Periodica Polytechnica
Transportation Engineering

47(1), pp. 44-50, 2019
https://doi.org/10.3311/PPtr.10547
Creative Commons Attribution

Quality and Competitive Ability Evaluation Method Development Mobile Fleet

Radik Ildarkhanov[1*]

RESEARCH ARTICLE

Received 27 January 2017; accepted 04 September 2017

Abstract

The purpose of the article was to develop the evaluation method of mobile fleet. It is found that to evaluate production quality criterion of "integrated quality coefficient" is needed. Quality coefficient can be defined analytically. The author proposes the special formula to do this. Usage of analytical formula enables to conclude where one model excels the other, and where it is inferior. The formula validity check was performed. The research activities pursued by author enable to conclude that designed formula gives opportunity to evaluate product quality level objectively. Thus, competitive ability evaluation method resolves itself into choosing estimated product analogues and defining product quality coefficient using analytical method. Subsequently, prices and analogous product quality coordinates are put on two-coordinate field and dependency diagram of product price on its quality is built via least square method. Such method enables to evaluate quality and competitive ability of mobile fleet and make right choice.

Keywords

quality evaluation, competitive ability, mobile fleet, international road transport

[1] Car Department, Naberezhnochelninsky Institute (bransh), Kazan Federal University, 423812, 10A, Syuyumbike ave., Naberezhnye Chelny, Russian Federation

[*] Corresponding author, e-mail: rfanis@mail.ru

1 Introduction

International road transport (IRT) market is one of the most rapidly developing in Russia. By 2013 international forwarding volume increased up to 33 million of tons. Road transport has gained considerable share according to cargo cost (Ildarkhanov, 2014; 2015). It made up 26% in commodity turnover. We can compare: railway service transports 29% of cargo in value terms, whereas according to volume data it transports several times bigger volumes. This means that generally high cost cargo needed fast door-to-door delivery is transported by road (Acosta et al., 2012). However, share of Russian automobile operating companies specializing in international freight transport (AOC IFT) doesn't exceed 40% of market volume due to low competitive ability. Only those companies can withstand competition, keep stable and increase transportation volumes which are capable to meet the clients' requirements to the fullest extent possible and offer services for the best prices (Kampf et al., 2012; Markovits-Somogyi et al., 2014).

Lack of home mobile fleet suitable for IRT is one of major reasons why competitive ability of Russian forwarders is so low (Ildarkhanov et al., 2015). International transport business has unified certification requirements to transport facilities (Borkowski et al., 2013; Hruška et al., 2013). These requirements serve as some sort of automotive equipment quality standard and base development of new international documents editions in IRT technical regulation.

AOC activity efficiency heavily depends on mobile fleet (Pagliara et al., 2017). Thus its selection procedure must be included in services quality management system of AOC IFT. Almost all transportation quality indices (speed, safety, reliability etc.) depend on mobile fleet technical economic characteristics and financial results (Fujimoto et al., 2014). Mobile fleet quality, in turn, is defined by many indices: durability, reliability, safety, economical efficiency, eco compatibility (Andrejszki et al., 2014; Török et al., 2014), acceleration capacity and etc. At AOC, depending on enterprise specialization (transportation regions and cargo range), mobile fleet evaluation methods based on quality factors must be developed.

Competitive ability is appreciated by the consumer property of the object which excels its analogs in quality and price performance at the moment in a specific segment of the market. Competitive ability determines the prosperity of the manufacturer who is interested in its achievement at the stages of development and production of goods and retention of the achieved level during other stages of the life cycle (Nelyubov, 2012). Due to this, the problem of measuring the competitive ability of products appears, because as of today there is neither common terminology, nor common methodology for its measurement, nor complex valuation measures for specific product groups (Pavlova, 2010).

The consumer characterizes market product by two criteria: quality and price. Quality and price are two interrelated categories inherent in any product. To measure competitive ability, it is sufficient to evaluate the quality and price of the product, and then compare them with similar values of competitors. The quality here refers to all the objective features of the product, including those associated with its service, utility, efficiency, etc.

The quality of the product is evident through its properties, which can be characterized qualitatively and quantitatively. The qualitative characteristics for the purpose of measurement must also be expressed in quantitative indicators of quality. Quality indicators quantitatively express the characteristics of the products that make up its quality during creating or consumption. The quality of the products is characterized by a set of indicators, but unfortunately, there is still no item and unified approaches to selection of quality indicators.

