

The object of the study is the personnel potential of aviation. The paper considers the problem of the effectiveness of monitoring the quality of airline personnel. According to the results of the study, it was stated that the stable growth in the volume of international cargo and passenger air transportation requires full-fledged provision of aviation with highly qualified specialists, a shortage of which has been observed in airlines in most countries of the world for several years. It is emphasized that a shortage of highly qualified specialists can be avoided only with the introduction of monitoring of the qualitative composition of the aviation personnel potential according to the competence approach. An algorithm has been developed for monitoring the qualitative composition of human resources based on the audit of compliance of professional competencies of civil aviation personnel with international standards of ICAO (International Civil Aviation Organization), EASA (European Union Aviation Safety Agency), IATA (International Air Transport Association) using triangulation of mixed methods. The expediency of using the monitoring results as a fundamental basis for building a centralized information platform with open access to information resources on the qualitative composition of the personnel potential of airlines and the industry is justified. It is reasonable that the implementation in practice of the algorithm for monitoring human resources according to the competence approach will allow stakeholders to have a clear understanding of the level of professional competence of personnel and the need to improve it in the short term, which will accelerate the elimination of the existing shortage of highly qualified specialists by timely taking measures to amend state programs for training civil aviation specialists, improving their qualifications and certification. It is emphasized that the application of this algorithm is possible in the presence of a sectoral qualifications framework

Keywords: *monitoring, civil aviation, human resources, staffing, personnel certification, information platform*

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MONITORING OF AVIATION PERSONNEL POTENTIAL ACCORDING TO THE COMPETENCE APPROACH

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1. Introduction

The processes of globalization of the world economy lead to a rapid increase in demand for international cargo and passenger air transportation. Therefore, the development of civil aviation is becoming a key driver of economic growth in each country, a factor in improving the quality of life of the population and the competitiveness of the national economy.

In turn, flight safety requires the full provision of highly qualified personnel to airlines. But, unfortunately, their shortage in aviation has been pronounced in recent years. Especially acute is the shortage of flight personnel, senior and engineering personnel of the airfield service, the flight electrical and lighting support service, the flight fuel and lubricants support service, emergency flight support, etc.

In order to solve this problem, some airlines independently create training centers. Others try to attract experienced

professionals with financial benefits. However, both the former and the latter succeed with varying success. Only according to the assessment of the International Association of Air Carriers (IATA), with the current pace of modernization of aviation equipment and airport infrastructure, stable growth in international cargo and passenger air transportation, the annual infusion of highly qualified specialists in civil aviation air and ground services should be at least 17 thousand, which at this stage is quite difficult to ensure due to the lack of a full-fledged information support on the qualitative composition of aviation personnel potential.

To date, none of the Central Asian countries has created a centralized information platform for aviation personnel, therefore, information on airline personnel is practically inaccessible, which significantly complicates the adoption of measures to prevent and overcome the shortage of highly qualified aviation personnel; train aviation specialists and improve their skills

in accordance with international standards ICAO, EASA, IATA and accordingly, for the further development of aviation.

Creating a centralized information platform with open access to information in the context of accelerated digitalization is not difficult. The issue is the lack of a clear algorithm for monitoring the qualitative composition of the personnel potential of airlines according to the competence approach.

Therefore, research on the development of this algorithm and the construction of a centralized information platform for the staffing of civil aviation is extremely necessary. Only with the creation of full-fledged information support on the quality of airline personnel, it is possible to form a human resource potential that meets the requirements of international standards and is able to quickly adapt to innovative technologies, strategic goals and imperatives facing aviation.

2. Literature review and problem statement

The results of the study of literary sources give grounds to assert that in recent years one of the most pressing problems of civil aviation is the shortage of highly qualified personnel [1]. The reason for this, according to the authors, is the existing gaps in the skills of aviation industry personnel. However, when studying the situation, the researchers used only the tools of qualitative analysis, which is not enough to fully assess the causes and depth of the shortage of airline specialists.

As emphasized in the paper [2], a diversified network of low-cost and traditional carriers is actively expanding the coverage, scale and frequency of traditional air transportation. Therefore, the demand for highly qualified specialists is rapidly outstripping the supply. The authors see the solution to this problem in the implementation of the CBTA structure in personnel planning in aviation, forgetting that the fundamental basis for planning aviation personnel and the introduction of a qualification training system are the results of monitoring the qualitative composition of the personnel potential of aviation enterprises.

In addition, graduates of higher educational institutions do not have the necessary skills to fill existing vacancies in the labor market [3] due to the significant time interval in their training [4], as well as radical changes in aviation caused by the Fourth Industrial Revolution (IR4.0), which are rapidly changing the requirements for professional competencies of specialists in air and ground handling of air transport [5]. At the same time, the issues of monitoring the quality of the personnel potential of airlines, as a fundamental basis for making forecasts, were not taken into account.

Therefore, in the paper [6], the authors recommend that when assessing the personnel potential of civil aviation, be guided not only by the current needs for personnel competencies, but also by forecasts of their changes. To build such forecasts, the authors propose to use a time series model based on the exponential smoothing method. An important advantage of this method is the possibility of additional consideration of the time value of information and adjustment of training programs depending on the changing situation. Meanwhile, in the paper [7], the researcher considers the problem of the shortage of qualified specialists in aviation as the lack of close cooperation between employers and educational institutions, which makes the product they produce absolutely inflexible – the competence of graduates, missing the importance of monitoring the qualitative composition of the personnel potential of aviation enterprises in solving this problem.

It is from this point of view that in the paper [8], in order to assess the qualitative composition of the aviation personnel potential, as well as to identify the causes of the shortage of highly qualified specialists, scientists propose to be guided by the indicators of the interrelationship of personnel, certification and induction (hereinafter referred to as the EU) of personnel, as well as the level of knowledge and skills. However, the expediency of their use in monitoring the qualitative composition of human resources has not been substantiated by researchers.

When studying the quality of professional training of civil aviation personnel in the papers [9, 10], theorists recommend using an assessment method using fuzzy cognitive maps, which, in our opinion, significantly complicates the process of monitoring the quality of airline personnel. A similar opinion is expressed by researchers who, in the paper [11], justify that there is no need to use complex techniques to study the qualitative composition of human resources. Improving the professionalism of aviation personnel, as noted in [12], is a competitive necessity due to globalization, as well as changes in technology and demography. Therefore, to accurately assess the professional competence of aviation personnel, it is sufficient to use automated stress testing of professional skills of personnel.

Thus, we conclude that the proposals of scientists to solve the problem of the shortage of professionals in aviation are quite diverse and interesting, however do not provide the expected result. And first of all because of the assignment of the issue of studying the professional competencies of airline personnel in the providence of monitoring the quality of civil aviation personnel of secondary importance.

Monitoring of the qualitative composition of human resources should primarily be carried out according to a competence-based approach, which will allow you to form a portfolio of professionalism of civil aviation personnel, and therefore have a clear understanding of its compliance with the requirements of the sectoral qualifications framework and international standards of ICAO, EASA, IATA. However, monitoring according to this approach requires the creation of a certain regulatory framework, the adoption of a number of organizational measures and the clarity of the procedure for its implementation. Therefore, studies of the procedure for monitoring the qualitative composition of aviation personnel potential based on the competence approach are extremely important now and in the near future. The creation of a centralized information platform and the timely adoption of measures to eliminate the existing shortage of highly professional air and ground aviation personnel largely depend on the clarity of the definition of the stages of the monitoring procedure, methods and techniques for its implementation.

