method for designing sustainable packaging that covers packaging systems and packaged commodities at every stage of the supply chain, from manufacturers to final customers. The suggested methodology, which serves as a "blueprint" for creating more environmentally friendly packaging solutions, pinpoints essential characteristics that support sustainability from all angles. According to this study, the five most crucial design attributes that consumers hunt for in packaging are Protection, reusable, affordable, adaptable and accessible. These sustainable packaging attributes will provide a emerging perspective to creative approaches that suit consumer needs while striking a balance between ecological responsibility and affordability. These attributes can be used develop sustainable packaging design that can have more design qualities, which will lead to a better sustainable packaging design solution. Kano model have utilized to identify the most desirable attributes classifying customer needs into five categories—Basic must have, one-dimensional, attractive, Indifferent, and Reverse Needs—the Kano Model aids firms in better understanding and prioritizing customer needs, making it a useful research tool. Packaging Industry may concentrate on what are the needs for customers. This study will offer insights into how many aspects of a product or service impact

customer happiness. Whether it's introducing unexpected attributes, boosting performance, or strengthening basic functions, it helps prioritize resources to increase consumer satisfaction. Furthermore, because the Kano Model is dynamic and acknowledges that customer expectations change over time, firms can benefit from continual research to stay abreast of market trends. Businesses can improve customer loyalty, lower unhappiness, and gain a competitive edge by employing this methodology to make well-informed, customer-centric decisions. Additionally, it promotes improved departmental communication by offering a common language for talking about consumer expectations and successfully directing product development.

5. Conclusions

To gain a competitive advantage, stakeholders in the packaging industry must understand the attributes that are most important to developing a better sustainable solution. This study not only identifies these attributes but also ranks them, enabling the industry to prioritize the most essential attributes. To meet the study's objectives, an extensive literature review was conducted, 12 key attributes are critical for developing sustainable packaging, with must-have attributes like protection, reusability, affordability, adaptable and accessibility being central to customer satisfaction. Findings from this study reveal that respondents experience varying levels of customer satisfaction depending on the fulfilment of specific attributes. The findings also showed that a sustainable packaging must protect the content inside in order to maintain its basic purpose, since this is an essential quality, as it lack would drastically reduce consumer satisfaction. Other than Reusability and affordability have scored the same SI and should be considered while designing a SPD along with adaptability and Accessibility. Aesthetics and informative are the attributes from the appealing group that is proportionately related to customer satisfaction but whose absence does not result in discontent from customers. Attributes like offering Durability and Functional are proportionately related to consumer pleasure. Majority of the attributes with a high degree of attribute strength come from the must-be and one-dimensional categories, according to the self-stated importance questionnaire. The results of this study will assist stakeholders of the sustainable packaging design industry in learning more about the relative significance of design attributes and will allow them to assess how their present procedures affect the degree of client satisfaction. This study demonstrates the application of the Kano model in evaluating customer satisfaction within the sustainable packaging sector. However, the findings are derived from the insights and expertise of design professionals. It is important to note that the results predominantly reflect the perspectives of this demographic and should not be generalized to other customer groups. The scope of this study will be expanded by include target participants who are clients from a number of different age groups. If there is a relationship between income level and customer satisfaction traits for the retail industry, it may be found by doing similar research in other regions of the world with varying economic circumstances. Likewise, this study might be practiced in industries other than retail, including the supply industry, to identify the traits that can be enhanced for increased output and contentment. The study reflects the perspectives of design professionals and should be expanded to include a broader range of customer demographics, including different age groups and income levels, to validate results. Further studies could explore regional and industry-specific variations in customer satisfaction and sustainable packaging preferences, enhancing the understanding of diverse consumer needs. The study's conclusions

would be more comprehensive if these varied demographics were included, enabling packaging Industry better to match their packaging techniques with a larger clientele. Additionally, further studies could investigate regional and industry-specific variations in customer satisfaction and packaging preferences. This would enhance understanding of how cultural, geographic, and sectoral factors shape consumer expectations, providing more targeted insights. Understanding these regional and industry-specific differences could help businesses tailor their sustainable packaging approaches to meet the unique needs of diverse markets and industries, ultimately fostering greater consumer satisfaction and engagement.

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Author Statement

Taruna Singh: Conceptualization, Methodology, Investigation. Ranganath M. Singari: Writing – review & editing. Sumer Singh: Supervision, Writing – review & editing.

Availability of data and materials

The raw processed data required to reproduce these findings cannot be shared at this time as the data also forms part of an ongoing study.

Declarations

Conflict of interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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