

# A Product Innovation Measure for Indian Automobile Industry: Scale Development and Validation

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## Abstract

The main agenda behind this research is to develop an empirically validated scale so that it is easier to measure the perception of personal vehicle users in respect of product innovation they are seeking in Indian Automobile Industry. Design/methodology/approach: A 36 item questionnaire on product innovation in Automobile Industry was developed and tested for reliability and validity using both exploratory and confirmatory factor analyses. SPSS 19 and AMOS 20 were used for exploratory and confirmatory factor analysis. The data was collected from personal vehicle users of the selected brands in Delhi NCR. Findings: The study identified eight factors namely Product uniqueness, Product design, Autonomy, Novelty, Product newness, Technology, Green product & Continuous updating as the key dimensions of product innovation in Indian Automobile industry. Originality/value: This scale can be a great help for the industry to set up new benchmarks in the product innovation from a user's perspective, focussing more on innovating, and framing policies & practices regarding product innovation. Since different dimensions have been found in this research each dimension can be taken as yardstick for the overall enhancement in the quality of Automobile sector.

## Introduction

In the post liberalization period, automobile industry has grown faster than any other industry in India which results in the rising of middle class income and increased demand of personalized vehicles. Automobile industry played significant role in maintain the India's economy. Because of the reforms and the presence of Indian producers like assemblers and component manufactures into the global value chain , the inflow of FDI and equity participation by foreign firm become possible in this segment. The reason for the huge sale of automobile is the swelling of middle class. There are two reasons why there is increase in sale, first the path for the growth combines the increasing per capita income and inequality and secondly, oligopolies control the imperfect nature of market.

One of the important factor for the strong growth of economy is the increasing purchasing power of the Indian middle class over a past few years and major auto manufacturers have attracted to Indian market. There are many factors responsible for the attraction towards the Indian domestic market for instance existence of trained manpower, exchange rate linked by the market. On one hand, there is a growth of Indian market and on the other hand, weakening of auto sector market in EU, USA and Japan which become responsible for the flow of capital to the auto industry. The most significant highlight of Indian manufacturing sector is resulted in the various choices of Indian consumers and productivity level get increased by almost 20 percent (IBEF,2018).

It is the year of 1898 when first car seen on the Indian roads(Sarwade, 2015). Since 1898, the Indian automobile industry has been progressing as a result it reached to its present status. By production wise, it revealed outstanding performance and wrote a new history in the production of automobiles. It progressed rapidly and has been progressing since 1898 and got strength. There is 7.1% share of automobile industry in India's Gross Domestic Product(Philip & V, 2020). Cars and others products of automobile industry of India were rolling on the roads of the other nations. With the annual production of over 3.9 million units, India is considered as the second largest and the fastest growing industry after the nation named as China(Kanupriya & Kumar, 2018).The production of cars of India is faster than China. This is how we can observe that Indian automobile industry progressed rapidly than other nations. In this competition, the nation like US is counted after India in the sector automobile. We can see the laborious work of our nation towards this sector, numerous steps were taken to hold good position and got second rank after China. This Indian automobile industry played significant role in the Gross Domestic Product. Cars manufactured by India is considered as best cars which have been rolling on the roads of the other nations. India got the sixth rank in the passenger cars and commercial vehicle in the world bit the best this is there is a great improvement in the export sector.

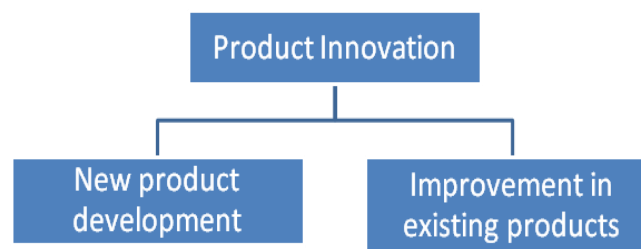
The automobile industry in India is world's 4th largest manufacturer of cars and 7th largest manufacturer of commercial vehicles in 2017. Indian automotive industry (including component manufacturing) is expected to reach ₹ 16.16-18.18

trillion (US\$ 251.4-282.8 billion) by 2026. Two-wheelers dominate the industry and made up 81% share in the domestic automobile sales in fiscal year 2018. Overall, Domestic automobiles sales increased at 7.01% CAGR between fiscal year 2013-2018 with 24.97 million vehicles getting sold in fiscal year 2018. Indian automobile industry has received Foreign Direct Investments (FDI) worth US\$ 18.76 billion between April 2000 and March 2018. Comprehensive automobile export from India was developed at 6.86% of the total annual growth rate between the financial years 2013 to 2018. In this addition, various initiatives are taken by the Government of India (GOI) and automobile companies in Indian markets.

