

## Assessment of Consumers' Satisfaction with the Automotive Product Quality

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### ABSTRACT

Relevance of article is caused by the fact that customers satisfaction currently serves as the mechanism allowing the carmakers to be competitive in the market. The paper describes issues of assessment of the quality of products manufactured by automobile companies. The assessment is based on widely applicable complex characteristics of the quality. The obtained values of the quality index with the price criterion can be used at all stages of the automotive manufacture as well as of the price-quality ratio which completes the process of decision-making on car purchase. Materials of article represent the practical importance, results of a research can be used by automobile companies in development of strategy of product quality improvement.

### KEYWORDS

Product quality, quality levels, automotive industry, consumer satisfaction, satisfaction score

### ARTICLE HISTORY

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## Introduction

Currently the global market presents many different cars by well-known carmakers such as: Toyota Motors, Volkswagen, General Motors, Daimler, Ford Motors, Honda Motors, Nissan Motors, Hyundai Motors, BMW, Peugeot. In order to maintain their products on the market, the companies have to conduct complex studies of their brand quality, in particular, reliability, comfort, durability, etc. Based on the research results, the automobile companies annually develop new strategic and operational goals on improvement of their product quality and reliability for next three to five years.

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The product quality analysis is known to be based on the data obtained during advanced marketing studies of customers' satisfaction. Following the obtained data, in particular, car rates by reliability are monitored, as well as complaints on characteristics of design, comfort, functionality, etc. The automakers' marketers receive the data based on the subjective perception of the products through a consumer, which greatly depend on an individual's features and requirements to their automotive product.

The higher the customers' requirements to the product characteristics, the less chance the automakers have to satisfy them. Also, it should be emphasized that the customer's confidence in the company and the brand plays an important role – the greater confidence level assumes the higher assessment of the products and the greater customer's satisfaction (Durczak, 2011; Sadovnikova 2016).

Therefore, the paper is believed to be relevant because customers satisfaction currently serves as the mechanism allowing the carmakers to be competitive in the market.

### Literature Review

The concept of the quality became deeper while science was developing. Many scientists in Ukraine, CIS countries, USA, Europe contributed to creation and development of modern quality systems.

All management theories for the recent years establish linkage between the efficiency on the market and the fact that the company is supposed to set as its strategy priority a consumer and its satisfaction of driving a car, purchased from the automaker through a dealer network, as well as satisfaction with after-sale service. The other group of researchers adduced a survey of independent autodealer's satisfaction by car brands (Independent automobile dealer satisfaction survey, 2009).

Besides, many researchers consider interaction between a client, service and the product quality with customer's satisfaction and loyalty to representative of the automotive industry (Asghar, 2011). Consumers' preferences for quality, such as emission levels, fuel consumption per kilometer per liter have also been studied by other researchers (Dean, 2007).

Also, an interesting analysis is presented by the third group of researches exploring the relationship of customer service and business opportunities for auto sale centers. The authors prove the impact of the service on the purchase and return for repeat purchase (Aaker, Shanby, 2007; Jahanshahi & Afshar, 2010).

Design and assembly of a car is a complex task to be performed within shorter time if the studied demand for certain car models is available, as buyers' requirements for reliability, durability, and comfort are getting higher every year.

To cope with these conflicting constraints, it's necessary to apply tools, to simplify the analysis of the data obtained at all stages of the car development. For this purpose, the fourth group of scientists described methods for solving the tasks of modeling of a quality competitive car at the stage of development, manufacture, and planning, as well as of service and maintenance (David, 2009; Pitts, Lei, 2003; Springdal, 2012; Steinbrecher & Moewes, 2010).

Not all car buyers would return to purchase again, the research authors assert. Repeat purchases can be defined as a positive reaction to the brand (i.e. behavioral loyalty) and automatism caused by and associated with a contextual tip (for example, habit).

The authors offer diagnostic tools to distinguish between two kinds of repeat purchases, and examine how they affect the consumers' reaction and sale of automakers' shares. This study deepens understanding of the causes of changes in automakers' share sales, and provides important management ideas for development of effective sales to regular customers (Dixon, Hopkins, Mador, Matthews, 2011; Levitt, 1981; Liu-Thompkins, 2010; Louw, Venter, 2006; Steiner, 2001).

