

LOGISTICS TECHNOLOGIES IN AVIATION

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Abstract: The article is devoted to prospective logistics technologies, which are known in all sectors. One such branches of the aviation industry that uses these technologies to enhance development among other sectors. The article analyzes and specifies logistics technologies used in aviation. Planning and organization of air transportation is applied particularly due to the international nature of this transport, when typically great distances have to be overcome meeting the economic and physiological requirements, asking for fast, convenient and safe services. It raises the need for unification of the basic requirements and regulations for the establishment and operation of an air carrier, air traffic control, passenger check-in, construction and operation of airports and other aviation-related activities.

1 Introduction

Planning and organization of air transportation is applied particularly due to the international nature of this transport, when typically great distances have to be overcome meeting the economic and physiological requirements, asking for fast, convenient and safe services. It raises the need for unification of the basic requirements and regulations for the establishment and operation of an air carrier, air traffic control, passenger check-in, construction and operation of airports and other aviation-related activities. All of these requirements for air carrier are stipulated in the Civil Aviation Act of the State and national legislation based on the so-called. ICAO Annexes. In Slovakia, the Rules of the Air L1 - 18, are in the process of implementation in via the Joint Aviation Requirements of European aviation authorities of the association known as the JAR (Joint Air Requirements). It is essential that anyone engaged in air operations be familiar with the relevant regulations. The documents published are available at the Aeronautical Information Services of the Slovak Republic (address is listed in the AIP SR, the first paragraph of the first 3rd GEN 2) [1].

Logistics technology is a sequence of decision-making processes and procedures, which in this economic environment, respecting the interactions between components of the logistics system as logistics using optimization methods lead to the optimization of logistics costs.

2 Logistics technologies in aviation

Logistics technology include aviation in the planning, organization, administrative control and enforcement operations in air cargo supply chain. These individual components are connected to the carriage of cargo in collaboration with intermediaries of air freight, airports, airlines and air traffic services.

Logistics technology based on the interaction of among the various subsystems of the logistics chain. The momentum of logistics technologies is usually based on production, but it to be controlled by and market needs and options. Thus, market affects production, but this binding also applies as a feedback - i.e. production affects the market. This interaction affects the choice of logistics technology and vice versa, logistics technology can affect the connection between production and market [1].

2.1 Selection of logistics technology

The design and selection of appropriate technology, logistics must be based on the following facts[2]:

a) The trend of the ratio of total logistics costs to the manufacturing costs for final products has been decreasing. It is the result of reducing and optimizing inventory and the transport processes.

b) The requirements of the transport market in the small, precise and frequent deliveries, which results in increased use of automated handling, transport and information systems.

c) The requirements for improving the quality of services represent a burden on infrastructure that will be addressed by regulatory policies, also with regard to ecological load on the environment.

d) Manufacturing companies are increasingly involved in the development of logistics chains.

e) Carriers are becoming subcontractors transport service operators, who organize and carry out services in the transport chain.

f) Quality and potential of the infrastructure greatly influence the formation of logistic chain and selection of logistics technology. Due to the integration of Europe there arises the need to deal with the quality of infrastructure in the context of Trans-European Transport Network [3].

System approach and control procedures, which with the help of exact and heuristic methods which in the economic environment lead to minimization of costs in the specific link of logistics chain. In effect they mean optimization of the economic results of the logistics system [3].

2.2 The design of logistics technologic

System design of logistics technologies should be performed in steps as follows:

a) The analysis by logistic structures, with object in particular:

- General trends of logistics performance in the economic environment.

- Driving forces and factors that lead to the logistic.

- Factors affecting the differences in logistics performance by sectors and in terms of time.

- Adaptability of individual subsystems (production, trade, transport, information) of logistics requirements.

b) Analysis of economic interactions – focused on economic growth, trade and structural consequences of the introduction of new logistics technologies.

c) Social space interaction - impact on employment, changes in the structure of professional qualifications and all that with respect to the development of the region.

The design and subsequent implementation of appropriate technology, logistics, or a combination must take into account the specific economic conditions of the environment, in addition to their own understanding of their functions. Further, one should also be aware of material flows, labor flows and information. All decision-making processes make up and framework in the logistics system are of crucial importance to the effectiveness and efficiency of all processes of non-productive nature [3], [7].