Moreover, the market grab total automobile domestic sales at 7.01% total annual growth rate between the financial years 2013-2018 with 24.97 million vehicles acquiring to be sold in the financial year 2018. The automobile industry establishes to evidence more extensive changes in the innovation system of electric vehicles shared the mobility of 'Bharat Stage VI engine emission and safety norms. The electrical automobiles in India are projected to bring the new green number plate and get free parking for three years as well as get toll waivers. The sales of electric two wheelers are also proposed to have overlapped 55,000 electric vehicles in 2017-2018. The top motorbike sales in India covered a million units in 2018 (IBEF, 2018).

### Literature Review

It can be opening of a new product into a market place for the first time(Kanter, 1982)(Kanter, 2006 ). Few people regarded innovation as the upgrading in the old products(Andreasen & Hein, 1985). Although, changes in the products for betterment is taken as product innovation in many corporate houses. Product Innovation may be distinct as the expansion of novel goods, alterations in features of recognized goods, or make use of novel resources or mechanism in the production of recognized goods.



**Figure 1.1 represents the product innovation in two categories of innovation:**

Product innovation can be defined as the creation of the goods and services according to the Cahill, 1996. On the other hand, over 80 percent novel goods be unsuccessful which do not results in the top – level development continuously. Due to the product innovation, the standard of purchaser improved and qualitative performance can be accomplished according to Sivasurbramanian&Mageswari, 2011, DeBresson&Amesse, 1991 . According to the researchers, executive knowledge is linked with the progress of novel facts, which is considered as the firm innovativeness and firm performance according to Liu et al,2002, Damanpour,1990 , Damanpour, 1991, Damanpour& Evan, 1984. Firms are permitted by important innovations which results in rising the fame in the marketplace. Khandwalla,2006 and Khazanchi, et al, 2007 stated that innovation in the firm consist of diverse proportions, product innovativeness examined from the customer as well as firm viewpoint. If the firm constantly praised by the marketplace it means there is a presence of product innovativeness. It is very difficult to launch successful goods according to Petrella 1996, Damanpour and Gopalkrishnan, 1999, Damanpour et al, 1989. Most of the times, many corporations are flourishing. Managers confront some of the major challenges for instance particulars, point in time stress, day-to-day changes, transactions and conception.

New product development is the one of the key factors for progress and competitive advantage in each country. The product life cycle has never been so short as now, therefore, new product development is one of the most important business tasks. Using only the traditional methods of increasing competitiveness, for example, cost reduction, it is not possible to remain on the market(SILINEVICA, IGAVENS, & AMANTOVA-SALMANE, 2016)

By product innovation we refer to a product which is new, at least in some respects, for the market into which it is introduced. Product innovations vary in their degree of newness from, on one extreme, products which create entirely new markets (e.g., the first airplane, photocopy machine, electronic gene synthesizer) to, on the other extreme, only

marginally new innovations (e.g., the first compact disk player allowing to charge more than one compact disk)(ANGELMAR, 1990)

(DANNEEL, 2002)Product innovation activities not only draw on, but also serve to develop firm competences, and thus contribute to firm renewal over time.

### **Brief description of the explored factors: -**

1) Product Uniqueness: -A unique product is that which is only manufactured once to the specification of an individual customer, products that are scarce, different and unique from competitors. According to an analysis of product uniqueness by Swink and Hegarty (1998) and Franke and Schreier (2008), uniqueness is a consequence of great reliability, durability, fitness, performance, and the extent of exclusiveness and rareness. Some scholars shared that if people use similar product, they feel unsatisfied and unhappy stated by Fromkin,1970; Snyder &Fromkin, 1980. Moreover, Lynn and Harris (1997) stated that every consumer has different desire for unique products. According to Rao, McLaughlin and Hawkes (1995), uniqueness plays a significant role when a company wants to introduce a new product. Moreover, the order of a new product is decided by the extent of its uniqueness. Similarly, Bloch (1995) state that a unique product has more positive consumer response and easily obtain marketplace achievement

2) Product Newness:- Product newness indeed matters, and give out as a “vital selling point” (Bloch, 1995, p. 25). newness is termed as “the degree to which a given product is outside the observer's experience”. Expert evaluation of newness on two bipolar items, referring to the extent to which the product was innovative, distinct, new and original.

