

# Dimensions of Vehicle Quality: Scale Development Study

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## Dimensions of Vehicle Quality: Scale Development Study

### Abstract

The aim of this study was to develop a scale to evaluate vehicle quality (cars and light commercial vehicles). The study also compared owners' assessment of the current status of their vehicles with the level of importance they assigned to the dimensions of vehicle quality. The sample consisted of 561 automobile owners. Data were collected using a questionnaire. Analysis revealed nine dimensions; reliability, user-friendliness, serviceability, performance, high-endness, aesthetics, perceived quality, comfort, and price. The gap between vehicle quality importance level and current vehicle status scores was greatest in the dimension "high-endness," followed by serviceability, reliability, comfort, price, key features, user-friendliness, perceived quality, and "aesthetics."

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## 1. Introduction

The post-industrial revolution witnessed the replacement of steam engines by internal combustion engines. The automotive industry has been a leading sector since Karl Benz manufactured the first car with an internal combustion engine in 1886. Both the use of automobiles in freight and passenger transportation and the public interest in them have always kept the sector alive.

The automotive industry is in constant interaction with other sectors, such as iron-steel, petro-chemistry, electric-electronic, glass, textile, tourism, construction, transportation, agriculture, defense, finance, and insurance. We can, therefore, state that the automotive industry plays a key role in the economy as it creates added value and provides employment opportunities (Anonymous, 2002).

The concept of quality varies across products and people, however, certain factors are taken into account to evaluate product quality, for which Garvin (1984: 30) focuses on eight dimensions:

1. Performance: Primary product characteristics
2. Features: Secondary attributes improving product performance and quality
3. Reliability: Probability of a product failing within a specific period
4. Conformance: Compatibility of operating characteristics with design
5. Durability: Amount of use before a product physically deteriorates
6. Serviceability: Any kind of service before, during, and after purchase
7. Aesthetics: A product's features that appeal to five senses
8. Perceived quality: Subjective evaluation of aesthetics

This classification is comprehensive but not exhaustive. There are many studies on the relationship between price and quality (Riesz, 1980; Lichtenstein & Burton, 1989; Chapman & Wahlers, 1999; Jo & Saigollu, 2007; Völckner & Hofmann, 2007). These studies focus on the relationship between price and perceived quality rather than regarding the former as a dimension of quality. Sebastianelli and Tamimi (2002) used Garvin's (1984) classification but found no correlation between any dimension of quality and value-based approach. The definitions of value-based quality suggest that price should be regarded as a dimension of quality. Brucks et al. (2000) evaluated price as a dimension of quality.

Kianpour and Jusoh (2014) focused on production processes and environmental impact of products and reported that customers were environmentally conscious, and that eco-consciousness should also be evaluated as a dimension of quality.

Producing high-quality products based on the dimensions of quality plays a key role in a company's success (Sebastianelli & Tamimi, 2002). According to Zhang (2001), dimensions of quality provide companies with great advantages because they allow them to produce high-performance products.

All these studies point to the importance of dimensions of quality for quality assessment. Future studies should also take these dimensions into account. However, the vehicle quality importance level of dimensions of quality varies from product to product. What is more, different features account for different dimensions of quality. The aim of this study was, therefore, to determine what features automobiles and light commercial vehicles were more important to users. The study took into account what product features corresponded to what dimensions of quality and adopted an approach involving all dimensions of quality.

## 2. Research on Quality in the Automotive industry

Numerous studies address different aspects of the automotive industry to assess the quality of automobiles and light commercial vehicles. Some of those studies focus on the aspect of service:

Bouman and Van der Wiele (1992) employed the 5-dimension SERVQUAL scale to determine the service quality in the Dutch car service industry. However, they found that only three dimensions (customer kindness, tangibles, and faith) were related to the Dutch car service quality.

Gencer and Ulaş (2017) developed a new scale to measure automobile service quality, such as service and after-sales service. Their scale consists of 28 items, the five dimensions of the SERVQUAL scale included.

Famiyeh et al. (2018) used the SERVQUAL scale to analyze the effect of service quality on customer satisfaction with and loyalty to automobile maintenance services. They found that all dimensions of quality, except for reliability, significantly impacted on customer satisfaction and that customer satisfaction was positively correlated with customer loyalty. Izogo and Ogba (2015) also used the SERVQUAL scale to evaluate the quality of Nigerian car repair services and reported that physical factors, warranty, reliability, empathy, and responsibility had a significant impact on customer satisfaction and loyalty.

Katarne, Sharma, and Negi (2010) also employed the SERVQUAL scale to evaluate and improve the service quality of an automobile dealership in India and found that the main reason for the low reliability on the part of customers was the delay in the delivery of automobiles at a specific time, resulting in dissatisfaction. The researchers created a fishbone diagram to determine the reasons for delays and to provide solutions. They concluded that the greatest reason for delays was limited space, and therefore, recommended that the automobile dealership undergo capacity adjustment, increase the number of working hours (shifts), and replace the manual car washing machines with automated ones.

Chen et al. (2018) examined the effect of first-time buyers' age on customer satisfaction and loyalty with regards to car service. They also used the five dimensions of the SERVQUAL scale to measure the quality of service and focused on six statements for each dimension. They used a modified Kano model instead of the Likert-type scale to evaluate the statements. They found that all dimensions of service quality had an effect on the loyalty of customers over 30 years of age but that the dimension reliability had no effect on the loyalty of customers under 30.

