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Technology and Structure of The Development of Personnel Strategy of a Project in The Aviation Industry

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Abstract*: The human resourcing component of the problem of analyzing the strategic efficiency of the industrial enterprises' projects for high-tech products (HTP) creation is highlighted. The dynamics of the key performance indicators of the aviation industry and the results of the analysis of achieving the target industry indicators in the aircraft manufacturing sector describing human resources are presented. A system is proposed for selecting the indicators for assessing the level of development of the project human resourcing. The specific features of the project human resourcing in the aviation industry of the Russian Federation are reflected. A method of assessing the level of development of personnel structural characteristics of the strategic efficiency of the HTP creation project in the aviation industry is proposed, taking into account the factor of their territorial production and assembly.

Keywords*: aviation industry, high-tech products, strategic efficiency of the project, project human resourcing, level of development, balanced scorecard for human resource assessment, methods for assessing the level of development of the personnel structural characteristics of the strategic efficiency.

I. INTRODUCTION

The methods for assessing investment projects existing in theory and practice are based on approaches to assessing the project efficiency prevailing in world practice, primarily on modeling cash flows, scenario prediction of the market environment and other external factors, achieving the required rate of return, and taking the uncertainties and risks associated with the project implementation into account. These issues are covered in the works of E.I. Krylov, V.M. Vlasova, I.V. Zhuravkova, D.Yu. Lapygin, Yu.N. Lapygin, and M.V. Chinenov [1-3]. However, there is no method in the world practice for assessing the level of developing the personnel structural characteristics of the strategic efficiency of a project to create HTPs in the aviation industry.

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II. METHODS

A. Block diagram

The analysis has revealed that the project activity of enterprises in the aviation industry is defined by the level of development and quality of using the human resourcing, material, technological, and service provision, which are the structural characteristics of the project's strategic efficiency [4]. One of the most significant factors defining the prolonged sustainable development of the aviation industry enterprises is their human resourcing. The economic potential of the country, the rate of production development, and the increase in the living standards largely depend on how fully and efficiently labor resources are used [1, 2].

Table 1. Specific features of projects human resourcing for the HTP creation in the aviation industry of the Russian Federation

#	Characteristics
1.	increasing complexity of labor due to the continuous increase in the level of labor equipment and production
2.	high proportion of industrial personnel in the total headcount
3.	special innovative activity and susceptibility of personnel
4.	high proportion of intellectual activity
5.	aging of human resources over the years in the aviation industry as a whole
6.	uniqueness of scientific design and technological schools, experimental bases, industries, personnel, and air transportation systems
7.	average age of employees is over 40
8.	share of employees with higher professional education is 43 % on average
9.	share of employees with high school and vocational education is 57 %
10.	more than 50 – 60 % of the total number of personnel are workers of the main production

The following trends are projected for changes in the key performance indicators of the aviation industry, in accordance with the state program of the Russian Federation "Development of the aviation industry for 2013 – 2025" [5-7]:

The achievement of target industry indicators describing human resourcing with indicators of labor productivity and return on personnel in terms of net profit was analyzed as part of the study of industry trends. The results of the analysis are presented in Figures 1 – 6.

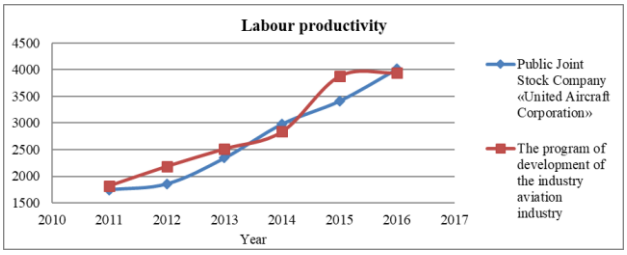

Fig. 1: Dynamics of labor productivity of PJSC United Aircraft Corporation in accordance with the aviation industry development program for 2011 – 2017

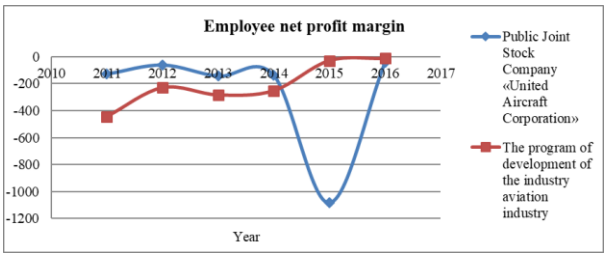

Fig. 2: Dynamics of return on personnel in terms of net profit of PJSC United Aircraft Corporation in accordance with the aviation industry development program for 2011 – 2017