3) Product design :- is increasingly identified as an significant strategic tool, responsible for the achievement of leading brands such as Apple and BMW according to Brunner, Emery, & Hall, 2008, as well as a calculated tool by which niche brands can transform themselves from competitors stated by Jana, 2008. There are numerous definitions of product design. When the term design is defined by the designers themselves, they start differentiating “form” from “function,” where “form” refers to physical form according to Bloch, 1995; 2011; Chitturi, Raghunathan, & Mahajan, 2007. Consumers always lured by the physical form, interacted with them and value added by the product by improving the quality of the usage experiences associated with it according to Bloch, 1995.

4) Green Product :- In recent times, “green” has become a prevalent catchword in business. Companies brand their products with environmentally friendly features and labels, as they keep on trying to transport to the market the image of a supportable company. Considering the automotive industry, through the ecological and sustainable path, competition is forwarded by the car manufacturers, betting on hybrid technologies and electrification. Transport report for roughly a third of greenhouse gases emissions worldwide and public opinion widely considers it as one of the most noticeable symbols of pollution. For this reason, car manufacturers are largely infusing in the development of more efficient and eco-friendly products, as well as in the communication of such features to the market.

5) Continuous Updating :- refers to constantly renovating & constantly upgrading . It means how frequently a brand update & improve its existing features, models & Specifications. Auto manufacturers have historically had a strong culture of Continuous Updates.

6) Technology :- The technology is improving day by day. There is a rise in the number of electric cars due to rise in the price of fuel. The technology is recognized on the basis of whether the technology is innovative, up to date, keeps on ameliorating the existing technology.

7) Novelty :- To assist the marketers differentiate their products from the competition, novelty is simply an incremental change to an existing product. Novelty is something that has not been experienced before and so is interesting. It is something new, fresh or unusual .E.g.the novelty of a self-driving car or novel way of driving.

8) Autonomy:- is the ability to make your own decisions about what to do rather than being influenced by someone else or told what to do. Without interference of the user, the first dimension of autonomy refers to the extent to which a product is able to operate in an independent and goal-directed way. Autonomy in car will be seen by its capability of performing tasks without assistance from others.

### **Research Methodology**

The objective of this is to designing as well as developing a scale to measure product innovation from users perspective in Indian Automobile Industry. The process of developing a scale begins with the development of assessment items for a construct. This is an inductive method where things are created first, then a deductive approach is used to develop scales. In reviewing the literature and conducting in-depth interviews with practitioners and specialists, 36 items were discovered. 150 users of personal vehicles completed a draught questionnaire as part of a pilot test, and they were asked to comment on any omissions, inaccuracies, or apparent ambiguities relating to the questionnaire's wording. The suggestions made in response to the comments were only marginally altered. After the pilot study, the updated

questionnaire was distributed to three experts (a researcher, an expert, and a practitioner) to obtain valid feedback for a full-scale study. The expert concluded that the questionnaire can be used to assess product innovation across various automobile manufacturers. The scale development techniques used were those described by PZB and supplemented by Cronin and Taylor in 1992, which were widely used by researchers. A well-designed questionnaire was used to gather the data from users of the chosen brand's personal vehicles. A sample of 300 to 400 respondents completed the survey. The NCR was divided into zones, and data from drivers of private vehicles was gathered twice. Once for the exploratory factor analysis and again for the confirmatory factor analysis. For this study, quota sampling is used. In NCR, the population was separated into four zones.

