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TÍTULO: Evaluación de la competitividad de las aerolíneas en base al método de clasificación multicriterio.

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RESUMEN: El artículo presenta los resultados de una revisión crítica de la literatura científica nacional y extranjera sobre la evaluación de la competitividad de las aerolíneas. Se proponen recomendaciones científicas y metodológicas para evaluar esta competitividad en la Federación Rusa, utilizando herramientas matemáticas de análisis de conglomerados y clasificación de criterios múltiples. El artículo analiza la estructura de divisiones y ligas de la aerolínea. Se propone formar tres ligas de aerolíneas (pasajeros, carga y mixtas) y cinco divisiones. La evaluación de la competitividad de las aerolíneas nacionales se ofrece en cuatro etapas. En conclusión, se compiló la matriz "tamaño - carga de la flota de aerolíneas". Se presentan resultados de la aprobación práctica de la tarea de evaluar la competitividad de ciertas aerolíneas.

PALABRAS CLAVES: transporte aéreo, líneas aéreas, competitividad, análisis de clusters, optimización multicriterio.

TITLE: Evaluation of the competitiveness of airlines based on the multicriteria ranking method.

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ABSTRACT: The article presents the results of critical review of domestic and foreign scientific literature on the assessment of the competitiveness of airlines. Scientific and methodological recommendations for assessing the competitiveness of airlines of the Russian Federation using mathematical tools of cluster analysis and multi-criteria ranking are proposed. The article discusses the structure of divisions and leagues of the airline. It is proposed to form three leagues of airlines (passenger, cargo and mixed) and five divisions. Assessing the competitiveness of domestic airlines is offered in four stages. In conclusion, the matrix "size – loading of the fleet of airlines" was compiled. The results of practical approbation of the task of assessing the competitiveness of certain airlines are presented.

KEY WORDS: air transport, airlines, competitiveness, cluster analysis, multicriteria optimization.

INTRODUCTION.

At present, the following problems are observed on the market of the commercial transportation of the Russian Federation: depreciation of fixed assets of air transport organizations, the predominance of import aircraft in the fleet of domestic airlines, low aviation mobility of the population, and others. Solving these problems is impossible without increasing the competitiveness of all participants in the airport services market, including airlines, since "... the key groups of airport customers who determine their competitive position in the market are airlines" (Andreyev, 2012a, p. 38). The assessment of the competitiveness of airlines in domestic and foreign scientific and technical literature is given special attention. The following publications are of interest here.

To assess the competitiveness of an airline, it is proposed to use a two-tier system of indicators (Wu et al., 2013a). At the first level, there are five indicators of the first order, and at the second level - 17 indicators of the second order. Evaluation of competitiveness is carried out by the airlines of the People's Republic of China. In our opinion, in the work by C. Wu (2013a), not enough attention is paid to the distribution of indicators. Thus, one first-order indicator includes four second-order indicators, and another second-order indicator is part of another first-order indicator. It should be added that the system of indicators for assessing the competitiveness of airlines includes indicators that characterize the financial condition. However, not all groups of financial ratios were considered by C. Wu (2013a).

DEVELOPMENT.

In the work by C. Wu (2013b), an assessment of the competitiveness of airlines was carried out based on indicators characterizing the financial condition, operational activity, quality of service, scale, etc.

The publication of airlines is divided into three groups such as private airlines, state-owned airlines, and state holding airlines. In our opinion, to assess the competitiveness of the airline, it is necessary to categorize based on the scale of the activity and the load of the fleet.

In the work by T.J. Hannigan, R. D. Hamilton III, and R. Mudambi (2015), to assess competitiveness, indicators are used that characterize the scale of activity, financial condition, operational activity, etc. A special feature of this publication is that it uses indicators that characterize the market activity of organizations and the state of the national economy. In the publication, there is no division of indicators by blocks.

The peculiarity of the work by S.-H. Yoon & J.-W. Park (2015) is that it proposes to evaluate the competitiveness of the directions (airlines). Evaluation is based on five factors. The significance of factors varies based on the direction in question. In the work by S.-H. Yoon & J.-W. Park (2015),

when determining the significance of factors, consumers of airline services are not segmented. Obviously, for different segments, the significance of factors will vary significantly.