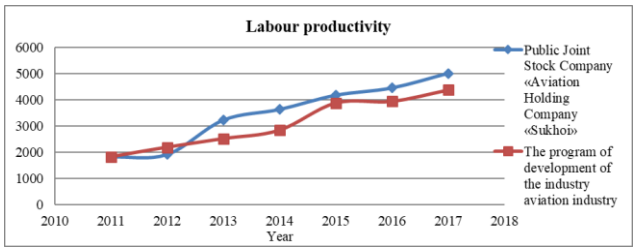

Fig. 3: Dynamics of labor productivity of PJSC Sukhoi Company in accordance with the aviation industry development program for 2011 – 2017

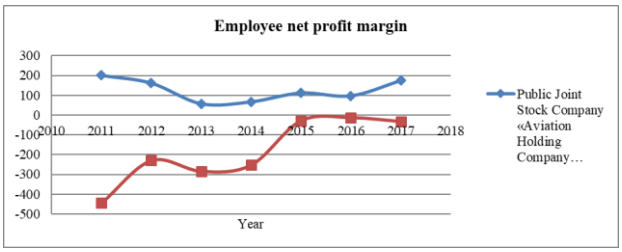

Fig. 4: Dynamics of return on personnel in terms of net profit of PJSC Sukhoi Company in accordance with the aviation industry development program for 2011 – 2017

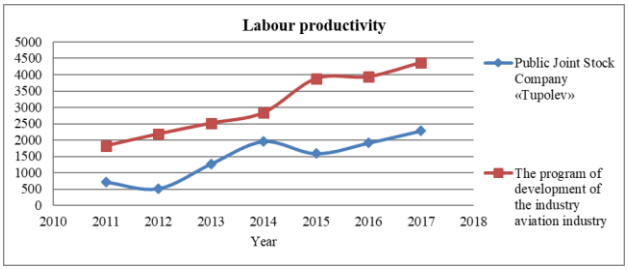

Fig. 5: Dynamics of labor productivity of PJSC Tupolev in accordance with the aviation industry development program for 2011 – 2017

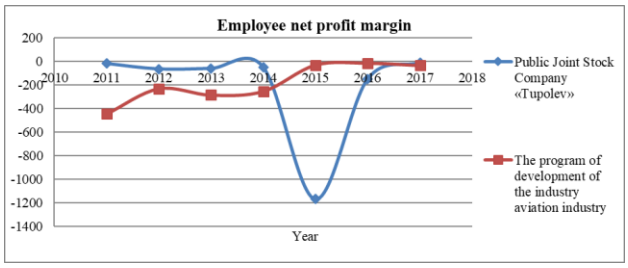

Fig. 6: Dynamics of return on personnel in terms of net profit of PJSC Tupolev in accordance with the aviation industry development program for 2011 – 2017

A balanced scorecard should be considered in order to fully assess the state of the project human resourcing to create HTPs in the aviation industry [2, 3, 7, 8]. In order to eliminate duplicate indicators or provide redundant and incorrectly structured information, an optimal system of indicators should be developed, which is a ready-made methodological toolkit for assessing project human resourcing taking into account the specifics of the industry and features of the enterprises participating in the project cooperation.

The strategic efficiency of projects of industrial enterprises is proposed for analysis in the study in order to create HTP from the standpoint of structural characteristics: material, personnel, technology, service, etc.

Goal of the study is to develop a method for determining the level of development of personnel structural characteristics of the strategic efficiency **of the HTP creation project**, taking the specifics of the aviation industry into account.

It is proposed to identify periods of recession, a sharp increase and a long steady growth (increase period) in the human resourcing analysis. It is also proposed to carry out an analysis of time levels: past, present and future.

The authors propose to assess the personnel structural characteristics of the strategic efficiency of the project using the following indicators (Tables 2 – 4):

Table 2. System of quality indicators to assess the level of development of the project human resourcing in terms of "industrial production personnel"

AREA OF ANALYSIS	INDICATOR
Industrial production personnel	Availability of special knowledge and experience of using technological processes and materials aimed at improving product designs by a specialist
	Ability to apply ACS/SAM/REM/CAD|CAE technology in design and preproduction
	Ability to design, manufacture, and install the equipment using the modern instrumentation systems
	Ability to apply high-speed laser and waterjet cutting technology (parts, workpieces)
	Ability to apply high-resource sealed riveting technology on automatic riveting machines
	Ability to apply high-speed machine processing with the development of group methods of machine processing
	Ability to apply effective coatings and proactive inhibiting compounds for anticorrosive protection of structures
	Ability to control the manufacturing process using laser optical measurement systems
	Ability to develop and implement quality control systems for cast, welded, machined parts and components made of PCM using modern non-destructive testing methods
	Knowledge and skills of personnel to produce aircraft flight technical and operational characteristics which exactly meet the technical task
	Skills of designing and manufacturing measuring and cutting tools, as well as technological equipment for working with new materials and products
	Knowledge and skills in the development and debugging of new technological processes for the manufacture of products from the new modern materials