The method of sampling is convenient sampling method where sample is drawn by selecting population units on the basis of convenience. For the study, primary data was collected through Questionnaire. Convenience sampling is used, as it is appropriate for exploratory studies. Data from around 300-400 personal vehicle users were collected from NCR using quota sampling technique by dividing them in the four zones in NCR and in every zones non-random of Judgemental sampling is used. As per the central tendency tools it is said that the value of N that is if N is more than 200 then the data can be assumed that it is normally distributed . To purify the measure Exploratory Factor Analysis (EFA) is used and after that confirmatory factor analysis was applied (CFA) and after looking the validated new assessment instruments (DeVellis, 2003; Worthington & Whittaker, 2006). Face validity, content validity, and construct validity (convergent and discriminant validity) were conducted and the main purpose of this is validation of six service quality construct. Then finally, the scale was proposed that is a valid and fit Indian Automobile Sector.

**Data Analysis & Results**

**Sampling Technique**

The data was collected from Personal vehicle users of Selected brands (namely Maruti Suzuki, Hyundai, Tata and Mahindra & Mahindra) using a thoughtfully constructed Questionnaire. Data from users of personal vehicles was gathered twice in NCR's zones. A confirmatory factor analysis will be performed after the initial exploratory factor analysis. The research employs quota sampling. Four zones in NCR were created to divide the populace. The population was divided into the four zones in NCR. The method of sampling is convenient sampling method where sample is drawn by selecting population units on the basis of convenience. For the final data analysis sample size of 350 for EFA & 324 for CFA was taken.

**Statistical Technique**

To purify the measure Exploratory Factor Analysis (EFA) is used and after that confirmatory factor analysis was applied (CFA) and after looking the validated new assessment instruments (DeVellis, 2003; Worthington & Whittaker, 2006). Face validity, content validity, and construct validity (convergent and discriminant validity) were conducted and the main purpose of this is validation of six service quality construct. Then finally, the scale was proposed that is a valid and can be used to measure product innovation in Indian Automobile Sector.

**Exploratory Factor Analysis**

To find out the dimensions of this scale, EFA was used to ensure that all items only loaded onto their respective dimensions. We applied an eigenvalue of 1 as the cut off value for extraction. The Eigen values for eight factors were 12.119, 3.708, 3.531, 2.826, 2.308, 1.910, 1.442 and 1.322 respectively. Following is the percentage of variance explained eight factors for measuring product innovation in Automobile sector are 15.211, 11.351, 10.951, 10.088, 9.761, 8.108, 7.975 and 7.572 respectively. The index for present solution accounts for 81.017 % of the total variations for compensatory consumption. As 36 items has been reduced to eight factors it can be said that it is quiet good extraction while 18.98 % information content has been lost for factors for measuring product innovation in Indian Automobile Industry.

**Table 1**

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %

1	12.119	33.663	33.663	12.119	33.663	33.663	5.476	15.211	15.211
2	3.708	10.301	43.964	3.708	10.301	43.964	4.086	11.351	26.562
3	3.531	9.809	53.773	3.531	9.809	53.773	3.942	10.951	37.513
4	2.826	7.850	61.623	2.826	7.850	61.623	3.632	10.088	47.601
5	2.308	6.411	68.034	2.308	6.411	68.034	3.514	9.761	57.363
6	1.910	5.306	73.339	1.910	5.306	73.339	2.919	8.108	65.470
7	1.442	4.006	77.345	1.442	4.006	77.345	2.871	7.975	73.445
8	1.322	3.672	81.017	1.322	3.672	81.017	2.726	7.572	81.017

### Reliability

Dependability alludes to the "exactness of estimation scores, or how precisely such scores will be imitated with rehashed estimation" (Dillon, Madden, & Firtle, 1994). The unwavering quality of the develop things was assessed utilizing Cronbach's coefficient alpha. Cronbach's coefficient alpha of the considerable number of builds is extended from .80 which is over the cut-off worth .70 (Nunnally, 1978). As all the qualities is over .70, it very well may be said that all the elements are reliable. The generally speaking unwavering quality of the estimation model was likewise settled by accomplishing a Cronbach Alpha measurement of 0.95.

**Table 2**

<b>Construct</b>	<b>Cronbach's Alpha</b>
Product Uniqueness	.967
Product Design	.964
Green Product	.965
Newness	.809
Continuous Updating	.995
Technology	.996
Novelty	.849
Autonomy	.994
<b>Cronbach's Alpha</b>	<b>N of Items</b>
<b>.943</b>	<b>36</b>

### Validity Analysis

There are three main types of Validity measures, namely Content Validity and Construct Validity consisting of Discriminant Validity and Convergent Validity. Confirmatory Factor Analysis (CFA) was used to determine the validity of all independent measurement models and constructs.