3. The aim and objectives of the study

The aim of the study is to develop a procedure for monitoring the qualitative composition of the personnel potential of airlines. This will allow you to create a portfolio of professionalism of civil aviation personnel, and therefore have a clear understanding of its compliance with the requirements of the sectoral qualifications framework and international standards of ICAO, EASA, IATA.

To achieve the aim, the following objectives were formulated:

- to study the trends in the development of civil aviation in the Republic of Kazakhstan;
- to identify the reasons for the shortage of highly qualified aviation personnel;

– to substantiate the expediency of using the triangulation of research using mixed methods in assessing the relationship between/among variables characterizing motivation, working conditions and the possibility of professional development of Aeroflot's air and ground service personnel;

– to develop a simulation model of the procedure for monitoring the qualitative composition of the personnel potential of airlines according to a competence-based approach based on an audit of compliance of the professional competencies of civil aviation air and ground service personnel with the requirements of the sectoral qualifications framework and international standards.

4. Materials and methods

The object of the study is the personnel potential of aviation.

The main hypothesis of the study is that monitoring human resources using a competence approach will allow stakeholders to have a clear understanding of the level of professional competence of personnel and the need to improve it in the short term, which will accelerate the elimination of the existing shortage of highly qualified specialists by timely taking measures to amend the training programs for civil aviation specialists, improve their qualifications and certification.

In this paper, it is assumed that the statistical data used are subject to the normal law of distribution. The presence of abnormal values detected in 2020 is allowed to be explained by the consequences caused by COVID-19. This paper uses the assumption that this is an isolated phenomenon that will not happen again. The application of the developed procedure is possible if there is a sectoral qualifications framework.

The simplifications adopted in the work are related to the fact that currently the system of information collection and exchange in the field of civil aviation in the Republic of Kazakhstan is not sufficiently transparent, which complicates the conduct of research. Therefore, as a simplification, a reduced set of indicators has been selected for modeling based on available sources of reliable information.

The materials for this study were: statistical data on the education, certification and experience of Aeroflot Kazakhstan air and ground handling staff; the regulatory framework of the international (in particular, the regulations of the ICAO, EASA, IATA) and national levels (in particular, legislative and regulatory acts of the Republic of Kazakhstan (RK) in the field of civil aviation); a report by researchers of the Academy of Civil Aviation (g. Alma-Ata) on the research work «Development of a strategy for ensuring and developing highly qualified personnel potential of the aviation industry of the Republic of Kazakhstan»; corporate reports of the Air Astana Group for the period 2015–2022.

The study was triangulated using mixed methods. Econometric methods of comparative analysis and panel data processing for average samples were used. Theoretical algorithms for the development of evaluation indicators were used, for which a modified method of normalization of indicators «by the scope of variation», the method of expert assessments for determining weighting coefficients, the method of weighted sums («linear convolution») for the components of the three basic components of the main indicator and «nonlinear convolution» for integral indicators were proposed.

The creation of a mathematical model for forecasting was carried out using the methods of correlation and regression analysis. The generalized least squares method was used to

assess the best correspondence of the mathematical model to real data. The adequacy of the developed model is confirmed by the coefficient of determination. Validation of the results was carried out using Fisher statistical tests.

5. Results of the development of an algorithm for monitoring the quality of civil aviation personnel potential

5.1. Trends in the development of civil aviation

According to the Concept of Development of the transport and logistics potential of the Republic of Kazakhstan (RK) for the period up to 2030 [13] (hereinafter referred to as the Concept), the main strategic objectives of civil aviation aimed at its further globalization, commercialization and liberalization, as well as the creation of a favorable environment for the sustainable development of air transport, are defined:

- ensuring flight safety;
- creation of favorable conditions for the development of the country's transit potential;
- opening of new international flights [13].

In particular, in order to ensure flight safety in 2019, the civil aviation management system was radically reformed in the Republic of Kazakhstan by transforming it to the European model of air transportation safety regulation. Namely, the Aviation Administration of Kazakhstan (AAK) was established as an independent agency responsible for technical control and supervision of civil aviation safety. AAK has successfully passed a number of international inspections, including the ICAO Validation Mission (ICVM), a technical visit by experts from the European Commission, a visit by experts from the US Transportation Security Administration (TSA) and systematically implements flight safety tasks in accordance with world best practices [14]. During the work of the AAC, 934 inspections and certifications were carried out, and about 1,500 permits were issued for flights. Operator certificates have been suspended or revoked from 7 airlines that did not meet the certification requirements and thus posed a threat to flight safety.

As a result of the fruitful work of the AAC, according to the results of an audit conducted by the International Civil Aviation Organization (ICAO) in 2022, the level of flight safety compliance with international standards in the Republic of Kazakhstan reached 82 %, i.e. it stood in line with such European countries as the Netherlands – 87 %; Belgium – 87 %; Portugal – 87 %; Czech Republic – 87 %; Latvia – 86 %; Denmark – 85 %; Iceland – 84 %; Poland – 84 %; Slovenia – 82 %, Cyprus – 82 %, etc. [15], thereby exceeding the global average by 15 %, approaching the EASA member countries (85 %), as well as surpassing the European and North Atlantic region (77 %) and the global average (67 %).

Regarding the solution of the second strategic task – the creation of favorable conditions for the development of the transit potential of the country of the Republic of Kazakhstan, we note the following: work is being systematically carried out at airports to modernize the air transport infrastructure. In total, during the years of independence, the reconstruction and construction of the runway at 22 airports, as well as the reconstruction and construction of passenger terminals at 16 airports were carried out. In 2022, 5 projects were implemented, in particular, for the reconstruction of terminals at the airports of Uralsk and Kostanay, runways at the airports of Ust-Kamenogorsk, Usharal, Urjara.

In 2023, 4 projects are being implemented in the cities of Almaty, Shymkent, Kyzylorda and Kostanay.

The domestic air transportation market has been fully liberalized so that it benefits all stakeholders and the economy of the Republic of Kazakhstan as a whole. Currently, in the Republic of Kazakhstan, domestic air transportation is carried out by 5 carriers on 56 domestic air routes with more than 700 flights weekly.

Subsidizing of air routes for domestic tourism has been introduced. In particular, 7.2 billion tenge has been allocated from the Republican budget for 2023 to subsidize 23 air routes in 7 regions of the Republic of Kazakhstan [16].

As for the third task, since 2017, Kazakhstan has introduced the «open sky» mode, which allows airlines to open new international routes annually. To date, international air transportation in the Republic of Kazakhstan is carried out to 27 countries on 103 air routes by 3 domestic and 26 foreign airlines. By the end of the year, it is expected to launch 9 more new international routes to Doha, Kuala Lumpur, Ankara, Karachi, Lahore, Jeddah, Muscat, Prague and Tel Aviv. Work is also continuing to prepare for the upcoming International FAA Flight Safety Assessment (IASA), the success of which will allow Kazakh airlines to launch direct flights to Mumbai, Hong Kong, Vienna, Tokyo, Singapore, New York and others by 2025 [16].

