

## THE ROLE OF AIR TRANSPORT IN THE SUPPLY CHAIN

**Katarzyna WĄSOWSKA**

*Siedlce University of Natural Sciences and Humanities*

*2 Konarskiego, 08-110 Siedlce, PL*

*katarzyna.wasowska@op.pl*

**Abstract.** *The twenty first century is a time of growing globalization of markets in which supply chains and channels of distribution of goods become increasingly complex and their operational area extends beyond the country borders. All activities undertaken in the supply chain are aimed at meeting the growing needs of customers. An important link in the supply chain that influences movement of goods is air transport which offers a wide range of services tailored to customers' expectations. The aim of this paper is to draw the attention to an important mode of transport – the air transport. The author deals with defining a role of the air transport in the supply chain.*

**Keywords:** *air transport; supply chain; network structure; cost of transport; cargo.*

### Introduction

Currently, the air transport is one of the most important element of infrastructure of modern economy of a country – world. It is one of the fastest, the most expensive, and at the same time the most effective kind of transport that plays a very important role in the supply chain processes as it ensures coherence of the supply chain, guarantees an essential flexibility and the ability to adapt to rapid changes of the surrounding. Air transport is involved in creating values at particular stages of the chain while generating an added value for the customer. The air transport operating under aforementioned conditions provides an opportunity to continue and develop in an effective way because it appears as both a factor and an optimisation tool of such formed network structure.

The dynamics of world trade and demand for transport services have been growing from year to year. Factors of their growth may be seen in increasing volume of transported commodity weight and in average distance of transports. Those reasons support the growth of global logistics development and the rise of global supply chains which subsequently lead to a further choice of movement of goods, forming a sort of basis for a new economic order in global terms.

Functioning of modern economy depends on efficient movement of goods, services and financial flow between different markets. It is not important whether we live in times of economic crisis or whether we experience prosperity, because the air transport constitutes a key element in a local and the world market coupling, which in turn influences their development.

## General characteristics of air transport and the supply chain

On 17th of December, 1903, two brothers – Wilbur and Orville Wright, made a first flight by Flyer biplane that was endowed in a front combustion-powered elevator. Historical flight took 12 seconds and the plane was launched from a primitive catapult (Rossa, 2008). This event initiated the growth of air transport, which plays a crucial role in global transport and facilitates a long –distance transport of passengers in a short time, as well as a movement of goods.

Thanks to rapid changes, the air transport became a high growth global business. A role of the air transport in a global economy is substantiated with macroeconomic data. Currently “aviation contributes 7.5 % of GDP of the world economy and maintains more than 32 millions of jobs” (Chakuu, Kozłowski & Nędza, 2012, p.4).

The air transport is currently one of elements of modern economy and global transport system. It is a modern, the youngest and the most dynamically developing transport mode that constitutes a basis for operating highly diversified passengers, cargo and mail transport market due to its functional, organisational and technological reasons (Rucińska, Ruciński & Tłoczyński, 2012, p.7).

That mode of transport is mainly used in intercontinental connections and it is utilised in the transport of goods which are the subject of international exchange of goods. The air transport indicates the highest rate of growth among other methods of transport. Even though, air performance amounts only to about 1 % of the world freight transport, the value of transported shipment hovers around 10% (Neider, 2015, p.77).

Indisputable advantages of the air transport are: a short time of transport; a wide spatial range of transport means – Table 1; a regular supply; safety.

**Table 1. Spatial extent of planes**

No.	Type of plane	Extent
1.	ATR 72	1500 km
2.	EMBRAER 170	3000 km
3.	BOEING 737 400	12600 km
4.	AIRBUS A380	14000 km when fully loaded 16200 km without a load

The air transport has also several disadvantages, which include: to little loading capacity (payload) of planes, which results in limiting the size of transported goods; heavy dependence on weather conditions; unattractive spatial distribution of transport network that enforces consignors to use other modes of transport for transportation of cargo from and to the airport; high costs – they lead to a reduction of air transport’s role only to operations related to high-valuable cargo (Neider, 2015, p.78).

Costs, time or loading capacity are attributes of the air transport which make this mode of transport the best to carry a high-valuable and small-size products which are fragile, perishable or require urgent delivery. Products which are carried mainly by the air transport include: car parts and accessories; cut flowers and plants; electric al and electronic equipment, e.g. mobile phones; vegetables and fruits; machines and spare

parts; metal items; photographic equipment and its spare parts with accessories; printed materials; clothes (Murphy & Wood, 2011, pp.315-316).

While describing airports characteristics, the most important airports should be indicated – Figure 1.