#### Content Validity

The most important research methodology is the content validity approach which states that how well the behavior is measured for which it is intended. For this study content validity of the instrument was established through reviewing literature and in-depth interviews of students and experts.

#### Construct Validity

Construct validity says whether the scale tests what it is supposed to be measuring. It includes validity which is discriminating, convergent and nomological (Malhotra, 2010). Discriminant validity and convergent validity are determined for the current research.

### Convergent Validity

In first phase for the verification that all the proposed measurement are part of construct itself that is why convergent validity is applicable. The degree to which there is a positive relation between the measures of a construct is shown by "Convergent validity" (Malhotra, 2010). It is formulated by "comparing Cronbach alpha of the construct with Average Variance Explained (AVE) by the measures" (Hair et.al, 2010). The AVE is square of average of the factor loadings. The Convergent validity is achieved if:

Cronbach alpha co-efficient is greater than 0.7

Cronbach alpha coefficient > AVE

AVE > 0.5

The above data shows the validity and reliability of all the dimensions. As the value of Cronbach alpha is above .07 that means all dimensions have good reliability and internal consistency. AVE is also above 0.4 which is threshold value. Therefore, convergent validity norms are met by the eight constructs.

### Discriminant Validity

There is "Discriminate validity" in the extent to which the construction differs. It is based on evaluation by comparing the paired constructs 'square correlation (R<sup>2</sup>) with each construct's AVEs (Fornell& Larcker, 1981). That demonstrates how dissimilar the constructions are from one another.

Criteria for proving discriminant validity: MSV > AVE, AVE (Hair et al., 2010).

The fact that both the MSE and ASV are below the AVE demonstrates how the constructions are distinct from one another. Validity tests for discriminant and convergent validity were successful. Due to a cross loading issue with one of the statements, the discriminating validity of that statement has been compromised. Each individual factor underwent a reliability test, and it was discovered that each one passed. As a result, it has been established that the product innovation scale developed in this study is a valid and accurate tool for assessing product innovation in the Indian automobile industry.

### Confirmatory Factor Analysis

The primary point of this examination was to plan a scale to gauge product innovation from users perspective in Automobile Sector of Delhi/NCR. After the EFA the subsequent stage is to break down the information through CFA. After EFA dependability test was led to satisfy the goal and afterward the zero-request CFA was led utilizing AMOS 20 followed by first request CFA and afterward legitimacy test was led utilizing AMOS 20. The corroborative factor systematic model was evaluated by means of the Maximum Likelihood technique is Consistent with the basic condition demonstrating writing (Chen, 2008) a scope of files were utilized to asses model fit. The estimation model showed extensively palatable degrees of fit over all examples (Hu&Bentler, 1999). We utilized a few lists to assess the decency of-attack of a build: 1) the estimation of the  $\chi^2/df$  measurement, where  $\chi^2/df < 5.0$  (Wheaton et al. 1977) 2) the similar fit record (CFI), and the non-normed-fit list (NNFI), which ought to be >0.90 (Medsker, Williams and Holahan 1994); and 3) the root mean square blunder of estimation (RMSEA) worth ought to be less than 0.08 (Browne & Cudeck 1992). As all estimation of the files was over the cut-off level, which demonstrates that the model is solid match in Indian setting?

**Table 3**

Indices	Recommended value	Product Uniqueness	Product Design	Product Newness	Continuous updating	Novelty	Technology	Autonomy	Green product
The Normed Fit Index (NFI)	It should be more than .90 (Byrne, 1994)	0.982	0.998	0.998	0.987	1.000	0.926	0.981	0.999
The TuckerLewis Index (TLI)	It should be nearer to 1	0.975	0.998	1.011	0.962	1.005	0.988	0.944	1.001
Incremental fit index, IFI	It should be equal to or greater than	0.985	0.999	1.004	0.987	1.001	0.926	0.982	1.000

	.90								
The Comparative Fit Index	It should be more than .93 (Byrne, 1994)	0.985	0.999	1.000	0.987	1.000	0.927	0.981	1.000
The Goodness of Fit Index	It should be more than .90 (Byrne, 1994)	0.944	0.991	0.999	0.930	1.000	0.970	0.901	0.996
RMR	It should be less than .08 (good models < .08)	0.017	0.007	0.011	0.005	0.001	0.006	0.007	0.003

### Higher Order Factor

For first order CFA, we check only discriminant validity and for second order CFA, we check convergent validity. If the constructs have multicollinearity, only then second order of CFA is required otherwise not. The structure of both types is exactly the same--namely the "common factor model" which claims that a latent variable is causally influencing lower level variables and, hence, is responsible for the correlations among the lower level variables.