The above facts convincingly testify to the stable development of the civil aviation industry of the Republic of Kazakhstan, which is confirmed by the data of the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan [17], shown in Table 1.

The dynamics of passenger turnover growth continues in 2023. In particular, in the first quarter of this year, the number of passengers transported by the airlines of the Republic of Kazakhstan increased by 38 % and amounted to 3.6 million people [17].

5. 2. Reasons for the shortage of highly qualified personnel in civil aviation

The Republic of Kazakhstan is becoming more and more attractive for transit flights. The volume of serviced flights in 2022 amounted to 410 thousand aircraft, which is 90 % higher than in 2021 (215 thousand aircraft). But, as the head of the Ministry of Industry and Infrastructure Development M. Karabaev notes, the further development of civil aviation in the Republic of Kazakhstan is hampered by a shortage of highly qualified personnel, the causes of which are [18]:

- the practical absence of offers from professionals in the field of civil aviation in the labor market;
- active replenishment of the air fleet with modern aircraft and, accordingly, the need to form a new generation of aviation personnel;

– expansion of international flights, which requires full provision of aviation with human resources with competencies in accordance with the requirements of the ICAO and other international organizations that control the safety of air transport. Currently, about 20 thousand people work in the field of civil aviation of the Republic of Kazakhstan. Of these, about 10 thousand airport employees, 2,857 flight personnel, 1,767 engineering personnel, etc. However, based on the planned launch of international flights in the coming years, a shortage of 500–600 aviation specialists is projected annually until 2025 [19].

Currently, there is only one educational institution and 25 certified aviation training centers in the Republic of Kazakhstan, which are engaged in training, retraining and maintaining the professional level of flight personnel, engineers, air traffic controllers, aviation station operators for the aviation industry, etc. However, they cannot completely solve the problem of personnel shortage in civil aviation, since even a graduate with an academy diploma is not allowed to work independently on an airplane until he has gained sufficient experience. To become a qualified mechanic, you need three years of experience working on an aircraft, and to become a certified engineer (categories B1 and B2), you need five years of experience. Therefore, airlines are forced to carry out personnel training either in foreign companies, or independently organize advanced training courses, trainings, testing, etc. A striking example of this among the seven airlines of the Republic of Kazakhstan performing regular commercial transportation (Air Astana, SCAT, FlyArystan, Qazaq Air, Zhetysu, Zhezkazgan Air and Southern Sky) is the Air Astana Group.

5. 3. Triangulation of environmental research to improve the professionalism of airline personnel using mixed methods

Using the example of the Air Astana Group (Republic of Kazakhstan), a triangulation of the study of the environment for improving staff professionalism was carried out, a technique that is applicable to similar studies of airlines in other countries.

Air Astana Group (Air Astana and FlyArystan (a low-cost carrier launched in 2019 in order to stimulate the market on under-developed domestic routes of the Republic of Kazakhstan)) – one of the largest airlines of the Republic of Kazakhstan and Central Asia, operating domestic and international flights from its hubs in Almaty and Astana. To date, the Air Astana Group's fleet consists of 43 Western-made aircraft, the average operational age of which is 4.9 years [20–31]. The route network includes 88 domestic and international flights (Table 2).

Table 1

The main indicators of the transport of the Republic of Kazakhstan [17]

Types of transport	Transported cargo, baggage, thousand tons		Cargo turnover, million tons-km		Passengers transported, thousand people		Passenger turnover, million p-km		Revenues of enterprises from transportation, total, million tenge	including:	
	the reporting period	in % by 2021	the reporting period	in % by 2021	the reporting period	in % by 2021	the reporting period	in % by 2021		transportation of goods and luggage	passenger transportation
Total, transport of the Republic of Kazakhstan	3886725.6	97.2	602962.5	101.0	7750817	102.3	116516.1	109.1	4072147.3	3264416.1	807731.2
including air transport	24.5	72.1	54.4	66.7	10993.6	116.5	20109.3	135.7	602049.6	13055.7	588993.9

Table 2

Dynamics of indicators of the size of the economic activity of the Air Astana Group during 2015–2022 [20–31]

Indicators	Years							
	2015	2016	2017	2018	2019	2020	2021	2022
Aircraft, units	31	31	32	34	35	34	36	43
Number of routes	64	65	66	69	69	74	84	88
Number of countries	18	20	21	21	21	21	20	22
Passenger traffic, million people	3.86	3.75	4.19	4.32	5.12	3.7	6.6	7.4
including internal	1.58	1.66	2.04	2.26	2.3	0.66	2.4	2.6
international	2.28	2.09	2.16	2.07	2.81	3.04	4.2	4.6
The load factor of the aircraft, %	63	61	67	66	71	71	80	83
The indicator of timely completion of flights, %	89.9	89.6	83.1	86	90.4	88	82	74
Cargo transportation volume, thousand tons	16.6	16.6	19.9	20.0	15.7	13.9	18.8	13.9

The Group focuses on the development of passenger destinations. However, freight transportation is still one of the business segments. During the COVID-19 pandemic, as well as in 2020, the Group took steps to increase cargo turnover by converting one of the Boeing 767 aircraft into a semi-cargo one. Thus, in 2020 and 2021, Air Astana transported 13,884 and 18,772 thousand tons of cargo, respectively. But with the increase in passenger traffic in August 2021, the Boeing aircraft was re-equipped for passenger transportation, which, along with some external factors (in particular, with an increase in the carrying capacity of road transport between Almaty and Astana, the suspension of flights to Russia and Ukraine, the absence of cargo charter flights from Almaty to Beijing due to established restrictions, etc.) led to a decrease in the volume of cargo transportation in 2022 by more than 1/3. Nevertheless, Air Astana is striving to expand its reach in the near future and thus increase the volume of cargo transportation.

However, the long-term success of the Air Astana Group depends not only on the scope of coverage, but also on the Company’s availability of specialists. According to the data of the integrated report for 2022 [20–31], 6184 employees work at Air Astana (Table 3).

The average work experience of the Group’s employees in 2022 was 7.2 years. The amplitude of fluctuations of this indicator during the studied period, based on the data in Table 2, is poorly expressed, since the management of the Air Astana Group provides employees with competitive wages and equal opportunities, safe working conditions, as well as training and individual professional development plans. Therefore, the average staff turnover rate is almost unchanged, with the exception of 2020, when a significant part of flights were suspended as a result of the COVID-2019 pandemic.

Realizing that human resources are one of the key assets, thanks to the experience, skills and competencies of which Air Astana is successfully growing and making plans for the future, the Company’s management has chosen a labor organization model based on such fundamental components as: financial incentives, comfortable working conditions and

psychological climate, as well as the opportunity for career growth and self-realization.

In particular, personnel costs in the Air Astana Group, as shown in Table 4, are continuously increasing every year, which is explained by the Company’s desire to retain highly qualified specialists.