3 The most commonly used logistics technologies

Logistics technologies are used in most of these concepts [1]:

a) **The concept of "Just in Time" (JIT) - (just in time delivery)**, means radical reduction of storage and inventory by exactly functioning transport (reduction of storage - not eliminating it!). A system based on small volumes of supplies of high frequency and high time reliability at a suitable geographical spread of sites of production and consumption.

b) **The concept of "sold earlier than made" - through production management**, rapid transport and orders made by means of rapid communication, your order can be classified primarily in the logistics chain. This will completely change the role of businesses and warehouses. Businesses assume the role of mediators without stocking, and the physical flow of goods can be routed directly from producer to consumer. The concept requires that the

transport infrastructure cope with small load currents with greater frequency when operating a large area.

c) **The concept of computer integrated manufacturing** to produce to order and communication systems also allow contracting production. Logistics chains are the result may be extended by a fine of up to networks that have high demands on information system.

d) **The concept of integrated warehousing and transportation terminals** deployed along the routes. Similarly as in the of JIT concept, the criterion of optimization is the reduction of overall costs, and generally increase in the cost of transport at the expense of far more substantial reduction of the cost of maintaining the inventory, storage and handling systems.

e) **The concept of vertical integration of logistics management**. In this concept, traffic becomes an integral part of the transformation process of production. Information systems and logistics coordination at a higher level of management will optimize the transport chain.

f) **The concept of "paperless transactions"** means that most documents will be replaced by communication via the computer network. This concept simplifies transport (especially in combined transport systems), the transmission tariff, tracking shipments, booking space for the shipment, payment and shipping etc. Implementation of the concept results in the reduction of human labour and logistics costs in the transport subsystem and forwarding services.

g) **The concept of a memory control and traffic management** is a concept that is based on the development and implementation of themes. The concept represents an automatic transmission of information about vehicles, containers and shipments based on identity cards, as well as automatic reading of data from relevant documents.

h) **The concept of "computerized transportation"** is a technology of network planning, capacity, loading and routes, which will increase the use of mobile means of transport at optimal load of transport routes.

i) **The concept of transport** is assumed in combination with other concepts, eg. JIT, or the concept of centralized warehouses, optimization of the organization in order to minimize transport costs. It can be divided into a system searching for the optimal combination of modes of transport and a system of optimal use of vehicles in the organization of transportation.

j) **The concept of transportation in the sphere of production** is designed to optimize inter-operational and technological services in the manufacturing process.

4 Logistics activities

In developing the logistics chains, i.e. when coordinating, linking and optimizing of material flow from the point of manufacture to the point of consumption, it is necessary to provide a range of activities [2] particularly those related to:

- Transportation,

- Packaging,
- Material handling,
- Storage,
- Customer service,
- Information flow, etc.

Set of logistics activities forms a logistics system. The separate logistics subsystems represent relatively independent economic activities, linked with other activities. Some of them activities may also function independently, without mutual interconnection. Such an approach can not be identified a system-based logical approach in managing the logistics flow processes.

Given the relatively large number of activities one has that ensure the product is delivered under optimum conditions to the right place. Further reference is made to those particularly related to the central topic of this work, knowing that all logistics activities more or less affect the logistics process as a whole.

Transportation is an integrating logistics activity linking different systems and ensuring their own moving material from the point of manufacture to the one of consumption. Providing transportation includes activities associated with the choice of the carrier or shipper (or operator), mode of transport, means of transport, mode of transport, transport routes and the like. In comparison to other logistics, these activities generally represent the largest cost items.

Packaging is a sum of the operations involved in preparing the goods for the circulation and consumption by means of packing. In terms of logistics, packaging and package provides protection of goods during storage, handling and transportation. Selection of the appropriate packing significantly influences the degree of damage to the goods and facilitates (or enables) transport and storage. It also fulfills the function of information and commercial.