Thus a potential buyer creates an own template, considering own requirements to the products, in particular to operating characteristics and design. When driving, a buyer compares own expectations to reality, and on this basis concludes on own satisfaction. When characteristics correspond to expected, the consumer is satisfied. According to W. Schneider (2014), the quality perception can be considered as a multifactorial phenomenon, which can be divided into three stages:

- before purchase;
- during purchase and sale;
- after purchase, after-sale service at network of dealerships and unincorporated service stations.

All the points of intersection of these stages can affect the customer satisfaction level - to increase or decrease it. It is therefore important so that the "customer focus" would be one of the priorities at the automobile enterprises and known, obvious and applied by all employees.

Opinion of different researchers and scientists on customer satisfaction and service quality has been studied by the authors (Peng-Chan et al., 2015), considering the four main variables of perceived quality (PQ), service quality (SQ), customer satisfaction (CS), customer loyalty (CL). The primary analysis was performed using SPSS 16.0 package and included the multifactor analysis of variance, reliability, accuracy of the proper analysis. A statistical analysis in a software environment was first performed for the study of the influence of demographic characteristics of four main variables PQ, SQ, CS. The analysis shows that users of different brands of sedans have significant differences of customer satisfaction in all four variables.

Representatives of the fifth group of researchers (Vinodini & Umarani, 2014) studied clients' ideas and expectations to improve the dealer's efficiency, and to find discontents and to find out a way to eliminate them. This survey helps to determine the level of customer satisfaction after the sale, service, and overall satisfaction.

Analysis of customer satisfaction brings significant advantages to the enterprise, namely:

- Determination of the most important for the buyer product properties allows to use them for ads, avoiding the costs for benefits insignificant for the consumer;
- It helps to accurately assess the market positions;

— It reveals opportunities to improve, first and foremost, the quality of product and processes, identifying improvement priorities.

Thus, we can say that currently assessment of customer satisfaction is considered to be the mechanism allowing automakers to be competitive in the market.

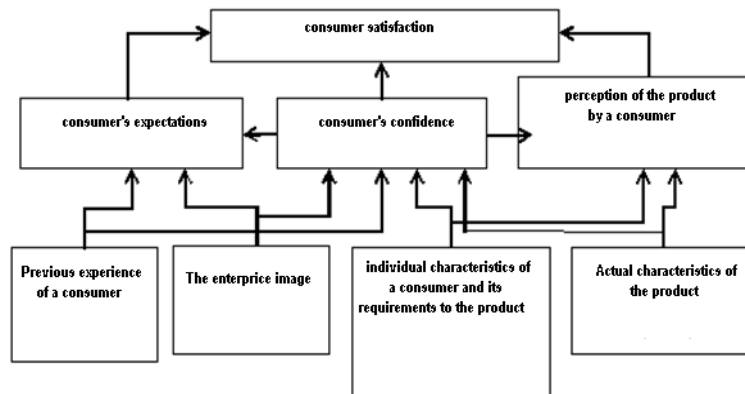
Today, customer satisfaction is assessed by several methods, for example:

- Methods aimed at unsatisfied consumers: complaints and suggestions, the guarantee workshops' data;
- Questionnaire methods: questionnaire "importance-compliance", CSI - Customer satisfaction index;
- Commissioned studies.

However, they do not allow full estimation of the quality of automotive products because of its comprehensiveness and diversity. In this regard, we attempted to develop a methodology for the study and evaluation of customer satisfaction with automotive products, which would allow the maximum evaluation of the quality, taking into account as many influencing factors as possible.

### ***Approaches used in development of the methodology for customer satisfaction assessment***

Currently, the customer satisfaction is affected by various factors, the number and variety of which is steadily increasing. Therefore, for ease perception and evaluation, the most important factors can be represented by the scheme (Fig. 1), demonstrating that before buying, a consumer forms own expectations for automotive products.



