

# Economic Efficiency of Establishing Russian Aircraft Repair and Maintenance Service Centers using Subsidized Project Financing

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**Abstract:** This study analyses the development of the aviation industry in Russia, based on the "Strategy for the Development of the Aviation Industry of the Russian Federation until 2030". Also, it examines the procedures for developing an investment project to create aviation service centers for after-sales maintenance and repair of aircraft, as well as the mechanisms for justifying the discount rate and methods for assessing the effectiveness of the investment project (risk analysis). Furthermore, this article sets and solves the task of developing and evaluating the efficiency of the investment project of creating an aircraft after-sale technical maintenance and repair center for Sukhoi Superjet 100 (SSJ 100). In order to solve these problems, the methods of financial and economic analysis, budgeting, economic and mathematical modelling were used. The result of the work is a financial model of the investment project for the creation of SSJ 100 aircraft after-sales service and repair center.

**Keywords:** aviation industry, government policy, investment project, after-sales service centers, investment costs, profitability index.

## I. INTRODUCTION

In 2016, the Government of the Russian Federation approved the "Strategy for the Development of the Aviation Industry of the Russian Federation until 2030", which is a continuation of the federal target program "Development of the Transport System of Russia (2010 - 2020)" [1]. The main provisions of the Strategy were updated to reflect the changes in Russia and the world.

The analysis showed that, in Russia, the consolidation of the aviation industry has been completed; scattered aviation assets have been collected in large integrated companies with state participation: PJSC United Aircraft Corporation, JSC Tactical Missile Corporation, JSC Russian Helicopters, JSC United Engine Corporation, JSC Concern of Radioelectronic Technologies, JSC Technodynamics. Over the last ten years, the production, design and research complex has been modernized, and new products for civil, military and special purposes have been brought to the market.

Volatility of the economic situation is observed. The competitive and market environment is changing, new competing countries and fundamentally new technological solutions in the aircraft industry have appeared. Geopolitical changes in the world raise the question about building new international alliances and import substitution in the industry.

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The state policy on the aviation industry has been adjusted. If five years ago the state policy was aimed at carrying out research and development, technical and technological re-equipment of aviation enterprises, in modern conditions the state support shifts towards promotion of aviation industry products in the domestic and foreign markets and creation of a leading, scientific and technical reserve.

An urgent practical task is to preserve the competitive advantages of Russian aircraft manufacturers not only at the stages of production and sales, but also throughout the entire life cycle of civil and military products. The lack of an effective after-sales service system for domestic aircraft is a serious problem for airlines operating Russian aircrafts and puts in question the proper level of competitiveness of Russian products. The analysis shows that the world's largest aircraft manufacturers (Airbus, Boeing, Embraer, and Bombardier) allocate from 30 to 50% of their working capital to the solution of after-sales service tasks carried out by their subsidiaries [10].

Within the framework of implementation of the strategy for development of the aviation industry and transport infrastructure, the Government of the Russian Federation approved the program of subsidies to Russian companies for creation of aviation service centers for aftersales maintenance and repair of aircraft SSJ 100 [2,4]. For these purposes, the budget for 2018 provides for 1.13 billion rubles; for 2019, 1.22 billion rubles; and for 2020, 2.41 billion rubles [4].

## II. OBJECTIVE

Development and evaluation of the effectiveness of the investment project for the establishment of an aviation service center for after-sales maintenance and repair of Sukhoi Superjet 100 (SSJ 100) aircraft.

Aircraft after-sales service and repair centers should provide 24/365 system support and provide the following range of services:

- aircraft maintenance and repair;
- maintenance of avionics;
- engine maintenance and repair;
- painting;
- quick access to the spare parts pool;
- services to eliminate the situation of AOG (Aircraft on Ground): this is the state when, for technical reasons, the aircraft is not ready for departure.

This is the main problem for airlines using Russian aircraft. Such situations lead to delays, downtime and, as a result, major losses for airlines.

**III. ECONOMIC AND FINANCIAL ASPECTS OF THE PROJECT**

SSJ 100 aircraft are operated worldwide. As of May 30, 2018, 163 aircraft have been built, of which 3 are for static testing and 160 are flying units. In addition to Russia, the SSJ 100 is operated in 7 countries, including Ireland, Kazakhstan, Mexico, Thailand, Armenia, Indonesia, and Laos. Mexico is the largest SSJ 100 customer, with 22 units transferred and operated, and new aircraft are expected to be

delivered. In Mexico, this type of aircraft is operated by Interjet Airlines (Figure 1). It ranks second after Aeroflot (35 aircraft) in terms of number of SSJ 100 aircraft in the fleet [17].

