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# Kano Questionnaire for the assessment of product attributes of alternative power plants in Kuala sub-district.

Rosnani Ginting<sup>1</sup>, Juliza Hidayati<sup>2</sup> and Muhammad Zulfin<sup>3</sup>

<sup>1,2,3</sup> Department of Industrial Engineering, Universitas Sumatera Utara, Medan 20155, Indonesia.

Correspondence addressed to Rosnani Ginting: e-mail: rosnani\_usu@yahoo.co.id, Contact number: +6281396747463

**Abstract.** Facing the challenge of increasing energy reserve, it is necessary to use other energy sources to replace the use of oil and fossil energy, which are clean, environmentally friendly and sustainable as long as the environmental condition of the geology and hydrology were maintained. Geographical, geological and natural conditions of Langkat regency have an enormous potential to be used as new energy sources, such as the sunlight, wind gusts, and river flow. This resources can be utilized as an electrical energy. This study is to propose an alternative energy-based on the power generation product. A questionnaire as a survey tool was used using Kano model to gain the information of customer need. As a result, according to the Kano analysis shows that the price attribute of the generator was in the attractive category. Meanwhile, the durability and ease of operation were included in the one dimensional, and aesthetic was the indifferent category.

## 1. Introduction

Alternative energy is a term that refers to all energy that can be used which aim to replace the conventional fuel without the unexpected effects of that. Generally, it is used to reduce the use of hydrocarbon fuel were cause environmental damage due to the high carbon dioxide emission, which contributes to global warming based on the Intergovernmental Panel on Climate Change.

In recent years, alternative energy utilization has been carried out in several regions. Geographical conditions that are difficult to reach in some of these areas make the use of alternative energy a logical choice. Among them, there are two villages in Kuala sub-district, Langkat district, namely in the village of a total of 30 units. Alternative energy sources used are solar energy. In its implementation, there are some obstacles that are felt by the user community. This study intend to assess and evaluate the satisfaction and desires of the community towards the use of alternative energy.

The output that is generated from this study is the information about the customer needs and expectations towards the use of alternative energy. The approach of Kano questionnaire was used to find out the crucial attributes from the design of the power plant. This design tool is able to categorize and determine the attributes of product and also customer needs based on how well the product is able to satisfy them. This method could indicate that product development should understand the response of technical characteristic using Kano model. It were used to identify the attributes that become advantages and disadvantages in accordance with the wishes of customers of a product..



## 2. Theoretical Background.

involving, capturing and listening to what customer needs, especially in capturing the information related to the product designed and developed is absolute. It is because the voice of the customer (VoC) can help the business make improvements suggested by the customer (Tzuoh, et al, 2015). To understand the customer satisfaction, Kano model has been widely used for customers' needs analysis, decision-making analysis, and other management practices (Meng, et al 2016).

The Kano model is one of design tool that can help in identifying and quantifying any customer needs. It was developed by Noriaki Kano in 1980, to decide customer satisfaction. This method categorizing the product attributes based on the customer need and quality of the product. Kano distinguishes three type of desired product that can affect customer satisfaction: (1) must-be, (2) one-dimensional, and (3) attractive. As shown in figure 1 shows the diagram fundamental concept of Kano model.

Product criteria that have the greatest influence on customer satisfaction can be identified, by classifying the product requirements into the dimensions of must-be, one dimensional and attractive, with a note, Kano model that used is oriented to the importance of prioritizing product characteristics based on customer's desire for their satisfaction by creating optimum prerequisites for the development of process-oriented products based on functional dan dysfunctional (Barutcu, et al, 2015).

"*Must-be (M)*" is a basic criterion that must exist in a product. If these requirements do not exist, are not fulfilled or not satisfied, then the customer will be dissatisfied. The customer considers "must be" as an absolute condition, they assume this category to be appropriate. However, a derivation of the attributes performance will not effect on decrease of satisfaction. Thus, customers usually and explicitly demand one-dimensional requirements. Hyejong, et al (2018) stated that "Must-be" is a factor if this category is not fulfilled, then user will be extreme dissatisfied. On the other hand, because customer consider it to be appropriate, the fulfillment will not increase customer satisfaction

Meanwhile, "*One-dimensional (O)*" requirement, explicitly always demanded by the customer. This category is proportional consumer satisfaction with attribute performance. The higher the performance attribute, the higher the customer satisfaction, vice versa. Further, Hyejong, et al (2018) also argued that by fulfilling this category will cause an increase of customer satisfaction, but if it not fulfilled, will not cause a derivation in the level of satisfaction.