Staff costs at Air Astana include competitive salaries consisting of fixed and variable parts, as well as short- and long-term social benefits. So, in 2022, the average monthly nominal salary of the company’s employees amounted to 589.9 thousand tenge, which is almost 1.5 times higher than the average monthly nominal salary of transport workers.

However, a significant excess of the level of the average monthly nominal salary of Air Astana employees over the level of the average monthly nominal salary in the field of transport has been observed throughout the study period. The only exception was 2019–2020, when the average monthly nominal salary of the Company’s employees exceeded this indicator in the field of transport by only 1.2 times. But as previously noted, the reason for this was the influence of external factors, in particular, the COVID-2019 pandemic.

As a socially responsible company, Air Astana, by creating jobs, provides employees with a high level of safety and comfortable working conditions (Table 5).

According to Table 5, the number of accidents in Air Astana during 2015–2022 has a tendency to decline. In November 2022, the Company passed an inspection audit of compliance with the requirements of the international standard ISO 45001:2018 without any significant comments. In addition, 2022 was held under the auspices of occupational health and safety. Therefore, a number of activities were carried out during the year: 193 employees participated in certified online training programs; 281 employees received training on industrial safety when working in hazardous conditions; 217 employees were trained in fire safety and technical minimum; annual medical examinations were organized for all employees whose working conditions are considered dangerous and/or harmful.

Table 3

Dynamics of the average number of employees of the Air Astana Group during 2015–2022 [20–31]

Indicators	Years							
	2015	2016	2017	2018	2019	2020	2021	2022
Average number, people	4613	4794	5079	5210	5532	5385	5551	6184
Average service life in the company, years	7.82	7.9	8.1	8.3	6.3	7.06	6.8	6.7
Average staff turnover, %	7	8	7	6	6.3	9	7	6.8

Table 4

Dynamics of motivation indicators for Air Astana Group employees during 2015–2022 [32]

Indicators	Years							
	2015	2016	2017	2018	2019	2020	2021	2022
Personnel expenses in total, million tenge	18,222.9	22,150.2	23,179.4	27,581.6	39,476.5	35,597.4	49,590.5	68,827.9
Including salaries of production staff, million tenge	11,855.4	14,168.4	14,682.5	17,696.4	25,649.9	20,449.4	29,820.4	40,321.0
Salary of administrative staff, million tenge	2,726.7	3,279.7	3,571.6	4,462.6	6,445.1	4,445.4	7,228.5	9,121.6
Salary of sales staff, million tenge	974.9	1,294.2	1,254.6	1,481.2	2,303.0	1,581.7	2,207.6	3,073.6
Contract crews, million tenge	n/a	n/a	n/a	n/a	n/a	1,434.0	8.0	12.8
Additional payments, million tenge	n/a	n/a	n/a	n/a	n/a	2,571.5	3,595.4	5,943.5
Social tax, million tenge	1,811.0	2,245.9	2,369.2	2,649.4	3,566.1	1,984.0	3,479.2	4,916.3
Average monthly nominal salary of the company's employees, thousand tenge	181.5	207.2	202.0	240.7	332.7	285.8	395.4	589.9
Average monthly nominal salary in the field of transport, thousand tenge	123.7	142.9	150.8	162.7	229.8	253.0	292.1	386.7

Table 5

Dynamics of indicators of working conditions of Air Astana Group personnel during 2015–2022 [20–31]

Indicators	Years							
	2015	2016	2017	2018	2019	2020	2021	2022
Average staff turnover, %	7	8	7	6	6.3	9	7	6.8
Number of accidents	40	19	29	28	27	18	25	17
Total accident rate per 1,000 employees (TAR)	4.12	3.96	5.71	5.37	4.88	3.34	4.48	2.75

Based on the experience of airlines such as Cathay Pacific (Hong Kong) and Emirates (Dubai, UAE), Air Astana has established the creation of the Air Astana Training Academy, the only EASA-certified center in the Republic of Kazakhstan that organizes theoretical and practical training of technical specialists in accordance with Part 147/145 standards. The Center offers 30 programs in the field of engineering design, ground and airborne services based on international standards (ICAO, IATA and EASA 147/145) and is certified by the AAK.

For those who want to connect their future with the sky, Air Astana introduced the Ab-Initio pilot initial training program back in 2008. Since its inception, 262 pilots have received theoretical training, who continued practical training at such European flight training schools as: FTE Jerez (Spain), Patria (Finland) and Atlantic Flight Training Academy (Ireland), which exactly launched the Company's serious investments in personnel training (Table 6).

Currently, more than 50 % of the Company's pilots are graduates of the Ab-initio program, 60 of them have already received the title of aircraft commander. In 2022, 47 pilots with a full license, 37 pilots without a license and 22 gradua-

tes of the Ab-initio program joined the ranks of Air Astana pilots, i.e. the staff of pilots increased by 101 people.

In August 2022, the Company introduced a mandatory continuing education module. By the end of the year, more than 600 employees of the Department of Engineering and Technical Support had passed it. In the same year, primary training was conducted for 450 flight attendants, 268 ground handling specialists, as well as mandatory refresher courses for more than 3,000 representatives of the production staff.

The latest development in the field of operational training of specialists was the creation of its own safety training center in 2023. Currently, with the help of a mock-up of an Airbus 320 aircraft, the crew is being trained in actions and rules of survival in an emergency situation. The implementation of this project allowed Air Astana to avoid the need to train specialists abroad and, accordingly, reduce staff training costs.

By investing capital in strengthening the professionalism of its staff, Air Astana practically invests in long-term progress, since by creating a favorable environment for training and acquiring the necessary competencies by the Company's personnel, the Group's performance indicators are simultaneously increasing (Table 7).

Table 6

Dynamics of investments in the training of Air Astana Group personnel during 2015–2022 [20–31]

Indicators	Years							
	2015	2016	2017	2018	2019	2020	2021	2022
Investments in personnel training, million dollars	10.9	23.9	*	*	41.6	4.71	3.96	5.9
Staff training total, people	676	817	1,086	1,328	1,619	1,823	2,241	2,313
Including advanced courses and trainings	454	348	420	617	787	1012	1500	1
Ab-initio and Embraer E2 training programs	46	27	38	26	25	28	36	36

Note: * – the indicators are determined by calculation, based on the US dollar exchange rate set by the NBK as of December 31, each year.