**Figure 1.** Factors affecting satisfaction of the carmaker's consumers

An analysis of the existing methods and approaches to evaluation of customer satisfaction showed that the most interesting are theoretically approaches of J.J. Lambin (2008), A. Parasuraman, L.L. Berry & V.A. Zeithaml (1985), E. Juan (2010). Customer satisfaction was evaluated by the five-point Likert scale, the Gap model, R. Kolman's (2009) scale, the method of complex research of integrated indicators of customer satisfaction. They allowed to form six phases of the evaluation of customer satisfaction, namely:

1 – determination of the survey goal; in particular – detection of critical indicators, entailing a decrease in demand for products; revealing of customers' expectations, essential for keeping market positions, separation of clients by values and so on;

2 – creation and ranking of the main indicators principal both for the manufacturer and for the consumer, and allowing to get answers to the set the survey goal;

3 – preparation of databases of companies-respondents;

4 – development of survey questions, of the rating scale;

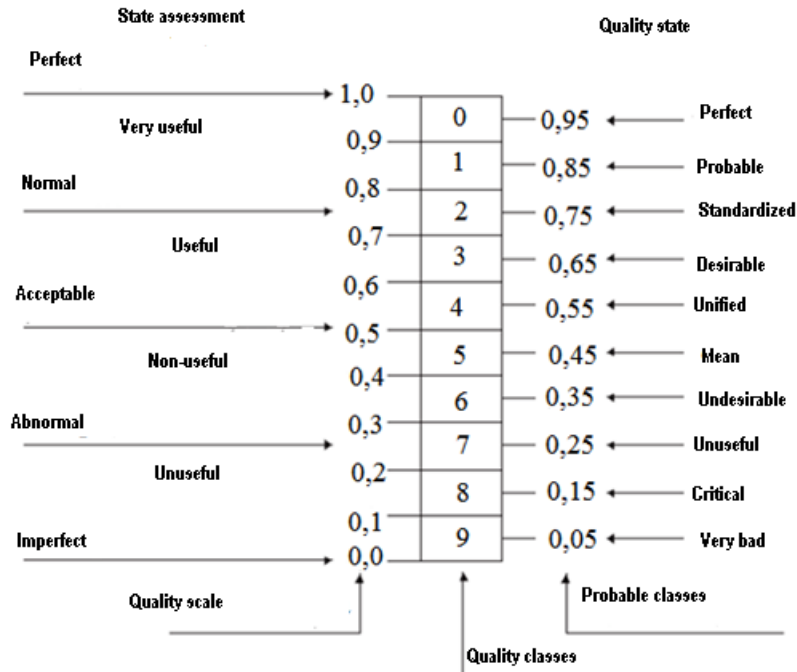
5 – distribution of surveys by fax or e-mail to the companies-respondents, while their routing is clearly tracked.

6 – evaluation of the collected survey data of consumers' satisfaction with the product quality and service level.

In order to increase the respondents' motivation to fill questionnaires and to arrange feedback from consumers, the results of each survey should be followed by written notices of the events developed and to be executed on the basis of the received survey data (Kolman, 2009).

The most promising approach to this issue is to use along with a quantitative assessment of satisfaction, its qualitative analysis. Thus a questionnaire of customer satisfaction, realizing the function of forming buyers' opinion on the car quality and reliability, is supposed to provide the consumer with a possibility to express own opinions on car driving problems and wishes of the automaker. Of course, this significantly increases the complexity of processing survey data. But we should not forget that the product competitiveness depends not only on how reliably and completely "view of the consumer" is measured but also on how well it is considered at the company's current and future activities.

As mentioned above, R. Kolman's (2009) scale (Fig. 2) was applied to assess the quality of cars. This multi-criteria method allows to accurately calculate the quality indicators.



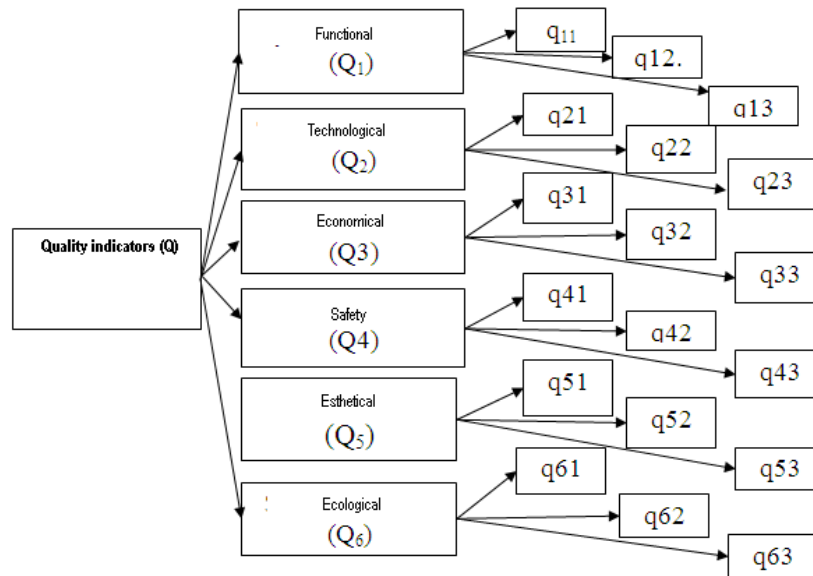
**Figure 2.** The universal R. Kolman's (2009) scale for assessing quality state

