

*Sokoly I.I.,
Doctor of Economic Sciences,
Professor at Department of Management Economics,
Odessa National Polytechnic University*

*Bukovskyi O.O.,
Postgraduate Student,
Odessa National Polytechnic University*

THE MAIN WAYS AND MECHANISMS OF DEVELOPMENT OF THE AIRCRAFT ENGINE MANUFACTURING IN UKRAINE

Summary. The article presents the suggestions of providing the innovative development of the aircraft engine manufacturing sphere of Ukraine. There are defined the goals, objectives, and stages of implementation of complex solutions for the development of aircraft engine manufacturing industry of Ukraine, outlined the contents of the main activities for the development of aircraft engine manufacturing industry of Ukraine. There is done a forecast of positive effects for the innovative development of aircraft engine manufacturing sphere of Ukraine from the implementation of the proposed activities.

Keywords: aviation industry, aircraft engine, aircraft engine manufacturing, industrial potential.

Formulation of the problem. Modern depression state of aircraft industry of Ukraine requires the development of a set of measures which will provide its output at a high international level. The scientific objective of the development of this complex is to define the goals and objectives for the development of Ukrainian aviation engine manufacturing industry, development in accordance with these objectives, specific activities, indicators of achievement and objectives.

Analysis of recent research and publications. Problems of innovative development of the aviation industry of Ukraine is a subject of many publications in which it is possible to trace the evolution of views on its role and place in the development of the state, and ways to ensure progress in its structural organization and methods of work. Problems of development of aviation industry of Ukraine were investigated by such experts as V. Androsova, C. Boguslaev, T. Burkinsky, S. Goncharov, V. Gorbulin, V. Zagorulko, S. Short, A. Kachan, D. Kiva, G. Krivov, J. Kulaev, N. Pechorin, C. Pedraza, I. Sokoly, A. Shevtsov etc.

Separation of previously unresolved parts of the common problem. The main question of scientific problems is the development of complex organizational and economic activities, which provide conditions for development of aircraft engine industry of Ukraine, taking into consideration the factor of globalization and challenging economic conditions.

The purpose of the article is to develop a set of measures that will provide conditions for effective development of the aircraft engine manufacturing sphere of Ukraine. These goals include:

- to define goals, tasks and stages of implementation of complex solutions for development of aircraft engine manufacturing industry of Ukraine;
- to develop and justify the main activities for the aircraft engine manufacturing of Ukraine;

– to define the criteria (indicators) of achievement of the goals and objectives of the development of the aircraft engine manufacturing industry;

– to predict positive effects in terms of innovative development of the aircraft engine manufacturing sector from the introduction of the proposed measures.

Presentation of the main material of the study. According to specified state priorities [1; 2] of the development of aviation engines in Ukraine the main objective is creating a globally competitive aircraft engine manufacturing industry of the world level. Ensuring the leading role of domestic companies in the aircraft engine industry on the world market it is expected to reach gradually and consistently the following: the achievements realized in controlled, relatively simple to enter segments (engines for civil aircraft, military aircraft engines, engines for helicopters, participation in cooperation in the supply of components for engines in the 2–4th level) with the subsequent transition to a more complex segment (engines for foreign civil aircraft). Every next major project, providing access into adjacent segments and expand the product line, will be implemented on the basis of the stated competencies and reputation. Each stage will be achieved at maximum concentration of resources on a limited list of priority projects.

In addition to a potential expansion of market presence, new products should strengthen the existing supply due to the high degree of commonality with existing products that reduces the cost of their establishment and development in the production and operation. In addition, new products must be resourced adequately: their implementation must not weaken or close the current program.

Critical are the reduction of dependence on domestic projects and the diversification of consumers at the expense of integration in the system of international cooperation. The immediate step in this direction is the consolidation of companies in the industry of engine production in the global market as a component supplier for 2–4th level of cooperation. In addition, to achieve economies of scale to reduce cost it is necessary to develop products for non-aviation related markets, for example, land-based and marine gas turbine units (GTU).

In the future, the development of new products should be conducted with an emphasis on making families of engines. New engine models are necessary to develop the orientation to use in several models of aircraft, including foreign aircraft manufacturers.

In the development and promotion of new products in the industry of aviation engine it is necessary to actively rely on international cooperation by developing its own global supply chain and creating strategic alliances with other participants of the market of aviation

engine-building, including in the framework of the profile of innovative territorial clusters.

In addition, companies in the sector of engine building you must go to the management of the complete life cycle of the motor, which is necessary to form a global service network.

To achieve this goal and taking into account the above principles must be implemented by following measures:

- 1) restructuring of companies in the industry of aviation engine;
- 2) entering the world market as suppliers of components 2-4 level;
- 3) the diversification into non-aviation markets;
- 4) entering the world market as a provider of competitive aircraft engines.

These activities are performed in three phases. At the first stage ensured the achievement of the goal of completion of the restructuring of the aviation engine industry.