Scientist provides to characterize product competitive ability by four comprehensive indicators of the I^{th} level: quality, price, costs of the consumer and quality of service (Fathutdinov, 2000). But the consumer costs are products efficiency properties, and as it is known that the set of properties characterizes the quality. Therefore, costs in operation are indicators of the quality of the product, and there is no need to distinguish them as a separate group. Thus, competitive ability can be characterized by two complex parameters: the quality and price of the goods.

Researcher suggests characterizing product competitive ability by three main groups of indicators: usefulness; the cost of the consumers in meeting their needs in the process of using this product; marketing conditions (Taran, 1998). Scientist also offers regulatory, economic, technological competitive ability indicators. It is correct, but all of these groups of indicators, enumerated by the author, characterize nothing but the quality of the product. In addition, the author just "forgot" about the existence of the most important performance indicator of any product – its price.

A number of authors (Kolesov et al., 2000) consider that it is improper to include indicators of products efficiency in the composition of quality indicators, arguing that they express the value of its consumer properties. Yes, the price really expresses the value of consumer properties implemented in the product, but the efficiency is not limited only to price. Besides price, there are indicators of efficiency such as cost, complexity of manufacturing and maintenance operation, maintenance and repair, the payback period under certain conditions of operation, the specific costs per unit of any index assignment, etc., which are objective properties of a particular system, i.e. characterize the quality of the product. It is necessary to consider separately the quality and cost effectiveness, and the quality and price. This brief analysis shows the ambiguity of the approaches of different researchers to the issue of classification of indicators of competitiveness of products due to the complexity and diversity of the category of competitive ability, the difference between the approaches to its assessment on the part of producers and consumers. It should be noted that the goods are for the buyer, and he definitely appreciates it by the price and quality, therefore, classifying the indicators of competitive ability, you must consider this simple axiom.

To determine the quality indicators well-known measuring, registration, sensory and computational methods are used (Carev et al., 2012). At the development stage estimated and sometimes registration measurement methods are most often used. Indicators of quality in corpore can be determined only in use. As getting closer to the operation phase, the values of the quality indicators are being specified.

In market economy new technology assessment should be made primarily from the point of view of customer requirements. In market a demand is only a competitive product, i.e. such that with its set of qualitative indicators exceeds the goods-analogues, and its price from the point of view of the consumer corresponds to the incorporated in the goods level of quality. Competitive ability should be evaluated on a two-coordinate field quality-price, because quite certain social costs correspond to the product quality level in each period of time, which are expressed in the price of goods. Competitive ability of goods is determined due to the deviations of its price from the public achieved when implemented at the product level of quality. To assess the competitive ability of the product it is necessary to set its price and quantify the quality of the product.

2 Materials and methods

To evaluate production quality criterion "integrated quality coefficient" (K_k), is needed. It can be defined by "profiles" method (Faskhiev et al., 2001). Product quality "profile" is graphic presentation of technical economic indicators (TEI) chosen according to certain rules. Product "profile" can be used to evaluate its quality level via comparing "profiles" of competitive products built up on the same estimating field.

To build the object profile the most significant from the point of view of consumers TEI are selected and a rectangular estimating field is built. The evaluation field is divided into equal (n-1) parts, where n- the number of TEI selected due to the consumers preferences. On the basis that in a competitive market all the properties of the product that characterize its quality are important, the weight of all of the TEI is the same.

The field width H is selected at random. Every TEI of the object is deposited on a pitch scale, and the qualitatively better value of the indicator the more right position on a pitch scale it takes. The essence of the method is that the larger the profile, the better the quality of the object. Profile allows to visualize different size products indicators on one evaluation field and combine them into the integral index. Integral index of product quality is defined as the ratio of the squares of profile and evaluation of the rectangular field

$$K_k = S_{pr} / S \tag{1}$$

$$S_{pr} = h\left(0.5Y_1 + Y_2 + Y_3 + \ldots + Y_{n-1} + 0.5Y_n\right), \tag{2}$$

where

h – is the distance between the pitch scales (selected randomly), mm;

Y_1, Y_2, ..., Y_n – are the coordinates of the vertices of the profile, mm.

The area of the estimating field is equal to

$$S = h\left(n-1\right)H, \tag{3}$$

where

H – is the width of the estimating field, *mm*.