However, the quality represented in digital form can be only an intermediate stage in the decision-making process, for example, to buy a car. Thus the objective, efficient and versatile methodology should be applied to estimate the car quality that allows to determine the complex quality indicator with values in the range [0;1] based on the weight values of the measured characteristics.

R. Kolman (2009) measured the quality in the range from [0;1] and asserted that among unlimited possibilities of the choice of any number for variations in the reference quality state, 1 is best matching as allows to interpret the limit final value of a degree of quality perfection.

### ***The methods used in the development of the methodology for customer satisfaction assessment***

Based on the R. Kolman's (2009) scale, an hierarchical structure of criteria of the automotive product quality can be built, consisting of several levels  $Q_i$  (where  $i = 1, 2 \dots n$  - number of the quality criterion), which in turn, can be divided into sublevels consisting of basic and additional criteria of the quality  $q_{ij}$  ( $j = 1, 2 \dots m$  - number of the sublevel). This structure is shown in Fig. 3.



**Figure 3.** The structure of the car quality criteria

An algorithm of the identification of the car quality (Fig. 3) should have the mathematical apparatus that allows to rank all the criteria, characterizing the car quality in the form of absolute and relative indicators with the tools used in quality engineering.

The final result of the algorithm application is to bring the product quality as a number in the interval  $[0;1]$ . Zero means that hypothetically there is a complete lack of quality, and unit - quality, satisfying one hundred percent of consumers' expectations.

Since the degree of satisfying the expectations which for certain features of cars deviates from consumers' expectations, the global quality of cars takes intermediate values between 0 and 1.

Determination of the product quality begins with the fact that the group of experts, referring to own experience, knowledge and intuition defines a number of basic criteria ( $Q_i$ ) and sub-criteria ( $q_{ij}$ ) and takes part in their ranking. Thus only those criteria inherent in cars are taken into account, and those values are highlighted which can not be considered as permanent and changing over time. The experts are also involved in the development of questionnaires and questions which later provided for car estimation by the users. Following the information from the questionnaires, on the basis of the developed algorithm, the global quality indicator is calculated.

Ratings of the individual experts to be controlled in terms of compliance. To test rate compliance, a coefficient CR is used, which characterizes what share of the market is accounted for a predetermined number of the largest manufacturers. Since the concept of "predetermined number" looks indefinitely, the abbreviation CR is added with the figure, showing number of the largest manufacturers discussed (Method of ranked criteria weights). Basically, the following indexes of concentration of quality indicators CR: CR2, CR3, CR4, CR5, CR8, CR10 are used. Actually the number of "the largest criteria groups" can

be any. Matrix of even comparisons (its number of rows equals the number of columns and equal  $n$ ) has a structure that allows to assess which of the factors is more important than others, and does not give a direct assessment of the importance of a particular criterion.

Therefore, to determine the balance of their factors (criteria of importance of the car quality factors) for criteria, the method of factors of the relative importance is used. This method is based on calculation of arithmetic (additive  $x$ ) or average geometrics (multiplicative) (Methods of the car quality assesment from the point of consumers' view).