Table 7

Dynamics of performance indicators of the economic activity of the Air Astana Group during 2015–2022 [20–31]

Indicators	Years							
	2015	2016	2017	2018	2019	2020	2021	2022
Total revenue, million tenge	163659.6	212848.9	250216.9	289336.8	343988.5	162716.5	324906.7	477981.8
million US dollars	761.7	621.0	767.5	840.9	898.7	400.3	761.8	1032.4
including passenger transportation, million tenge	156038.3	201848.9	234125.9	279336.8	315750.4	145548.9	305252.6	462171.9
cargo and mail, million tenge	4313.1	5366.6	6411.2	7136.5	8093.2	10207.2	14304.3	10209.4
– total revenue from passenger and freight transportation, million tenge	160351.4	207215.5	240537.1	286452.9	323843.6	155756.1	319556.9	472381.3
including: domestic directions, million tenge	52520.4	60094.0	67179.1	76741.4	89227.8	70384.9	131824.8	168629.4
international, of which: Asia and the Middle East, million tenge	37289.8	59264.9	51403.4	73969.6	83508.4	34341.9	66486.5	118867.6
CIS, million tenge	34318.8	101100.5	69342.8	71989.9	81265.9	19739.7	63210.7	52311.1
Europe, million tenge	36222.4	46850.2	52611.8	63772.4	69841.5	31289.6	58034.9	132573.1
– other income, million tenge	3308.3	5270.4	6915.9	3379.9	18353.6	4593.8	3360.6	5600.5
Net profit, million tenge	10362.7	–12833.9	12818.4	1844.9	11494.7	–38672.8	15485.6	37582.9
million US dollars	30.5	–38.5	39.32	5.35	30.03	–93.9	36.2	78.4
EBITDA, million US dollars	137.3	122.8	150.1	130.9	171.3	33.1	224.9	288.4

According to Table 7, Air Astana receives most of its total revenue from domestic and international passenger air transportation, which became possible with an increase in the number of routes as a result of certification of flight personnel, engineering support personnel, flight attendants, etc. In 2021, this figure amounted to 562.4 million USD, and in 2022 it increased even more by 39.2 %, reaching 782.9 million US dollars. At the same time, the growth in freight traffic observed during the COVID-19 pandemic has stopped, and revenues in this sector have decreased to USD 20.7 million in 2022 (2021: USD 31.9 million). Nevertheless, Air Astana’s contribution to the Group’s total revenue amounted to USD 875.9 million (2021: USD 659.7 million).

FlyArystan’s passenger revenue also increased by 40.3 % from USD 153.4 million in 2021 to USD 215.2 million in 2022. Other revenues remained stable, thus FlyArystan’s total contribution to the Group’s revenues in 2022 amounted to USD 217.9 million, compared with USD 156.5 million in 2021, i.e. an increase of 39.3 %.

To determine the closeness of the relationship between the favorable environment for improving the professionalism of the Company’s staff and the effectiveness of its business activities, the author’s methodology of a three-phase approach based on a set of properties (indicators) is proposed: motivation, working conditions and career growth.

To carry out modeling and assessment of the impact of the integral indicator of the favorable environment for improving the professionalism of personnel on the performance of aviation enterprises, its components should be dimensionless, whereas the initial indicators (indicators) may have

different dimensions. Therefore, in general, all the component indicators (selected indicators for modeling) should be converted to a normalized dimensionless value using one of the normalization methods.

At the same time, in the process of forming a set of indicators and their normalization, it was necessary to determine their contribution to the assessment of the integral indicator (weighting coefficients). It should be noted that in order to increase the favorable environment for improving the professionalism of staff, the value of some indicators of stimulants should be increased, while other stimulants should be reduced. The unidirectionality of the indicators is achieved by their specific selection and rationing.

The limitation of this study is that currently the system of information collection and exchange in the field of civil aviation in the Republic of Kazakhstan is not sufficiently transparent, which significantly complicates obtaining data on the conditions for improving the professionalism of airline personnel. Therefore, as an assumption, a reduced set of indicators was chosen for modeling based on available sources of reliable information (Table 8).

Table 8

A set of indicators for assessing the favorable environment for improving the professionalism of the airline staff

Indicators	Units of measurement	Designation	Expert assessment of weight coefficients
Motivation			
Employee incentive costs (Employee benefits)	million USD	x_1	0.39
Average monthly nominal salary of the company’s employees	thousand USD	x_2	0.61
Working conditions and safety			
Average staff turnover	%	x_3	0.6
Number of accidents	units	x_5	0.2
TAR, total accident rate	units	x_4	0.2
Career development			
Total staff training	people	x_6	0.44
Investing in training	million USD	x_7	0.56

As follows from Table 8, a certain structure of the integral indicator of the favorable environment for improving the professionalism of staff contains 7 indicators, the list of which is not a dogma and may vary depending on the goals and depth of the study. It is usually necessary to choose a compromise between simplicity and complexity. When using a very simplified list of indicators, there is a possibility that important features are not taken into account, and with a large number of indicators (even more than 50), the problem of increasing the dimension arises, which leads to a very rapid increase in the volume of space, as a result of which the available data become sparse, which prevents the use of a method using statistical significance. In general, there are no established rules for the formation of indicators, so the proposed list reflects the vision of the authors.

In this study, the Matlab R2018 software product was used for calculations, data analysis, construction of computational processes, models and drawings.

Denote by r_i ($i=1, \dots, 7$) the normalized dimensionless value of the corresponding indicator x_i from Table 8.

The rationing procedure performs two main functions:

- converts indicators of different dimensions to dimensionless values in the range $[0+1]$;
- allows you to compare multidirectional indicators.

After normalization, the dynamics of the normalized indicators should accurately reflect the dynamics of the original ones.

One of the most frequently used methods by researchers is normalization «by the scope of variation» with some modifications for indicators of a positive direction:

$$r_i = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}}, \quad (1)$$

for negative direction indicators:

$$r_i = \frac{x_{\max} - x_i}{x_{\max} - x_{\min}}. \quad (2)$$

Due to the fact that our indicators have not reached their maximum value and should continue to grow, we will introduce a normalizing coefficient $k_{norm} > x_{\max}$, for the selected data, we offer $k_{norm} = 1.3 x_{\max}$, to be able to increase the indicators by almost 30 % in our model in the near future.

Then we will rewrite formulas (1), (2) for indicators of the positive direction:

$$r_i = \frac{x_i - x_{\min}}{k_{norm} - x_{\min}}, \quad (3)$$

for negative direction indicators:

$$r_i = \frac{k_{norm} - x_i}{k_{norm} - x_{\min}}. \quad (4)$$

Indicators of a positive impact on the favorable environment for staff training are indicators of motivation and career growth, which we use to normalize (3). Indicators of average staff turnover, the number of accidents and TAR, the growth of which characterizes the negative side of working conditions, are indicators of negative influence, for which we apply rationing (4).

For the three components of the integral indicator of the favorable environment for training personnel of compe-

tencies, it is necessary to form some scalar function of the individual components r_{it} (indicators). The task of forming a scalar function is similar to the formation of a generalized criterion for multi-criteria optimization. The vast majority of researchers use the so-called «additive utility function» (linear convolution) by forming the sum of individual criteria multiplied by their weight coefficients – the «weighted sum method» [33, 34]:

$$I_t = \sum_{i=1}^n a_i \cdot r_{it}, \quad \sum_{i=1}^n a_i = 1, \quad a_i > 0, \quad (5)$$

a_i – weight coefficients.

We apply the method of expert assessments to find the weighting coefficients:

$$\begin{aligned} I_{motivation} &= 0.39 \cdot r_1 + 0.61 \cdot r_2, \\ I_{safetyLabor} &= 0.6 \cdot r_3 + 0.2 \cdot r_4 + 0.2 \cdot r_5, \\ I_{career} &= 0.44 \cdot r_6 + 0.56 \cdot r_7, \end{aligned} \quad (6)$$

where $I_{motivation}$ – motivation indicator; $I_{safetyLabor}$ – indicator of working conditions and safety; I_{career} – career growth indicator.