Based on the above formula, the integral index of product quality equals to

$$K_k = \left(0.5Y_1 + Y_2 + Y_3 + \ldots + Y_{n-1} + 0.5Y_n\right)/\left(n-1\right)H. \tag{4}$$

To determine the quality factor it is not necessary to build a "profile" for each object although it is evident.

Quality coefficient can be defined analytically (Ildarkhanov, 2014). To do this equation is used

$$K_k = \left(0.5X_1 + X_2 + X_3 + \ldots + X_{n-1} + 0.5X_n\right)/\left(n-1\right). \tag{5}$$

where

n – number of factors;

X_1, X_2, ... X_n – factors ratio, defined by formula (6) - (7).

For factors, which values increase and thus improve the results, ratio X_i – is calculated by formula

$$X_i = I_i / I_{i\max}, \tag{6}$$

where

I_i – current index value i;

I_{Imax} – maximal value among i factor.

When index value increases, the results are getting worse, X_i is calculated by formula

$$X_i = \left(I_{i\max} - I_i\right)/I_{i\max}. \tag{7}$$

Offered method was checked via example of freight trucks with loaded weight 40 *tons*. Volvo FH12 has the biggest quality coefficient among compared trucks. These trucks were evaluated by experts within TransEuroTest, when 8 trucks covered 1800 *km* in competitive mode (Lapshin, 2000). Calculation results on 13 quality factors indicate (Table 1) that placements given to trucks according to quality coefficient almost coincide with those placements given to trucks by experts within tests. For comparative analysis technical economic indicators of two streamlined semitrailers KAMAZ-5460 and MAZ-543268 were additionally included in Table 1. The obtained results turned out to be slightly unexpected.

Fig. 1 gives computed quality coefficients indices of compared streamlined semitrailers.

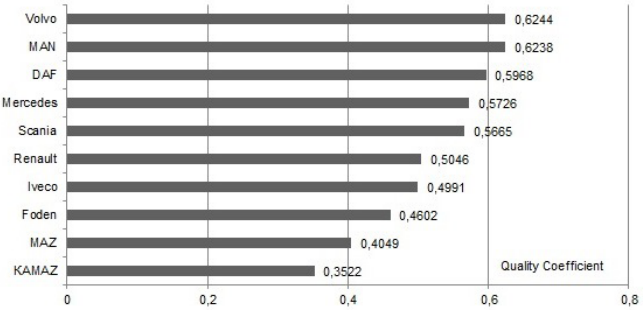

Fig. 1 Quality indices of compared streamlined semitrailers

Quality coefficients of compared streamlined semitrailers defined via above-mentioned method (see Table 1) indicate that Volvo FH12 has the best quality coefficient value - 0,6244, and KAMAZ-5460 has the worst - 0,3522, i.e. 1,77 time less. It should be pointed out that it doesn't mean that KAMAZ-5460 is 1, 77 time less qualitative, than Volvo FH12. In the first place, failure of particular truck indicates construction flaws. Difference between the semitrailers is not so big, as it may seem (excluding KAMAZ and MAZ). Majority of heavy-duty truck manufactures don't have substantial advantages. Placement order of streamlined semitrailers, defined by quality coefficient 100% coincided with placements established by experts of magazine «Autorevu» (see Table 1) (Lapshin, 2000).

Usage of analytical formula enables to conclude that where one model excels the other, and where it is inferior. Formula (1) validity check was performed on winter tires, tested by experts of magazine «Autorevu». Tires rate, defined according to quality coefficient, almost 100% coincided with placements established by experts of magazine «Autorevu» (Table 2) (Ildarkhanov, 2014). This and other research activities pursued by author enable to conclude that formula (1) gives opportunity to objectively evaluate product quality level.

While studying quality and price of many analogous products it's possible to define price dependency on integrated quality coefficient $P = f(K_k)$, as it was done in Fig. 2 for freight trucks, which technical economic indicators are shown in Table 1. "Worth" price function of these trucks from quality coefficient, defined by least square method, is as follows (thousands RUB):

$$P = 6365K_k - 1301. \tag{8}$$

Table 1 Technical economic indicators of streamlined semitrailers - participants of «TransEuroTest» (run 1800 km)