A feature in the work by X.-J. Li, Q. Si, and J. Deng (2011) is that it assesses the competitiveness of airlines located in different countries of the world. The system for assessing the competitiveness of airlines is a three-level. The assessment is carried out mainly on the operational, financial indicators and indicators characterizing flight safety. In the work by X.-J. Li, Q. Si, and J. Deng (2011), indicators that characterize the quality of passenger service are not used. In our opinion, such indicators should be considered when assessing the competitiveness of airlines, since passengers are the main consumers of airline services.

In the work by Y.-H. Chang and C.-H. Yeh (2001), an assessment of the competitiveness of airlines was carried out based on 11 indicators included in five factors. Most indicators characterize operational activities. Indicators are unevenly distributed. In assessing the competitiveness of airlines by Y.-H. Chang and C.-H. Yeh (2001), indicators characterizing the financial condition of organizations are practically not considered.

In the work by Z. Poberezhna (2017), it was proposed to use the method of recruiting competitive elements for ranking the competitiveness of airlines, considering the quality of aviation services. In this publication, airlines are not differentiated based on the scale of the activity. Next, let's consider domestic publications.

A.V. Andreyev (2012b, p. 30) presents the methodology for the development of measurable indicators of management efficiency of enterprises in the air transport industry. The publication identifies four main categories of the system of efficiency indicators such as economic, productivity, level of service, the efficiency of internal processes.

V.G. Afanasyev (2009) presented criteria for the significance of the parameters of the airline's products for the passenger. Scientists carried out the categorization of criteria by the degree of

importance to consumers. The publication does not pay enough attention to the segmentation of passengers.

Ye.V. Gurina (2017) considers the indicators of competitiveness of modern airlines in the global economy, and M.M. Dobrova (2016) - factors of competitiveness for the airline. In our opinion, in these publications, not enough attention is paid to the ranking of indicators and competitiveness factors.

In the work by N.O. Dunayeva and Ye.Yu. Kuznetsova (2008), the competitiveness of airlines is considered based on scientific and methodological approaches, but specific scientific and methodological recommendations for evaluating the competitiveness of airlines are not presented.

N.I. Yefremova (2010) proposes a methodology for assessing the competitiveness of airlines, considering the most complete satisfaction of the needs of air passengers, and discusses the main characteristics of competitiveness. In our opinion, in these publications, not enough attention is paid to the accounting of indicators characterizing the financial condition of the airline.

The Transport Strategy of the Russian Federation for the period up to 2020 considers the competitiveness of air transport in the domestic and international markets ("Transport strategy," n.d.); however, specific guidelines in the document are not presented.

Thus, based on a review of domestic and foreign scientific and technical literature, the following conclusions were obtained:

- First, the theoretical, methodological aspects of assessing the competitiveness of airlines are widely covered in domestic and foreign scientific and technical literature. Many questions remain controversial. Among domestic and foreign researchers there is no consensus regarding the composition and the system of indicators, methodological support for assessing the competitiveness of airlines.