We propose to determine the integral indicator of the favorable environment for the acquisition of competencies by personnel using the following formula of nonlinear convolution [34]:

$$I_{profess} = I_{motivation}^{0.43} \cdot I_{safetyLabor}^{0.2} \cdot I_{career}^{0.37}, \quad (7)$$

where the degree indicators are also expert assessments.

It should be noted that in this work, during calculations and modeling, statistical data were analyzed for the presence of abnormal values detected in 2020, which is explained by the consequences caused by COVID-19. This paper uses the assumption that this is an isolated phenomenon that will not happen again. Therefore, all initial values for 2020 were smoothed based on the nearest neighboring values.

The trend of investment in training of the Company's personnel has been considered only since 2020, because until this year significantly higher values of training costs are associated with obtaining training services abroad. Since 2020, the training of the Company's personnel has mainly begun to be conducted in the Republic of Kazakhstan, which has significantly reduced the need for investments in training. Therefore, in order to better match the data model, the linear trend of the last three years is used in research.

The dynamics of the indicators and the integral indicator of the environment for improving the professionalism of the staff of the Air Astana Group, calculated according to formulas (6) and (7), are shown in Table 9.

We will conduct a study of the influence of the integral indicator of the favorable environment for improving the professionalism of personnel on the volume of revenue of the enterprise in order to identify functional dependencies and the possibility of forecasting. A significant impact on revenue was also noted from the mobility indicators shown in Table 10. Therefore, it is proposed to establish a multiple dependence of revenue volume on the influence of the integral indicator of the favorable environment for improving the professionalism of staff and the integral indicator of mobility.

Table 9

Dynamics of the integral indicator of the favorable environment for improving the professionalism of the staff of the Air Astana Group

Year	Motivation indicator	Career growth indicator	Indicator of working conditions and safety	An integral indicator of the favorable environment for the acquisition of competencies by personnel
2020	0.310358	0.511412	0.777333	0.448609
2021	0.367994	0.485143	0.74388	0.469228
2022	0.568461	0.700506	1	0.687581

Table 10

A set of indicators for assessing the level of airline mobility

Indicators	Units of measurement	Designation	Expert assessment of weight coefficients
Aircraft	units	x_8	0.1
Number of routes	units	x_9	0.3
Passenger traffic	million people	x_{10}	0.21
Cargo transportation volume	thousand tons	x_{11}	0.21
The load factor of the aircraft	%	x_{12}	0.18

All mobility indicators are indicators of a positive direction for the normalization of which we apply (3).

We propose to determine the integral mobility indicator using the nonlinear convolution formula in the same way (7):

$$I_{mobility} = r_8^{0.1} \cdot r_9^{0.3} \cdot r_{10}^{0.21} \cdot r_{11}^{0.21} \cdot r_{12}^{0.18}. \tag{8}$$

We also normalize the total revenue according to the formula (3). After conducting correlation and regression analysis of the data, smoothing the data and comparing various models, as well as finding the coefficients of multiple nonlinear regression after initial linearization using the generalized least squares method in matrix form [34], the authors propose a dependence of the following form:

$$I_{revenue} = 0.110 + 0.272 \cdot \sqrt{I_{profess}} + 0.731 \cdot I_{mobility}^2. \tag{9}$$

The resulting coefficient of determination is $R^2=0.74$, therefore, the selected type of connection should be considered sufficiently high in density.

The calculated value of the Fisher coefficient based on sample data $F=7.08$, the critical value of the Fisher coefficient $F_{cr}=5.79$ by degrees of freedom $k_1=2, k_2=5$, the level of significance $\alpha=0.05$. Checking according to the Fisher criterion $F > F_{cr}$ showed that with 95 % reliability, it can be considered that the proposed mathematical model (9) is adequate to statistical data and appropriate for practical application.

The surface corresponding to the dependence (9) is shown in Fig. 1, which clearly shows that the growth of mobility and the favorable environment for improving the professionalism of staff contributes to the growth of the performance indicators of the airline's business activities.

The Air Astana Group, taking into account its projection on the mobility of air transportation and the favorable environment for improving the professionalism of aviation personnel.

Fig. 2, based on formula (9), shows the dependencies of the total revenue of the Air Astana Group on the level of mobility of air transportation at a fixed value of the indicator of the favorable environment for improving staff professionalism at the level of 2022 (line 1) and on the level of the favorable environment for improving staff professionalism at a fixed value of the indicator of mobility at the level of 2022 (line 2). According to the

proposed model (9), with an increase in the integral indicator of environmental friendliness by 30 %, the volume of total revenue will increase by 32.48 % compared to the indicator of 2022 with a fixed value of the mobility indicator at the level of 2022, i.e. it will reach the amount of 1.368 million USD. With an increase in the integral indicator of the mobility level by 30 %, it is possible to increase the total revenue of the Air Astana Group by 43.78 % compared to 2022 with a fixed value of the indicator of the favorable environment for improving staff professionalism at the level of 2022, i.e. to the level of 1.484 million USD.

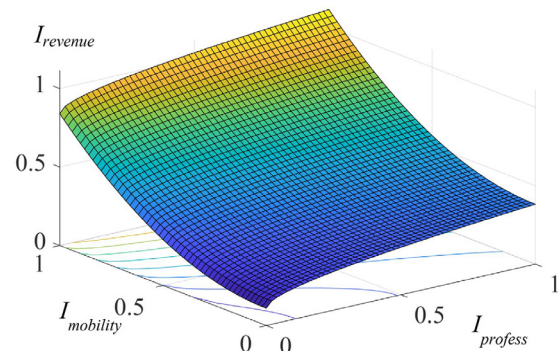


Fig. 1. Triangulation of economic performance

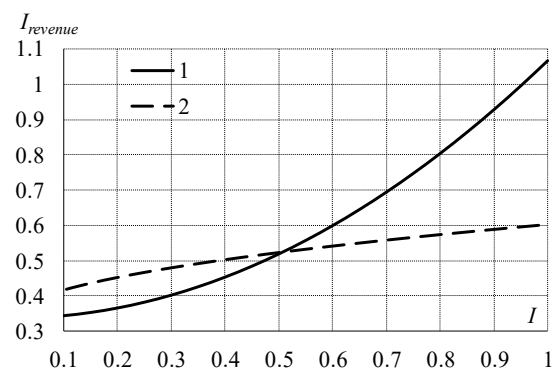


Fig. 2. The impact of mobility indicators (line 1) and the favorable environment for improving staff professionalism (line 2) on total revenue with fixed corresponding other indicators at the level of 2022

And so, according to the results of the analysis, we conclude that the more influential factor in the development of airlines, which significantly increases the growth rate of their total revenue, is the mobility of air transportation. However, its growth is possible only if airlines are fully provided with highly qualified personnel potential.

It is quite difficult to determine what the real volume of the shortage of specialists in aviation in the Republic of Kazakhstan is, since access to information on the qualitative composition of the personnel potential of airlines is practically closed. Therefore, we have the opportunity to see the necessary information about the qualitative composition of the Company's human resources only in the reports [20–25] on corporate social responsibility (CSR) for 2015–2017 (Table 11).