Soiki et al. (2018) conducted two-step research to identify the features of perceived quality and the impact of those features on car owners' satisfaction, regret, reliability, pride, and verbal communication. In the first stage, they interviewed twenty car owners to determine the features of perceived quality. They then developed a questionnaire based on those features and administered it to different

car owners. They considered not only the physical features but also the service elements. They found that perceived car quality had a multidimensional structure involving status and power, handling dynamics, corporate responsibility, brand heritage, second-hand value, durability, and interior and luggage capacity. They also reported that perceived car quality had significant impacts on satisfaction, regret, word of mouth, reliability, and pride.

Some studies have focused on the factor of noise. For example, Jeong and Hahn (2001) looked into the effect of interior sound on speech recognition systems and proposed a car noise reduction technology to improve the speech recognition rate.

Zhang et al. (2013) focused on three different models of cars to investigate the effect of automobile door closure sound on customers' evaluation and found that it impacted on their evaluation of the quality of automobiles.

Li and Zou (2013) proposed a model based on backpropagation neural networks to evaluate the interior sound quality and tested it on applications in moving vehicles. Zhuang and Zuo (2014), who focused also on car interior sound quality, found that sound quality was better than sound pressure and that sound sharpness was more disturbing than volume. Hou, Han, and Xu (2012) used psychoacoustic metrics instead of conventional interior sound measuring methods, which they believed fell short of evaluating interior sound quality. They specified the frequency bands of the car compressor. They also evaluated alternative improvement results and stated that the proposed compressor had a lower noise level and vibration.

Kim, Lee, and Lee (2009) also argued that it was hard to evaluate interior sound quality by using only the sound pressure level. They, therefore, proposed luxury sound quality indices that took into account mechanical–electrical sounds (engine sound dominant during acceleration and steady-state driving, and the sunroof, turn signals, and door lock). They tested the model on 33 luxury car drivers. Cho et al. (2011) reported that although the sound level of the motor was lower than other sounds, the high sound level of window motors might lead to customer dissatisfaction. The researchers developed sound quality metrics to measure loudness, sharpness, roughness, and fluctuation strength and a model to evaluate the sound level of window motors.

Jambor, Majerik, and Bajcik (2010) investigated the effectiveness of a quality management system implemented by SEAT for its business partners between 2004 and 2008. They concluded that business partners who adopted and implemented the quality management system were more successful than others in terms of sales, customer satisfaction, transparency, and accountability.

Baishya and Kakati (2019) focused on Indian auto customers' perceptions of price and quality and reported that Indian auto customers were highly price-sensitive.

According to the researchers, objective quality and perceived quality are two different things, perceived quality is a long-term phenomenon that forms in the minds of customers, and price plays a key role in perceived quality. They also conclude that, to customers, high price means high quality, whereas low price means low quality.

Arguing that rapid advances in the Chinese automotive industry brought with them product quality issues, Ting, Yang, and Qun (2012) investigated whether the “7 Diamond Process” was an effective method for solving the quality issues in the industry. They introduced the model and concluded that 7 Diamond Process was an effective method for improving the product quality in the Chinese automotive industry.

Xu, Blankson, and Prybutok (2017) looked into how product quality and service quality impacted customer satisfaction and found that product quality had a more significant impact on customer satisfaction than service quality. They also reported a negative correlation between product quality and customers’ intention to switch brands. The researchers evaluated product quality in terms of performance, durability, and aesthetics, and evaluated serviceability in terms of customer orientation, physical aspects, delivery, communication, and customer service.

Nichols (1998) investigated what role advertising, as a source of information and quality, played in the American automotive industry between 1985 and 1990 and concluded that the advertisements contributed to perceived quality by 15%.

Fouto and Francisco (2011) examined the effect of the features of economy cars with a 1000 cc engine on price in the Brazilian automobile market. The researchers employed the hedonic pricing model and found that the most important criterion was brand, followed by steering assistance, air conditioner, airbag, and ABS brakes. Wang, Xu, and Si (2014) proposed a fuzzy-based method and employed it to assess air quality in four cars focusing on different pollutants.

Lee and Tai (2009) looked into the effects of characteristic-, benefit-, and image-attributes on Kazakhstan consumers’ perceived quality. Characteristic-attributes are explanatory features characterizing a product or service. Benefit-attributes are perceived features attributed by customers to a product or service. Image-attributes are mostly subjective and perceived features based on consumer's interpretation. The marketing literature defines “image” as an abstract concept involving the effects of promotion, reputation, and evaluation of alternatives. In Lee and Tai (2009), characteristic-attributes were maximum speed, horsepower, and gas consumption; benefit-attributes were delivery time and financial service; image-attributes were images of retailer and manufacturer, and country-of-origin. They concluded that consumers were more sensitive to the benefit attributes than the characteristic attributes.

Khanna et al. (2006) focused on the use of 23 Total Quality Management (TQM) tools in the Indian automotive industry. They found that those tools, especially Six Sigma, were too superficial to be beneficial for the Indian automotive industry.

