

Supplier Management Improvement in Aviation Industry: A Case Study of Beriev Aircraft Company

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Abstract—The purpose of this research is to study and analyze domestic and international experience in supply chain management of the aviation industry to enhance the competitiveness of aircraft factory products. In our paper, we designated specific production of civil aircraft issues, which have, from the authors' view point, the major influence on the industry product competitiveness for the aircraft factory. A case study applied at the aircraft factory to propose a method of selecting suppliers for improving the quality and competitiveness of the industry product. Based on undertaken analysis, the authors designated specific areas of strategy implementation for the supply chain management when entering new markets with products of aircraft factory. According to current situation at aviation industry, strategic scenario of quality management improvement with the priority of supply chain management processes is proposed after aircrafts' mass production launch at aircraft factory.

Keywords—Supply Chain Management (SCM), Quality Improvement, Aviation Industry, Aircraft Factory, Case Study, Supplier Selection.

1. Introduction

The speed and multi-vector of world development, increasing the realization risk of large long-term projects in all areas of socio-economic development creates a high demand for the study of functioning problems of domestic enterprises in the international labor sharing. Market stability of Russian producers in the international labor sharing in the world product markets today is based on the price advantage. Cheap high-qualified labor determines lower prices for similar products in

comparison with foreign competitors. Availability of own raw material base reduces the reproduction process dependence of the international exchange and becomes the main factor and development prospective of Russian foreign economic relations.

However, the conditions of competitive advantages development in the past twenty years have undertaken significant changes, and therefore eliminate the industry dependence on the production factors existence in the country. Therefore, prerequisites for strengthening the country's position in the global economic relations system are economic restructuring and technological base upgrade, improving the efficiency and competitiveness of production, export structure diversification.

Currently, in Russia only 4-5% of domestic enterprises are engaged in introduction of innovations, while in the countries such as Germany, USA, France and Japan, their share is from 70 to 82%. Innovative business focus should be fundamental in the work of Russian production majority. This industrial policy based on innovations can lead to the development of technological advances and a breakthrough of the domestic economy. Evidence of no alternative innovative renovation strategy for industrial production requires more attention to the investment process and the innovation component. Domestic production prospects for high-tech products will largely depend on the success of the state science and technology policy that ensures the continuous growth of investment in fundamental and applied research and development in priority areas. The largest segment of the knowledge-intensive high-tech industry, able to compete with the developed countries of export products on the world market, is focused on the external supply of the Russian aviation industry.

Modern socio-political and macroeconomic situation in Russia is unfavorable for active work in the field of real investment. We point out the main

aspects of the current situation, with the greatest force affecting the investment activity in general and impeding the investment projects implementation in particular:

- the general instability and unpredictability of developments in all spheres of country economic activity;
- the specifics of the market financial resources, characterized by negative real value of money-capital;
- the imperfection of the current legislation, which does not allow to fully take into account the negative impact of high inflation;
- budget cuts caused by the global financial crisis.

All of these problems are directly related to domestic aviation industry.

In modern practice the problems of aircraft production take on a new character in an ever-changing geopolitical situation in the world. In the light of economy globalization and internationalization the problem of increasing domestic aircraft production competitiveness comes to the fore. Quality improvement is a multi-edged economic category, which can be considered at the level of the products, their producers and industries and at the international level as a whole. However, all these levels are closely interrelated, since it is quality improvement of individual aircraft factory suppliers and their products will eventually determine quality improvement of aircraft industry of the country.

Uploaded with orders aircraft factories are highly profitable, their budgetary efficiency is also high, because of tax revenues the whole regions where aircraft factory is mono-industry can live. The largest share of innovative product exports is owned by such industries. Applied science-intensive technologies create a large number of jobs, not only at their enterprises, but also in related industries. Export potential of the aviation industry can be effectively used for balancing of formed in recent years irrational export structure, also to eliminate dependence of Russia on the global economic market situation.

From the point of view of innovation and technological development base of the Russian economy the importance of the aviation industry cannot be overstated due to large scope and range of its scientific, technical and technological achievements and interests. The aviation industry is one of the most promising trends for development of the national high-tech production. It requires special attention, as the potential is the source of a qualitatively new economic growth of countries in general and Russia in particular. In our research, we designated specific production of civil aircraft issues, which have, from the authors' view point, the major influence on the industry product competitiveness for the aircraft factory.

The purpose of this research paper is to study and analyze domestic and international experience in supply chain management of the aviation industry to enhance the competitiveness of aircraft factory products. In addition, we seek to answer the following questions: What is the forecast of global market of aviation products and services? What are the peculiarities of the Russian market and aviation industry in the context of modern logistics technologies introduction? How should aviation industry implement domestic and international experience in supply chain management modeling? Are there successful examples of supply chain management implementation in Russian aviation industry? What should be done for further improvement of the aviation industry on global level?

By answering these questions, the contribution of our paper is threefold. - A case study applied at the aircraft factory to propose a method of selecting suppliers for improving the quality and competitiveness of the industry product. Based on undertaken analysis, the authors designated specific areas of strategy implementation for the supply chain management when entering new markets with innovative products of aircraft factory. According to current situation at aviation industry, strategic scenario of quality management improvement with the priority of supply chain management processes is proposed after aircrafts' mass production launch at aircraft factory.

The rest of the paper is organized as follows: Section 2 provides a brief analytical review of global aviation market and retrospective analysis of Russian aviation industry development. Section 3 discusses the methodology of supply chain management used in this study; it also researches supply chain management model in aviation industry. Subsequently, Section 4 discusses the case study applied at the aircraft factory. Finally, Section 5 concludes with the overall purpose of the paper and directions for future research activities.

2. Market Review

2.1. Global aviation market overview

Currently, the global aviation industry has experienced a number of radical changes, and the goal of which is an impact on the further development of air transport has yet to be realized. The underlying mechanisms of industry functioning have changed. Development concept, production, sales and after-sales service of aircraft technology have significantly changed.