In the case of a first order CFA, the lower level variables are error-containing measured/observed variables. These can be observations in a field study or responses in a questionnaire survey.

In the case of a second order CFA, the lower level variables are themselves latent variables (which themselves have effects on their measured indicators)

**Table 4 Summary Table Model (First Order CFA)**

The Normed Fit Index (NFI)	0.917	The Normed Fit Index (NFI) Exceeds .90 (Byrne, 1994) or .95 (Schumacker & Lomax, 2004)
Incremental fit index, IFI	0.939	IFI should be equal to or greater than .90 to accept the model
the Tucker-Lewis Index (TLI)	0.932	the Tucker-Lewis Index (TLI) should be nearer to 1
The Comparative Fit Index	0.939	The Comparative Fit Index exceeds .93 (Byrne, 1994)
RMSEA	0.053	the RMSEA (good models < .08)

**Table 5 Summary Table Model (Second Order CFA)**

The Normed Fit Index (NFI)	0.910	The Normed Fit Index (NFI) Exceeds .90 (Byrne, 1994) or .95 (Schumacker & Lomax, 2004)
Incremental fit index, IFI	0.932	IFI should be equal to or greater than .90 to accept the model
the Tucker-Lewis Index (TLI)	0.927	the Tucker-Lewis Index (TLI) should be nearer to 1
The Comparative Fit Index	0.932	The Comparative Fit Index exceeds .93 (Byrne, 1994)
RMSEA	0.066	the RMSEA (good models < .08)

It shows the model fit indices of all the constructs namely Product uniqueness, Product design, Autonomy, Novelty, Product newness, Technology, Green product & Continuous updating. All value of indices found to be above the threshold, which implies that model is good fit in Indian Context. The value of IFI, TLI, CFI is also above the cutoff level, the value of GFI and NFI value also very near to the cut-off value, RMSEA and RMR value is also good.

### Conclusion

The intention of this analysis was to identify dimensions which influence product innovation of Automobile Industry in Delhi NCR. To identify the dimensions Factor analysis, which is a data reduction technique was used. From the analysis, eight factors were finally extracted regarding Automobile Product Innovation, these are: Product uniqueness, Product design, Autonomy, Continuous updating, Green product, Technology, Novelty & Newness. It has been found the total percentage of variance explained by all the factors affecting product innovation in Automobile Industry is 81.01%. It is a very good extraction as it can be economized on the number of factors ("from 42 it has reduced to 8 factors") while we have lost 18.99% information content for factors for measuring product innovation in Automobile industry. It has been found the percentage of variance explained by factor affecting Automobile industry product innovation is 33.66% for Product uniqueness, 10.30% for Newness, 9.80% for Autonomy, 7.85% for Green product, 6.41% for Product design, 5.30% for Continuous updating, 4.00% for Novelty and 3.67% for Technology.

### Managerial Implication

The practical applications of the research's findings include the researcher's ability to improve product innovation understanding from the user's perspective and, as a result, serve as a solid foundation for the whole automotive industry, helping to uphold the industry's standards. There are numerous practical inferences in the current research through which consequences are found not only specific Automobile brands but for the entire Indian Automobile Industry. As the Automobile market is expanding rapidly there is a need to focus continuously on innovating & enhancing the quality of Cars. Automobile Industry is responsible for managing overall innovation in the firm. They are responsible for making choices regarding the available resources that they should use. It is possible for the industry to spend resources effectively and attain excellence by understanding individual opinions regarding product innovation. More happy customers will result from the effective implementation and management of the policies and practises related product innovation. To set up new benchmarks in the all perspective of innovation and to increase customer satisfaction, this scale can be a great help for the industry.

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