Table 3. System of quality indicators to assess the level of development of the project human resources in terms of "enterprise management"

AREA OF ANALYSIS	INDICATOR
	Skills in negotiating the organization of the sale of finished products through leasing – the practice of creating the optimal financial and leasing schemes
	Ability to form a backlog of firm orders, ensuring a uniform production load in accordance with the schedule of return on investment
	Ability of the management to comply with the terms of technical re-equipment and hold a tender for the selection of the equipment suppliers and contractors
	Ability to develop and implement programs for an efficient system of technical maintenance of operation throughout the entire product life cycle all over the world
	Knowledge of tax legislation
	Experience in the preparation of technical solutions for the layout of components

The workforce quality is a complex, multidimensional category. It is defined by the level of qualification, vocational training, education, work experience, age, and also largely depends on the socioeconomic conditions where the main part of the working-age population is located.

Table 4. The system of quantitative indicators for assessing the level of development of the project human resourcing

AREA OF ANALYSIS	INDICATOR
Use of labor conditions and its organization	Personnel constancy rate in the calendar year
	Personnel turnover rate
	Personnel stability rate
	Indicator of the share of industrial personnel in the total headcount
Implementation of the plan	Indicator of the plan implementation in terms of the project productivity
	Indicator of the plan implementation for the payroll of industrial personnel
	Indicator of the plan implementation in terms of production costs
General indicators of the human resources efficiency	Labor productivity
	Return on labor resources by payroll
	Deviation rate of the average salary from the average for the industry
	Salary return on revenue

	Salary capacity of products

B. Algorithm

The method for assessing the level of development of the **personnel structural characteristics of the strategic efficiency of the HTP creation project in the aviation industry** includes the following four main stages:

1. Classification of the structural elements of the HTP production object by their functional purpose.

2. Classification of the HTP creation process: – the stage of production and the stage of the primary assembly of purchased components; – the stage of final assembly of HTPs. As such, the personnel structural characteristics of the strategic efficiency of the project are described by the following: – development of the quality of the personnel's dealing with materials; – development of the quality of the personnel's dealing with production and assembly of components; and – development of human resourcing of the final HTP assembly.

3. Classification of the HTP design elements with due consideration for the development of the project human resourcing (grading scale):

1 – low development of the project human resourcing;

2 – average development of the project human resourcing;

3 – above average development of the project human resourcing; or

4 – the highest development of the project human resourcing.

4. Assessment of the quality of the HTP structural elements and the human resourcing development with due consideration for the degree of the country risk using the scoring method:

4.1. A single system of indicators describing the development of the structural characteristics of the strategic efficiency of the project is formed. Further, on the basis of the developed system of indicators, the human resourcing development is determined using the matrix questionnaires for each i_m-th component of the m-th structural element of the HTP. At the same time, an individual list of indicators describing the human resourcing development can be selected for each i_m-th component of the m-th structural element of the HTP, taking the significance factor into account. The system of qualitative and quantitative indicators for assessing the human resourcing development is presented in Tables 3 – 5.

Further, the initial assessment of the human resourcing development of the i_m-th component of the m-th structural element of the HTP at the production stage is defined, which does not take the territorial factor into account:

$$O_{i_m}^{j_{HR}}(\overline{X^t}) = \sum_{q=1}^{n} I_{i_m}^{j_{HR}}(\overline{X^t}) * B_q, \quad (1)$$

where $O_{i_m}^{j_{HR}}(\overline{X^t})$ is the assessment of the human resourcing development of the i_m-th component of the m-th structural element of the HTP at the production stage;

$i_m = 1 \ldots n_m$ is the component of the m-th structural element of the HTP;

$j_{HR} = 1 \ldots 3$ is the element describing the structural characteristic of the strategic efficiency of "human resourcing" – 1) development of the quality of the personnel's dealing with materials; 2) development of the quality of the personnel's dealing with production and assembly of components; and 3) development of human resourcing of the final HTP assembly;

$q = 1 \ldots n$ is the number of the indicator in the system of indicators describing the human resourcing development of the i_m-th component of the HTP m-th constructive element at the production stage;

$I_{i_m}^{j_{HR}}(\overline{X^t})$ is the assessment of the category of the indicator, which describes the development of the i_m-th component of the m-th constructive element of HTP at the production stage and is determined by experts using the appropriate system of indicators; and

B_q is the weight of the indicator in the general system of indicators describing the human resourcing development of the i_m-th component of the HTP m-th structural element at the production stage, in shares. The significance of an indicator is determined by experts according to its place in the system of indicators and the fact how accurately (directly or indirectly) it fully describes the object of study being analyzed.

