6. Using the Concept of Supply Chain Management in Aviation Logistics

Mariia Hryhorak

National Aviation University Kiev, Ukraine
Association "Ukrainian Logistics Alliance", Ukraine

Ladislav Šimák

University of Žilina, Slovakia
International University of Logistics and Transport in Wrocław, Poland

Air transport plays an extremely important role in servicing global supply chains, as it offers highly integrated and comprehensive fast delivery with safe, reliable, convenient and highly efficient services. And although it carries only 1% of total cargo, but the value of these goods reaches 30-40% of the world trade. The aviation industry, as an important area that creates jobs and benefits the economy, is also an important contribution to the rapidly growing global economy. Due to the multiplier effect, the growth of air transport services by 10% causes the growth of GDP of economically developed countries from 0.6 to 1.9%. An extensive network of air services allows us to create significant competitive advantages in global supply chains both in terms of production and trade [1].

In [2] it is proved that the scale and profitability of the air transport sector has a positive effect on the scale and profitability of the logistics industry. 80-90% of microelectronics and pharmaceuticals are transported by aircraft. High air transportation costs are offset by cost savings in maintaining inventories of expensive products. Consolidation of small shipments, coordination of the movement of physical goods and management of the information flow between airlines, terminals and customers allows us to get the effect of scale and additional benefits for customers in terms of speed and quality of service. The quality of infrastructure, including air transport, affects the total volume of international trade and is a factor in the effectiveness of trade. In particular, trade with an export-oriented country that has doubled the number of airports will lead to a 15% increase in bilateral trade in the future [3].

Scientific publications [4] emphasize the leading role of air transport in creating global value added (Global Value Chains, GVC). The internationalization of production has led to the movement of significant volumes of components and semi-finished products that require rapid and reliable movement between production sites located in different countries. For example, in the United States, up to 70% of the cost of imported computer components and accessories is delivered by aircraft.

The opening and integration of large markets of a number of developing countries, such as China and India, into the world economic system, the creation of the European Single Market and other regional trading blocs, accompanied by strong growth in trade and investment worldwide, has benefited the aviation industry. Positive changes in the aviation market, such as deeper liberalization of the aviation market in the economies of developed countries and improving the position of low-cost airlines on intra-regional routes, have also contributed to the growth of the aviation market [5]. The International Civil Aviation Organization (ICAO)

estimates that every $ 100 spent on air transport ultimately benefits the economy by $ 325. And every 100 additional jobs in civil aviation lead to the emergence of 610 new jobs in various sectors of the economy in a wider range of professions [6]. At the same time, aviation itself directly provides a fairly large number of jobs for highly qualified professionals.

Thus, in the aviation industry there are tens of thousands of enterprises engaged in industrial production, supply and storage of spare parts and materials, transportation of goods and passengers, provision of air transport services. These companies interact in the framework of intersectoral or international cooperation, therefore, participate in various supply chains. However, according to industry experts, the absolute dominance of production and operation of aviation equipment over services disappears. Expanding the range of new services and increasing consumer demands for quality and safety of aviation services requires new conceptual frameworks and practical mechanisms for managing various supply chains, as well as the implementation of international standards for operations and procedures. The aviation industry is undergoing system structural transformations based on logistical approaches, which facilitates the formation of network relationships between aircraft manufacturers, independent dealers for the supply and sale of aircraft parts, maintenance and repair companies, aircraft operators and air carriers in the form of integrated supply chains networks. Aviation enterprises that form supply chains for aviation products or services involve other industries in the process of creating added value. The general scheme of formation of value chains of commercial air transport is divided into segments of the upper and lower levels (Fig.. 1). Airlines are a central hub in the aviation cost chain.

Thus, the upper level consists of aircraft manufacturers and/or suppliers (aircraft, spare parts and units), leasing companies and other sources of capital, airport aviation infrastructure service providers, fuel suppliers, air navigation service providers (ANSP), aviation connection suppliers (air-to-air, between ground stations, etc.). The lower level includes companies engaged in the distribution and sale of passenger and cargo transportation services, in particular, travel companies, freight forwarders, logistics providers, etc.