In second phase the emphasis will transfer to achieving the goals of entering the world market as a supplier of components 2-4 level and diversification into non-aviation markets.

Also in the second stage of the company industry start the decision goal of entering the world market as a provider of competitive aircraft engine with a family of new engines MC500B m MC400.

Phase three is dedicated to the expansion of domestic propulsion on the world market as suppliers of finished products. Under phase ends achieve the goal of entering the world market as a provider of competitive aircraft engines.

The achievement of the objectives intended to be achieved by implementing the following main activities.

1. The restructuring of the aircraft engine industry:
 - optimization and modernization of assets and management systems of companies in the industry of aircraft engine (the event does not require budget financing);
 - the closure and withdrawal of redundant and inefficient assets from the structure of the industry of aircraft engine;
 - diversification of suppliers; with the aim of improving the quality of the engines in the event it is necessary to remove restrictions on foreign suppliers of components and materials (implementation of the event does not require additional funding); also this measure requires participation of relevant regional innovation clusters;
 - implementation of the system of targets aimed to increase the value of companies in the aircraft engine industry (EVA, ROA, ROIC);
 - optimization of production processes and introduction in the aircraft engine industry the advanced systems of quality control and management, appropriate international best practices (Lean, Six Sigma, etc.);
 - technical re-equipment of the industry;
 - completion of corporatization of the industry and the IPO to expand the participation of private capital in the equity of companies in the industry engine;
 - the provision of subsidies to Ukrainian producers of aircraft and aircraft engines to the reimbursement of part of expenses for payment of percent on the credits received in credit institutions and state Corporation "Ukrtranslizing" on technical re-equipment for up to 5 years, and part of expenses for payment of lease payments for technological equipment supplied by leasing companies under leasing contracts. The additional condition of providing these subsidies in terms of technological equipment used at the stage of research and development can be established providing public access to rele-

vant equipment, including participant organizations of the profile of innovative territorial clusters.

2. Entering the world market as suppliers of components 2-4 level:

- the creation of centers of technological competence in casting, the blades and the combustion chamber, including with the involvement of innovative territorial clusters;
- bringing manufacturing processes in accordance with the requirements of international integrators of the 1st level.

In the framework of this measure assumes the implementation of advanced quality control systems and management (Lean, Six Sigma, etc.), as well as to implement other changes required to obtain the status of official distributor of an international integrator of the 1st level. At the initial stage, this event can be implemented in a pilot mode based on a profile of innovative territorial clusters:

- international certification of production processes, quality control systems and finished products with the goal of integration into the global chain suppliers.
- diversification of the customer portfolio (the event does not require budget financing).

With the aim of achieving the necessary scale of production and establishing relations with foreign integrators 1 level in the framework of this event will go from orientation exclusively on domestic producers of aircrafts in the supply of components, and when modifying existing products and developing new engine families:

- incorporation into international programs at the provider level 2-4 level with the aim of increasing the scale of production and establishing relations with foreign engine manufacturers;
- the creation of centers of technological competence in casting of turbine blades and combustion chambers, including with the involvement of innovative territorial clusters;
- certification of production processes and products (does not require budget financing);
- perform R & D to create products of the second stage of key competencies (does not require budget financing), including in the framework of innovative regional clusters.

3. The diversification into non-aviation markets:

- conducting R & D to create products, with the exception of aircraft engines and components to solve the problem of insufficient scale of production (does not require budget financing).

In this regard, a particularly attractive segment of the gas-pumping units for the oil and gas industry. Solutions to pressing environmental problems involves the massive use of gas turbine technology for utilization of associated gas and other needs. Structures of domestic energy and housing and communal services is estimated in the same period, also up to thousands of gas-turbo units. And the largest consumers of CIS needs the industrial gas turbine with an efficiency of at least 40% (in the combined cycle – not less than 60%) and ecological characteristics that meet the prospective standards for thermal power, utilities, oil and gas sector and transport infrastructure, shipbuilding, rail and road transport. It is projected that in 2020 domestic market of the CIS ground-based gas turbines, which can be satisfied by ZPO "Motor Sich", will amount to 60-70 units per year.

4. The entrance of the aircraft engine companies to the world market as a producer of competitive aircraft engines. The main task in this direction is the completion of R & D on engine MS-500V and brings it to the stage of readiness for serial production. The main objectives of the project engine family MC500B is to create a family of engines in the power class of 600...1000 HP, designed for installation on helicopters for various purposes with a takeoff

weight of 3.5 to 6 tons. According to experts, the sector of the market for helicopters in this class due to their versatility will be one of the most promising in the coming years. When designing the engine MS-500V was used constructive solutions are intended in the future to enable the creation on its basis of promising engines of other types and purposes. It is turboprop and turbofan engines for small business aircraft and aircraft General aviation, auxiliary engines, gas turbine drives, etc.:

- granting subsidies to companies in the industry of engine building with the purpose of subsidizing primary sales of new products;
- creation of a network of service centers in the industry of engine support system 24/365 at the global level (activity does not require budget financing);
- organization of global service network and after-sale service system is a prerequisite for selection and implementation of promising projects in the field of engine;
- perform R & D to develop engines of the VI generation of the MS-700, which in the future can be created turbo shaft and turboprop engines up to 1400 K. S., and small engine MS-400, MS-400II, MS-450, MS-100 for unmanned aerial vehicles, which are in demand for the war effort;
- participation in international programs for the sharing of risks with the aim to facilitate the participation of Ukrainian engine builders in the programs for development of new substations;
- development and production of engines for aircraft small aircraft (the event is financed by own funds of ZPO “Motor Sich”).