4.2. Assessment of the human resourcing development of structural elements of the HTP, taking into account the factor of their territorial production, i.e., the country-specific risk. Those components and constructive elements of the HTP that are manufactured using the human resourcing of the Russian enterprises in Russia are recognized as strategically efficient. The scale of the country-specific risk coefficients includes two values of variables (Boolean variables):

0 – production and assembly are carried out by personnel of the Russian Federation;

1 – production and assembly are carried out by personnel of the Russian Federation.

It is assumed that the final assembly is carried out exclusively by the staff of the Russian Federation, i.e., the country-specific risk factor of the final assembly is equal to one and is not reflected in the formula.

Assessment of the human resourcing development of the m-th structural element of the ECP at the production stage is carried out according to the following formula:

$$OG_{i_m}^{j_{HR}}(\overline{X^t}) = \sum_{i_m=1}^{n_m} O_{i_m}^{j_{HR}}(\overline{X^t}) * B_{i_m} * CR_{i_{m'}} \quad (2)$$

where: $m = 1 \ldots m'$ is the constructive element of the HTP;

B_{i_m} is the significance (weight) i_m of the i_m-th component of the m-th structural element of the HTP at the production stage, in shares.

Elements of the structure that are key from the standpoint of their strategic efficiency are identified;

CR_{i_m} is the coefficient of the country-specific risk for the production of the i_m-th component of the m-th structural element of the HTP at the stage of production and assembly of components.

Comprehensive assessment of the design element of the HTP at the production stage:

$$OG_{i_m}^{HR}(\overline{X^t}) = \sum_{i_m=1}^{n_m} OG_{i_m}^{jHR}(\overline{X^t}) * B^{jHR}, \quad (3)$$

where, B^{jHR} is the weight of the structural characteristics.

4.3. Assessment of the human resourcing development of the m-th constructive element of the HTP, with due consideration for the factor of their territorial primary and final assembly.

This stage begins with determining the human resourcing development of the m-th structural element of the HTP, which is determined similarly $O_{i_m}^{HR}(\overline{X^t})$ (formula 1) using the corresponding system of indicators.

Further, the country-specific risk factors are determined for the assembly of purchased components and for the final assembly of HTPs in general. Further, a comprehensive assessment of the human resourcing development for the creation of a constructive element of the HTP is found:

$$O_m^{FA}(\overline{X^t}) = OG_{i_m}^{HR}(\overline{X^t}) * CR_m * B_{PA}^{HR} + O_{i_m}^{HR}(\overline{X^t}) * B_{FA}^{HR}, \quad (4)$$

where CR_m is the country-specific risk coefficient for the assembly of the m-th structural element of the HTP at the stage of production and assembly of components;

B_{PA}^{HR} is the weight of the assessment of the human resourcing development of the m-th constructive element of the HTP at the production stage, in shares; and

B_{FA}^{HR} is the weight of the assessment of the human resourcing development of the m-th structural element of the HTP at the final assembly stage, in shares.

4.4. Comprehensive assessment of the human resourcing development in the HTP creation:

$$O_{BC}(\overline{X^t}) = O_m^{FA}(\overline{X^t}) * B_a \quad (5)$$

III. RESULTS

The practical implementation of the algorithm for assessing the human resourcing development (stage 4.2. – 4.3.) is shown in fragments, by the example of the MS-21 composite wing project, with the production site being JCS AeroComposite – Ulyanovsk. The main customer of the company is JSC Irkut Corporation. The company is equipped with the modern automated equipment developed in accordance with the requirements of the AeroComposite [9, 10]. The modern polycomposite constructional materials are used in the production of elements of designs.

The industrial production personnel of the enterprise should be able to produce the wing structural elements using a vacuum infusion method, which involves the following steps: tooling preparation, laying out auxiliary materials, laying out a dry carbon tape and automatic pre-shaping on the laying equipment, assembling a vacuum bag, infusion (impregnation) of a dry stock material in a thermal infusion automated center, package development and stripping of parts, nondestructive testing, mechanical processing, control of geometry, painting, and assembly of the product.

A comprehensive assessment of the human resourcing development for the composite wing creation for passenger medium-haul aircraft MS-21-300 at the production stage can be defined using formulas 2 – 3.