- Secondly, in the Russian Federation, there are no generally accepted scientific and methodological recommendations for assessing the competitiveness of airlines. The legal documents present the requirements for passenger service, as well as the requirements for legal entities, individual entrepreneurs engaged in commercial air transport. In our opinion, the competitiveness of an airline comes down not only to compliance with certification requirements, since the competitiveness of products accumulates a combination of its quantitative and qualitative attributes (Rodionova & Kantor, 2014, p. 257).
- Thirdly, due to the peculiarities of the domestic commercial air transport market, as well as the state of the national economy, foreign methods are not recommended for assessing the competitiveness of domestic airlines. Thus, in the work C. Wu (2013a), it is proposed to use indicators that characterize the activity of airlines in the international transportation market. Most domestic airlines are focused on the domestic market. According to the data of the Federal Air Transport Agency “Rosaviatsia” (“Data of the Federal Air Transport”, n.d.), it was established that the proportion of passengers transported in international traffic in the transportation structure of civil aviation passengers in 2018 is 40.77%. Evaluation of the competitiveness of airlines of the Russian Federation according to the system of indicators presented in the works by C. Wu (2013a), C. Wu (2013b), S. A. Delbari, S. I., Ng, Y. A. Aziz, and J. A. Ho (2016), X. Li (2011), Y.-H. Chang and C.-H. Yeh (2011), Z. Poberezhna (2017) is not recommended, because when evaluating the competitiveness of airlines in these publications, financial ratios are either not presented, or not all groups of financial ratios are used. The expediency of accounting for these indicators is due to the closure of a significant number of airlines in the Russian Federation due to bankruptcy. The technique presented by T.J. Hannigan, R.D. Hamilton III, and R. Mudambi (2015) is also not recommended for use in the Russian context since the shares of most domestic air transport organizations are not listed on the stock exchanges.

- Fourthly, in most publications, when evaluating the competitiveness of airlines, indicators are used that characterize the financial condition of the airline, flight safety, operations, quality of service (Krimkevich & Filippova, 2012).
- Fifth, when evaluating the competitiveness of the airlines are not categorized. In our opinion, it is incorrect to evaluate the competitiveness of an airline carrying passengers and having a large fleet of aircraft, with an airline carrying cargo and having a small fleet of aircraft. In this regard, when assessing the competitiveness of airlines of the Russian Federation, it is necessary to consider their size and type of loading of the fleet. Airlines operating in the domestic air transportation market differ from each other in structure, size of their fleet (Table 1) and other indicators.

Table 1. Data on the type and number of aircraft in the fleet of certain airlines of the Russian Federation as of 05.23.2019.

Indicator / Airline	Type, number of aircrafts.	Total number of aircraft in the fleet.
PJSC Aeroflot – Russian Airlines	A320-214 (80), A-321-211 (36), A-330-243 (5), A-330-343 (17), B-737-8LJ (19), B-737-800 (28), B777-3MOER (17), B777-300ER (2), RRJ-95B (48)	252
Red Wings Airlines	A-320-232 (4), A-321-211 (2), Tu-204-100V-04 (2), Tu-204-100 (1), Tu-204-100V (2), A321-231 (8)	19
Volga-Dnepr Airlines, LLC	An-124-100 (9), Il-76TD-90VD (5)	14
Erofey LLC	B-757-200 (1)	1

Source: the table is compiled by data (“Data of the Federal Air Transport,” n.d.).

As of May 23, 2019, 106 operators with an air operator certificate for commercial air transportation are operating in the Russian Federation (“Data of the Federal Air Transport,” n.d.). As the review of the scientific and technical literature presented by R.N. Kidrachev (2018) and of certain

publications such as A.V. Andreyev (2012), I. Kirschnerova (2017), M. Urban, M. Klemm, K.O. Ploetner, K. O., and M. Hornung (2018) show, the categorization of airlines uses different indicators and methods.

Thus, scientific and methodological recommendations for assessing the competitiveness of airlines require further development.

Assessment of the competitiveness of airlines of the Russian Federation is proposed to be carried out according to the scheme presented in Figure 1.