The civil aviation industry always responds not only to the challenges of the external environment in the ever-changing global economy. Aircraft production quickly responds to urgent requests

generated by constantly developing passenger air transport, as a main customer. At the current stage of industry development the very understanding of the fact what a modern airliner should represent has changed. An innovative component of the product is an important factor not only competitive, but in principle existence of the product [1]. It is not possible to offer a good product to the market. Just a good product for the world market is a synonym for lack of demand from key global and regional carriers. Only high level of performance, unique technical characteristics, plainness in maintenance and development of a new type of aircraft may allow a new producer to become a significant player, and keep the existing positions. This innovation in civil aviation is dictated by the potential demand of air carriers on passenger vessels with a completely certain technical characteristics that would allow to develop effectively in the aircraft industry.

The development of the aviation industry is closely linked to the development of the world economy, the growth of its gross domestic product (GDP). If economy is successfully developed, its GDP is growing and volumes of passenger and cargo traffic, increasing demand of the population and sectors of the economy on the aviation services are growing too (Table 1). If the stagnation or world crises begin, the volume of air traffic is decreased and the rate of development of civil aviation is reduced – this is a consistent pattern that we cannot avoid.

Table 1. Worldwide airline Industry

	2010	2011	2012	2013	2014	2015F	2016F
REVENUES, \$ billion	564	642	706	720	751	718	709
Passenger, \$ billion	445	512	531	539	539	518	511
Cargo, \$ billion	66.1	66.9	63.5	60.7	62.5	52.8	49.6
EXPENSES, \$ billion	536	623	687	695	716	659	647
Fuel, \$ billion	152	191	228	230	226	181	127
Non-fuel, \$ billion	384	431	460	465	490	478	519
Capacity growth, atk, %	3.7	6.0	3.0	3.7	5.4	6.3	6.3
Flights, million	27.8	30.1	31.2	32.0	33.0	34.8	36.8
OPERATING PROFIT, \$ billion	27.6	19.8	18.4	25.3	35.1	59.5	62.2
NET PROFIT, \$ billion	17.3	8.3	9.2	10.7	13.7	35.3	39.4
ROIC, %	6.2	4.7	4.6	4.8	5.9	9.3	9.8

Source IATA

The calculations show and the practice confirms that for every percentage of change in the GDP air transport market responds to a change in traffic volume at the two percent level and the duration of the crisis periods and the subsequent market recovery to pre-crisis levels are comparable.

Currently, the global market of aviation products and services has impressive volumes and is developing quite rapidly, showing annual growth of about 10-12% (Table 2). The main driver of growth from a geographical point of view is the Asia-Pacific region, which demonstrates the growing demand for both aeronautical engineering and air transport services [2].

Table 2. System-wide global commercial airlines (Net Profit, \$ billion)

	2010	2011	2012	2013	2014	2015E	2016F
Global	17.3	8.3	9.2	10.7	13.7	35.3	39.4
<i>Regions</i>							
North America	4.2	1.7	2.3	7.4	11.2	21.5	22.9
Europe	1.9	0.3	0.4	1.0	1.0	7.4	7.5
Asia-Pacific	9.2	5.0	5.8	2.3	1.8	7.2	7.8
Middle East	0.9	1.0	1.0	0.3	0.4	1.4	1.6
Latin America	1.0	0.2	-0.2	0.2	0.0	-1.5	0.1
Africa	0.1	0.0	-0.1	-0.5	-0.8	-0.7	-0.5

Source IATA

Currently the world market of civil aviation equipment is represented in more than 80 companies from 20 countries. However, despite the apparent current duopoly of two civilian equipment manufacturers (Boeing and Airbus), we cannot say that the other aircraft manufacturers do not have the opportunity to fight for the leadership and continuing to challenge oligopolistic nature of the market. Attempts are undertaken on a regular basis and several succeeded. The most successful examples are Brazilian Embraer and Canadian Bombardier, which in the early 1990s were engaged in active development of regional niches for aircraft up to 100 seats which were not covered by the leaders. As a result these two products occupy approximately 10% of the market together, which, objectively speaking, more than enough to be considered significant producers of aircraft. At the same time 10% is the whole segment of the single-aisle commercial regional aircraft excluding turboprop aircraft [3].

However, the idea that the EU and the USA duopoly in the civil aviation market can be challenged, is formalized also in the fact that, besides those already mentioned above manufacturers in the development of independent productions are starting to include companies from other countries, such as China with their projects (main C919 and regional ARJ21), and even Japan with regional aircraft MRJ.

According to data in 2016 Airline CFOs and heads of cargo reported that they were less positive about cargo aircraft, but become more positive about future growth in air travel. There may be some more price stimulus to travel, but underlying economic activity is fragile, as recent weakness in business confidence in both advanced and emerging economies has shown, which further

lowered the economic growth forecast for 2016. This year will show slower growth, as weaker confidence induces consumers and business to save lower energy costs rather than to increase spending. The fleet is forecast to increase by over 1100 aircraft to end this year at almost 28,000 aircraft; lower fuel prices will lead to fewer older aircraft leaving the fleet. The average size of aircraft in the fleet is continuing to rise slowly. So by the end of 2016 there will be around 3.9 million available seats. These seats are also being used more intensively, which is critical for profitability in a capital intensive industry – and it also reduces environmental impact. Passenger load factors are expected to slip from 2015 levels but to hold at 80% on average this year. Aircraft are also being flown more intensively. The number of scheduled aircraft departures is forecast to exceed more than 36 million this year. That's an average of 70 aircraft departing each minute of 2015 [4].

This brief overview of global aviation market confirms one of the most promising trends for development of the national high-tech production of the country. It requires special attention, as the potential for manufacturers in the development of independent aircraft productions and become the source of a qualitatively new economic growth of countries in general and Russia in particular.

2.2. Analysis of Russian aviation industry development

The aviation industry is a number of scientific and industrial complexes of the closed-design process cycle, consisting of design organizations, experimental and production of industrial enterprises, the central research institutes for the development, production, repair and modernization of civil and military aviation, as well as ground support equipment, providing the operation of the aviation.