The main specialization of Interjet is the performance of passenger flights within Mexico itself along 37 destinations. The airline's hub airports are in Mexico City and Toluca de Lerdo, from where it also operates international flights to the United States, Colombia, Costa Rica, Cuba and Guatemala.



**Figure 1. Interjet route network [17]**

In 2017, the Mexican airline had to "disassemble" several Russian aircraft for spare parts due to problems with their delivery. Three Mexican airlines have not flown since May 14, July 18 and August 21, 2017. The fourth one was damaged in October 2015 when towing at the airport [17].

The most important problem of SSJ 100 now is the after-sales service. Currently, there are no Russian aircraft maintenance and repair centers in Central and South America. Long downtimes and the lack of an established maintenance and repair system may have a negative impact on the agreements between the airline and the manufacturer, and further close the promising sales market.

To eliminate this problem, it is proposed to create a network of service centers in the countries to which the SSJ 100 is supplied. This will make it possible to increase the level of competitiveness of Russian aircraft and expand the sales market. In the study, the efficiency of the investment project for the creation of a service center, providing maintenance and repair of elements and units of SSJ 100 aircraft in Mexico was assessed. It is planned to create a subsidiary structure of the manufacturer and to open a branch in Mexico City.

**Table 1. Project basic data**

Name of project	SCAC, Sukhoi Civil Aircraft Company - Service
Investment size	3.35 billion rubles / 53.49 million dollars
Initiator of project	SCAC, Sukhoi Civil Aircraft Company
Key contributors to project financing	PJSC Sberbank - 75% SCAC, Sukhoi Civil Aircraft Company - 25%
Special design company	SCAC, Sukhoi Civil Aircraft Company - Service
Loan rate	9.75%
Project duration	5 years

The selection of suppliers of equipment, software, materials and components, as well as the training of personnel will be carried out by placing notices on the official website of public procurement and conducting competitive procedures.

The profitable part of the project is calculated based on the scope of work and the cost of maintenance. There are two methods of calculation: depending on flying hours or depending on the cost of the aircraft [10,11].

One hour of flight requires 50 man-hours of work. Interjet Airlines flies to 37 destinations. About 28 000 flights are operated per year [17]. The cost of working hour

of Daily Check, A-Check and C-Check for Russian airlines is 2 000 rubles. Interjet's route network for the first quarter of 2018 shows that they operated 7 000 flights with SSJ 100 aircraft, 10 145 hours per quarter. During the year, about 28 000 flights or 40 500 flight hours were flown. Thus, maintenance of 22 aircraft costs them 65 million dollars per year.

According to open data from airlines' websites, the average annual maintenance and repair costs range from 11 to 14 per cent of the cost of an aircraft.

According to the calculations for 22 aircraft operated by this airline, it should spend an average of 65.34 million dollars per year. Thus, the two methods of calculating the cost of planned fleet maintenance and repair work yield approximately the same result.

An increase of 2 units is planned for the second year and another 2 units for the third year. By 2025, the service center will be servicing 30 SSJ 100 aircraft.

Table 2 shows the list of works on the project.

Components of the project consumables:

1. To implement the project, it is necessary to create a maintenance and repair center for SSJ 100 aircraft with an area of 3 000 m<sup>2</sup>.

Rent of the commercial areas near the airport in Mexico City makes from 3.5 to 4.5 dollars for 1 m<sup>2</sup>. For the technical center the area of 3 000 m<sup>2</sup> it will cost 12 thousand dollars a month, 144 thousand dollars a year.

Acquisition of premises with the area of 3 000 m<sup>2</sup> will cost 3.689 thousand dollars. In Mexico, the tax on the purchase of real estate is established at 2% of the value.

2. Staff training. On average, training of one specialist on the territory of Russia costs 50 thousand rubles or 802 dollars. Aviation personnel need to undergo training and certification for aircraft repair specialists. In addition, all personnel need to take language courses.

For a service center with 128 employees, the cost of training, including foreign language training, will amount to about 6.4 million rubles, or 102.36 thousand dollars.