**Figure 1. List of airports in Poland (www.tvn24.pl, 2017)**

**Supply chain**

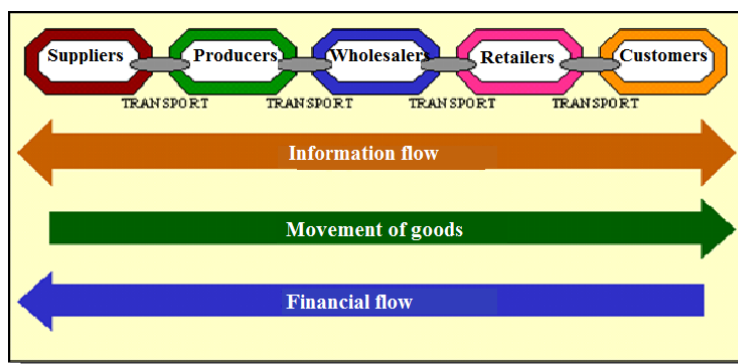
Changing market conditions, development of globalization and technological progress had a significant impact on conceptual evolution of the supply chain, especially in terms of interpretation of its substance, aims and actors. Differences in the subjective characteristic of the supply chain gave a rise to express distinct views on objectiveness, practicality and purpose of cooperation. Therefore, the concept of the supply chain is not clearly and unambiguously (Witkowski, 2010, p.13) as proven in Table 2.

**Table 2. Summary of selected interpretations of the supply chain (Witkowski, 2010, p.13)**

No.	Authors	Definition
1.	A.J. Battaglia G. Tyndall	“Supply chain is a strategic concept based on understanding and management of sequence of activities – from a supplier to a customer – adding value to the products transferred through the supply pipeline”.
2.	C.B. Bozarth R.B. Handfield	“Supply chain is a network of producers and service providers who cooperate with each other to process and transport goods – starting from the raw material to the end user level. All these entities are connected with movement of goods, information and financial flow”.
3.	M. Christopher	“A supply chain is the network of organisations that are involved through linkages with suppliers and customers in different processes and activities that produce values in the form of products and services delivered to ultimate consumers”.
4.	M.C. Cooper L.M. Ellrama	“Supply chain is an integrating philosophy of managing the total flow in the distribution channel”.
5.	J. Witkowski	“Supply chain is constituted by companies collaborating in different areas: mining, production, commercial and service

		with its customers, between which flow the stream of products, information and financial means”.
6.	European Committee for Standardisation	“Supply chain is a sequence of processes adding value to the product during its flow and processing from raw material, through all the intermediate forms, to form in line with end customer requirements”.
7.	The Association for Operations Management	“Supply chains are processes from the initial raw materials to the ultimate consumption of the finished product linking across the supplier with the customer and the functions within and outside a company that enable the value chain to make products and provide services to the customer”.

While referring to J. Witkowski’s definition of the supply chain, its core can be illustrated in the following way, as shown in Figure 2.



**Figure 2. The core of the supply chain (adapted from J. Witkowski) (Słowiński, 2008, p.52)**

Efficient functioning of the supply chains is based on several simple rules which contribute to mitigating conflicts among the actors in the supply chain: transparency and trust – needed while sending market information to the actors that is related to demand, prudent forecast, production schedules or procurements; strategic cooperation – involves mutual planning and implementation of the supply chain strategy together with determining a place and a role of its chains; leadership – choosing a central coordinator of the flow – the main initiator of taken actions who controls their execution; mutuality – agreement of principles related to sharing the risk and also to potential benefits, resulting from joint venture (Kisperska-Moroń & Krzyżaniak, 2009, pp.35-36).

A development and a shape of current supply chains depend on many interrelated factors. A number of those factors accounts for their complexity and requires efficient and effective management – Table 3.

**Table 3. Factors shaping the form and the development of current supply chains**

No.	Factor	Characteristics
1.	Globalisation and internationalisation of enterprises	In the age of globalisation and internationalisation of enterprises, most of movements of goods are international and even global. The internationalisation is mainly favoured by outsourcing, a tendency to purchase goods or locate the production in distant countries.
2.	Pressure on cost reduction	Globalisation and internationalisation of enterprises also contributed to the fact that the large number of American and European undertakings produce or subcontract the production on the Asian market which is a result of the pressure on the cost reduction.
3.	Individualisation of massive production	This trend refers to the mass production (mass customisation) of vary diverse consumption goods, which are produced for the needs of global market and also cover individual needs of the customers. It requires establishment of effective supply chains which are oriented for the ultimate customer.
4.	Outsourcing of logistic functions	It was noted that logistics operators are increasingly participating in the logistics service of the supply chains. They facilitate the flow of products between manufacturing and retail companies, therefore the latter can focus on the key competences and thereby reduce efforts to fulfill supporting functions of the business, such as transport or stock management.
5.	Modern information and Communications technology	Increasing utilisation of advanced technologies made the integration of the supply chain in the electronic information flow easier and faster. It facilitates obtaining the information about the flow of products and enterprises which are the actors of a given supply chain. Information technologies provide an opportunity to small and medium enterprises to incorporate into global supply chains.
6.	Changes in the structures of retail	In the recent years, there is noticeable increase of large surface shopping centres and business premises where the customer can do all the shopping in one place. Share of sales of the above mentioned trading companies is steadily growing when it comes to the value of total sales of products. Chain stores require a new approach to collaboration and partnership, as well as a modern transport and storage service in terms of its technology and organisation.
7.	Increase in competition	The growing competition enforces enterprises to seek savings, not only in the area of product's quality and price but also in activities increasing the value associated with purchasing and using the products by the customers.
8.	Reduction of held reserves and the lead time of order	Enterprises try to cope with pressure connected with stores reduction and shortening the time between placing an order and delivery to the customer. Therefore, they organise more frequent supplies of raw materials and components, minimise transport time and improve indicators related to the reliability of supply. Carrying out these tasks is supported by services of logistics companies.