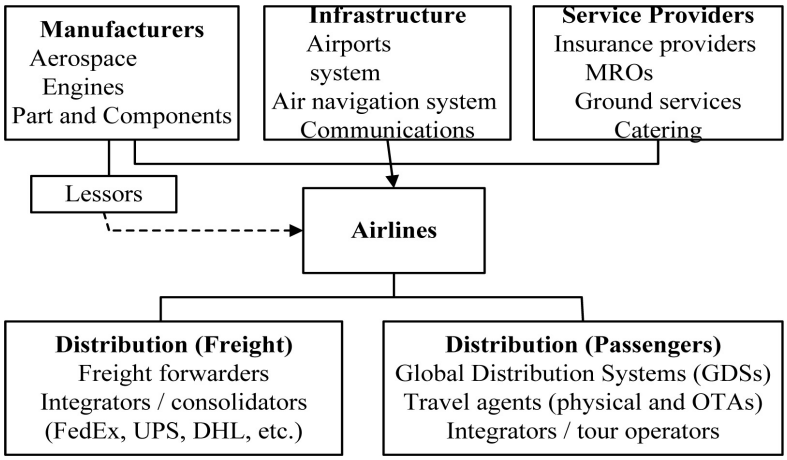

Fig. 1. Commercial aviation value chain

Source: [154, p.6]

In the presented scheme, the airline is the core of the aviation value chain, as it directly carries out air transportation and thus creates value for consumers. Other participants - the subjects of the air transportation market - provide the production and consumption of air transport services together with the airline. Analyzing the activities of various air carriers in the air transportation market, we hypothesized that the value created by the airline is closely related to its business model. A retrospective analysis shows that the airline's business model

changes depending on various environmental factors. A generalized classification of the stages of development of the air transportation industry and changes in consumer preferences is presented in Fig. 2.

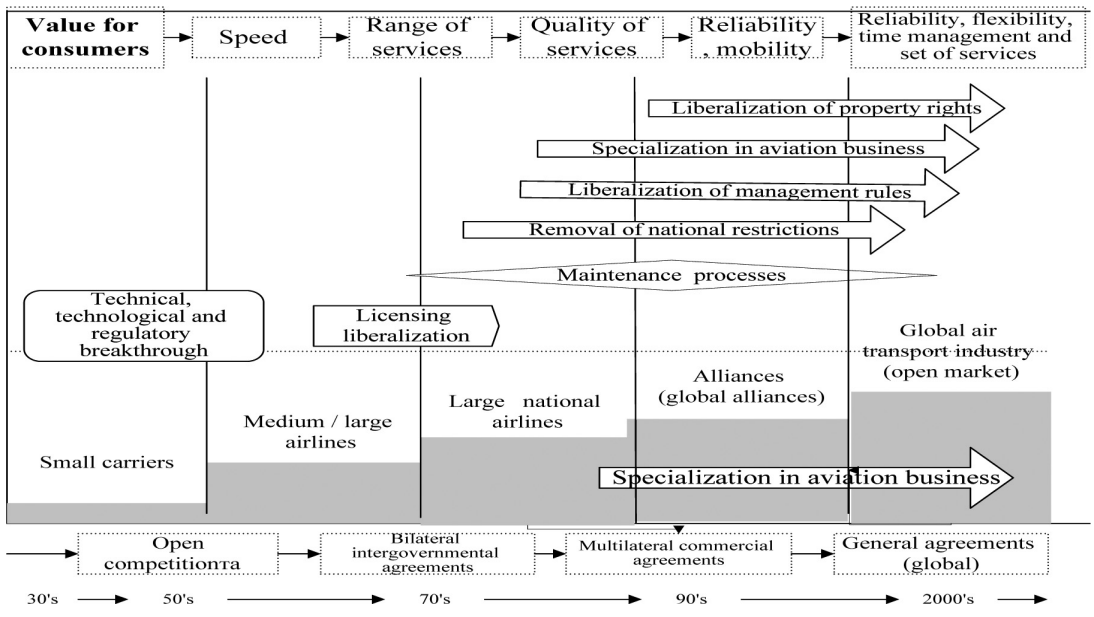

Fig..2. Stages of development of the air transportation industry and migration of the value of air services

Thus, for consumers of air services not only the speed of movement in space and time is important, but also safety, reliability and comfort of transportation. Changing consumer needs require an adequate response from airlines, which encourages them to constantly search for optimal and competitive business models that depend on the network of routes, the number of destinations in which the transportation is performed, the depth of the route network, i.e. the frequency of flights within the current schedule and the market share it occupies. An airline's business model is a reflection of the airline's actual or planned future operations in a form that can clearly demonstrate all the significant features of the airline related to its ability to interact with other members of the aviation supply chains.