Material handling represents the most extensive area of logistics activities involving all transactions related to the movement of material. In the production process, e.g. receipt, processing operations and dispatch of the material, while in the sphere of circulation it involves mainly loading operations. But handling of the material also includes activities associated with the storage, for example. storage material, but also packaging, palletizing, etc. Circulation, material handling (transfer of material) always incur certain costs associated with these activities, but usually does not increase the utility value of the goods handled. Handling activities should therefore focus on minimizing the costs associated, particularly by reducing transport distances, minimizing inventory, increasing the degree of mechanization of loading and storage operations and the like. The optimization of material flow and handling activities associated with the material can result in significant financial savings.

Storage has its specific logistics status depending on whether associated to the stocks in the production,

circulation and consumption. The activities carried out in different groups of stocks are generally similar, but warehouse features often differ. They include the storage processes: material receipt, material identification, material storage and shipping materials. In addition to them, storage can also include activities such as inventory management, storage system design, warehouse location, etc. [3].

The role of inventory management is to keep in stock such a quantity of material which would provide an adequate level of customer service while minimizing costs related to storage, that is to say non-committed funds to maintain inventory and warehouse operating costs.

Suitable storage location is a fundamental strategic decision of influencing the level of transport costs and the level of customer service.

Customer service is the output of the logistics system and its role is to ensure proper placement of the product at the right time at right place and if possible at the lowest possible total costs. Activities associated with the formation of customer service are mostly service aimed at customer satisfaction. Prerequisite of good customer service is sound marketing practices.

Information flow related to logistical communication is another prerequisite to the functioning of the individual subsystems and the system as a whole. Quality of the information flow is essential to the formation of the company's competitive advantage [6].

5 Forms and methods of air freight

Air freight began to develop in the postwar years as campaign freight - guaranteeing seasonal transport of agricultural crops (fruits, vegetables). The development of air freight depends largely on the development and composition of the airline fleets. In the present, the following forms of air freight are applied[1]:

- In the form of additional loads to transport passenger aircraft - bulk depending on the number of transported passengers (passengers);
- In the form of additional loads to transport passenger aircraft - in containers, depending on the number of transported persons (passengers);
- Transport of goods in the semi-mixed versions of the aircraft - SQC (Semi-Quick- Change) bulk and containers;
- Transport of goods in mixed versions of the aircraft - QC (Quick Change) in containers and on pallets;
- Transport of goods in cargo versions of pallets and containers.

The ratio of these forms of transport of goods by the airlines vary and depend on many factors:

- Build background airline for air freight;
- Volume of the network of international and domestic routes;
- Economic potentials of the airline.

6 Air carriers

The nature and extent of air freight also depends on the options, or orientation and size of the network carrier. By the applied methods, airlines can be divided into four groups: [1]

Group 1 - includes companies that are strong enough to establish their own freight as equal to the total air passenger traffic (Lufthansa, Aeroflot).

Group 2 - includes the companies that have introduced intermodal QC and continues to contribute to transport additional loads in passenger aircraft, or have available a limited small fleet of cargo aircraft (British Airways).

Group 3 - includes companies that operate only freight cargo aircraft (Heavy Lift).

Group 4 - includes companies in which goods are transported running additional loads in passenger aircraft, with the provisional measures applied to increase capacity for freight.

This distribution shows that aircraft are distinguished by carrying cargo in bulk, bulk cargo inserted in the space, or on pallets and in containers.

7 Air freight intermediaries

The complex of services by intermediaries in the air is now extensive. Not limited to the actual shipment, but includes a wide range of services associated with the formalities for the movement of goods through the customs border clearance of goods at the airport and handling it. Intermediaries are able to provide full shipment from sender to recipient without the sender having to enter into relations with other third parties. Intermediaries provide services:

- Own flight - the parcels, transfer of large (volume) of mail, express shipping, transportation, from "house to house";

- Special transportation – re-dispatch, replacement transportation, transportation of special goods [3].

7.1 IATA cargo agents

IATA Member States of the late 60s came up with the idea to establish an air cargo agency. They set minimum requirements to be satisfied:

- Professional knowledge and capabilities of the staff;
- Average level of office equipment;
- Turnover and sufficient funds for marketing;
- Cargo handling;
- Documentation.