The aviation industry is a specific sector of the economy and has, regardless of regional or national origin, some common features that are inherent in both the industry and its products. The specifics of the aviation industry in the following ways: high-tech products; high capital intensity of production; the complexity of products; long product life-cycles; high duration of the production cycle; high level of industry segments specialization; industry complex structure.

Aircraft industry is the most high-tech and systematic, it is composed of aircraft, helicopter and engine industries. In recent years, significant changes have taken place in the aerospace industry of the Russian Federation.

Prior to the 1990s, the level of the Russian aviation industry development supported it with a strong position in the top three world's leading aviation centers (the USSR, the United States and Europe).

In sales of aviation equipment the Soviet Union firmly ranked second place in the world, yielding only to the United States. Widely developed market of aviation equipment met not only domestic needs, but also those of other countries, politically closely linked to the USSR. This made it possible to annually produce and sell up to 2,500 aircraft and helicopters of all types.

However, the transition period of 90^s of the XX century in the Russian economy had a severe impact on the aviation industry, a condition which, in comparison with other sectors of the economy is particularly deplorable. In a planned socialist economy conditions, the aviation industry had a strong government support, the aviation market was artificially regulated. After the collapse of the Soviet Union for about 15 years the aviation industry was in stagnation conditions. If the USSR annually produced more than 150 mainline, regional and cargo aircrafts and 300 civilian helicopters, more than 620 aircrafts and 390 helicopters for military use, in modern Russia the production of military aircraft in the country decreased by 17 times, combat helicopters by 5 times, and civil aircraft by 15 times.

Today aircraft market is a global market with fierce competition without national boundaries, the prospect of which is defined as the supply of military and civil aircraft products. Specificity of production processes of the aviation industry is the need to create conditions for large-scale involvement in its capital, and the payback is stretched for more than 10 years. Aircraft industry is large-scale, technologically complex and high risks associated with huge investments in new projects.

Typical for the old-time commodity expansion of the industry gave way to the cross-border movement of the production, the development of industrial complexes on a global scale. The reasons for such transformations become actualized by the market problems of cheaper aviation production and its improvement, the solution of which was carried out by:

- relocation of production output to countries and regions, ensuring lower costs;
- building of cross-border processing chain with the rational use of local advantages in all of its units;
- bringing of production to the areas of consumption mutually overlapping marketing efforts;
- combination of design and technological capabilities and research and R&D work for the modernization and development of high quality new products, demand for which is dictated by the market, in accordance with the increasingly stringent environmental requirements.

One of the most powerful incentives for the establishment and maintenance advantages,

allowing taking a leading position in any area of the world market is the existence of competitive relations developed in the country. This is evidenced by the fact that the most competitive on an international scale of the company is not a single industry haphazardly scattered in different states, and tend to concentrate and efficiently compete on the national markets [5] (see. Fig. 1).

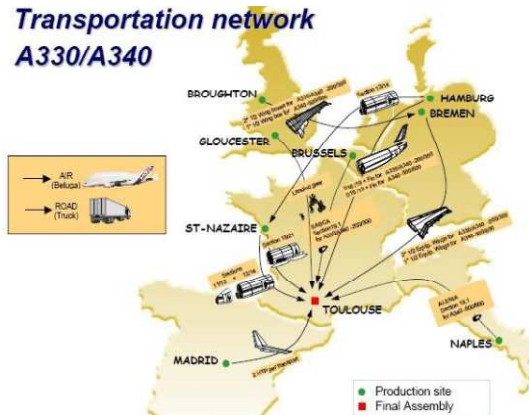


Figure 1. An example of the aviation industry interaction in Europe,

Source Airbus

However, the development of competition in the country is important but not the only condition that enhances the competitiveness of domestic producers of aviation products. Among its diverse determining factors are the level of production costs, productivity and intensity of labor that affect the value and quality of products, the nature of innovation and investment. In this regard, indicative of the fact that according to the calculations of experts, the majority of Russian industry unit cost of production is higher today than in Japan, 2.8 times; US - 2.7; France, Germany and Italy - by 2 times. Speaking of productivity, it should be noted that this figure in the domestic manufacturing industry on average is 5-6 times lower than in industrialized countries and is 3-4 times lower than in the newly industrialized. As for the intensity of labor, it is in many ways dependent on components such as the duration of the working week and working year. Interestingly enough, in Russia on the average official number of working hours per year is 1440, while in South Korea the figure is 2547, in Japan - in 2017, in the US - 1945, in the UK - 1880 hours [6].

At the end of the XX-th century the aviation industry organization had a number of serious shortcomings and challenges:

- the production and supply of aircraft is continued to be individual production;
- the market forecasting system of aviation equipment and long-term orders for series production and supply is not organized;

- the system for ensuring the organization of working capital on the basis of obtaining favorable government and commercial loans is not organized;
- the system of providing after-sales operation and maintenance of aircraft airworthiness corresponding to world level is not organized;
- the volume of attracted extra-budgetary resources to carry out development work is insufficient [7].

The poor quality of life and the small capacity of the Russian internal air transportation market are an obstacle to the revival of a competitive aviation industry. There arose a situation that blocks the development of aviation production: expanding air travel market is impossible without a sharp increase in the welfare of the population and reducing the internal costs of air carriers. The problem of domestic aircraft industry was the lack of an internal market, without which it is impossible to launch a series of new models (the original amount of their orders must be at least 100 aircrafts). None of the aircraft factory is not able to establish large-scale production and reduce the price of the aircraft. Aircraft production in Russia has long been a unique phenomenon - each aircraft produced by special order out of unique components, which led to a sharp increase in its cost. In limited small-scale production it is impossible to achieve hardware price reductions. With small-scale orders component manufacturers simply are not interested in having to fight for the cost reductions.