The study of the factors of value creation by the world's leading airlines has revealed the following patterns:

- traditional airlines are more focused on the international transport market, in particular, transatlantic transportation, differentiation of services provided, high level of quality of service both on the ground and in flight, active participation in global alliances, interline and code-sharing agreements with other airlines, constant expansion of the route network and high frequency of flights, formation of own infrastructure of aviation and passenger service;
- low-cost airlines try to minimize the cost of all business processes, use the same type of aircraft fleet, dominate the domestic transportation markets, achieve high productivity, focus on small airports and certain segments of passengers;
- almost all airlines are actively implementing new information technologies - e-tickets and the Internet to stimulate sales, revenue management and scheduling software, monitoring of freight and passenger flows, fuel consumption control and more.

Based on the described business models, it can be concluded that there are different mechanisms for the integration of airlines into global aviation networks and global supply chains of transport facilities from the origin to the final destination (see Fig. 3).

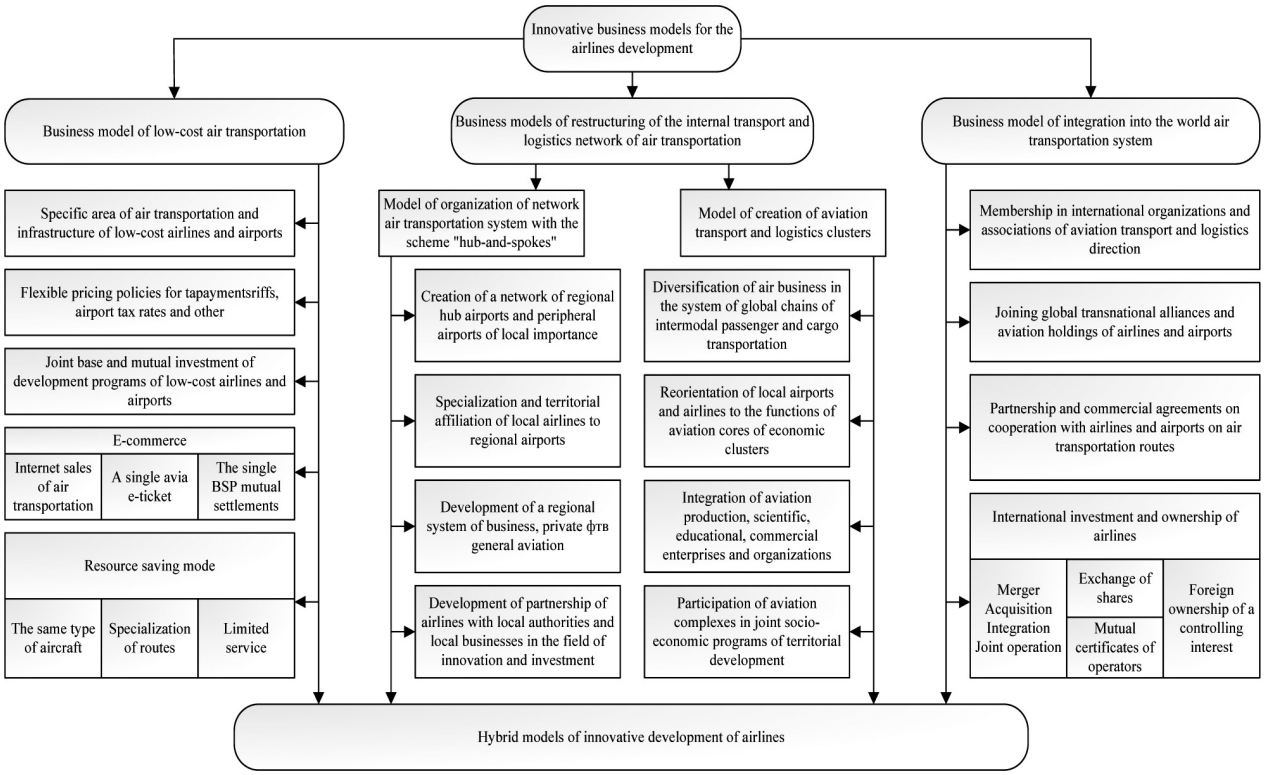

Fig. 3. Basic business models of competitive development of airlines

Analyzing business innovations of geoeconomic nature and the experience of modern aviation mega formations, we can formulate the following trends:

1. Variable search depending on the strategic situation of the most profitable form of internationalization of air transport activities, starting from the expansion of the network of international flights and routes, the use of the best samples of foreign aviation and ground equipment, the formation of international crews and labor teams of technical, commercial, representative and other subdivisions ending with the creation of a single system of common use - free trade Duty Free, aviation security, maintenance, etc.
2. Formation of a single information, regulatory and methodological space through membership and active participation in the activities and development of international recommendations on methodology and regulatory requirements by numerous organizations ICAO, IATA, UNCTAD (UN Conference on Trade and Development), ECAC (European Civil Aviation Conference), OECD (Organization for Economic Co-operation and Development); UN WTO (World Tourism Organization), IMF (International Monetary Fund) and many others. Geoeconomic activities of airlines provide for their compliance with the general rules of certification of operators, aviation personnel, aviation security systems, etc., as well as standards of technical, economic, operational, noise requirements and recommendations for formation of aviation tariffs, airport fees, air navigation charges, operating costs and revenues of airlines.
3. The transition from fierce competition to the search for forms and methods of mutually beneficial cooperation, partnership and cooperation of different economic entities in one logistics chain of air transportation with a common systemic goal of timely and high-quality satisfaction of consumer needs in air transportation. This business model successfully uses already known widely tested schemes of joint operation of airlines, interline agreements, code-sharing agreements, charter commercial agreements, bilateral and multilateral pool agreements, etc. At the same time, the current geoeconomic situation requires deeper forms of integration - the creation of aviation alliances, international aviation holdings, various forms of vertical and horizontal integration - from acquisitions to conglomerate corporations, the formation of

multidisciplinary aviation concerns, global logistics chains and supply networks, transport corridors with leading participation of air carriers.

4. A specific strategy of the integrative business model is the financial and investment system of partnerships of airlines. The policy of liberalization of transportation - open airspace - has introduced opportunities for any carrier to receive revenues from air transportation in "foreign" territory, expanding access to new markets, which is a concern for countries whose airlines are unable to compete with foreign companies. Privatization once helped reduce the state's financial burden on financing airlines by investing in new equipment and renovating airports. But even for most privatized aviation companies, their innovative development and constant technical and technological renewal requires significant funds that exceed their capabilities. The integrative business model is aimed at the interpenetration and pooling of capital of cooperating aviation entities. The main trend is to increase the possibility of acquiring part of the capital in foreign airlines, up to attempts at transactions in foreign ownership of a controlling stake, including cross-border mergers or acquisitions. But there are difficulties of an aeropolitical, economic and regulatory nature, which limit the volume of exchange packages, stimulating mainly short-term foreign investment, which contributes to the creation or strengthening of airlines alliances.

According to world trends, the most promising and realistic for most airlines is the third group of innovative business models of internal restructuring of aviation transport and logistics activities within aviation supply chains:

- a model of structural reorganization of the network of air traffic routes according to the principle of wheel design - "hub-spokes", focused on expanding the number of direct medium and short haul flights to final destinations ("spokes") from regional hub airports ("hubs") connected by long-distance routes with world centers - global hubs of general or special purpose;
- model of diversification of air transportation centers ("hubs") in the composition of local airports and airlines of local base as aviation cores of transport and logistics clusters.

New principles of formation of the world, national and local network of air transportation routes require significant complex changes in the aviation infrastructure, starting from the structure of the aircraft fleet. The ICAO analysis and forecast foresees a further reduction in the average size of aircraft, with a faster growth in the number of medium- and short-haul aircraft, as well as business jet aircraft and private aircraft. The conclusions about future changes in the structure of the aircraft fleet, which were made by ICAO analysts, are as follows:

- the need and priority of direct communication requires orders and commissioning of medium and small aircraft;
- congestion of airports and airspace intensifies the use of regional airports, which leads to reduction of the time and range of flights (again in favor of increasing the number of lighter aircraft);
- quite the opposite trend is provoked by the processes of liberalization and competition, which force airlines to unite to use larger aircrafts with lower unit costs.