The personnel composition and salaries of technical and managerial personnel are determined at 1 796 000 dollars.

4. Other overheads expenses for accommodation of the personnel in the territory of Mexico involve 692.94 thousand dollars per year.

5. Equipment for workshops and laboratories of the service center (Table 3).

**Table 2. List of works on the project.**

Corporation/workshop	List of works
Glider repair workshop	Fault detection, repair, refinement of airplane glider and of removable components and assemblies
	Maintenance and repair of fuselage, wheels, on-board electrical network, cabin
	Picking compartment
	Final assembly of aircraft
	Engine replacement
	Testing and development of aircraft systems
	Flushing and painting units
	Periodic and routine maintenance on aircraft and engines
Aircraft equipment repair workshop	Maintenance and repair of oxygen system
	Maintenance and repair of aircraft systems
	Maintenance and repair of lighting equipment
	Maintenance and repair of devices and remotes
	Maintenance and repair of flight data recorders
	Maintenance and repair of oxygen equipment
	Maintenance and repair of position sensors, aerodynamic angles, vibration and other products
	Maintenance and repair of navigation system
	Maintenance and repair of electro mechanisms
	Maintenance and repair of manometers, pressure switches
	Picking compartment
Repair workshop for electronic equipment	Maintenance and repair of navigation complex and take-off and landing systems
	Maintenance and repair of multifunction indicators, control equipment
	Maintenance and repair of radio stations, switching devices, digital computers
	Maintenance and repair of communication facilities, radio altimeters
	Maintenance and repair of air traffic control systems
	Repair area for circuit boards and block models
	Maintenance and repair of power supply systems
Maintenance and repair of airborne radar	
Repair workshop for aircraft and engine units	Maintenance and repair of landing gear
	Maintenance and repair of units of airframe and engine systems

<b>Corporation/workshop</b>	<b>List of works</b>
	Maintenance and repair of pumps, fuel system units, radiators and cylinders
	Maintenance and repair of hydraulic system units, gas system, valves and actuators
	Assembly and testing area for airframe and engine systems
	Unit conservation area
	Picking compartment
Central laboratory	Area for analysis of the quality of fuels and lubricants
	Verification area of instrumentation and testing equipment
	Nondestructive testing laboratory

According to the authors' calculations, the total cost of equipment and supporting materials for the preparation and equipping of repair hangars will amount to 48 million dollars.

6. Materials, parts and components. In this case, an analysis of the costs of similar companies was carried out and adjusted for the number of aircraft and the cost of the aircraft. Materials costs were 8 million dollars per year. In addition, special attention should be paid to working with suppliers of components for SSJ 100 in order to ensure enough timeliness of deliveries.

7. Installation of software for equipment: 300 thousand rubles or 4.8 thousand dollars.

8. Insurance of 100 million rubles or 1.6 million dollars per year. A mandatory condition for aircraft maintenance activities is insurance of the contractor's liability as an aircraft maintenance company and as the owner of hangars and premises for aircraft maintenance services.

9. Certification of activities. The following EASA Part-145 and BDA/AMO/657 certificates are required for the performance of OKVED (hierarchical classifier) 33.16 Aircraft Repair and Maintenance, Including Space Vehicles Activities. The EASA Part-145 certificate is a basic certificate issued to aircraft and component maintenance organizations. The certificate gives the right to perform maintenance on components with their subsequent installation on the European registration aircraft, or registration of other countries outside the European Union, but recognizing the requirements of the European Aviation Safety Agency (EASA) in respect of airworthiness maintenance. Receipt of certificates for the implementation of activities amounts to 16.04 thousand dollars.

#### IV. METHODOLOGY

In order to solve these problems, the methods of financial and economic analysis, budgeting, economic and mathematical modelling were used.

An important role in evaluating the efficiency of an investment project using the method of discounted Cash Flows is played by the discount rate, as it directly affects the Cash Flow of the project [6,14,16]. According to the methodology of the Government of the Russian Federation № 1470 to the value of risk-free rate of return added bonuses for various types of risk associated with a particular investment project.

$$r = r_f + r_1 + \dots + r_n,$$

(1)

where  $r$  is the discount rate;

$r_f$  is the risk-free rate of return;

$r_1 + \dots + r_n$  are the risk premiums for various risk factors.

The rate of return on long-term government bonds (8.11%) is the risk-free rate of return here.