The sharp reduction of the state order has resulted in a fragmented operation of sub industries of aviation production. Financial and economic situation in the military and civil aircraft, engine and helicopter is very different. The best state is now in military aircraft, due to its foreign trade contracts and domestic civil aviation is experiencing major problems.

Due to the fact that Russian aircrafts had long lost their important competitive advantages over Western airliners i.e. low price, it becomes evident that led to the transition of Russian air carriers to the Western technique with the trend of stagnation of domestic aviation. To resist this process it is necessary to reduce the cost of domestic aircraft while maintaining a consistently high level of quality. Since at present in aviation industry the cost of foreign spare parts at times ranges from 50% to 70% of the fully loaded aircraft, the use of preferential custom tariff and tax regulation mechanisms is particularly important.

Under these circumstances, the Russian aircraft manufacturers are forced to either reduce production capacity, which would inevitably lead to a decrease in technological capacity, or to search for new markets for their products.

The civil sector of the aviation industry has become the subject of intense interest for potential new market players for quite specific reasons. The most important of them is that the research and

development of civil aviation programs spending their multiplier effect generated eightfold increase made in the national value-added economy in related industries. This is explained by the fact that as a result of works on large-scale programs to create one product chain operation is provided as the scope of related services, and of related industries, respectively, not less high-tech than civil aviation production [8].

The need for the civil aviation industry bailout is due to the high importance of this sector to the economy and irrationally probability of loss. This becomes the most important task of the state, which is reflected in the state program "Development of the aviation industry in the years 2013-2025" (as amended by Decree of the Russian Federation from April 15, 2014 № 303). It is aimed at creating a highly competitive aviation industry and consolidating its position at the global market as the third place producer according to the volume of aircraft manufacturing. The total volume of financing of the state program in the years 2013-2025 will be more than 714 billion rubles (in prices of corresponding years). For the realization of the subprogram "Aircraft" it is planned to allocate over 83 billion rubles from the federal budget (see. Fig. 2).

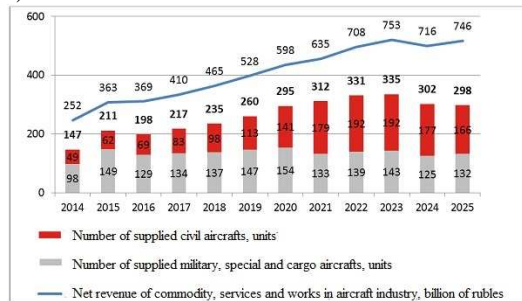


Figure 2. The main target indicators of the subprogram "Aircraft production" in state program "Development of the aviation industry in the years 2013-2025"

To achieve this, the sub-program "Aircraft production" is necessary to address a number of priorities, including:

- completion of the aircraft industry restructuring;
- increased presence of aircraft companies in the market;
- development of a global service network and after-sales service system;
- meeting the needs of the Russian Federation in the civil aviation due to domestic production.

The expected results of the State Program "Development of the aviation industry in the years 2013-2025" in the sub-program "Aircraft production":

- an increase in labor productivity of industrial organizations of aircraft up to 19 184 thousand rubles per person per year by 2025;

- cost savings delivered aircraft by improving productivity and increasing mass production to ensure efficient loading rhythmic organizations for the period of the program;
- achievement of 3,2% and 10,9% of world market share in terms of money in civil (3.2%) and military (10.9%) aircraft by 2025;
- completion of the development of competitive world-class organizations with the optimum model range;
- achieving sustainable profitability of aircraft organizations;
- achieving stable positive reputation at the world market and high operational reliability of aircraft SSJ 100 and MC-21;
- meeting the needs of the Russian Federation in the civil aviation largely due to domestic production;
- increasing the role of the aviation providing for the national security of the Russian Federation;
- additional job vacancies in the production of high-tech products with high added value;
- improving economic performance of a number of the Russian Federation subjects (payments to the budget, infrastructure development, favorable social conditions).

In accordance with developed program Russia is actively involved in the supply of civil engineering and related products of the aviation industry. In 2015 156 Russian aircrafts were delivered to the foreign and domestic markets, including 25 units of SSJ-100, 212 helicopters and 1263 aircraft engines for civil and military purposes. In comparison, in 2014 159 aircraft were delivered to the foreign and domestic markets, including 27 units of SSJ-100, 271 helicopters and 1181 aircraft engines for civil and military purposes. Total revenues of the sector on the basis of 2015 are amounted to over \$ 1 trillion of rubles, which is almost 20% higher than in 2014 [8].

Taking into account all of the above for further study the main subject of this article will be production of civil aircraft in Russia, and important part of which is the organization of materials and components deliveries, which is referred to as the world's supply chain management.

3. The Methodology and Model

3.1. Supply chain management review

Supply Chain Management (SCM) came to life in the early 1980s to describe the range of activities coordinated by an organization to procure and manage supplies [9]. Some specialists in logistics[10] considering supply chain management from the perspective of material flows and can be seen as an "umbrella construct" that has been

described as integration between supplier and partnerships [11].

Others believe that the management of supply chain logistics concept is the organization of production as network sourcing and value chain management [12], or as a demand chain [13]. Supply Chain Management focus on the organizations activities interdependence in a collaborative way to improve the efficiency of the global logistics channel [14] [15], integrated logistics management [16], for example, supplier development as any effort by a buying firm to improve a supplier's performance and/ or capabilities to meet the manufacturing firm's short-and/ or long-term supply needs [17].

The modern approaches show that Supply Chain Management [18-21] is a part of the concept of corporate (or strategic) management at the enterprise, where the most popular definitions of Supply Chain Management for today are those:

- Supply Chain Management is design, planning, execution, control, and monitoring of supply chain activities with the objective of creating net value, building a competitive infrastructure, leveraging worldwide logistics, synchronizing supply with demand, and measuring performance globally [22].