The new system of relationships in the air transport business is based on a logistical approach to the management of the global transportation chain and partnerships of airlines not only with customers and suppliers, but also with the local business environment, government and local authorities. Such cooperation becomes especially important and effective in the field of innovation and investment, in search of the best solutions for local conditions and specific situations and with innovations from the arsenal of business know-how accumulated by leading airlines.

ICAO analysts believe that among the main problems that require constant attention and innovative changes in order to implement the latest scientific and practical developments of a regulatory nature, are:

- safety, quality and efficiency of air transport services;
- optimization of the use of airspace and capacity of airlines;

– environmental protection;
– economic regulation of relations between airlines.

The implementation of innovative strategies for the development of airlines also requires an innovative approach to the optimal use of air transport and the formation of optimal infrastructure for airlines and airports.

The composition of such organizational and technological innovations, in our opinion, should include:
– development of forms and methods for globalization of the operational system of airspace organization with the use of modern technology and achievements of avionics, the latest IT technologies for aircraft traffic control, the choice of criteria for optimal separation;
– development of network methods for regulating the pricing of aviation tariffs and payments, machine reading of travel documents, optimal operational use of services of secondary, reserve and local airports on the basis of a single information space;
– technological improvement of the infrastructure of airports, systems of entry and exit steering tracks at airfields, transport and logistics equipment of aviation logistics centers in order to eliminate congestion of leading airports.

Each of these areas of development of airlines covers a range of technical, technological, organizational and economic improvements. This leads to the need for a broader interpretation of aviation supply chains, which include ground maintenance services, airport customer service, handling service, etc. (Fig. 4).