Table 5. Comprehensive assessment of the human resourcing development for the composite wing creation for passenger medium-haul aircraft MS-21-300 at the production stage

Structural characteristics of the project's strategic performance	**Human resourcing development**						Country-specific risk for production
	Development of the quality of the personnel's dealing with materials			**Development of the quality of the personnel's dealing with production and assembly of components**			
	Score	Weight	Col.1*Col.2*Col.7	Score	Weight	Col.4*Col.5*Col.7	
	1	2	3	4	5	6	7
Structural elements of the wing for passenger medium-haul aircraft MS-21-300							
1. Wing slats	3.00	8 %	0.24	3.00	8 %	0.24	1.00
2. Panels of the nose part of the wing console	2.00	9 %	0.18	2.00	9 %	0.18	1.00
3. Winglets	2.00	20 %	0.40	1.00	20 %	0.20	1.00
4. Panels of the tail part of the wing console	2.00	9 %	0.18	2.00	9 %	0.18	1.00

Structural characteristics of the project's strategic performance	**Human resourcing development**						Country-specific risk for production
	Development of the quality of the personnel's dealing with materials			**Development of the quality of the personnel's dealing with production and assembly of components**			
	Score	Weight	Col.1*Col.2*Col.7	Score	Weight	Col.4*Col.5*Col.7	
	1	2	3	4	5	6	7
5. Aileron	2.00	8 %	0.16	1.00	8 %	0.08	1.00
6. Outer flap	2.00	8 %	0.16	2.00	8 %	0.16	1.00
7. Inner flap	2.00	8 %	0.16	2.00	8 %	0.16	1.00
8. Interceptors	2.00	10 %	0.20	1.00	10 %	0.10	1.00
9. Air brake	2.00	20 %	0.00	2.00	20 %	0.00	0.00
Comprehensive assessment of the development of the structural characteristics of the wing components	1.68			1.30			-
Weight of the structural characteristics	50 %			50 %			
Comprehensive engine evaluation	**1.49**						

A comprehensive assessment of the human resourcing development for the composite wing creation for passenger medium-haul aircraft MS-21-300 at the final assembly stage can be defined using formula 4.

Table 6. Comprehensive assessment of the human resourcing development for the composite wing creation for passenger medium-haul aircraft MS-21-300 at the final assembly stage

Structural characteristics of the strategic efficiency of the project / Constructive element of the HTP	Stage of production and assembly of components		Final assembly stage	**Comprehensive assessment of the human resourcing development for the composite wing creation for passenger medium-haul aircraft MS-21-300 at the final assembly stage**
	Comprehensive assessment of the structural element of the wing for passenger medium-haul aircraft MS-21-300	Coefficient of the country-specific risk	Human resourcing development of the final assembly of the aircraft / Assessment of the structural element of the HTP	
1	2	3	4	5
Wing creation for passenger medium-haul aircraft MS-21-300	1.49	1.00	3.30	**1.53**
Weight of score	75.0 %		12.5 %	

The estimated score of 1.53 falls into category 2 – the average level of development of the **personnel structural characteristics of the strategic efficiency** of the composite wing creation project for the passenger medium-haul aircraft MS-21-300.

As such, this method secures a comprehensive technical and economic assessment of the human resourcing development for the structural elements of HTPs and the production facility as a whole that influences the formation of the strategic efficiency of the HTP creation projects in the aviation industry, taking into account the factor of territorial production and assembly.

IV. DISCUSSION

The relevant and significant method for assessing the personnel structural characteristics of the strategic efficiency of the HTP creation projects in the aviation industry has been developed. However, a method for determining the strategic efficiency of the project with due consideration for the assessment of the level of development of structural characteristics, which is used to increase the efficiency of managerial decisions at the strategic planning level, should be developed. It is advisable to develop a mechanism for evaluating the strategic efficiency of the HTP creation projects in the aviation industry with a feature of planning the direction of development of the personnel structural characteristics of the strategic efficiency of the project.

V. CONCLUSION

The current state and development trends of industrial enterprises in the aviation industry have been explored in the article. The personnel component of the problem related to analyzing the strategic efficiency of the HTP creation projects of industrial enterprises is substantiated.

The indicators of the aircraft manufacturing sector describing human resourcing for 2011 – 2017 have been analyzed. The balanced scorecard for indicators assessing the project human resourcing development has been substantiated. The method has been developed for assessing the development of the personnel structural characteristics of the strategic efficiency of the HTPs project creation in the aviation industry, taking into account the factor of their territorial production and assembly. The method for assessing the development of the personnel structural characteristics of the strategic efficiency of the project to create a composite wing for passenger medium-haul aircraft MS-21-300 has been implemented in practice.

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