There are relatively simple operational methods for determining the coefficients of the relative importance:

— Method of the direct numerical assessment (M1) when each expert should directly indicate the importance coefficients for the elements satisfying the condition of normalization;

— Method of the score assessment (M2), when each expert should evaluate in a given scale an element  $d_j \in D$   $j = 1, m$  in accordance with decreasing of their preference (for example,  $d_1 > d_2 > d_3 > \dots > d_m$ ). Thus a scale [0:100] is often selected, where the point 100 corresponds to the most preferred element;

— Method of relative frequencies of ranks (M3), when experts should strictly order sets of presenting elements. The elements of an ordered set are assigned numbers (inverse ranks), corresponding to the number of the dominant elements. Thus, the best element would have rank  $r - 1$  (it is better than anyone but itself), and the worst - rank 0;

— Method of pairwise comparison with gradations (M4), when experts should make paired comparisons of elements, guided by a predetermined scale of expression of preference.

The method of ranked weight coefficients for the criteria is, in fact, a special case of the method of weighted sums. It uses the same formula for calculating the rating, the expert ranks the criteria by importance - from most important to least important.

There are other methods of ranking their criteria:

1. The linear decrease of the law.
2. The exponential law.
3. The Zipf-Pareto law.
4. Predictive law.

The analysis of the law showed that the determined task can be solved by the predictive law, allowing to develop scientific substantiation forecasts of future consumers' preferences to the product quality. But there are no free parameters in this law, and the criterion  $W$  weight depends only on its number in the ranked list  $i$  and the total number of criteria  $m$  at this level. It is interesting that the first two criteria in this law always have equal weight:  $W_1 = W_2$ , decreasing with an increase  $n$ .

## Results

Upon analysis of customers' comments and their preferences, it was revealed that they most pay attention on certain quality criteria. In this regard, considering the specificity of the automotive industry, indicators of the global





QMR quality (Quality Management Representative) were included in the predictive law and the statement that the criteria always have different weight indicators. This is a new approach to the choice of weighting coefficients (Babenkova, 2010; Hadi, 2016). In this regard, the formula for calculation of the quality indicators is as follows:

$$W_i = \frac{i \cdot 2^{1-i}}{\sum_{i=1}^m i \cdot 2^{1-i}} \cdot K \quad (1)$$

$i$  - the number of the criterion in the ranked list;

$K$  - the importance criterion (to be defined for each criterion by the importance level) ;

$m$  – the total number of criteria in the given sublevel.

This formula does not contain a free parameter, the criteria weight depends on the value of the criterion for consumers in the ranked list  $i$  and the total number of the criteria in a given sublevel  $m$ .

The criteria, defined for the group of users of cars being studied, were assessed at the following stage by criteria using the method of ranked criteria weights.

The study subject was the cars from different manufacturers, but with the same parameters and in the same price category. For this purpose, the corresponding questionnaire was developed to be completed by potential buyers at different car dealers (Kosach, Siroklyn & Hadi, 2016). About 50 potential customers at auto shows in Kharkov and Zaporozhye were interviewed, namely:

1) In Kharkov:

— Vehicle Service Station Autocentre "Horizon" Branch PAT "Kharkiv-Avto" Vehicle Service Station No.2. Address: 5, Pyatihatskaya St, Kharkov;

— "Automotive Consulting Company" (Car Dealer VAZ Kharkov) at: 201B, Gagarina St, "Ovis" gas station, Kharkov;

— Car dealer "SAMAND" of "TASKO-Ukraine", 130/1, Moskovsky av, Kharkov;

— Car dealer "OOO Lada Ukraine", 247, Moskovsky av, Kharkov;

— Ltd. "Bogdan-Avto Kharkov", 256G, Moskovsky av, Kharkov.

2) In Zaporozhye:

— Autocenter "ANT VOSTOK", 8, Skladskaya;

— Autocentre of Progress Company "Grad Auto", 124, Kosmicheskaya;

— -Autocentre of Progress Company ("Grad Auto" Ltd), 124/1, Kosmicheskaya;

— Car supermarket "STAN AUTO", 8, Skladskaya.

A questionnaire of 2 sections with 20 questions was developed.

Followed by the questionnaire data analysis, a group of the most important characteristics was determined, significant for judgement about the product quality. The resulting list should be formed on the basis of customer satisfaction measurement.

Table 1 presents the criteria for assessing the car quality and their values by the survey data.