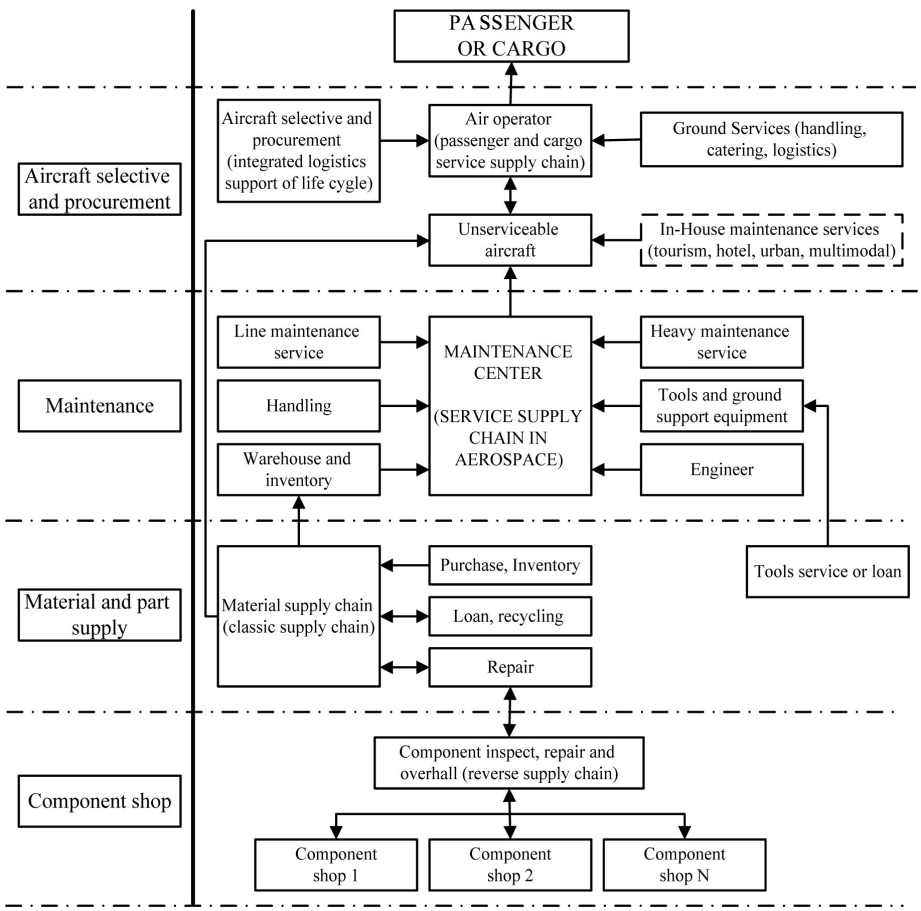

Fig.. 4. Aviation Supply chain framework

Thus, in the aviation industry there are traditional supply chains associated with the movement of physical objects (raw materials, spare parts and units, finished products). In essence, the supply chain of the aerospace and defense sectors are extremely complex, especially in terms of after-sales service. Most aircraft have a short production cycle, but have a very long service cycle; sometimes up to 30 years. This creates a service supply chain with significant requirements for maintenance, repair and overhaul and spare parts. In addition, there are monitoring and compliance requirements at every step of the supply chain. In several cases, a repair component removed from a particular aircraft may require reinstallation on the same aircraft after its repair. To manage all these complexities, a well-thought-out supply chain strategy is required, along with good process discipline and systems that support strategy and processes.

In the most general form, aircraft manufacturers choose one of the possible strategies - to build their own infrastructure for supply chain management or attract separate service providers. Both scenarios address key processes and recommended strategic, tactical, and best practices that should be considered when an organization is ready to implement a world-class supply chain management infrastructure. The main processes and requirements for supplier selection are data tracking, forecasting, inventory management, supplier order management, warehousing, customer order fulfillment, reverse logistics (warranty and repair processing), systems and technologies. The key idea of building supply chains in the aerospace industry is the concept of Integrated Logistic Support for the aircraft life cycle, which is the basis of CALS-technology. It is interpreted as a set of measures (processes and procedures) aimed at solving logistics problems to reduce costs at all stages of products life cycle and especially at the stage of operation with ensuring a high level of readiness for use.

Therefore, in the process of commercial operation there is a need for post-production service support of aircraft. The objects of recovery of air technics are aircraft and their components, namely: manned and unmanned aircraft, helicopters, their components (engines, avionics, components, units, main gearboxes, auxiliary power plant, etc.), removable and stationary equipment, simulators, etc. Currently, there is a separate segment of the services market related to the implementation of various types of MRO.

Service supply chains related to the provision of a range of aviation and non-aviation services for the transportation of goods and passengers are actively developing. Currently, the problem of service management in aviation logistics is complicated by the fact that in the provision of aviation and non-aviation services, inter-functional and inter-company contradictions are manifested. Fig. 5 demonstrates the role of different players in the formation of aviation service supply chains. This complexity is to be observed by each party so that a flexible organization can adapt to changing competitive conditions.

The ground services are updated and regulated by international authorities, and the regulations are designed by relevant industrial institutions. Services are classified by Civil Aviation General Directorate in association with Ministry of Transport and in accordance with international organizations. The fourteen activities are Representation, Cargo Control and Communication, Unit Loading Equipments Control, Passenger Traffic, Cargo and Mail, Ramping, Aircraft Cleaning, Fuel and Oil, Aircraft Line Maintenance, Flight Operation, Transportation, Catering Services, Supervision and Management, Aircraft Private Security Service and Supervision. As in all supply chains, the final objective is to satisfy the customer in the aviation supply chain, namely the passenger whose basic expectancy is to fly from one place to another.

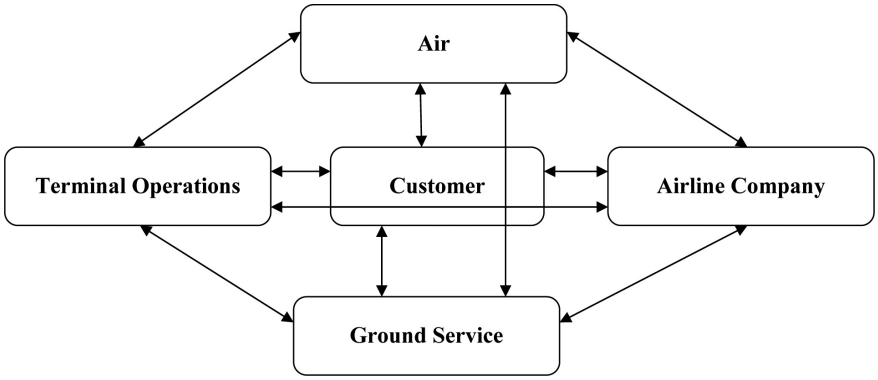

Fig. 5 Role Players and Interactions in Aviation Supply Chain

Source: [7]