In case of successful entering classes and segments of engines for regional and vesicopustular passenger aviation, will achieve positive results of negotiations in international cooperation, and the establishment of a scientific and technical reserve, in the future may be considered in new, more complex segments.

To evaluate results of the implementation of these activities within the constraints of budget funding provides for the use of the following targets (indicators):

- revenue (net) from sales of goods, products (works, services) industry aviation engine;
- profitability of assets in the industry of engine (ROA);
- labor productivity in the industry engine.

Indicators (indicators) solutions specific objectives.

1. For the purpose of “completion of the restructuring of the industry of engine”:

- profitability of sales companies in the industry of engine clean.

2. For the purpose of “entering the world market as suppliers of components 2–4 level”:

- sales of components to foreign producers of aviation engines in terms of money.

3. For the purpose of “diversification into non-aviation markets”:

- sales of products with the exception of aircraft engines and components in monetary terms.

4. For the purpose of “entering the world market as a provider of competitive aircraft engine”:

- the share of Ukrainian producers of civil aircraft engines and components in the world market;
- the share of Ukrainian producers of military aircraft engines and components in the world market;
- export volume in monetary terms of engines for civil aircraft and components, except engines and components for export in the Russian domestic aircraft;

- export volume in monetary terms of engines for military aircraft and components, except engines and components for export in the Russian domestic aircraft;
- the number set by the civil aviation and non-aviation engines to the external market;
- the quantity of military aviation and non-aviation engines to the external market;
- the number set by the civil aviation and non-aviation engines for the domestic market;
- the quantity of military aviation and non-aviation engines for the domestic market.

Conclusions. As a result of implementation of the developed interventions are expected to achieve the following results. It will be stable established the national world-class aircraft engine concern “Motor Sich” with optimal product portfolio, which will be able to:

- modernize production capacity and production processes (according to international standards);
- implement modern technologies and formulate required key competencies;
- supply components and complete aircraft engines for the global market;
- make integration into the international program as a supplier of 2–4th levels;
- generate a significant portion of the proceeds for non-aviation markets (mainly due to gas-turbine units for various industries).

To ensure sustainable positive reputation of Ukrainian production aircraft engine industry at the global level:

- to create a global market for positive sales history of aircraft engines produced by engine-building industry of Ukraine;
- to ensure compliance of products with technical characteristics to the characteristics of world analogues;
- to ensure stable sales of products-the source of sustainable profit engine of the industry;
- to form a global service network, well-functioning and equal quality of services the main competitors.

To provide conditions for the effective conduct of the research and development of new generation engines intended for use in both the domestic and foreign aircraft, land-based and marine installations.

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Соколи І.І., Буковський О.О. Основні шляхи та механізми розвитку авіаційного двигунобудування в Україні

Анотація. У статті наводяться пропозиції щодо інноваційного розвитку сфери авіаційного двигунобудування в Україні. Визначаються цілі, завдання та етапи реалізації комплексу рішень з розвитку сфери авіаційного двигунобудування України, викладається зміст основних заходів з розвитку авіаційного двигунобудування України, визначаються показники (індикатори) досягнення цілей і вирішення завдань розвитку авіаційного двигунобудування. У висновках робиться прогноз позитивних ефектів щодо інноваційного розвитку сфери авіаційного двигунобудування України від впровадження запропонованих заходів.

Ключові слова: авіаційна промисловість, авіаційний двигун, авіаційне двигунобудування, промисловий потенціал.

Соколы И.И., Буковский А.А. Основные пути и механизмы развития авиационного двигателестроения в Украине

Аннотация. В статье приводятся предложения по инновационному развитию сферы авиационного двигателестроения в Украине. Определяются цели, задачи и этапы реализации комплекса решений по развитию сферы авиационного двигателестроения Украины, излагается содержание основных мероприятий по развитию авиационного двигателестроения Украины, определяются показатели (индикаторы) достижения целей и решения задач развития авиационного двигателестроения. В выводах делается прогноз положительных эффектов касательно инновационного развития сферы авиационного двигателестроения Украины от внедрения предложенных мероприятий.

Ключевые слова: авиационная промышленность, авиационный двигатель, авиационное двигателестроение, промышленный потенциал.