- It is a complex approach that helps effectively integrate suppliers, manufacturers, distributors and retailers. Following these initial concepts, stated that *"A supply chain ...consists of all parties involved, directly or indirectly, in fulfilling a customer request"*

- The supply chain is a set of links of information, money and commodity flows. It starts with the purchase of raw materials from suppliers and ends with the sale of finished goods and services to the client. SCM as providing a shared vision that focuses everyone in an organization on product, production and quality improvements that are required both by the market and the need for companies to survive [23-24].

- Supply Chain Management is a total system approach to manage the entire flow of information, materials, and services from raw-material suppliers through factories and warehouses to the end customer [25].

There are two processes which can be divided into two groups:

- Supply Chain Planning (SCP) includes supply chain planning and business processes in its separate units;

- Supply Chain Execution (SCE) involves the implementation of plans and the operational management of the supply chain links (for example, transport, storage).

The design, planning, execution and control of supply chain activities are used with the objectives of creating net value; building a competitive infrastructure; leveraging worldwide logistics;

synchronizing supply with demand; measuring performance globally:

In today's world, Supply Chain Management enables organizations to remain competitive and increase its benefits, as the rapid development of the market, increased competition, the requirement to improve the quality of customer service, pose new challenges for companies. Supply Chain Management allows to optimize all processes of the value (from the raw materials supply to end user service) [26].

Supply chain management methodology involves the following main stages:

1. Planning. The selection of suppliers based on price has been a traditional approach in Supply Chain Management. Here are defined sources of supply as analyzed priorities in consumer demand, specifies requirements for the distribution system, are scheduled reserves and production volumes, as well as the amount of supply of raw materials / materials and finished products.

2. Supplies. At this stage, the basic elements of supply management are formed, deliveries quality control is carried out, suppliers and contracts signed with them are evaluated and selected.

3. Production. This phase includes the production processes; management structure elements, for example, control of technological change; management of production cycles and facilities (equipment, buildings, etc.), production quality, production schedule changes, etc.

4. Delivery. Delivery stage consists of three main processes: order management, warehouse management, transportation.

5. Return. At this stage, the elements of the return of the products are defined, for example, defects requiring repairs that have arisen at any stage from production to delivery, condition of the product, make repayment schedule and directions to the destruction and / or recycling.

Supply chain management optimization aims to achieve the following objectives:

- compression of the entire cycle of planning and expanding its horizon, thanks to the timely receipt of reliable information.

- optimization between the expenses selected products and their suppliers, the definition of important counterparties, support interaction with them.

- minimizing production costs through the organization of information exchange between the contractors and the optimization of production flows. Timely communication between different areas of the supply chain helps to prevent the formation of the so-called "bottlenecks" in the production process itself.

- minimizing storage costs by optimizing production volumes in line with demand. This task is responded to Just-in-Time supply chain management concept.

– flexibility and timeliness of delivery processes can improve the quality of customer service. Supply Chain Management methodology provides best customer service at lowest production costs, lowest inventory investment, lowest distribution costs for the aviation industry in particular.

3.2. Supply chain management model in aviation industry

In Russian aviation industry it is especially important to use the latest technology supply chain management in the management of industrial enterprises and to coordinate their activities with the government. One of the areas on the aviation industry reform lies in the creation of a mechanism that would provide flexible and efficient interaction of supply chain elements: "production - spare parts - operation - maintenance and repair - recycle". At the same time the following main problems should be solved:

- carrying out products cataloging and registration;
- definition of the real possibilities of businesses, including their resource component, based on the creation and maintenance of an electronic database;
- establishment of a monitoring system for the change of state enterprises and their products, including the subsystem of the crisis early warning;
- creation and gradual implementation of quality systems;
- introduction of further certification order management systems, supply and service of products and parts mainly intended for export under government contracts. [27]

Aerospace industry has made important strides in supplier integration, including:

- *Planning phase*, where strategic supply chain design is a core competency.
- *Development phase*, where early supplier integration into product development is critical.
- *Production phase*, with supplier certification and long-term supplier partnerships (process control & parts synchronization).

Aerospace community faces new challenges and opportunities, including imperative to take "value stream" view of supplier networks. It needs to focus on delivering best lifecycle value to customer and evolve information-technology-mediated new organizational structures for managing extended enterprises in a globalized market environment. Such implementation efforts have required new approaches, such as re-examination of basic assumptions (e.g., make-or-buy policy); new roles and responsibilities between primes and suppliers and communication and trust fundamental to implementation.

There are two types supply chain management, which predominantly present at aviation industry (see Fig. 3).

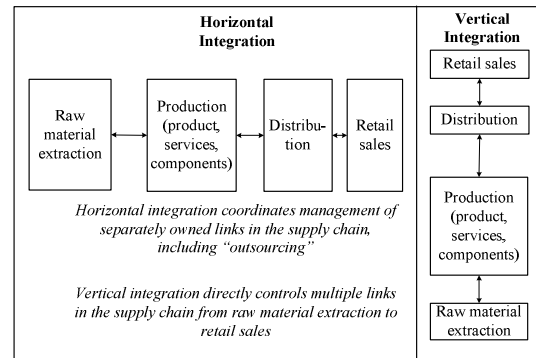


Figure 3. Two types of supply chain management model

Each of them has its own benefits. The benefits of vertical integration are no dealing with competitors for supplies; enhanced visibility into operations; same ownership and management for all activities in supply chain. The benefits of horizontal integration are economies of scale and scope; improved business focus; improved expertise.

Currently, in the world horizontal integration is an increasingly popular type. In order to increase the incentives for the development of foreign cooperation and reduce the level of vertical integration in Russia at the level of ministries and agencies it is necessary to continue improving pricing methodology.

At the level of integrated structures one of the first tasks for the next few years is to create conditions for the emergence of new suppliers by attracting private capital for joint ventures, development of uniform transparency requirements for suppliers, access to joint development plans and long-term contractual relationships with suppliers.

At government level it is necessary to promote the creation and development of suppliers in the industry through the provision of preferential long-term funding to conduct research and development of production and service, to fully support the export of aviation products and the incorporation of local suppliers in the international division of labor due to the partial subsidization of the international products certification and management systems quality development, as well as the maximum convergence of aviation industry certification requirements of the Interstate Aviation Committee (IAC) and European Aviation Safety Agency (EASA) / Federal Aviation Administration (FAA), which will help to move from Stage 1 to Stage 4 (see. Table 3).