Undoubtedly, the best results in the aviation service supply chains can be achieved by those enterprises in the aviation industry that will use the integrated logistics concept, which will combine the efforts of the management personnel of companies, their structural divisions and logistics partners for end-to-end management of the main and accompanying flows in the integrated business structure. The principles and methods of this approach should be aimed at obtaining the optimal solution, in particular, minimizing the overall logistics costs of enterprises. Reducing all types of costs associated with material flow management, order management, transportation, and reducing logistics risks will allow enterprises to free up financial resources for additional investments in equipment, information and computer systems, advertising, marketing research, etc. Optimal logistics solutions can be obtained not only by the criterion of minimum total costs, but also by key indicators such as lead time and quality of the logistics service.

The criteria required by Air Traffic Services Performance Focus Group for the evaluation of performance objectives and proper service quality measurement given under complex operation environment are specified as follows [8]:

1. Delay – measures the completion period of an operation beyond optimum.
2. Predictability – measures the expected variations in the aviation services system by the user.
3. Flexibility – measures the system capacity to cover varying requirements of the user.
4. Efficiency – measures the flight path curve containing the route and altitude.
5. Access – measures the insertion to the aviation services system and the coverage of requests.
6. Cost of Service – Aviation services assign and Airline Company spends.

Research in the field of customer service shows that a customer whose problem was quickly and efficiently resolved by the representatives of the contracting company subsequently demonstrates an even higher level of loyalty to it than those customers who did not have problems at all. Therefore, the effective management of service supply chains involves an integrated approach that allows sharing the responsibilities of chain participants and integrating their economic interests in the most productive way. The coordination task consists in optimal coordination at the operational level of the various requirements arising in the service supply chain.

The logistics approach to the management of goods movement means the integration into a single management system of elements that are in constant motion in time and space, such as material and service flows, as well as accompanying financial and information flows of the company and other participants in the logistics chain. The goal of logistics is meeting the needs of end customers with a total minimum cost of time and resources. The concept of integrated logistics support for the aircraft life cycle means that manufacturers, components' suppliers and service organizations are jointly responsible with the airlines for the return of unusable products and their disposal in case of impossible reuse [9].

In world practice, among other logistics concepts over the past decade, the concept of BSCM (Back Supply Chain Management) has become widespread. This is the concept of reverse flow management in the logistics chain, aimed at integration within the reverse supply chain and consolidation of all logistics functions in order to improve the efficiency of enterprises belonging to this chain, increase accountability and trust between the participants for maximum total profit.

The strategic advantages of air transport supply chains are associated with the creation of conditions that ensure the organizational, technological, informational, innovative, service and financial unity of stream processes. Knowledge and information give the consumer a market offer at the right time and right place at a competitive price, accompanying him with the appropriate level of service. For such a chain to work efficiently, it is necessary to solve the problem of synchronizing and coordinating the movement of material resources and information with numerous business processes in passenger, cargo, and service supply chains.

But everything is changing very quickly. It's no secret that today's supply chains have become more complex than ever, with socioeconomic and market dynamics underscoring organizations' need to respond to an outside-in, demand-driven world. Such innovations are associated with new expectations and high standards, forcing logistics companies to either adapt or lag behind competitors. In addition, customers who want to receive goods or services faster and cheaper than ever before put extreme pressure on carriers [10].

All these new trends and development scenarios will require new researches and, in fact, set new areas of scientific search for increasing the efficiency of supply chains involving air transport. In the monograph presented, we showed that the aviation supply chain consists of many partners with individual goals, interests and prospects. Due to the increase in the level of digitalization in the exchange of information, the efficiency of the operational activities of the main players in the air transportation market is increased. This will have a positive impact on the quality and duration of customer orders.

Mariia Hryhorak
National Aviation University Kiev, Ukraine;
Association Ukrainian Logistics Alliance, Ukraine
mariia.hryhorak@npp.nau.edu.ua

ORCID 0000-0002-5023-8602

Ladislav Šimák
University of Žilina, Slovakia
International University of Logistics and Transport in Wrocław, Poland
ladislav.simak@fbi.uniza.sk

ORCID: 0000-0001-9216-9134