	Indicators	KAMAZ–5460	Foden Alpha 3000	Volvo FH12	Mercedes Actros	Scania R124	Iveco Eurostar Cursor	MAZ–543268	Renault Premium	DAF 95XF	MAN F2000
1.	Motor power, hp	360	380	420	394	420	430	400	392	480*	460
2.	Cubic capacity, l	11.0	10.8	12.1	11.95	11.7	10.3	11.9	11.12	12.6	12.8*
3.	Curb weight, kg	7050	6880	7300*	6980	7140	7080	7250	6800	7280	7240
4.	Brake type[#], grade	3.2	3.2	5	5	5	5*	3.2	3.8	3.2	3.8
5.	Acceleration time 0 – 80 km/h, sec	62.0*	58.02	55.37	61.7	57.47	56.52	58.0	49.94	38.85	38.95
6.	Resilience 60 – 80 km/h, sec	40*	32.78	29.39	33.23	29.18	34.28	34.2	35.4	29.3	24.00
7.	Noise intensity by V_T =85 km dBA	80*	70	68	68	65	69	80	69	65	67
8.	Average fuel consumption $Q_{av,}$ l/100 km	42.0*	38.72	36.67	37.29	37.89	39.78	39.0	38.53	37.76	38.08
9.	Average road speed V_T, km/h	73.0	75.36	78.07	77.00	76.96	77.33	76.0	75.53	78.55	79.32*
10.	Efficiency factor difference, %	-	6.6	0*	1.8	4.2	6.7	-	5.8	1.7	1.3
11.	Cab, grade	-	36	42*	40	42	40	-	40	41	40
12.	Cost, grade	-	37	42*	39	41	38	-	40	38	40
13.	Torsion torque, N·m	1431	1825	2000	1950	2000	1900	1730	1800	2050	2100*
14.	Quality coefficient, K_k	0.352	0.460	0.624	0.572	0.566	0.499	0.404	0.504	0.596	0.623
15.	Placement according to quality coefficient	10	8	1	4	5	7	9	6	3	2
16.	Expert rating, placement[¤]	-	8	1	4	5	7	-	6	3	2
17.	Expert rating, grades[¤]	-	418	470	446	445	419	-	429	447	463
18.	Actual price, thousands RUB.	841	1800	2600	2790	2200	1620	1360	1920	2290	2700
19.	"Worth price", thousands RUB	941	2673	2673	2344	2305	1876	1276	1911	2498	2670
20.	Competitive ability margin, thousands RUB	100	-172	73	-446	105	256	-84	-9	208	-30
21.	Competitive ability coefficient	1.118	0.904	1.028	0.840	1.047	1.158	0.938	0.995	1.090	0.988
22.	Placement according to competitive ability coefficient	2	9	5	10	4	1	8	6	3	7

* Critical index value. [#] 3.2 – drum brake; 3.8 – disc/ drum brake; 5 – disc brake.

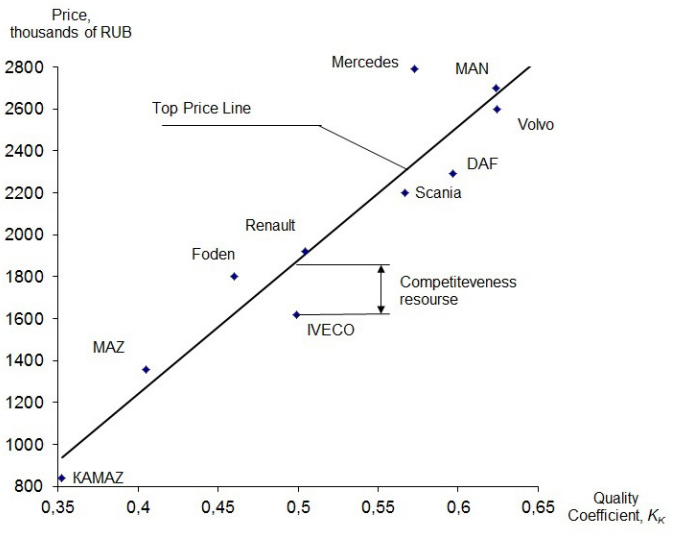

Fig. 2 Price dependency on quality coefficient of streamlined semitrailers

Competitive ability coefficient K of product within defined integrated quality coefficient K_k is calculated by formula

$$K\left(K_k\right) = P_w / P_a\,, \tag{9}$$

where

P_w, P_a – "worth" and actual price of the product respectively.

While value $K(K_k)$ increasing, product competitive capabilities are increasing too. When $K(K_k) > 0$, consumer underpays for the goods. If competitive ability coefficient is less than one, product is evaluated more expensive than it actually costs.