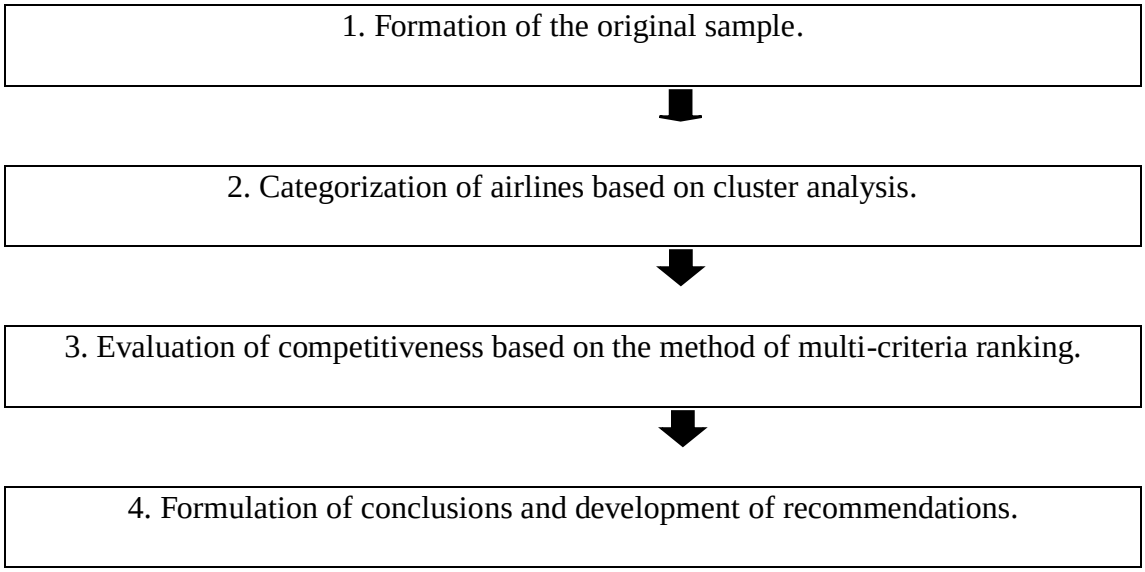

Figure 1. Airline Competitiveness Assessment Scheme.

Let's consider the scheme in more detail.

The first stage of the research is devoted to the formation of the initial data. Compiling the initial sample, it is proposed to form from the airlines of the Russian Federation. The information base of the study consists of data from the Federal Air Transport Agency "Rosaviatsiya" ("Data of the Federal Air Transport", n.d.), airline data, Internet materials, and other sources.

The second phase of the study is devoted to categorizing airlines based on cluster analysis. First, a hierarchical cluster analysis is carried out, as a result of which the number of clusters is determined by experts. Next, a non-hierarchical cluster analysis is performed using the K-means method. After carrying out cluster analysis, dispersive analysis is performed, and a matrix of Euclidean distances is compiled. For cluster analysis, it is proposed to use the following indicators:

- The number of passengers carried in a calendar year.

- The volume of cargo and mail transported in a calendar year.

As a result of cluster analysis, it is proposed to compile a matrix “size - type of loading of the fleet” of airlines. Based on the fleet loading, it is proposed to divide the airlines into three leagues such as passenger, cargo, and mixed. Each division is proposed to allocate five divisions (Table 2).

Table 2. The proposed structure of the divisions and leagues of the airline.

League / Division	Passenger airline League	Cargo airline League	Mixed League
Division 1	1st	1st	1st
Division 2	2nd	2nd	2nd
Division 3	3rd	3rd	3rd
Division 4	4th	4th	4th
Division 5	5th	5th	5th

The third stage of the study is devoted to assessing the competitiveness of air companies based on the method of multi-criteria ranking. It is proposed to evaluate the competitiveness of airlines for each group of airlines separately. After determining the characteristics of the nodal points of the membership function and determining the values of the parameters corresponding to the nodal points of the membership function, the values of the coefficients of the membership function are determined. To assess the competitiveness of airline companies, a two-tier system of indicators is proposed (Table 3).

Table 3. The system of indicators for assessing the competitiveness of airlines based on the method of multicriteria ranking.

Block	Entitlement of a single indicator.
Quality of service	The proportion of delayed flights of the total number of flights completed in a calendar year.
	Destination network.
	Death toll in flight accidents.
Infrastructure	The average age of the aircraft fleet.
	Number of aircraft in the fleet.
	The proportion of domestic aircraft in the fleet structure.
Carriage of passengers	Carriage of passengers.
	Passenger traffic.
	Passenger load factor.
Freight transport	Freight transport and mail traffic.
	Cargo turnover.
	Payload percentage.
Financial position	Return on sales.
	Average annual cost of net assets.
	Total debt to equity.
Growth rate	The average annual rate of growth of carriage of passengers.
	The average annual rate of growth of freight transport and mail traffic.
	The average annual rate of growth of the revenue growth.