After meeting all the requirements (IATA are controlled directly by the Office for agents) and having obtained IATA approval, they may use the name of IATA Cargo Agent.

Between the IATA and the agent a contract is concluded. It contains a provisions on the appointment, registration, extent of the agent's sale of air freight,

handling shipments, remuneration, reimbursement and payment obligations, compensation, communications, promotions carrier services, storage and filling out bills of lading.

Normal services offered by IATA agent:

- Provide necessary information regarding the upcoming realized export or import of the case;

- Provide facilities for receiving and picking up mail from the sender in accordance with its instructions;

- Ensure pick up mail from the sender's office;

- Prepare documents - bills of lading to fill, check invoices and other documents required for air transport and customs clearance;

- Check the export or import licenses;

- Check that packing lists and any statements or certificates of the sender (for dangerous goods and live animals) are in accordance with government regulations and IATA regulations;

- Provide assurance to the customer;

- Ensure the transport of goods, booking cargo space in airlines, make a schedule to send items to the airport;

- Track the movement of the consignment to its destination.

Air cargo agencies are intermediaries between senders and receivers and the airline and are characterized by providing a wide range of services.

IATA cargo agent represented by the designated airlines of acting on their behalf (includes space on the plane). Its mission is to prepare and arrange the shipment and all documents necessary to transfer the carrier. For his work receives a commission from the airline. The rights and obligations of the IATA cargo agent is completely processed by IATA decision in the manual, which will each registered agent. IATA cargo agent offers services related to the export shipper of goods, possibly assisted by the consignee (importer) on his side [1].

7.2 Air freight forwarder - consolidator

A wide range of activities and services than the IATA agent is offered by a consolidator - freight forwarder. It is an agent or agency dealing with air freight consolidation, benefiting from lower tariffs, set by airlines to transport larger items - collected many different items and sends them as one large shipment of a consignment note. Consolidation requires good technical support - for example, sufficient storage space.

Consolidator sets his own price – selling its own transportation system to their own tariffs, but also assumes the responsibility of the carrier. The price takes into account the tariff and its costs, expenses and profit (IATA cargo agent offers the normal fare). If sending several consignments as one bulk shipment at a certain point, at the addressee of the shipment there is his agent called: „ Drop-down agent. His role is to subdivide the bulk shipment again divided into the original single consignments and take care of them (delivering to the addressee).

Consolidator provides services related to export and import.

The Slovak transport market intermediary in the cargo transport several types of companies are active [4]:

- Independent freight forwarding companies – agents.
- Freight forwarding companies, which also deal with other types of transportation.
- Subsidiaries of foreign forwarding companies.
- Courier delivery services.

8 Air freight

For air transport the most favorable product is the one with high specific price at which the relatively high fees take effect less than at substrates of lower value. Consequently, the higher the price of transported substrate, the smaller the portion paid for transport of the total selling price of the product. This relationship does not always hold consistently, because there are many other criteria that affect it [5].

8.1 Air cargo

Product suitable for air transport must meet the requirements, both in terms of volume and weight, established for various types of aircraft. In terms of requirements for air travel, we distinguish the following groups of products [1].

1. Substrates with relatively low value. These include for example coal, wood, oil, grain and so on. This product is for their physical and chemical properties of aviation inappropriate.

2. Diverse range of goods such as appliances, precision engineering products, electrical and other motors, articles of clothing and textile industry. Currently, air transport of goods carried in a small scale in the future is taking shape as a very promising because they provide a uniform and regular utilization of aircraft.

3. Goods requiring quick transportation for economic reasons, such as. Parts (late delivery may result in increased costs due to penalties, loss of market - the economic losses the company).

4. Those requiring rapid transport of goods in terms of timeliness, for example. newspapers, magazines. Despite the low weight of the shipment by air is convenient for reasons of regular delivery of goods, thereby affecting the utilization even planes. They also include means for emergency aid, medicines, medical equipment, plasma.

5. Goods at the price of losing long-standing transportation and storage, for example. fresh vegetables, fruits, flowers, live animals and the like. The transport of animals is the high cost of the expenses for treating the time-consuming transport

6. Goods with high value that is to say precious metals, furs, jewelry, art objects, etc. .

8.2 Aircraft pallets and containers

The goods are in transit in most cases, palletized or stored in containers.