It's possible to calculate product competitiveness resource R_c using "worth" and actual price

$$R_c = P_w - P_a. \tag{10}$$

Competitiveness resource, on one hand, shows underpaid (overpaid) sum by consumer for the goods, on the other hand, - prospective opportunities to balance product prices with prices for such quality level goods which were settled on market. Naturally, the more competitiveness resource is, the higher potential of market share expanding this product has.

Competitive ability coefficients of compared freight trucks (see Fig. 2) defined by formula (9) equal to:

Iveco Eurostar Cursor $K(K_k = 0.4991) = 1.1580$;

KAMAZ-5460 $K(K_k = 0.3522) = 1.1189$;

DAF 95XF $K(K_k = 0.5968) = 1.0908$;

Table 2 Winter tires tests results – sizes 175/65 R14 and 185/60 R14 on automobile VAZ- 2112

	Indicators	Kumho KWN 7401	Hankook W400	Sava Eskimo S2	Kama514	M-265 Snowgueen	NIISHP-Rally 2000	NIISHP - Rally 2000 Sport
1.	Manufacturer	South Korea	South Korea	Slovenia	Russia	Russia	Russia	Russia
2.	Braking properties on ice, m	74.4	94.2	96.7	102.7	99.9	93.5	94.8
3.	Acceleration dynamics on ice, sec	13.5	19.1	21.3	22	24.8	17.2	15.8
4.	Braking properties on snow, m	24.9	29.1	26.5	25.2	26.5	26.6	25.2
5.	Acceleration dynamics on snow, sec	5.4	6.2	5.8	6.3	6.1	6.0	5.3
6.	Passing ability, grade	8	6	7	6	5	9	10
7.	Circular route clear time, sec	107.2	112.1	105.6	110.0	111.3	111.0	106.1
8.	Running reliability on circular route, grade	9	6	8	6	7	5	10
9.	Running reliability on winter motorway, grade	8	9	9	7	8	4	6
10.	Braking properties on wet asphalt, m	92.7	81.5	91.7	83.0	79.1	91.1	105.0
11.	Running on wet asphalt, km/h	81.0	84.0	86.3	86.0	85.7	80.5	78.5
12.	Resource on stand with curvilineal drum, km	8040	7200	3230	9910	4900	3360	4480
13.	Geometric and power dissimilarity, grade	10	9	10	7	7	8	8
14.	Ride comfort, grade	8	6	7	7	7	8	9
15.	Acoustic comfort, dBA	73.3	71.2	71.0	74.1	73.9	75.1	73.4
16.	Acceleration time on asphalt 60-120 km/h, sec	23.8	24.3	24.8	25.8	25.0	26.5	26.5
17.	Automobile run down from speed 50 km/h, m	711	636	600	567	607	533	543
18.	Quality coefficient, K_k	0.5263	0.4373	0.4445	0.424	0.396	0.3871	0.4654
19.	Placement according to quality coefficient	1	4	3	5	6	7	2
20.	Placement according to experts' evaluation "Autorevu"¤	1	4	3	5	6	6	2
21.	Experts' evaluation, grade¤	9.0	7.6	7.7	7.3	7.1	7.1	8.0
22.	Actual price, RUB.¤	1530	1710	1460	890	970	900	900
23.	"Worth price", RUB.	1530	1183	1210	1132	1022	987	1292
24.	Competitive ability resource, RUB.	0	-527	-250	242	52	87	392
25.	Competitiveness coefficient	1	0.692	0.829	1.272	1.054	1.097	1.436
26.	Placement according to competitiveness coefficient	5	7	6	2	4	3	1

Scania R124 $K(K_k = 0.5665) = 1.0477$;
Volvo FH12 $K(K_k = 0.6244) = 1.0281$;
Renault Premium $K(K_k = 0.5046) = 0.9953$;
MAN F2000 $K(K_k = 0.6238) = 0.9889$;
MAZ-543268 $K(K_k = 0.4049) = 0.9382$;
Foden Alpha 3000 $K(K_k = 0.4602) = 0.9044$;
Mercedes Actros $K(K_k = 0.5726) = 0.8401$.