The "*Attractive (A)*" requirements. This category is a product criterion that has the greatest effect on customer satisfaction if given. Attractive requirements are not required to be available and not expected by customers. A high level of customer satisfaction will be achieved in the fulfillment of this category. But if it is not, it will not cause a decrease in satisfaction level.

Lin ,et al (2010) argued that attributes of customer requirements in product or service design have six category besides Attractive, One Dimensional and Must-be: (1) if the presence or absence of a service does not affect customer satisfaction, it includes a category of *Indifferent (I)*, (2) *Questionable (Q)*, it means that sometimes customers are satisfied or dissatisfied if the service is given or not, and (3) *Reverse (R)*, customer become dissatisfied when the performance of the product attributes is high. It refers to the low of attributes resulting in satisfaction. By using these six Kano attributes, the relationship between performance criteria and customer satisfaction can be well understood so that the key performance of product design will also be identified (Borgianni & Rotini, 2015).

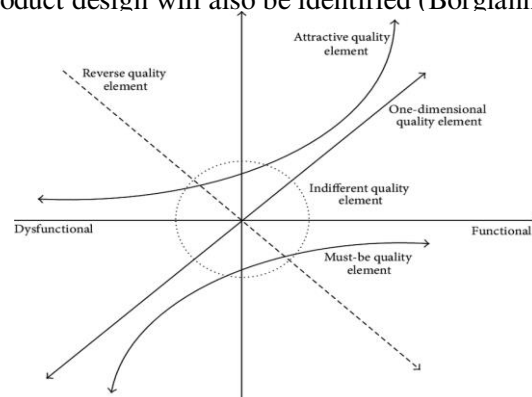


Fig. 1. Kano's Analysis (Matzler & Hinterhuber, 1998)

Xiong, et al (2015) stated that, Kano model is an absolute requirement to identify customer needs, hierarchies and priorities. It is used to determine the importance and feature of individual products or services for customer satisfaction and, create absolute optimum conditions for process orientation in product development activities. In other words, this engineering design tool The Kano model provides a linear view of the results given by product achievements or services to customer satisfaction which may be used to recognize definite characteristics that have the potential to achieve customer satisfaction or dissatisfaction.

Many researchers extensively focused on Kano model in product planning, development, and design. Some of them are Tzuoh, et al (2015), they developed a psychology-based evaluation procedure for the innovative design of the stationary bike. They priority the product characteristics and the prior engineering as the key performances to redesign. They proposed an innovative design compile technical importance ranking to determine the importance of each technical characteristics that have the highest value, based on customer needs and the priorities of product attributes. Yixiang & Jianxin (2018), develop an innovation and new product development of Electric Scooter design. They used the combination of six sigma method with Kano model to weight adjustment method based on the Fuzzy Kano Model classification to reprioritize the criteria. The result showed that the attribute of attractive attributes give more positive effects to customer and improve product image in the mind of customer when compared to competing product. For instance, Qingliang et, al (2016) combine a nonlinear programming model with Kano model to formulate the relationship of customer satisfaction and sufficiency elements. They proposed for maximizing machinery industry service quality under budget constraints by considering the trade-off between customer satisfaction and service costs, with integrated with other mathematical models for optimizing customer-focused product.

Moreover, Harijith and Naduthodi, et al (2017) argued on their research, which applied Kano model to measure customer satisfaction (patient) of a government medical college, by identify the healthcare quality attributes. They presented the results that the attributes of customer needs (based on Kano category) that have a positive effect on patient satisfaction are one-dimensional attributes. The attributes of customer needs that are categorized as must-be and attractive attributes have no effect on patient satisfaction. According to the results of their study, the perceptions of respondents (patients) on the performance of must-be attributes are very good, resulting in insignificant influence because the fulfillment of these attributes will not increase the level of patient satisfaction. The perceptions of respondents (patients) on the performance of these attractive attributes are low, resulting in a non-significant effect because of the low performance of these attributes does not reduce the level of patient satisfaction.