According to information mentioned above Russian aircraft manufacturing industry model still remains ineffective because of:

- excessive degree of vertical integration in the industry;
- the lack of critical competencies for number of suppliers (supply chain management, project management, competence in marketing and sales);

- a few examples of successful independent suppliers and partnerships that have managed to integrate into the supply chains of world leaders;
- state support measures that are mainly aimed at the integrated structure and weakly support the development of independent suppliers.

Table 3. Supply chain management model stages

STAGE	DESCRIPTION
Stage 1. Traditional logistics	<ul style="list-style-type: none"> - Impulsive activity - No teamwork - No information exchange
Stage 2. Semi-functional enterprise	<ul style="list-style-type: none"> - Inventory reduction in owned facilities - Purchasing strategies - Hard-skills training, job enhancement - Enhances marketing and forecasting - Lack of initiative coordination
Stage 3. Integrated enterprise	<ul style="list-style-type: none"> - Focus on process and internal processes integration - Intranets across functions - Design team
Stage 4. Collaborative supply chain	<ul style="list-style-type: none"> - Processes integration across boundaries - Eventual electronic information connections among multiple partners - Supply chain value

The situation is exacerbated by high expenses for the domestic industry. The absence of harmonized requirements for aviation industry from IAC and EASA / FAA, as well as to the quality management system requirements, increases the cost and timing of the new products output on the international market.

One of the key issues of domestic suppliers is a relatively small size of the domestic market (in comparison with the markets of China, US, EU, India) [28] (Fig. 4).

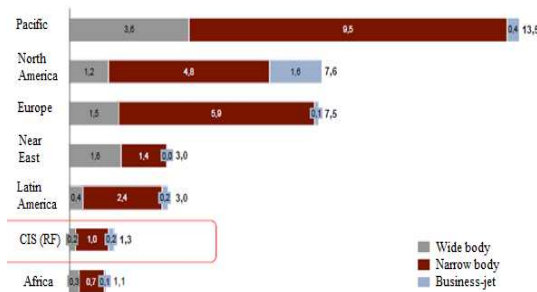


Figure 4. Deliveries forecast of civil aircrafts in 2014-2033

Source Boeing

Russian suppliers taking into account the small scale of the internal market should head for the

global market. It is the scale of international market-presence should become a measure of their competitiveness. The integrated structure in order to improve efficiency should be focused on core competencies, reduce the level of vertical integration, gradually passing over to the vendor functions of 2-4 level, and for this purpose to invest time and money in the creation and development of the supplier base. However, in order to increase market share and improve operating efficiency, all the integrated structures of the industry have initiated changes in their business models, involving the development of system suppliers (internal and external).

4. Case-study of Beriev Aircraft Company Supply Chain Management

4.1. Beriev Aircraft Company review

A good example of the benefits for a favorable international division of labor and production cooperation is PJSC "Taganrog Aviation Scientific-Technical Complex named G.M. Beriev "(Beriev Aircraft Company), founded in 1916. For the 100-year period, the company has made a significant contribution to the national science and technology, the development of civil and military aircraft and hydroplanes.

Since its foundation the Beriev Aircraft Company has created 29 types of aircraft for various purposes, of which 14 were commercialized. For seaplanes and amphibious airplanes, created in different years Beriev, set 232 world records, recorded and recognized by the International Aviation Federation. In the course of research and development work Beriev team received more than 900 copyright certificates and patents for aircrafts and elements of their designs [29].

During the design and development of aircraft advanced technology is used in the systems design based on the three-dimensional electronic models of CAD / CAM / CAE / PDM, actively introducing CALS-technologies[30]. Now Beriev Aircraft Company is working on a number of projects in cooperation with domestic enterprises (OJSC "NPK "IRKUT"", OJSC"АHK "Sukhoi"", OJSC "VASO" and others) and with foreign partners such as the European Aeronautic Defense and Space Company (EADS), the company ELTA Systems (Israel), "Airbus Industry" (France-Germany-Spain) and others.

In 2016 Beriev Aircraft Company mastered serial production of the modernized aircraft amphibious Be-200ES, for the purpose of which technical re-equipment of operating capacity purchase of equipment, modernized production lines and workshops was carried out during the preceding 5 years. In 2017 the company should reach the level of production of four aircraft per year. Given the demands of the Russian Emergency Situations Ministry, prior approval from the Ministry of Defense for 2018-2019 and foreign customers, the company orders will be provided for six aircrafts per year from 2018 to 2021 years [8].

Special priority is given to work of Be-200 modifications and development of new hydroplanes. In particular, the aircraft Be-200 is certified according to European standards, which will increase its competitiveness in the international market. Russian amphibious aircraft with function of firefighting - Be-200ES - has a high export potential. Beriev Aircraft Company is negotiating its sale with a number of foreign countries. In particular, Memorandums on deliveries of the Be-200ES amphibious aircraft with Thailand and China have been already signed. Indonesia and Vietnam also show interest in the plane.

A wide range of products requires special attention to proving production process with necessary raw materials, materials and components. Therefore, an important role in the enterprise is played by supply chain management. The main challenge for the supply chain management of Aircraft Company is a smooth and timely supply of material resources, production, and transportation, warehousing and storage of inventory, their in-plant movement and delivery to production lines.

At present, office supply consists of departments, offices and shops. Department of material procurement is involved in purchases of raw materials, Department of complete set is involved in purchase of a complete set of components. Department of instruments performed work on providing tools and industrial equipment production, storage and accounting organization, as well as the issuance of the instrument in the shop. Equipment Department is engaged in the acquisition of equipment for the enterprise, on-time control, technical acceptance of special equipment organization and transfer of equipment received in the unit for installation and operation.