Palletization and containerization facilitates faster ground handling and loading and unloading of aircraft.

Aircraft pallets are matched to mechanized loading and also for fixation and fixation in aircraft cargo pallet. It is a platform made of compact material onto which individual items are stored so that the whole constitutes one shipping unit. It features handles a nets to hold the variety of goods..

The air container is a compact box that can be made from various types of material (pressed paper, fibre-board, metal, plastics). The walls of the container are fixed. The container is the unit cost for transporting large quantities of parcels.

The introduction of containers and pallets for air freight has brought significant advantages and benefits [4].

- Packages are transported in a single consignment, which is manifested: in reducing the cost of ground clearance, better utilization of the aircraft, a reduction in packaging costs, better control and registration of all movements in the handling of goods.

- Possibility of using standardized and mechanized equipment for handling, resulting in: check-in time reduction, reduction of physical effort, saving staff.

- Reduction the need for storage space and facilities at a faster movement of goods in containers and on pallets, better oversight of shipments.

- Possibility of application of combined transport

- Reduction in tariff rates.

The advantages of containerization and palletizing are not only advantageous for airlines but also users of air transport mainly in terms of economics and ground handling.

Currently a number of containers and pallets are used in aviation. It was caused by the great variety of aircraft types that have not been originally designed for this mode of transportation.

International Air Transport Association - IATA with the participation of experts, airlines has developed and announced a single programme for containerization and palletization. Standardization of containers and pallets covers a wide range of international organizations. The best known is the International Organization for Standardization - ISO, with IATA which works in this field [5].

Developed programs allow the application of the principle of common containers and pallets focusing on:

- Dimensional, volume and weight limits.

- Principles of labeling, freight rating.

- Technical specifications for production.

- Definitions of basic terminology.

- Principles for testing.

- Principles for circulation and use, etc.

In the context of the tasks for the expansion of container traffic in organs was IATA recommended use of 17 standard sizes of containers outside the volume of 0.5 m³ to 11.5 cubic meters of container weight from 8.5 kg to 275.5 kg.

The basic conditions to be met by air containers (with attestation IATA and ISO) are:

- Light weight, made from aluminum, different types of plastics, paperboard or special impregnated fibrils (mass air container is 6 to 10% of its gross weight of cargo, such as low container type: Stennis IGLOO weighing 123 kg can be loaded with goods weighing 1,160 kg).

- Pressure at the bottom of the container, how to construct a surface or in the form of lysine (unacceptable are wedges of scissors) must not exceed 9.7 kPa.

- Resistance to cutting or deformation.

- Dimensions must not vary more than 2% (allowable manufacturing tolerance should not exceed 2-5 mm).

All types of containers and pallets on integral base are termed as ULD - Unit Load Devices, translated into the Slovak language as standardized loading unit. Aircraft ULD - are part of the aircraft, and units can be rented by the consignor for loading purposes. Those, however, must demonstrate that they are able to handle them professionally.

Non-aviation ULD - are not bound by the dimensions and design of aircraft. However, they must be registered by the IATA. They are owned by the shipper or agent. Consignment transported in ULD must remain all the time in the same ULD [4].

9 Tickets

The air transport of goods is necessary documents required:

- prior to shipment,
- during transport,
- following transport.

The basic document of carriage of goods by air, the air waybill - Air Waybill (AWB).

The air waybill is a contractual documents for air cargo transport between the shipper and carrier. The Warsaw Agreement it is accompanying the consignment from the airport of departure to the destination airport. Contract of carriage between the shipper and carrier can also be signed also by the air carrier agent. On the one hand, they are acting as agents in relation to the carrier and are authorized to sign transport documents. The consignment note is not purely a document on just having concluded the contract of carriage, but it also performs several other functions such as:

- Acknowledgment of receipt of the consignment.
- Order on dealing with the consignment .
- Order on transport routes.
- Field Declarations.
- Accounting documents.
- Proof of dispatch.

- Proof of insurance.