As can be seen from Table 3, each unit includes three single indicators.

After calculating the values of the parameters of the membership function, the value of the aggregating membership function is calculated using the geometric average formula for each block. Then the values of the aggregation function of accessions for all blocks are averaged. Based on this, the evaluation of the airline's competitiveness is carried out (Table 4).

Table 4. Characteristics of the levels of competitiveness of the airline.

The arithmetic average of the aggregate function of membership for all blocks	The level of competitiveness of the airline
From 0.80 to 1.00	High
From 0.63 to 0.80	Elevated
From 0.37 to 0.63	Medium
From 0.20 to 0.37	Reduced
From 0.00 to 0.20	Low

At the fourth stage of the study, conclusions are formulated, and recommendations are made.

The practical significance of the proposed scientific and methodological recommendations lies in the fact that their results can be used by state authorities in charge of air transport in the formation of regional transport and logistics systems in air transport.

Based on the study, the following conclusions were made.

First, based on the data obtained as a result of cluster analysis, a matrix "size - type of loading of the fleet" of airlines was compiled (Table 5).

Table 5. Matrix "size - type of loading of the fleet" airlines.

Type of loading of the fleet / Size	Freight transport	Carriage of passengers	Freight transport and carriage of passengers
Large	AirBridgeCargo (1)	–	Aeroflot (1)
Medium	Abakan Air, Aviastar-TU, ATRAN, Volga-Dnepr, and others (7)	Azur Air, VIM Airlines, Nordwind Airlines, Red Wings, and others (9)	Siberia, UTair, Ural Airlines (3)
Small	224 Flight Unit, Aviation-Rescue Company EMERCOM of Russia, Vityaz-Aero, Shar Ink Ltd, and others (7)	I-Fly, Gazpromavia, Komiavaiatrans, and others (7)	Angara, Polar Airlines, Izhavia, IrAero, and others (6)

As can be seen from Table 5, no large airlines are specializing in the carriage of passengers only in the Russian Federation's commercial air transport market.

Secondly, based on size, there are three types of airlines such as small (20 airlines), medium (19 airlines) and large (2 airlines). Based on the type of loading of the fleet, there are also three types of airlines such as freight (15 airlines), passenger (16 airlines) and mixed (10 airlines). Thus, the results of a cluster analysis confirm the need to consider the size and type of load of the airline fleet when evaluating competitiveness.

Thirdly, as a result of assessing the competitiveness by the method of the multi-criteria ranking of medium size and mixed by type of load of the aircraft fleet of airlines (Table 6), the lowest average values of the aggregating membership functions are recorded in the "Infrastructure" and "Carriage of passengers" blocks.

Table 6. Results of evaluating the competitiveness of airlines based on the method of multi-criteria ranking.

Airline / Block name	Siberia	Ural Airlines	UTair
Block 1 "Quality of service"	0.663	0.553	0.586
Block 2 "Infrastructure"	0.334	0.196	0.534
Block 3 "Carriage of passengers"	0.838	0.384	0.250
Block 4 "Freight transport"	0.832	0.400	0.268
Block 5 "Financial position"	0.478	0.823	0.229
Block 6 "Growth rate"	0.456	0.841	0.266
Average value	0.600	0.533	0.356
Competitiveness edge	Medium	Medium	Reduced

It should be noted that the level of competitiveness of airlines is relatively low (Table 6).

CONCLUSIONS.

Based on the conducted research the following "bottlenecks" were identified:

- The low share of domestically produced aircraft in the structure of the airline's aircraft fleet.

- A small number of aircraft in the fleet.

- The high average age of aircraft in the fleet.

- A small number of passengers carried.

- Low passenger turnover.

To increase the competitiveness of airlines, the following recommendations are offered:

- The creation of a state-owned bank specializing in servicing transport enterprises, organizations, the cargo clientele, and passengers.

- Zeroing (or reduction) of the value-added tax rate for domestic flights.

- Formation of an aviation alliance based on the largest airlines of the countries of the Eurasian Economic Union.

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