Iveco has the highest competitive ability coefficient among compared trucks. Buyer of this automobile "underpays" 256 thousand RUB. However, this automobile doesn't belong to the best in its class, i. e. it has very low integrated quality coefficient. It must be admitted that in relative determinations buyer most of all underpays for this automobile. On markets, where effective demand is very low, this automobile will be much sought after. Among the compared automobiles DAF has the highest competitive ability. This automobile has the highest quality coefficient within competitive ability coefficient, which significantly exceeds one. Volvo and Scania have the same high competitive ability value. However, Mercedes gained fourth placement according to integrated quality coefficient, has competitive ability coefficient less than one – 0.840. Buyer of this automobile overpays 446 thousand RUB.

Actual price for Renault automobile almost corresponds with consumer cost, i.e. manufacturer set a price on product which it deserves.

"Price-quality" dependency enables to compare competitive models, considering consumer's preferences. For example, automobile quality coefficient within 0.55…0.65 is quite enough for buyer. Then choice will be made according to price. The cheapest automobile within coefficient 0.55…0.65 is Scania, the buyer will most likely choose it. While choosing products on low financial solvency market, buyers as a rule pay attention to price indicators. For example, buyer can afford to acquire freight truck at price level 1700 thousand RUB. Among

compared models only one meets this condition – Iveco, and the buyer will have to acquire this freight truck.

Using Fig. 2, even in the absence thereof the "red" price line, it is possible to compare any pair and determine their rank. For example, if we take a pair of Mercedes - MAN. The car MAN has the higher quality and lower price than Mercedes, thus, MAN is superior to the Mercedes in both criteria. But if we compare Scania to DAF, we can see that the DAF quality factor is 1.05 times higher, and the price is only 1.04 times higher than Scania. Solvent purchaser is likely to prefer the higher quality truck DAF, as a quality product usually has lower operating costs.

3 Conclusions

Orders of arrangement of truck tractors and tires, determined by analytical formula, coincided with the places identified by the experts during the tests (Tables 1-2), which proves the validity of the results.

A method of measuring quality and competitive ability needs to satisfy the main qualitative requirements: suitability, sufficiency, uniqueness, reliability, quantification, integrality, individuality, flexibility, absence of laboriousness, efficiency, improvement ability, quantity, identity, globality, uniqueness, comparability, reproducibility, comprehensiveness, sensitivity, monotony, accuracy, economic efficiency (Ildarkhanov, 2014). In accordance with these requirements, the accuracy of measurement significantly increases. Of course, to meet all twenty-two requirements of quality control in practice is difficult, however, any proposed method of measurement should fit most requirements, and to meet the rest at least partially. The proposed methodology of competitiveness measurement estimation well corresponds to qualitative requirements. Of all 22 requirements the method does not meet one requirement – personality. The method cannot be implemented if there are no analogs-competitors, because in this case it is impossible to build the "red" price line, although it is possible to set both the price and level of quality of the evaluated product individually. But on the other hand, if there are no competitive products, the meaning in the assessment of competitiveness is lost. The obtained integral estimation, if there are no objects for comparison, becomes unnecessary.

The analytical formula makes it possible to objectively assess the quality of the product with the help of a single number – the integral coefficient. The competitiveness of a product is set for a certain level of quality with ratio of customer value to the actual price of the goods. The margin of competitiveness is greater when the consumer value of a product is above its actual price. Analysis and model selection are carried out on schedule price-quality, based on the preferences of the buyer. The proposed criteria, the methods for their determination allow us to evaluate the quality and competitive ability of products at all stages of their life cycle and take measures for their improvement.

Thus, competitive ability evaluation method resolves itself into choosing estimated product analogues and defining product quality coefficient by analytical method. Subsequently, prices and analogous product quality coordinates are put on two-coordinate field and dependency diagram of product price on its quality is built via least square method. Such method enables to evaluate quality and competitive ability of mobile fleet and make wise choice.

References

Acosta, N., Toloza, J. (2012). Techniques to improve GPS Precision. *(IJACSA) International Journal of Advanced Computer Science and Applications.* 3(8), pp. 125-130. https://doi.org/93cb3189ec534a97aa22cfaecc1133cb

Andrejszki, T., Gangonells, M., Molnar, E., Török, A. (2014). For FITS: a New Help in Transport Decision Making for a Sustainable Future. *Periodica Polytechnica Transportation Engineering.* 42(2), pp. 119-124. https://doi.org/10.3311/PPtr.7442