Kozlovsky and Aydarov (2017) compared three models of car (a well-known European brand, a Russian brand, and an Eastern brand) to measure customer satisfaction. They used a 46-item scale and SWOT analysis to determine the automobile features that should be considered in customer satisfaction with the Russian brand. The researchers underlined the need for general questionnaires to measure customers' perceived quality of automobiles and pointed out that those questionnaires should address the aspects below:

- ✓ Questionnaires should not only focus on specific products, but they should compare both the results of different studies and different brands.
- ✓ Questionnaires should provide comfortable communication conditions and consist of items that enable customers to respond completely and sincerely.
- ✓ Questionnaires should be detailed to provide comprehensive quantitative and qualitative information on products and their environment.
- ✓ Questionnaires should contain unexpected questions to elicit spontaneous responses that would reveal what customers feel and think.
- ✓ Questionnaire items should be differentiated from one another to make sure that quantitative scores do not lead to speculation over written explanations.
- ✓ Questionnaires usually measure the current situation, but they should also be able to measure customer expectations to ensure future customer satisfaction.

Suhud and Willson (2019) focused on two brands of cars (Toyota and Daihatsu) and investigated the effect of brand image on perceived quality and price as well as the effect of perceived quality and price on low-cost green car purchase intention among Indonesian consumers. They found that brand image in both brands impacted on perceived price and quality. They also reported that perceived price and quality had no effect on consumers' intention to purchase Toyota but had an effect on their intention to purchase Daihatsu.

Some studies have focused on product appearance. Forslund and Söderberg (2008) conducted a case study at a Swedish car manufacturer and reported that aesthetic requirements prevented visible geometrical deviations from negatively impacting customers' evaluations of cars. Wua, Liao, and Chatwuthikrai (2014) used conjoint analysis to identify features impacting on Thai consumers' intention to purchase compact-class vehicles. They found that purchase intention was most affected by

vehicle appearance, followed by fuel efficiency, price, reliability, power, and accessory.

Stylidis, Wizkman, and Söderberg (2019) focused on relative vehicle quality importance levels and identified eight assessment dimensions to determine perceived quality for cars. Appearance quality is the section/edge, surface/edge quality, etc. Joining quality is the quality of blended and separable joints and adhesives. Geometrical quality is the harmony between visible components. Illumination quality is the interior and exterior illumination for visual operations. Material quality is the quality of materials used in a vehicle. Paint quality is the quality of color, paint execution, and surface finish. Olfactory quality is the quality of the interior smell intensity and signature. Solidity is the force feedback and coordination. Sound quality is the quality of the interior audio environment.

Li, Wang, and Fu (2016) proposed alternative methods for quality control in the production process of vehicle engine blocks. Coelho and Dahlman (2000) investigated the comfort and functionality quality of automobile seats.

### 3. Research Method

The primary objective of this study was to develop a scale regarding quality dimensions for automobiles (cars and light commercial vehicles). A preliminary questionnaire consisting of the eight dimensions of product quality as well as price, eco-friendliness, user-friendliness, and comfort dimensions was developed based on a literature review. A pilot study was conducted, and a heterogenous (age, gender, and socioeconomic status) group of 35 car owners were interviewed. A 58-item scale was developed based on their feedback. The main sample consisted of 561 car owners in Kastamonu, Sinop, and Çankırı. Participants evaluated not only the fifty-eight items in order of importance but also their automobiles. They then checked the status of their automobiles against the level of importance they attributed to features. First, composite reliability and reliability were established. To that end, exploratory and confirmatory factor analyses were used. Demographic characteristics (Table 1) were determined before analysis.

#### 3.1. Demographic Characteristics

Table 1 shows the participants' demographic characteristics. Of participants, 205 were 26-35 years of age, 179 were 36-45 years of age, 69 were 18-25 years of age, and 108 were 46 years of age or older. One hundred and two participants were women, and one participant did not answer the question of gender. Of participants, 238 had a bachelor's degree, 179 a high-school degree, 62 a master's degree, 46 a college degree, and 42 a primary school degree. Three participants did not answer the question of education level.

**Table 1: Demographic Characteristics**

<b>Age</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
18-25	69	12,3	12,3
26-35	205	36,5	48,8
36-45	179	31,9	80,7
46 +	108	19,3	100,0
Total	561	100,0	
<b>Gender</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
Female	102	18,2	18,2
Male	458	81,6	100,0
Total	560	99,8	
Missing	1	,2	
Total	561	100,0	
<b>Education</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
Primary education	42	7,5	7,5
High School	170	30,3	38,0
College	46	8,2	46,2
License	238	42,4	88,9
Master and PhD	62	11,1	100,0
Total	558	99,5	
Missing	3	,5	
<b>Total</b>	<b>561</b>	<b>100,0</b>	

### 3.2. Composite Reliability and Reliability

First, an exploratory factor analysis (EFA) was performed to establish the composite reliability and reliability of the scale. Table 2 shows the results.

The scale items were loaded on nine factors; reliability (factor loading of 0.553 to 0.77), user-friendliness (factor loading of 0.412 to 0.649), serviceability (factor loading of 0.449 to 0.697), key features (factor loading of 0.465 to 0.649), high-endness (factor loading of 0.504 to 0.748), aesthetics (factor loading of 0.604 to 0.703), perceived quality (factor loading of 0.531 to 0.649), comfort (factor loading of 0.486 to 0.599), and price (factor loading of 0.726 to 0.740). The KMO value was 0.961, for which Bartlett's test result was significant (0.000), indicating that the sample size was large enough for factor analysis (Karagöz, 2016). The nine factors accounted for 62.319% of the total variance.