The premium for the risk of promotion of the new product to the market is 13-15%. Thus, the discount rate is assumed to be 22.11%

The study analyzed the risks associated with the project to establish an aviation service center abroad, as well as possible ways to level them [8,16].

1. Financial risks, in particular:

- currency risks. As the project is planned to be launched abroad and calculations will be made in dollars, it is necessary to consider possible fluctuations in the exchange rate. The given kind of risk should be put in calculation of a rate of discounting;

- change of rate on the loan. The rate on credit at project financing is defined based on the key rate of the Central Bank. Growth of the key rate may negatively affect the financial flows of the project [7];

- excess cost estimates. Excess estimated costs of the project may be exceeded both in case of unforeseen costs and in case of unrecorded costs. Options for unrecorded costs may include consulting services, technical supervision of the project, and other services.

2. Entrepreneurial, in particular:

- risk of change in demand. Minimizing this risk is possible by entering into a long-term contract with Interjet for the maintenance of all aircraft equipment supplied by Russia. The terms and conditions should be acceptable to both parties. It is also necessary to specify in the contract the conditions for increasing the volume of maintenance equipment;

- qualification of personnel. The technical staff is the basis for this project.

All personnel should receive better training and certification. Staff should also undergo periodic refresher training during their work in order to comply with international practices and requirements;

- management. Management level of the project company. An important role is played by the head of the project company and selected participants for the project





implementation. Participants should have experience of such work.

Risks should be clearly distributed among the participants and each participant should bear responsibility within his or her competence [9].

3. Risks of the project initiator. The initiator of the project is a large Russian aircraft building corporation. The main risks for the corporation are the project's unprofitability and loss of reputation. Launching the project of creation of the service center and acting as its initiator, the corporation is obliged to supervise all stages of realization of the project and to give resources and the information on maintenance service of the vessels.

4. Logistics risks. At designing it is necessary to define in advance all suppliers of materials and accessories for repair. It is necessary to carry out the analysis of the market of suppliers, to consider their site and to calculate transport logistics, terms of deliveries, currency changes, features of political and economic relations of Russia with the country of finding of the supplier. It is necessary to project in advance a logistical chain of

deliveries, to consider terms and cost of deliveries to the Mexican region.

Logistics is one of the serious risks for this project, as SSJ 100 consists of imported materials by 70%, and contracts will be concluded with suppliers from France, Great Britain and Germany [13].

5. Risks of the project creditor. The main creditor is PJSC Sberbank of Russia. Since the Regulation on project financing defines the dependence of the loan rate issued by the bank on the key rate of the Central Bank of the Russian Federation, the lender bears the risk of reduction of expected loan repayments as a result of reduction of the key rate of the Central Bank [7].

## V. RESULTS

Thus, the total investment cost of the project is 53 485.98 thousand dollars.

Project implementation stages and sources of financing are presented in the Table 3. The financial part of the project is presented in the Tables 4 and 5.

**Table 3. Project roadmap**

Periods	Stages	Financing
2018	<ol style="list-style-type: none"> <li>1. Development of a detailed business plan.</li> <li>2. Submission of the project for consideration by VEB.RF (Vnesheconombank).</li> <li>3. Creating a project company - a subsidiary of SCAC, Sukhoi Civil Aircraft Company.</li> <li>4. Selection of the remaining project participants: suppliers, lenders, contractors.</li> <li>5. Choice of financing schemes and coordination with bank.</li> <li>6. Agreements and contracts with all project participants.</li> <li>7. Distribution of risks between participants.</li> </ol>	25% of all project expenses are funds of project initiators
2019	<ol style="list-style-type: none"> <li>8. Acquisition of hangars in Mexico, preparing them for commissioning.</li> <li>9. Announcement of procurement procedure for equipment, software, materials and components, staff training.</li> <li>10. Acquisition of necessary equipment for aircraft maintenance.</li> <li>11. Installation of equipment in Mexico.</li> <li>12. Software installation.</li> <li>13. Search, recruitment and training of personnel.</li> <li>14. Insurance, licensing of activities.</li> <li>15. Purchase and formation of a warehouse of parts and accessories.</li> </ol>	75% of all project expenses are a loan from PJSC Sberbank
2020	<ol style="list-style-type: none"> <li>16. Agreement with the airline for maintenance of SSJ 100.</li> <li>17. Launch of the project.</li> </ol>	