**Table 1.** Criteria for assessing the car quality

Symbol	Characteristic	Criteria and their values						
		Z1	Z2	Z3	Z4	Z5	Z6	Z7
K1	Price	0.21	0.19	0.21	0.18	0.19	0.1	0.21
K2	Convenience	0.1	0.16	0.13	0.15	0.15	0.13	0.18
K3	Brand recognizability	0.2	0.1	0.1	0.13	0.16	0.1	0.15
K4	Price of spare parts	0.2	0.1	0.12	0.16	0.11	0.13	0.18
K5	Fuel consumption	0.1	0.16	0.13	0.15	0.15	0.12	0.02
K6	Engine performance	0.19	0.15	0.14	0.18	0.1	0.06	0.08
K7	Carrying capacity	0.2	0.13	0.1	0.11	0.14	0.12	0.1
K8	Service	0.21	0.2	0.18	0.13	0.08	0.08	0.02
K9	Design	0.1	0.06	0.03	0.08	0.06	0.03	0.5
K10	Durability	0.22	0.19	0.17	0.15	0.16	0.06	0.04
K11	Car interior noise	0.18	0.16	0.13	0.18	0.3	0.04	0.05
K12	Noise in the internal combustion engine and gearbox during driving	0.19	0.16	0.13	0.15	0.4	0.05	0.06
K13	Quality of facial gaps	0.18	0.16	0.13	0.15	0.13	0.06	0.1
K15	Speed of the gearbox	0.21	0.18	0.13	0.16	0.06	0.06	0.04
K16	Decoration	0.16	0.16	0.13	0.17	0.08	0.04	0.19
K17	Suspension	0.19	0.15	0.13	0.18	0.15	0.09	0.06
K18	Frame	0.17	0.2	0.13	0.2	0.18	0.1	0.12
K19	Heating	0.13	0.16	0.13	0.12	0.15	0.04	0.14

Applying the values of the global QMR indicator to the R. Kolman (2009) quality scale, the values of the quality criteria can be defined. The quality criterion Z3 and ZJ, Z6 - an identifier, Z1 - profitability, Z2, Z5 and Z7 - convenience, Z4 - golden price-quality ratio. (Z - quality criterion, W - criterion weight, K - characteristic).

During quantification (division, reduction of quality to quantity) of the car quality, only particularities are considered (K1-K19). Measurable particularities can be evaluated by a scale according to the selection on the basis of the presented method of evaluation of the car quality.

The main factors were evaluated by two subject groups, functional (K2-K5, K14-K19), and technical particularities (K1, K6-K13). The values of the weighting factors for the criteria of the car quality assessment using the specialized additive method are shown in the graph in Fig. 4.

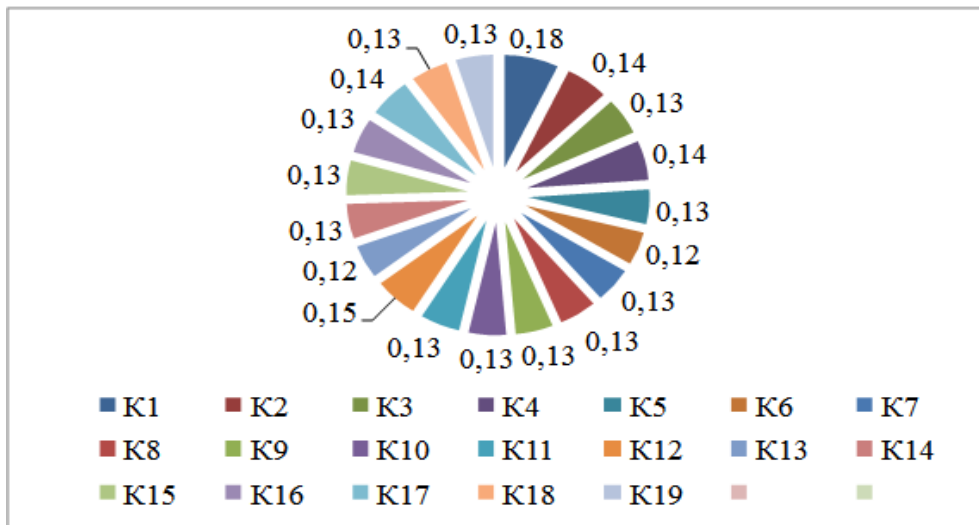


Figure 4. Weight of the criteria of the car quality assessment

K1 - Price; K2-Convenience; K3 - the brand recognizability; K4 – Spare parts price; K5 - Fuel consumption; K6 - Engine performance; K7 – Carrying Capacity; K8 - Service; K9 - Design; K10 - Durability; K11 - Car interior noise; K12 - Noise in the internal combustion engine and gearbox during driving; K13 - Quality of facial gaps; K14 - Speed of the gearbox; K15 - Decoration; K16 - Suspension; K17 - Frame; K18 - Heating; K19 - Material.