Borkowski, S., Stasiak-Betlejewska, R., Török, A. (2013). Theoretical Investigation of Supply Chain Service Level in Hungary and Poland. *Transport and Telecommunication.* 14(2), pp. 93-101. https://doi.org/10.2478/ttj-2013-0008

Carev, V. V., Kantarovich, A. A., Chernysh, V. V. (2012). Оценка конкурентоспособности предприятий (организаций). (Assessment of the Competitiveness of Enterprises (organizations).) *Theory and Methodology: textbook.* – Unity-Dana. pp. 799 (in Russian)

Faskhiev, H. A., Kostin, I. M. (2001). Обеспечение конкурентоспособности грузовых автомобилей на этапе разработки. (Ensuring the Competitiveness of Trucks in the Development Phase.) Naberezhnye Chelny: Publishing house of the Kama Polytechnic Institute. pp. 349 (in Russian)

Fathutdinov, R.A. (2000). Конкурентоспособность: экономика, стратегия, управление. (Competitiveness: Economics, Strategy, Management.) M.: INFRA-M. 312 p. (in Russian)

Fujimoto, R., Guin, A., Hunter, M., Park, H., Kanitkar, G., Kannan, R., Pecher, P. (2014). A Dynamic Data Driven Application System for Vehicle tracking. *Procedia Computer Science.* 29, pp. 1203-1215. https://doi.org/10.1016/j.procs.2014.05.108

Hruška, R., Průša, P., Babić, D. (2013). The use of AHP method for selection of supplier. *Transport.* 29(2), pp. 195-203. https://doi.org/10.3846/16484142.2014.930928

Ildarkhanov, R. F. (2015). Выбор подвижного состава для международный автомобильных перевозок. (The Choice of Rolling Equipment for International Road Transport.) Textbook for Students of Higher Educational Institutions. Kazan: Publishing House of Kazan University. pp. 132 (in Russian)

Ildarkhanov, R. F. (2014). Разработка методики оценки конкурентоспособности подвижного состава. (The Development of Methodology for Assessing the Competitiveness of the Rolling Equipment.) Saarbrucken: LAP LAMBERT Academic Publishing. pp. 150 (in Russian)

Ildarkhanov, R. F., Buguev, A. A., Zaharov, A. S., Popov, E. S. (2015). Оценка качества автомобилей. (Quality Assessment of Motor Vehicles.) *Science and Business.* 4 (46), pp. 96-99. (in Russian)

Kampf, R., Gašparík, J., Kudláčková, N. (2012). Application of different forms of transport in relation to the process of transport user value creation. *Periodica Polytechnica Transportation Engineering.* 40(2), pp. 71-75. https://doi.org/10.3311/pp.tr.2012-2.05

Kolesov, I. M., Sycheva, N. A. (2000) Качество и экономичность продукции. (The Quality and Cost of Production.) *Standards and Quality.* 9, pp. 70-72. (in Russian)

Lapshin, F. N. (2000) Тягачи на пороге тысячелетия. (Truck at the Turn of Millennium.) *Autorevu.* 1, pp. 34-35. (in Russian)

Markovits-Somogyi, R., Bokor, Z. (2014). Assessing the logistics efficiency of European countries by using the DEA-PC methodology. *Transport.* 29(2), pp. 137-145. https://doi.org/10.3846/16484142.2014.928787

Nelyubov, L. P. (2012). Конкурентоспособность товаров. (The Competitiveness of Goods.) *Laboratoriya knigi.* p. 140 (in Russian)

Pagliara, F., Esposito, M., Troisi, C. (2017). Planning and Designing Transport Infrastructures for Sustainability: the Great Project NAPLEST. *Periodica Polytechnica Transportation Engineering*. 45(2), pp. 53-57. https://doi.org/10.3311/PPtr.9812

Pavlova, A. A. (2010). Качество и конкурентоспособность. (Quality and Competitiveness.) *Laboratoriya knigi.* p. 152 (in Russian)

Taran, V. A. (1998). Конкурентоспособность предприятий: проблемы современной политики и стратегия в области качества. (The Competitiveness of Enterprises: Problems of Modern Policy and Strategy in the Field of Quality.) *Mashinostroitel.* 2, pp. 6-12. (in Russian)

Török, Á., Török, Á., Heinitz F. (2014) Usage of Production Functions in the Comparative Analysis of Transport Related Fuel Consumption. *Transport and Telecommunication Journal.* 15(4), pp. 292-298. https://doi.org/10.2478/ttj-2014-0025