The consignment note shall be made in 14 specimens: 3 originals and 11 copies. The reverse of the original are printed in terms of the contract of carriage, which inform the sender of the rules under which goods are transported. The first original - green-is for the sending airline. The second original - red - is for recipient and accompany consignment of. The third original - blue - is for the sender. Use 4 to 14 copies (yellow) is indicated below the lower edge, are a confirmation of sending mail. The exact distribution is not specified, but one must get a copy of the document as an airline involved in the transport, IATA agent, office, airport and another destination. Subsequent orders (change of route, change of destination airport) can enter only the party who owns the original bill. Consignment notes are marked with a three-digit numeric code that the serial number for the sending air carrier.

All items loaded into one aircraft must be included in the CARGO MANIFEST, which is filed by the carrier sending the consignment of and the is attached to the Loadsheet informing about the distribution of the substrate for the specific flight. Before transporting the air waybill must contain:

- The destination airport if desired route of transportation.

- Weight and dimensions.

- Type and quantity of goods.

- Value of goods.

- Method of payment of fees.

- Whether it be insurance of goods.

- Notes.

- List of documents attached.

In addition to the air waybill this group also include:

- Documents required for customs clearance at departure and destination.

- Different documents depending on the nature of the goods (e.g. medical certificates).

- Various documents for purposes of payment (letter of credit, bill, payment to the bank).

Shipping documents during transportation: AWB for direct consignment of, MWB HWB along with the consolidated shipment, a list of items (CARGO MANIFEST). After transport to the customs documents for negotiations [2].

10 Air freight settlement system

In order to facilitate settlement between brokers and carriers the CASS-Cargo Accounts Settlement System have been developed. It is open to both members and non-members of the IATA.

The system consists in the fact that each of the air waybill copy is sent to a special account for processing. The settlement panel records all the necessary data for simple handling to the account of each bill of lading.

Each agent receives a bill for any one carrier with which it works and information on the total amount to be paid to all carriers. Everyone receives information about the accounts relating to its agents. The data used in the Settlement are ordered by AWB numbers to be checked easily. On the day of settlement, the agent will pay the total amount of account control panel. The money received from the agents are placed on the account from which a single payment is made to each carrier [1].

11 Conclusion

Transport and the activities associated with storage are the biggest cost items in the supply chain, and therefore due attention is to be paid to their design and optimization.

Air freight has recorded a long-term growth of their performances, despite some negative effects in the past or in the current period. This mode plays an irreplaceable role in the global, continental and intercontinental transport relations for certain types of supplies, particularly supplies of high value and low volume. In order to ensure high quality transport services, particularly in terms of quality and accuracy of delivery, further growth of the integrated express carriers can be expected, and creating strategic alliances and partnerships between individual carriers. Air freight is increasingly becoming an integral part of a more robust global supply chains adding to their values.

References

- [1] FERENC, J. et al.: *Prevádzka letísk*, Letecká fakulta, Technická univerzita v Košiciach, 2013. (Original in Slovak)
- [2] BOROŠKA, J., ŠADEROVÁ, J.: *Technické prostriedky logistiky I*, Elfa, s.r.o., Košice, 2001. (Original in Slovak)
- [3] GAJDOŠ, J., URBLÍKOVÁ, D.: *Logistika teoretické základy a prípadové štúdie*, Ekonomická univerzita v Bratislave, 2005. (Original in Slovak)
- [4] KOŠČÁK, P., FERENC, J.: *Organizácia a riadenie prevádzky letísk*, 1st ed., Košice, LF TU, 2010. (Original in Slovak)
- [5] KOŠČÁK, P., OLEJNÍK, F., FERENC, J.: *Riadenie prevádzky letísk*, 1st ed., Košice, LF TU, 2012. (Original in Slovak)
- [6] KHOURI, S., KAČMÁRY, P. Optimalizácia tokov informácií v modelovej firme prostredníctvom zavedenia ERP systému, *Doprava a logistika*, Special issue Nr. 6, p. 125-127, 2009. (Original in Slovak)
- [7] ŠADEROVÁ, J., KAČMÁRY, P.: The simulation model as a tool for the design of number of storage locations in production buffer store, *Acta Montanistica Slovaca*, Vol. 18, Nr. 1, p. 33-39, 2013.

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