**Table 2: Exploratory Factor Analysis**

	Reliability	User-friendliness	Key Features	Serviceability	High-endness	Aesthetics	Perceived Quality	Comfort	Price
RL22	0,707								
RL24	0,695								
RL23	0,681								
RL25	0,679								
RL27	0,604								
RL20	0,592								
RL21	0,586								
RL19	0,577								
RL26	0,555								
RL28	0,553								
UF50		0,649							
UF49		0,645							
UF48		0,62							
UF53		0,559							
UF51		0,54							
UF54		0,539							
UF57		0,536							
UF55		0,526							
UF47		0,514							
UF46		0,508							
UF58		0,505							
UF39		0,412							
KF8			0,649						
KF4			0,627						
KF9			0,619						
KF7			0,616						
KF3			0,609						
KF5			0,604						
KF1			0,595						
KF2			0,57						
KF6			0,558						
KF10			0,519						
KF11			0,465						
SA34				0,697					
SA33				0,688					
SA32				0,606					
SA31				0,593					
SA30				0,496					
SA29				0,449					

HE16	0,748	
HE17	0,713	
HE18	0,707	
HE56	0,504	
AES36		0,703
AES37		0,636
AES38		0,62
AES35		0,604
PQ40		0,649
PQ42		0,638
PQ52		0,581
PQ41		0,552
PQ43		0,531
COM13		0,599
COM15		0,559
COM12		0,55
COM14		0,486
PRC45		0,74
PRC44		0,726

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KMO: ,961 Ki square: 21224,694 df: 1653 sig: ,000 Total explained variance: % 62,319

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Following EFA, a first-order (Figure 1) and second-order (Figure 2) confirmatory factor analysis (CFA) was performed.