One of the sections in the logistics warehousing organization is responsible for the reception and

storage of materials, preparing them for productive consumption, the direct supply of workshops with the necessary material resources. Workshops providing storage and distribution of materials face such kinds of problems.

Sales, packaging and delivering products workshop is involved in the organization of packaging and shipment of cargo from the plant. In addition, the objectives of this workshop is to receive cargo from suppliers by rail, aircraft, vehicle or other means of transportation, mail and transfer them to other units.

Continuous cargo transportation in accordance with the production process, the vehicle maintenance in good working condition is made possible by the Transport workshop. Transportation is carried out by means of its own fleet and by hiring a third-party motor vehicles according to the signed contracts.

Structure of supply services is mixed type, when trade departments and bureaus are specialized in the supply of specific types of raw materials and equipment. However, along with the trade in the supply of services a functional unit, the one of Analytical Department is included. Analytical Department performs supply control, compliance control of actual expenditure standards, enterprise supply analysis and shops of raw materials, as well as evaluates current financial need in the context of objects.

4.2. Supply Chain Management at Beriev Aircraft Company

The author of the article worked at Beriev Aircraft Company in the position of Chief Procurement Officer from 2003 to 2014 and his powers included:

- Building the interaction system with contractors for various types of work;
- Creating and maintaining a database of all contractors of the enterprise;
- Management of asset materials for enterprise (warehousing);
- Establishment of the logistics supply chain of material assets (auto, air, sea and rail-transport);
- Development and implementation of result-oriented production organization system, (KPI-indicators);
- Establishment of JIT supply chain;
- Minimizing of the enterprise stock resources;
- Development of supplier evaluation systems (criteria and indicators);
- Organization of lean manufacturing (lean-technology) in the field of storage facilities as the

part of the acquisition, storage and delivery of products and materials for production;

– Creation of supplier chain management, etc.

As part of these authority and their goals and objectives, as well as taking into account the requirements of international standards and a wide variety of products, new supply chain management system has been created at Beriev Aircraft Company for the last 5 years, which allows to ensure timely and uninterrupted supply of components for aircraft for a relatively small cost. In 2014 on the basis of the information system "1C: Production Enterprise Management 8.0" the automated subsystem "Supply Management" has been developed and implemented to improve work with suppliers, which performs the following tasks:

- stock value optimizing, acquisition costs, retention and transparency in the distribution of material resources by automating planning and control processes, logistics;
- maintaining supplier database, supply history, price history;
- storage of account numbers, price lists;
- maintain the version history of price lists, bills, invoices;
- the ability to consolidate applications from all services of the enterprise;

– selection and approval of suppliers from a single register of suppliers;

– signed contract registration;

– automated calculation of the required products and materials, according to the planned nomenclature;

– automated calculation and development of the consolidated financial specifications taking into account existing stocks in warehouses;

– accounting of ordered, received and issued by the inventory center sorted by the budget, the orders, the topics;

– registration of incoming goods and materials on the release date, indicating the resource performance and shelf life.

The supply chain management process itself is built and automated as follows.

On the basis of applications from industrial and technological services analytical department of Beriev Aircraft Company, a summary statement of the necessary products and materials in all subjects of the enterprise (deficit) is created. Once the deficit of products and materials, compiled a schedule of deliveries of goods and materials tied to the construction schedule of each individual aircraft, made by authors (Fig.5).

Components Delivery scedule for amphibious aircraft BE-200ES

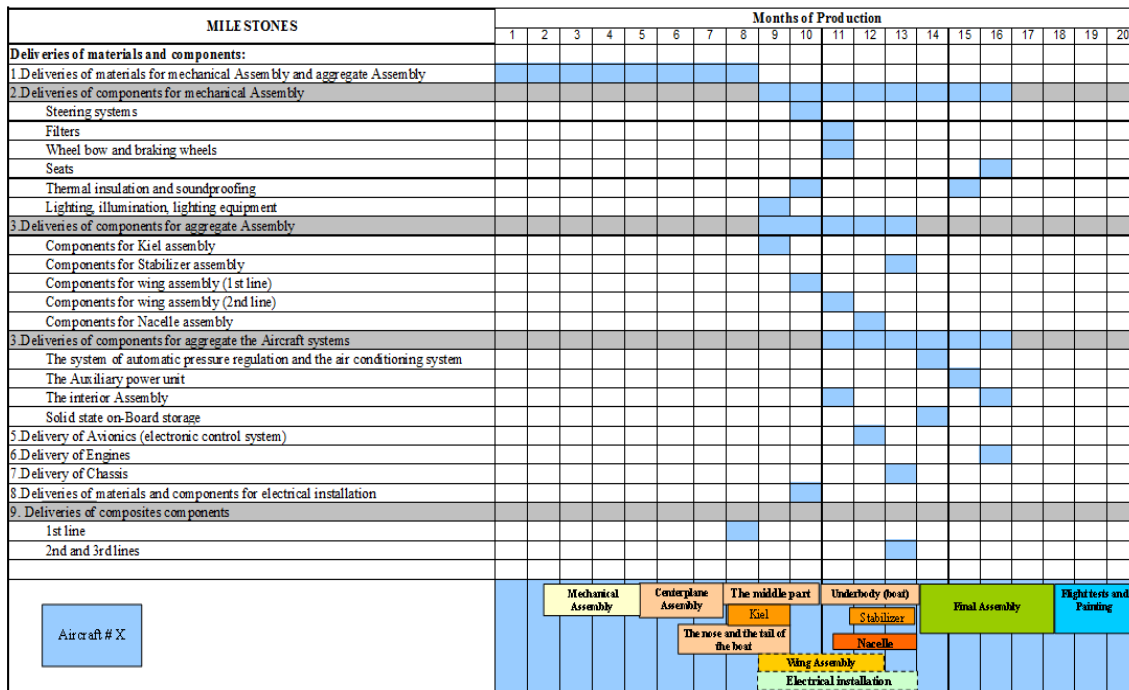


Figure 5. Schedule of products and materials delivery

Guided by the above deadlines, supply services staff make up a list of possible suppliers, consisting of regular suppliers, which have signed the agreement on long-term cooperation, and possibly

new identified through various information channels. Moreover, all the suppliers take internal certification procedure and are entered into the register of approved suppliers.