**Table 4. Projected Cash Flow statement**

in thousand dollars	2020	2021	2022	2023	2024	2025
<b>Operating Cash Flow</b>	-	33 298.11	37 067.79	40 599.48	44 131.16	47 662.84
<b>Inflows</b>	-	65 000.00	71 280.00	77 220.00	83 160.00	89 100.00
Revenue		65 000.00	71 280.00	77 220.00	83 160.00	89 100.00
<b>Outflows</b>	-	31 701.89	34 212.21	36 620.52	39 028.84	41 437.16
Salaries of administrative staff		381.14	381.14	381.14	381.14	381.14
Salaries of production personnel		1 414.82	1 543.44	1 672.06	1 800.68	1 929.30
Payroll insurance		542.38	581.22	620.07	658.91	697.75
Depreciation of equipment		4 800.00	4 800.00	4 800.00	4 800.00	4 800.00
Material costs		8 000.00	8 727.27	9 454.55	10 181.82	10 909.09

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in thousand dollars	2020	2021	2022	2023	2024	2025
Liability insurance		1 600.00	1 600.00	1 600.00	1 600.00	1 600.00
Other overhead		692.94	692.94	692.94	692.94	692.94
Net profit		47 568.72	52 953.99	57 999.25	63 044.51	68 089.78
Direct taxes		14 270.62	15 886.20	17 399.78	18 913.35	20 426.93
<b>Investment Cash Flow</b>	- 53 485.98	-	-	-	-	-
Inflows	-	-	-	-	-	-
Outflows	<b>53 485.98</b>	-	-	-	-	-
Equipment purchase	48 000.00					
Acquisition of premises (hangar)	3 762.78					
Training	102.36					
Liability insurance	1 600.00					
Software	4.80					
Obtaining activity licenses	16.04					
<b>Financial Cash Flow</b>	40 114.49	- 10 514.60	- 10 514.60	- 10 514.60	- 10 514.60	-10 514.60
Inflows	40 114.49	-	-	-	-	-
Credit	40 114.49					
Outflows	-	10 514.60	10 514.60	10 514.60	10 514.60	10 514.60
Interest repayment	-	3911.16	3267.33	2560.72	1785.21	934.10
Repayment of principal	-	6603.44	7247.27	7953.88	8729.39	9580.50
<b>Project Cash Flow</b>	<b>-13 371.50</b>	<b>22 783.51</b>	<b>26 553.19</b>	<b>30 084.87</b>	<b>33 616.56</b>	<b>37 148.24</b>

**Table 5. Project effectiveness criteria**

Net present value	68 420.77
Internal rate of return	183.66%
Profitability Index	11.232
Pay-Back Period	Less than 1 year

Thus, the analysis shows the effectiveness of the investment project for the establishment of the SSJ 100 aircraft after-sales service and repair center in Mexico.

## VI. CONCLUSION

Competitiveness of modern aircraft is determined not only by its technical and flight characteristics, but also by an efficient after-sales service system. World practice shows that the organization of such a system is initiated directly by aircraft manufacturers or large airlines.

It is proved that an effective after-sales service system enables an aircraft building corporation to receive a guaranteed income from the implementation of technical and repair works of the aircraft in the amount exceeding the income from the sale of the airliner itself. Designing such a system requires systematic planning, analysis of economic and geopolitical risks, and major financial investments. There is a development of subsidized project financing, in which large Russian banks finance the project at a minimum rate, the size of which is regulated [2]. The main condition is the availability of an effective management team capable of implementing the project.

In Russia, a large project is being implemented to produce civil aircraft SSJ 100. The deliveries of this equipment abroad are being actively carried out. Mexico is our main customer now, but there is a problem with the organization of after-sales service. There are no centers on

the territory of Mexico that allow us to service our aircraft. A project is proposed to establish an aircraft after-sales service and repair center for SSJ 100 aircraft in Mexico City.

The study developed a financial and organizational-economic model of the project. The conducted assessment of the efficiency of the investment project for the establishment of the SSJ 100 aircraft after-sales service and repair center in the operator's country and the analysis of risks shows the efficiency of this area of investment. With the support of the state and the provision of a subsidized rate on the loan, the project is effective. Creation of service centers is a factor that increases the competitiveness of our products in the global market and allows us to compete with the largest companies Boeing and Airbus.

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