### 3. Research Methodology

This research was conducted in two stages: First, observes the geographical conditions, such as identification of river water flow, rainfall, sunlight intensity, and wind frequency. Second, identify the community need and satisfaction, which is done by conducting a survey of open and closed questionnaire survey and also Kano (functional dan dysfunctional questionnaire). The closed questionnaire using a Likert scale 1- 5. Data from the survey was used to determine the degree of importance between attributes. Meanwhile, the survey of Kano model was done by adjusting data that obtained from functional and dysfunctional tables.

To find out the validity of closed/open questionnaire and Kano model survey data, then testing was conducted with validity and reliability testing. The validity test was used the product moment or Pearson (Pearson's Product Moment Coefficient Correlation) with SPSS version 10 for windows. While the reliability of the pre-test and the post-test instrument is calculated by Alpha Cronbach formula. The variable can be declared Alpha Cronbach's coefficient of reliability when  $> 0.60$ . It means that the reliability phase of 0.60 is a reliable indicator (Park & Myoung, 2009).

#### 4. Result and Discussion

Data collection was done by questionnaires distributing technique to the respondents. Questionnaires were distributed in 2 stages, the first stage was an open questionnaire. This questionnaire is a form of question asked the respondent about the expectation of power plant user, people of Kuala sub-district. Respondents' answers contained in the open questionnaire as shown in Table 1, resulted in several modes that support the attribute of the question in the second stage questionnaire. Determination of the number of respondents is based on the sampling method used in the study of total sampling (population research).

**Table 1.** Customer Needs to Power Plant

Attributes
Generator Price
Operation cost
Safety factor
Ease of Operation
Durability
Enviromental Impact
Output of Energy
Aesthetics

The survey results using Kano questionnaires were processed to determine the categories of each attribute based on the Kano model. Traditional Kano model survey results are calculated on the number or value of each Kano on each attribute to all respondents. The number of categories of Kanos of each attribute on all respondents that have been obtained is then determined by Kano category of each attribute by using Blauth's formula.

1.  $O + A + M > (I + R + Q)$ , then the grade obtained is the maximum value of O, A, M.
2.  $O + A + M < (I + R + Q)$  then the grade obtained is the maximum value of I, R, Q.
3.  $O + A + M = \text{total value } (I + R + Q)$  then graded is the maximum value among all categories of Kano (O, A, M and I, R, Q) .

The result of Kano calculation and classification analysis can be used for mapping the Kano category of each customer needs to all respondents as seen in Table 2, as follows.

**Table 2.** Mapping Each Attribute

No	Attribute	Kano Category					
		A	O	M	I	R	Q
1	Generator Price	4	3	3	4	1	0
2	Operation Cost	2	1	7	5	0	0
3	Safety Factor	1	4	6	4	0	0
4	Ease of Operation	2	5	4	4	0	0
5	Durability	1	6	5	2	1	0
6	Enviromental Impact	1	3	6	5	0	0
7	Output of Energy	2	2	7	4	0	0
8	Aesthetics	2	3	1	8	1	0

From the table 2 above, the next step to determine the Kano category using Blauth's formula. For example for attribute 1 ( $O + A + M$ ) = 10 and ( $I + R + Q$ ) = 5. Then, the Kano category for attribute 1 is Attractive (A). Table 3 shows the recapitulation of each category of Kano.

**Table 3.** Kano Category using Blauth's Formula

No	Atribut	Kategori Kano
1	Price of Generator	A
2	Operation cost	M
3	Safety factor	M
4	Ease of Operation	O
5	Durability	O
6	Enviromental Impact	M
7	Output of Energy	M
8	Aesthetics	I

Table 3 above shows that there is one attribute in the “Attractive” category, two attributes are “One dimensional”, and 4 attributes are “Must be” category. Meanwhile, one attribute lies in Indifferent category. Aesthetic attributes are categorized as Indifferent”. It means that we can eliminate these attributes. While the designer more focuses on the attributes of ease of operation and durability. It is a normal requirement of customer needs, where the higher the functionality of the product, then the higher customer satisfaction will be.

## 5. Conclusion

Kano category mapping produces one attribute in “Attractive” category, two in “One-dimensional” category, and four attributes in “Must-be” category. For example, the attributes that fall into the category of ‘Must-be’ better if they are not developed further with high investment. It is because these attributes are indeed attributed that must exist. It is better to develop attributes in “One-dimensional” category. While the attributes included in the “Indifferent” category means that the development of these attributes will not have much effect on customer satisfaction.

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