Figure 1: First-Order Confirmatory Factor Analysis Diagram

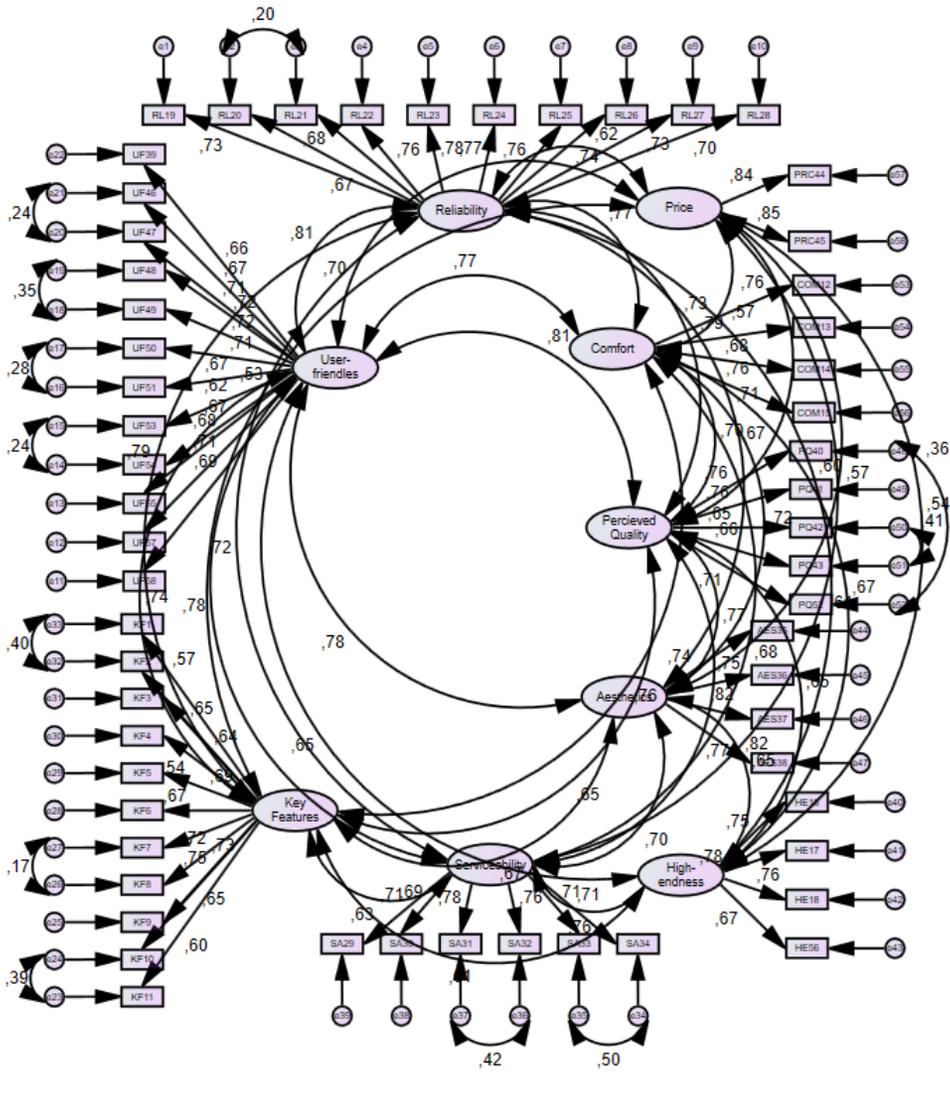
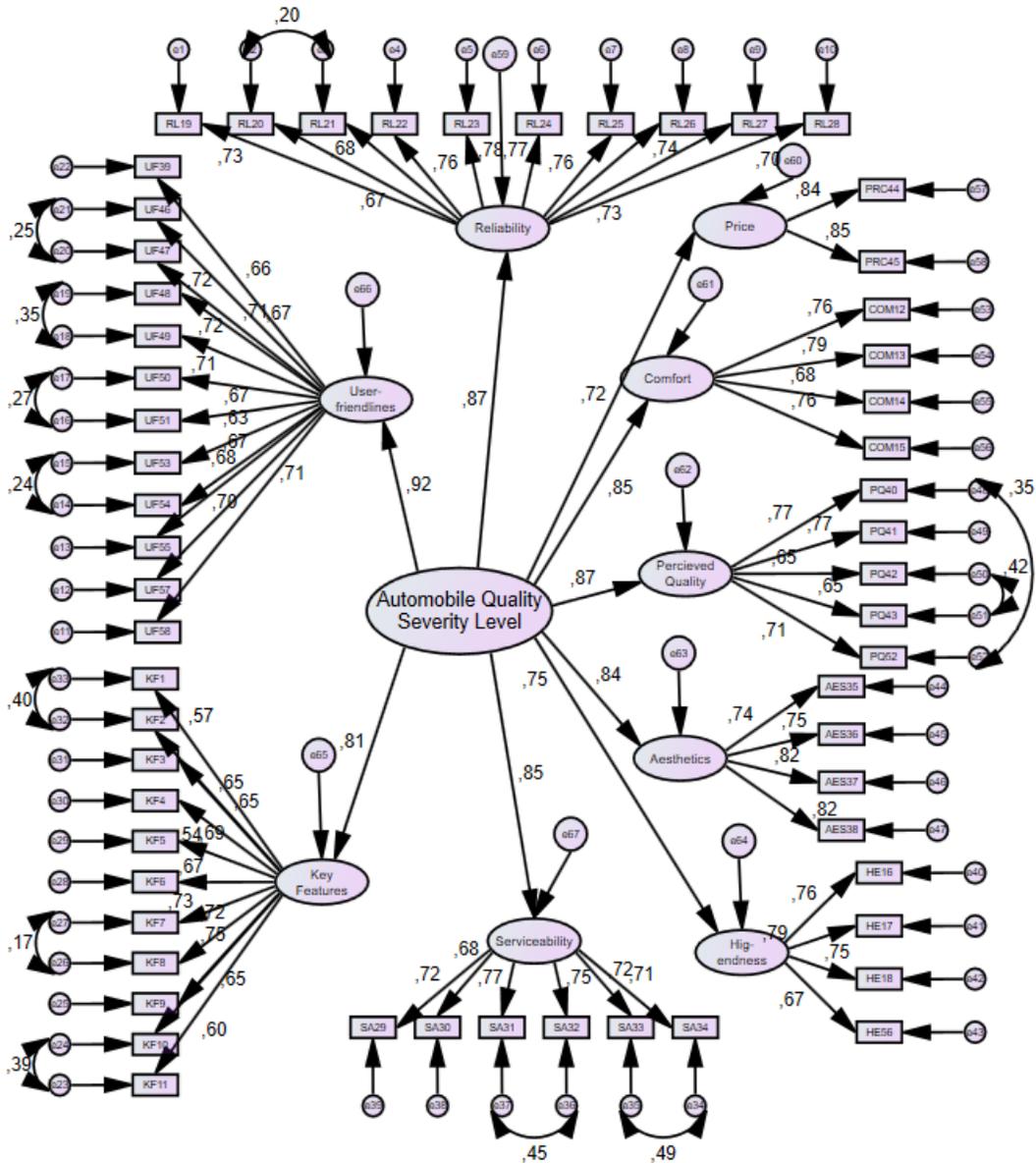


Figure 2: Second-Order Confirmatory Factor Analysis Diagram



The second-order CFA results showed that vehicle quality was most affected by user-friendliness, followed by reliability, perceived quality, comfort, serviceability, aesthetics, key features and price.

Table 3 shows the CFA goodness of fit values for the scale.

**Table 3: Confirmatory Factor Analysis Goodness of Fit Values**

Variable	$\chi^2$	df	$\chi^2/df$	CFI	SRMR	RMSEA
Criterion			$\leq 5$	$\geq 90$	$\leq 08$	$\leq 08$
Vehicle quality First-Order	3508,734	1532	2,29	0,903	0,0416	0,048
Vehicle quality Second-Order	3539,401	1556	2,275	0,903	0,0434	0,048

The scale had a CMIN/DF, CFI, SRMR, and RMSEA value of 2.29 ( $<5$ ), 0.903 ( $>0.90$ ), 0.0416 ( $<0.08$ ), and 0.048 ( $<0.08$ ), respectively, indicating that the scale met the acceptable criteria of goodness of fit (Aksu et al., 2017; Özdamar, 2016).

Table 4 shows the CFA factor loadings and average variance extracted (AVE) and composite reliability (CR) values.