Table 11

The qualitative composition of the personnel potential of the Air Astana Group by employee categories for 2015–2017 [20–25]

Indicators	Years		
	2015	2016	2017
Average number, people	4,613	4,794	5,079
Including: senior management	19	20	23
Heads of functional divisions	17	19	20
Specialists	1,058	1,096	1,118
Flight crew	345	347	336
On-board service	1,342	1,449	1,569
Ship maintenance	287	319	331
Sales managers	276	292	314
Information technology	52	49	54
Other (working staff)	423	519	580

A similar situation is observed with regard to information on the qualitative composition of the Company's human resources by age categories, taken from sources [20–25] and shown in Table 12.

Table 12

The qualitative composition of the personnel potential of the Air Astana Group by age categories for 2015–2017 [20–25]

Indicators	Years		
	2015	2016	2017
Average number, people	4,613	4,794	5,079
Including those under the age of 25	973	934	1,019
26–35 years old	2,425	2,584	2,694
36–55 years old	1,066	1,101	1,159
Over 56 years old	149	175	207

The CSR reports for 2015–2017 [20–25] provide information on the qualitative composition of the Company's human resources by work experience (Table 13).

Table 13

The qualitative composition of the personnel potential of the Air Astana Group by work experience for 2015–2017 [20–25]

Indicators	Years		
	2015	2016	2017
Average number, people	4,613	4,794	5,079
Number of employees with 1–4 years of work experience	2,154	2,315	2,482
5–10 years	1,887	1,909	1,983
More than 10 years	572	570	614
Average length of service of employees, years	7.82	7.9	8.1

However, all these data do not correspond to the principles of building a Sectoral Qualifications Framework (SQF) in the aviation industry of the Republic of Kazakhstan, which clearly defines eight levels of qualification and competence of aviation employees. Currently, the Academy of Civil Aviation has developed an Information Map for assessing the state of the personnel potential of the air enterprises of the Republic of Kazakhstan, which will allow visualizing the compliance of airline personnel with the sectoral qualifications framework, professional standards and international requirements of ICAO, EASA, IATA [35].

The maintenance of Information Maps by airlines will create the necessary information support for monitoring the qualitative composition of the personnel potential of aviation of the Republic of Kazakhstan according to the competence approach, as well as building a centralized information platform on the level of professionalism of airline personnel, which will allow stakeholders involved in the development of aviation in the country to have a clear understanding of the compliance of professional competencies of civil aviation personnel with the requirements of the sectoral qualifications framework and international standards of ICAO, EASA, IATA.

5. 4. Building a simulation model of the procedure for monitoring the personnel potential of air enterprises using a competence-based approach

The need to build a universal algorithm for monitoring human resources using a competence-based approach is relevant for airlines in many countries [1, 2]. However, in each country it is necessary to take into account the specifics of local legislation. Based on the results of this study obtained above and taking into account world experience [1–5], we consider it advisable to monitor the quality of civil aviation personnel according to a competence-based approach, based on the triangulation of research using mixed methods, using data obtained as a result of the application of Information Maps of aviation enterprises developed by the Academy of Civil Aviation in accordance with the SQF of the Republic of Kazakhstan (Fig. 3).

In the context of the active digitalization of the aviation industry, which has been clearly expressed in recent years, the organization of monitoring of the personnel potential of airlines according to the competence approach according to the SQF of the Republic of Kazakhstan, as well as the creation of a centralized information platform is absolutely not difficult. However, the expected effect of their implementation in practice is enormous.

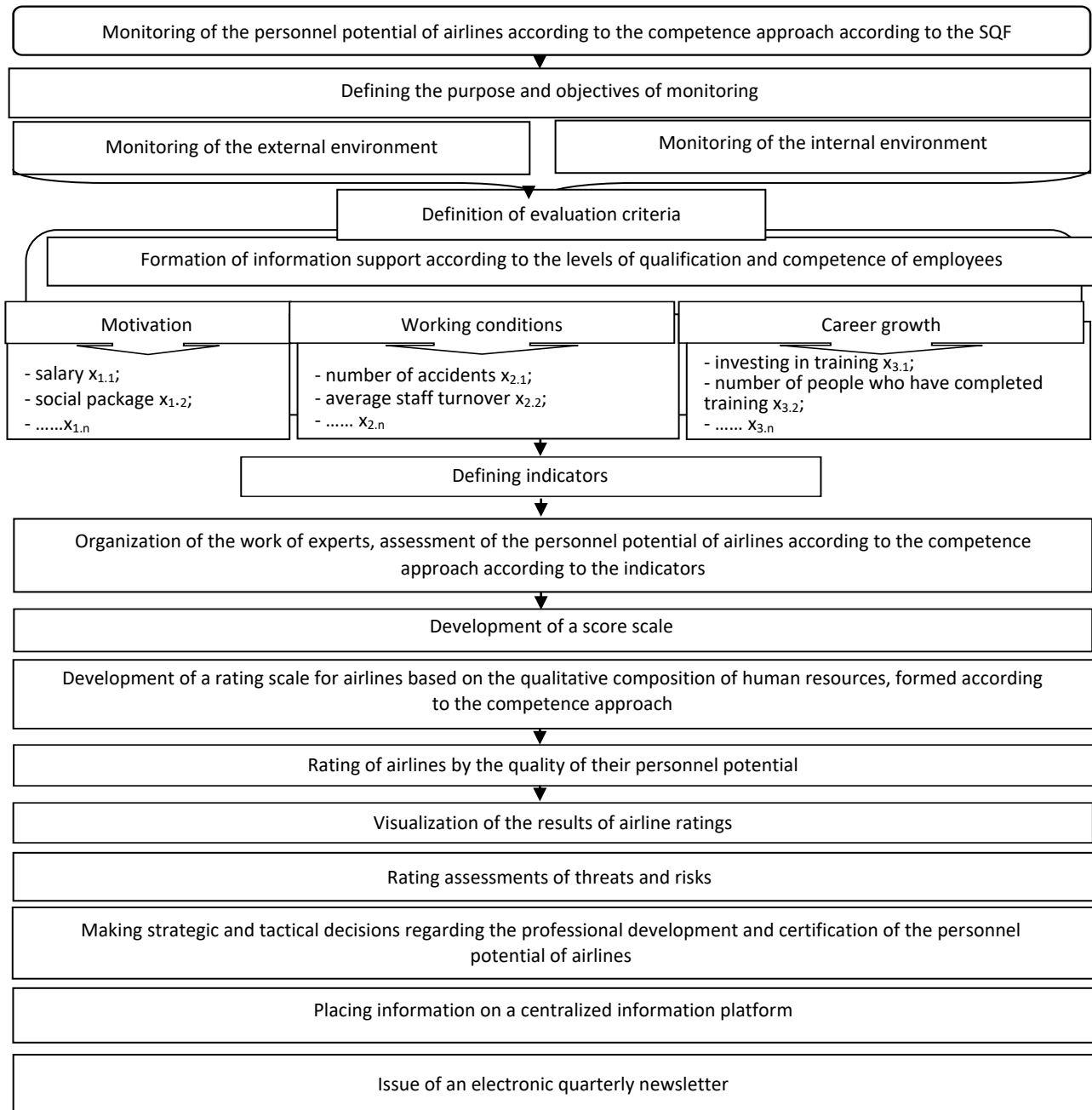


Fig. 3. A simulation model of the procedure for monitoring the qualitative composition of the personnel potential of airlines according to the competence approach

6. Discussion of the results of a study on the monitoring of the personnel potential of airlines based on the competence approach

The results of this work confirm the need for competency-based training and assessment and the importance of pilot training, which was presented in [2], which also indicates that the airline should review its organizational culture and implement the proposed recruitment method, however, a radical change in the personnel management system without taking into account local characteristics may be more or less effective, in relation to specific legislation on the terms of employment in different countries. The work [2] also lacks a quantitative statistical analysis of the impact of employee motivation indicators, working conditions and safety, and

accordingly there is no transparent monitoring algorithm. Unlike the study [1], where only a qualitative analysis was carried out, this work is also based on quantitative indicators.