When the order time of products and materials is coming, an oral (by telephone) or in writing (email or fax) request to the supplier for the supply of products and materials is formed, and when you receive goods from the supplier fills the required form.

After ordering correspondence or oral negotiations with the provider is conducted in the following cases:

- changes in delivery schedules;
- control the timing of shipment of products and materials;
- clarify the mode of delivery of products and materials;
- failure to comply with the terms of delivery;
- defective products and materials shipped.

After entering the enterprise products undergo incoming inspection, we arrive in warehouses and service supply canned or immediately released into production.

Thus, the implementation of the subsystem "Supply Management" at Beriev Aircraft Company allowed within 2 years of its implementation the following results:

- conducting registration supply operations within 24 hours from the time they occurred, as a result of the creation of a common information space and a single reference data;
- avoid double data entry;
- reducing labor costs for processing of primary documents and, as a result, increased productivity, centralized storage of documents prepared in electronic form or scanned paper copies;
- access personnel supply services to control the functions of accounts receivable and, consequently, a decrease in the latter;
- increasing the speed of receiving reports with the ability to receive a variety of customization options of any reports;
- operational data analysis and preparation of consolidated reference for internal and external users;
- improving the quality of the information provided and, as a consequence, improve the quality of management decisions.

In the nearest future it is necessary to implement a complete system of evaluation and approved suppliers and their division into 4 groups: "Totally reliable", "Reliable enough", "Moderately safe" and "Unstable".

Suppliers division to these categories should be carried out depending on the outcome of their work with the Beriev Aircraft Company, taking into account the following indicators:

- the duration of the Supplier work;
- the percentage of timely execution of orders in the total number of orders of the Supplier;
- the lack of complaints about the quality of the supplied products;

– the percentage of product returns at the time of its commercial operation for the entire period of its life cycle.

This will allow the company to place orders with suppliers from the first and second groups in the most convenient time and at a reasonable price.

If the supplier of the first and second groups is not able to provide at the stage of order acceptable for the company delivery time must be addressed to the suppliers of the third group.

Suppliers who have fallen into the fourth group must notify the company of their non-compliance requirements and give life to the elimination of inconsistencies of data (usually up to 3 months). In case of failure to eliminate in this period causes Supplier to lose the status of "Approved supplier".

5. Conclusion

Engineering enterprises function on the basis of consolidating technology, covering a wide network of suppliers. Therefore, when there is a real competitive environment, large financial flows and highly standardized products likelihood of supply chain management control will be high. Creating the conditions for the unification of industrial enterprises and infrastructure in an integrated supply chain, capable of fast, on time and with minimal costs to supply require state support.

Taking into account the limited size of budget financing and high capital intensity of the aviation industry, a major role in the development of providers must obtain private capital.

The government is important to ensure equal access to support measures by both public and private companies as finalists and first level integrators and suppliers of 2-4 levels.

An additional measure of support could be the introduction of counter-claims by the inclusion of domestic suppliers in the supply chain as suppliers of 2-4 levels, as well as localization of components or parts for R & D in the procurement of foreign products aviation industry.

To create a favorable environment for the aviation industry enterprises, to be implemented at national level, a number of direct support mechanisms:

- 1) the system of guaranteed orders, for example, direct government purchase of aircraft;
- 2) government funding of scientific research of new types of aircraft, preparation of production and certification of these products on the federal targeted programs of industrial focus;
- 3) the use and transfer of developers - companies the rights to the results of scientific and technological activities, received in the course of public procurement to develop products.

To effectively build a supply chain and achieve these goals a description, calculation and evaluation of the functions of enterprises - participants is required. The most urgent problem -

the maximum use of the highly profitable sphere for the supply of spare parts, including their transportation and after-sales service, giving stable foreign exchange earnings.

Improving the competitiveness of Russian companies is possible in three ways:

1. Acceleration of the market reaction, on the basis of supply chain information systems allow companies with the coordinating role of the state to resolve the problem by:

- ensure timely delivery of products, significantly reduce costs and delivery times;
- the establishment of flexible and reliable traffic management technologies;
- «transparency» supply systems on the basis of management and control in real time the movement of material flows.

2. Obtaining competitive advantage by:

- more efficient after-sales service;
- control the passage of the documentation based on the original production data (filter for "gray" suppliers of spare parts).

3. Systemic restructuring of enterprises aviation industry through the introduction of CALS-technologies and quality systems.

Currently, Russia is taking certain steps for the implementation of CALS-technologies, which are regarded as a tool for organization and information support of all participants in the creation, production and use at all stages of the life cycle of products, reducing costs in the production and operation and improve service levels. Integrated supply process provides a choice of components, coding products and spare parts, procurement planning (supply) and operational control over the execution of orders. ILS system provides enterprise operational and analytical information in an electronic environment, which makes cross-section interaction between participants of the aviation market more efficient and reliable. This solved the main problems of constructing the logistics supply chain: the definition of the structure and composition procedures in the supply chain; choice of organizational form and functioning of the information technology supply chain and their interaction with the main focal point; development of a mechanism of selection and evaluation of suppliers based on the level of functioning of the organization of production, quality and cost of deliveries, availability of quality systems and modern infrastructure, goods movement. Building integrated logistic chains in a network, covering processes from product design, procurement of raw materials and components to shipments of parts and assemblies. The leading form of organization becomes a network distributed structure, focused on supply chain management technology. The economic basis of this process is the desire to reduce overall costs and the need to focus on

companies only specialized technology and resources.

The accumulated scientific and technical potential allows Russia in the short term to create high-performance new generation of aircraft with higher technical, operational and economic indicators that could allow Russia to achieve a competitive advantage in the medium term and to take a long-term niche position as a global leader in the organization and operation of transport systems served by seaplanes.

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