**Table 4: Confirmatory Factor Analysis Factor Loadings**

Level of Importance	Factor Loading	AVE	CR
<b>Reliability</b>			
Item 19: I can/should be able to shift gears easily.	0,728		
Item 20: A car should not/my car does not break down too often.	0,668		
Item 21: I should be able to drive a car/have been able to drive my car for a long time.	0,68		
Item 22: A car engine should have/my car has a long life.	0,762		
Item 23: A car should have/my car has a solid hood.	0,782	0,536	0,920
Item 24: A car should have/my car has good braking distance.	0,768		
Item 25: A car should have/my car has a high grip.	0,759		
Item 26: A car should have/my car has a strong lighting system.	0,738		
Item 27: A car should have/my car has enough airbags.	0,731		
Item 28: A car should have/my car has a good hill start.	0,696		
<b>User-friendliness</b>			
Item 58: A car should not/my car does not lose traction even when it is fully loaded.	0,695		
Item 57: Car-size should meet/my car meets my expectations.	0,711		
Item 55: A car should be/my car is easy to park.	0,678		
Item 54: A car should have/my car has a widespread service network.	0,67		
Item 53: Car parts should be/my car's parts are affordable.	0,625	0,473	0,915
Item 51: A car should have/my car has an easy-to-use trunk.	0,673		
Item 50: A car should have/my car has a wide field of vision.	0,713		
Item 49: A car should be/my car is easy to get in and out of.	0,718		
Item 48: A car should be/my car is easy to clean.	0,72		
Item 47: A car should not/my car does not lose its value over the years.	0,712		
Item 46: A car should not be/my car is not expensive to maintain.	0,671		
Item 39: A car should have/my car has enough ground clearance.	0,664		
<b>Key Features</b>			
Item 11: A car should have/my car has excellent upholstery.	0,602		
Item 10: A car should not/my car does not have manufacturing defects.	0,654		
Item 9: A car should not lose/my car has not lost its grip over the years.	0,75		
Item 8: A car should not lose/my car has not lost its comfort over the years.	0,721	0,435	0,893
Item 7: A car should not lose/my car has not lost its traction over the years.	0,733		

<i>Item 6: A car should have/my car has a good suspension system.</i>	0,673		
<i>Item 5: A car should have/my car has comfortable seats.</i>	0,688		
<i>Item 4: A car should consume/my car consumes little fuel.</i>	0,54		
<i>Item 3: A car should allow/my car allows for a smooth ride even at full capacity.</i>	0,64		
<i>Item 2: A car should be able to /my car can climb the slopes easily.</i>	0,655		
<i>Item 1: A car should have/my car has good throttle response.</i>	0,571		
<b>Serviceability</b>			
<i>Item 34: Car parts should be/my car's parts are readily available.</i>	0,706		
<i>Item 33: A car should have/my car has affordable out-of-warranty service and repair options.</i>	0,708		
<i>Item 32: A car should have/my car has a warranty that provides coverage for a wide range of problems.</i>	0,764	0,529	0,870
<i>Item 31: A car should have/my car has a long warranty.</i>	0,782		
<i>Item 30: The car firm should promote the car well.</i>	0,688		
<i>Item 29: The seller should provide/my car offered appropriate purchase conditions (installments, loans, etc.).</i>	0,715		
<b>High-endness</b>			
<i>Item 16: A car should have/my car has a user-friendly navigation system.</i>	0,755		
<i>Item 17: A car should have/my car has a good rearview camera.</i>	0,783	0,550	0,830
<i>Item 18: Seats of a car should have/the seats of my car have extra systems (electric, heating, cooling, etc.).</i>	0,757		
<i>Item 56: A car should have/my car has high-end exterior features (steel rim, sunroof, etc.).</i>	0,67		
<b>Aesthetics</b>			
<i>Item 35: A car should have/my car has a nice exterior.</i>	0,742		
<i>Item 36: A car should have/my car has a nice color.</i>	0,747		
<i>Item 37: A car should have/my car has aesthetically pleasing upholstery.</i>	0,821	0,614	0,864
<i>Item 38: A car should have/my car has an aesthetically pleasing control panel.</i>	0,822		
<b>Perceived Quality</b>			
<i>Item 40: A car should be/my car is known for its high-quality.</i>	0,763		
<i>Item 41: I should know that I am buying a high-quality car/I have a high-quality car.</i>	0,765		
<i>Item 42: A car should have/my car has low carbon emissions.</i>	0,653	0,505	0,835
<i>Item 43: A car should have/my car has brake pads made of eco-friendly material.</i>	0,658		
<i>Item 52: A car should have/my car has high brand prestige.</i>	0,707		
<b>Comfort</b>			
<i>Item 12: A car should have/my car has good sound insulation.</i>	0,759		
<i>Item 13: A car should have/my car has a user-friendly console panel.</i>	0,789	0,556	0,833
<i>Item 14: A car should have/my car has a good air conditioning system.</i>	0,676		
<i>Item 15: A car should have/my car has a powerful media/audio system.</i>	0,756		
<b>Price</b>			
<i>Item 44: The car I would like to buy should be cheaper than its counterparts/my car is cheaper than its counterparts.</i>	0,842		
<i>Item 45: A car should have/my car has a high price-performance ratio.</i>	0,847	0,713	0,832

The reliability items had a factor loading of 0.668 to 0.782. The user-friendliness items had a factor loading of 0.625 to 0.718. The key features items had a factor loading of 0.54 to 0.75. The serviceability items had a factor loading of 0.688 to 0.782. The high-endness items had a factor loading of 0.67 to 0.783. The aesthetics items had a factor loading of 0.742 to 0.822. The perceived quality items had a factor loading of 0.653 to 0.765. The comfort items had a factor loading of 0.676 to 0.789. The price items had a factor loading of 0.842 to 0.847. All dimensions had a

factor loading greater than 0.50. Moreover, the scale had a CR and AVE of 0.983 (>0.70) and 0.514 (>0.50), respectively, indicating that the scale satisfied component reliability.