The numerical values of the quality index with the price criterion can be used at the following stages, taking into account the price-quality ratio that completes the decision-making on buying a car.

Figure 5 presents a graph of the price-quality ratio and the car power (axis - the price-quality ratio, this graph is constructed using an online graphing calculator).

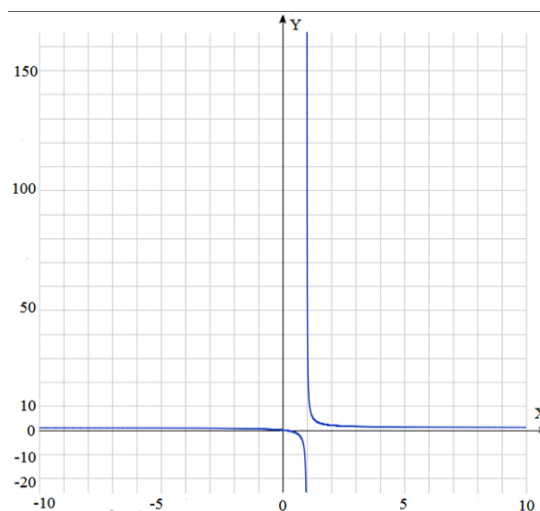


Figure 5. The graph of the ratio of the car price and power

According to Table 1 and Fig. 4, 5, the favorable offer by competitive price and good quality are cars by selected criteria Z5 and Z1, since the largest number of respondents determined that they considered these criteria to be the most important at buying a car.

### Discussion and Conclusion

Therefore, the analytical methods of the quantitative analysis for the quality calculation should be used to study the car quality, as well as to analyze important for a consumer main quality elements. Only an efficient, objective and universal method of quality assessment is required. Such one is described herein allowing to assess the car quality on the basis of accepted criteria sets.

The quality criterion Z3 and Z6 - identifier, Z1 - profitability, Z2, Z5 and Z7 – convenience, Z4 - the golden mean. Only the characteristics are considered (K1-K19) during quantifying the car quality. Measurable characteristics can be assessed by a scale in accordance with the selection on the basis of the provided method of the car quality assessment. The main factors were categorized into two subject groups - functional (K2-K5, K14-K19), and by technical particularities (K1, K6-K13).

The resulting numerical values of the quality index with the price criterion can be used at the subsequent stages, completing the process of decision-making to buy a car.

A huge number of quality assessment methods is revealed. The own algorithm of the car quality assessment has been developed. Car consumers have been interviewed. The consumers' preferences have been revealed and processed into the numerical results. These results can be considered to be reliable and devoid of subjectivity, if independent experts from the industry.

### Implications and Recommendations

The issues of assessment of the quality of products manufactured by automotive companies. It is based on evaluation of commonly used complex quality characteristics. The conducted studies have shown a huge number of quality assessment methods. All of them allowed to develop the own quality algorithm of the car quality assessment.

The quality assessment calculations resulted in the following conclusions:

1. The quantification assessment of quality as a decimal fraction in the range [0-1] of a final set of similar cars allows to evaluate the quality and, consequently, divide seemingly identical cars according to the quality criteria.
2. The assessment of the car quality allows, in turn, to determine the rating of the car in the form of the examination on the basis of a universal 10-step quality R. Kolman's (2009) scale.
3. The car quality is expressed in numbers within a scale from zero to one and allows to make the right decision about the quality.
4. Methods of the product quality assessment generally contain an heuristic stage where the knowledge and skills of the group of the well-chosen experts are used.

The results of these estimations can be considered as reliable and devoid of subjectivity, if made by independent experts from the industry. To assess the car quality, experts from universities, factories, service stations, car dealerships



with practical experience in engineering, or employees of research institutes should be involved.

### Disclosure statement

No potential conflict of interest was reported by the authors.

### Notes on contributors

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