In this study, according to the author’s methodology based on the use of triangulation by mixed methods, a comprehensive analysis of the environment for improving the professionalism of Air Astana Group personnel through indicators of motivation, working conditions and safety, as well as career growth opportunities (Tables 4–6) was carried out, the results of which indicate a high level of interest of the Company in the formation of human resources in accordance with the requirements of the SQF of the Republic of Kazakhstan and international standards.

Air Astana is a socially responsible company, successfully growing and making plans for the future. Guided by

previously conducted research [36] and realizing that human resources is one of the key assets contributing to its development, the Company increases investments in personnel from year to year (Table 4), which ensured the practical immutability of the average staff turnover rate during 2015–2022 (Table 3) (with the exception of 2020, when a significant part of flights were suspended due to the COVID-2019 pandemic), as well as an increase in the airline's performance indicators (Tables 2–7).

The closeness of the relationship between the company's performance indicators, the level of acquired staff compactness (7) and the mobility of air transportation (8) is characterized by an economic and mathematical model (9). This dependence has no analogues in the literature. Its appearance is explained by the correlation and regression analysis of panel data.

Fig. 1 clearly shows that the growth of mobility and the favorable environment for improving the professionalism of staff contribute to the growth of the performance indicators of the airline's business activities. With an increase in the integral indicator of the level of mobility by 30 %, the total revenue of the Air Astana Group can grow by 43.78 % compared to 2022 with a fixed value of the indicator of the favorable environment for improving staff professionalism at the level of 2022, i.e. to the level of 1.484 million USD (Fig. 2). Based on the proposed dependencies, it can be concluded that the mobility of air transportation is a more influential factor in the development of airlines, significantly increasing the growth rate of their total revenue. However, its growth is possible only if airlines are fully provided with highly qualified potential, which is a rather urgent problem for aviation in many countries today [1].

It is quite difficult to determine what the real volume of the shortage of specialists in aviation in the Republic of Kazakhstan is, since access to information on the qualitative composition of the personnel potential of the country's airlines is practically closed.

Currently, the Academy of Civil Aviation of the Republic of Kazakhstan has developed an Information Map for assessing the state of aviation personnel potential, the application of which in practice will allow: to visualize the compliance of airline personnel with sectoral qualifications frameworks, professional standards and international requirements of ICAO, EASA, IATA [35]; to create the necessary information support for monitoring aviation personnel potential according to a competence approach; to launch a centralized information platform. This will allow stakeholders interested in the development of the country's aviation to have a clear understanding of the completeness of the fulfillment by air carriers of the requirements for personnel certification.

According to the results of this study, the expediency of monitoring the quality of the personnel of civil aviation according to the competence approach, based on the triangulation approach of research using mixed methods, has been proved. The use of this approach in other countries is also relevant and possible, since this study was based on the international requirements of ICAO, EASA, IATA, but with mandatory consideration of the specifics of national professional standards.

Taking into account the Information Maps proposed by the Academy of Civil Aviation of the Republic of Kazakhstan on the assessment of the personnel potential of airlines and its compliance with the requirements of the SQF of the Republic of Kazakhstan, guided by the interests of stakeholders

in obtaining complete and reliable information, a simulation model of the procedure for monitoring the qualitative composition of the personnel potential of airlines according to the competence approach has been developed (Fig. 3).

The introduction of a centralized information platform and the organization of monitoring of the personnel potential of airlines according to the competence approach according to the developed algorithm in the conditions of accelerated digitalization of the industry do not pose significant difficulties. However, the expected effect of their implementation in aviation of the Republic of Kazakhstan is enormous, since it will ensure not only the development of the industry, but also the economy of the country as a whole.

The main limitation in this study was the lack of full-fledged information support on the qualitative composition of the personnel potential of airlines, since the issue of creating a centralized information database on personnel competencies and their compliance with the SQF of the Republic of Kazakhstan and international standards has not yet been resolved at the state level. The organization and monitoring of the qualitative composition of aviation personnel potential according to the competence approach will help solve this problem in the future and will provide an opportunity to expand the scope of this study by introducing additional indicators characterizing the level of professionalism of personnel. The use of this approach in monitoring the quality of aviation personnel in other countries requires taking into account the specifics of national legislation.

7. Conclusions

1. It was found that the trends in the development of aviation in Kazakhstan are characterized by positive dynamics achieved as a result of: systematic work at airports to modernize the air transport infrastructure, complete liberalization of the domestic air transportation market, the introduction of subsidized air routes for domestic tourism, etc. This is confirmed by data from the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, according to which, by the end of 2022, almost 11 million passengers were transported by domestic airlines, which led to an increase in passenger turnover by more than 35 % compared to the previous year, and the volume of flights serviced amounted to 410 thousand aircraft, which is 90 % higher than in 2021 (215 thousand aircraft).

2. It is proved that one of the factors negatively affecting the development of aviation in the Republic of Kazakhstan is the shortage of highly qualified personnel, the causes of which are recognized:

- the launch of new international flights, which is possible if the airline of Kazakhstan is fully provided with human resources with competencies in accordance with the requirements established by ICAO and other international organizations that control the safety of air transport;
- replenishment of the air fleet with modern aircraft and, accordingly, the need to form a new generation of aviation personnel;
- the practical absence of offers from professionals in the field of civil aviation in the labor market.

3. The expediency of using triangulation research by mixed methods in assessing the favorable environment for improving the professionalism of airline personnel, as well as the relationship between/among variables characterizing

motivation, working conditions and the possibility of professional development of Aeroflot air and ground staff is justified.

4. An algorithm for monitoring human resources has been developed based on an audit of compliance of professional competencies of civil aviation personnel with international standards of ICAO, EASA, and IATA, the application of which in practice will create a centralized information platform with open access to data on the staffing of airlines and aviation in general, which will ensure the elimination of the existing shortage of personnel by timely adoption of corrective measures to amend the state training programs for aviation specialists, as well as to improve their skills.

The use of the developed algorithm is possible in other countries, since this study was based on the international standards of ICAO, EASA, IATA, but with mandatory consideration of the specifics of national professional standards.

Conflict of interest

The authors declare that they have no conflicts of interest in relation to the current study, whether financial, personal,

authorship, or otherwise, that could affect the study and the results reported in this paper.

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Data availability

All data is available in the main text of the manuscript.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the submitted work.

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