Reliability was assessed following EFA and CFA. Table 5 shows the results.

**Table 5: Reliability Analysis**

Dimensions	Cronbach's Alpha	Number of Items
Reliability	,920	10
User-friendliness	,917	12
Key Features	,896	11
Serviceability	,882	6
High-endness	,827	4
Aesthetics	,864	4
Perceived Quality	,850	5
Comfort	,830	4
Price	,833	2

All dimensions had a Cronbach's alpha greater than 0.80, indicating that the variables were reliable.

Correlation analysis was performed to determine the relationship between the dimensions. Table 6 shows the results.

**Table 6: Correlation Analysis**

	Mean	Std. Dev.	Reliability	User-friendliness	Key features	Serviceability	High-endness	Aesthetics	Perceived Quality	Comfort	Price
Reliability	4,5150	,58550	1								
User-friendliness	4,3887	,61927	,739**	1							
Key Features	4,3844	,57332	,713**	,661**	1						
Serviceability	4,2614	,79225	,643**	,691**	,538**	1					
High-endness	4,0276	,96172	,534**	,575**	,520**	,638**	1				
Aesthetics	4,0334	,80102	,301**	,321**	,259**	,264**	,193**	1			
Perceived Quality	4,2966	,71495	,620**	,691**	,546**	,649**	,549**	,268**	1		
Comfort	4,3213	,67994	,681**	,668**	,659**	,581**	,575**	,279**	,579**	1	
Price	4,3734	,76475	,545**	,609**	,462**	,507**	,459**	,238**	,550**	,475**	1

The variables were positively correlated ( $p < 0.01$ ). The reliability and aesthetics dimensions had the highest and lowest values, respectively.

### 3.3.Results

This section focused on differences between participants' AVE and CR values in all dimensions. Table 7 shows the results.

**Table 7: Analysis of Average Variance Extracted and Composite Reliability**

Items	Current Vehicle Status	Importance	Score	Dimension	Dimension Score
RL19/O19	4,140	4,501	<b>-0,361</b>	Reliability	-0,4885
RL20/O20	4,083	4,540	-0,457		
RL21/O21	4,115	4,513	-0,399		
RL22/O22	4,124	4,560	-0,436		
RL23/O23	3,941	4,485	-0,544		
RL24/O24	3,998	4,563	-0,565		
RL25/Ö25	4,030	4,551	-0,520		
RL26/Ö26	4,030	4,465	-0,435		
RL27/Ö27	3,882	4,501	<b>-0,619</b>		
RL28/Ö28	3,921	4,471	-0,549		
UF39/Ö39	4,052	4,421	-0,369		
UF46/Ö46	3,776	4,362	-0,585		
UF47/Ö47	3,868	4,376	-0,508		
UF48/Ö48	4,088	4,310	-0,223		
UF49/Ö49	4,168	4,383	<b>-0,215</b>	User-friendliness	-0,3729
UF50/Ö50	4,152	4,424	-0,273		
UF51/O51	4,129	4,414	-0,284		
UF53/O53	3,836	4,332	-0,496		
UF54/O54	4,046	4,449	-0,403		
UF55/O55	4,218	4,446	-0,227		
UF57/O57	4,103	4,378	-0,275		
UF58/O58	3,754	4,371	<b>-0,617</b>		
KF1/O1	4,104	4,428	-0,324		
KF2/O2	4,020	4,421	-0,401		
KF3/O3	3,942	4,337	-0,394	Key Features	-0,4211
KF4/O4	3,971	4,458	-0,487		
KF5/O5	3,996	4,349	-0,353		
KF6/O6	3,905	4,376	-0,471		
KF7/O7	3,815	4,332	<b>-0,517</b>		
KF8/O8	3,819	4,335	-0,516		
KF9/O9	3,932	4,380	-0,448		
KF10/O10	4,045	4,458	-0,413		
KF11/O11	4,047	4,355	<b>-0,308</b>	Serviceability	-0,5921
SA29/O29	3,749	4,269	-0,520		
SA30/O30	3,666	4,144	-0,478		
SA31/O31	3,482	4,219	-0,737		
SA32/O32	3,441	4,237	<b>-0,796</b>		
SA33/O33	3,641	4,303	-0,662		
SA34/O34	4,036	4,396	<b>-0,360</b>		
HE16/O16	3,064	4,039	<b>-0,976</b>	High-endine ss	-0,823
HE17/O17	3,148	4,059	-0,911		
HE18/O18	3,013	3,872	-0,859		

HE56/O56	3,595	4,141	<b>-0,546</b>	Aesthetics	<b>-0,3065</b>
AES35/O35	4,082	4,408	-0,326		
AES36/O36	4,176	4,362	<b>-0,185</b>		
AES37/O37	3,900	4,282	<b>-0,381</b>		
AES38/O38	3,975	4,308	-0,333		
PQ40/O40	3,945	4,292	-0,348	Perceived Quality	<b>-0,3636</b>
PQ41/O41	4,064	4,365	-0,301		
PQ42/O42	3,922	4,294	-0,373		
PQ43/O43	3,701	4,212	<b>-0,512</b>		
PQ52/O52	4,034	4,319	<b>-0,285</b>		
COM12/O12	3,789	4,348	<b>-0,559</b>	Comfort	<b>-0,464</b>
COM13/O13	3,970	4,373	<b>-0,403</b>		
COM14/O14	3,946	4,380	-0,433		
COM15/O15	3,725	4,185	-0,461		
PRC44/O44	3,914	4,380	<b>-0,466</b>		
PRC45/O45	3,984	4,367	<b>-0,383</b>	Price	<b>-0,4245</b>

As for the reliability dimension, the difference between vehicle quality importance level and current vehicle status was greatest in the item “A car should have/my car has enough airbags” and smallest in the item “I can/should be able to shift gears easily.” Result shows that users find the number of airbags in their cars inadequate.

As for the user-friendliness dimension, the difference between vehicle quality importance level and current vehicle status was greatest in the item “A car should not/my car does not lose traction even when it is fully loaded” and smallest in the item “A car should be/my car is easy to get in and out of.” This result shows that users are dissatisfied with the traction capacity of their cars when fully loaded.

As for the key features dimension, the difference between vehicle quality importance level and current vehicle status was greatest in the item “A car should not lose/my car has not lost its traction over the years” and smallest in the item “A car should have/my car has excellent upholstery.” This result shows that users are unhappy with their cars losing traction over the years.

As for the serviceability dimension, the difference between vehicle quality importance level and current vehicle status was greatest in the item “A car should have/my car has a warranty that provides coverage for a wide range of problems” and smallest in the item “Car parts should be/my car’s parts are readily available.” Result shows that users are displeased about the fact that they have a limited warranty.

As for the high-endness dimension, the difference between vehicle quality importance level and current vehicle status was greatest in the item “A car should have/my car has a user-friendly navigation system” and smallest in the item “A car should have/my car has high-end exterior features (steel rim, sunroof, etc.).” This result shows that users find the navigation systems in their cars useless.

As for the aesthetics dimension, the difference between vehicle quality importance level and current vehicle status was greatest in the item “A car should have/my car

has aesthetically pleasing upholstery” and smallest in the item “A car should have/my car has a nice color.” This result shows that users are mostly unhappy with the upholstery of their cars.

As for the perceived dimension, the difference between vehicle quality importance level and current vehicle status was greatest in the item “A car should have/my car has brake pads made of eco-friendly material” and smallest in the item “A car should have/my car has high brand prestige.” This result shows that users think that their cars have brake pads made of environmentally harmful material.

As for the comfort dimension, the difference between vehicle quality importance level and current vehicle status was greatest in the item “A car should have/my car has good sound insulation” and smallest in the item “A car should have/my car has a user-friendly console panel.” This result shows that users are unhappy with the sound insulation of their cars.

As for the price dimension, the difference between vehicle quality importance level and current vehicle status was greatest in the item “The car I would like to buy should be cheaper than its counterparts/my car is cheaper than its counterparts” and smallest in the item “A car should have/my car has a high price-performance ratio.” Result shows that users think that their cars are more expensive than their counterparts in the market.

As for all dimensions, the difference between vehicle quality importance level and current vehicle status was greatest in high-endness, followed by serviceability, reliability, comfort, price, performance, user-friendliness, perceived quality, and aesthetics. This result indicates that users are unhappy about their cars lacking high-end features.

#### 4. Conclusion

The primary objective of this study was to develop a scale for the quality dimensions of automobiles (cars and light commercial vehicles). To that end, a 58-item scale was developed. The scale addressed the eight dimensions of product quality as well as price, eco-friendliness, user-friendliness, and comfort dimensions. Car owners (n = 561) were asked to evaluate not only the fifty-eight items in order of importance but also their cars in terms of them. The two evaluations were compared to identify unmet quality features. The composite reliability and reliability of the scale were established using EFA, CFA, and reliability tests. The factor results revealed a nine-factor structure; reliability, user-friendliness, serviceability, performance, high-endness, aesthetics, perceived quality, comfort, and price. The items on performance, conformance quality, and interior high-endness were loaded on one factor named as “performance.” This trend showed that those items were related

to the expectations that automobile owners wanted to be met in terms of quality in general. The items on reliability high-endness and performance consistency were also loaded on one factor. The results showed that participants considered all features on the scale to be important.

The greatest difference between vehicle quality importance level and current vehicle status was in the item “A car should have/my car has enough airbags” in the reliability dimension, “A car should not/my car does not lose traction even when it is fully loaded” in the user-friendliness dimension, “A car should not lose/my car has not lost its traction over the years” in the key features dimension, “A car should have/my car has a warranty that provides coverage for a wide range of problems” in the serviceability dimension, “A car should have/my car has a user-friendly navigation system” in the high-endness dimension, “A car should have/my car has aesthetically pleasing upholstery” in the aesthetics dimension, “A car should have/my car has brake pads made of eco-friendly material” in the perceived quality dimension, “A car should have/my car has good sound insulation” in the comfort dimension, and “The car I would like to buy should be cheaper than its counterparts/my car is cheaper than its counterparts” in the price dimension. All in all, automobile owners find the number of airbags and the navigation systems inadequate; think that they paid more for their cars than they should have and that the brake pads of their cars are made of environmentally harmful materials; they are also unhappy with the sound insulation, upholstery, and traction capacity (when fully loaded) of their cars and with the fact that their cars have a limited warranty and have lost traction over the years.

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