## Demand for transport services

Demand for transport services is determined by many relations between bidders and recipients who are willing to purchase a service at a specified time, place and price. The transport demand results from spatial requisition for goods which are the subject of movement, whereas the factors that influence the demand size arise from a character and the number of spatial linkages between the representatives of supply and demand sides of the market. The development of an offer for providing transport services by logistics operators is based on the specification of the distribution of potential demand places and finally on specific transport needs.

The factors that determine the transport demand include: a size and a structure of transport needs; a financial capacity of the recipient; the level of prices for transport services; a size and a structure of demand offer (Kauf & Tłuczak, 2015, pp.124-125). Macro – and microeconomic factors determining transport demand are: current and expected GDP; changes in the structure of economy; volume, structure and value of foreign trade turnover; the structure of households' expenditures; changes of location and settlement; the level of implementation of modern technologies in the field of information, transports and transshipment in the transport sector; Transport Policy of the State; programmes for the development of transportation infrastructure (Mindur, 2009, p.163).

Taking into account the first group of factors, it is worth to present two modes of transport for the sake of comparison and consider choosing one of them – Table 4.

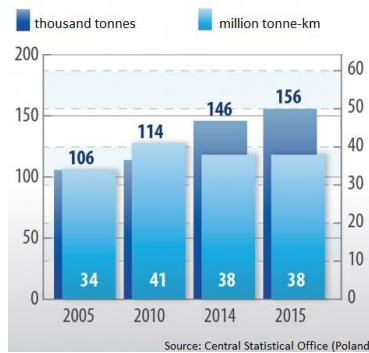
**Table 4. The choice of transport modes**

Itemisation	Air transport	Sea transport
Number and nature of the shipment	10 cartons	4 trunks
Net weight of the shipment	2730 kg	2730 kg
Gross weight of the shipment	2800 kg	2900 kg
Volume of the shipment in cubic meter	9,8 m <sup>3</sup>	10,4 m <sup>3</sup>
Value of the shipment	409 200 000 PLN	409 200 000 PLN
Packaging costs	220 000 PLN	330 000 PLN
Supply costs and other elements of costs calculated at the beginning	80 000 PLN	700 000 PLN
Freight	6 630 000 PLN	2 504 000 PLN
Costs of load transports from the airport/seaport	180 000 PLN	250 000 PLN
Custom duties	5 475 000 PLN	5 512 000 PLN
Insurance	230 000 PLN	744 000 PLN
Credits interest rate	152 000 PLN	761 000 PLN
Transport time	1 day	21 days
Global costs	12 967 000 PLN	10 804 000 PLN
Cost difference	2 163 000 PLN = 16.6%	
Time saving	20 days	

The above table shows that the air transport is unbeatable in terms of transport time. However, the sea transport is better on price basis. Despite a fairly substantial price difference regarding carriage of goods by air, this mode of transport can be cost-

effective in many cases, for example, when the transport route is long and the carriage has to be quickly delivered to the place of destination ([www.transportbezgranic.pl](http://www.transportbezgranic.pl)).

The quantity of transported consignments by Polish airports has been growing from year to year. That reflects a significant role of the air transport in the supply chains – Figure 3.



**Figure 3. Transport of goods by air in Poland ([www.wnp.pl](http://www.wnp.pl), 2017)**

Referring to data from Civil Aviation Office, in 2015 there were nearly 82 thousands tons of cargo transferred from/to Poland by air transport, which marked a growth of almost 12 % compared to the previous year. PLL LOT, DHL, Emirates, UPS and TNT transport the biggest number of goods. The most popular destinations, in terms of transported mass, were: German, USA, United Arab Emirates, China, Belgium and recently also Iraq.



**Figure 4. Air cargo transport in Poland – an amount of handled parcels ([www.biznes.gazetaprawna.pl](http://www.biznes.gazetaprawna.pl), 2017)**

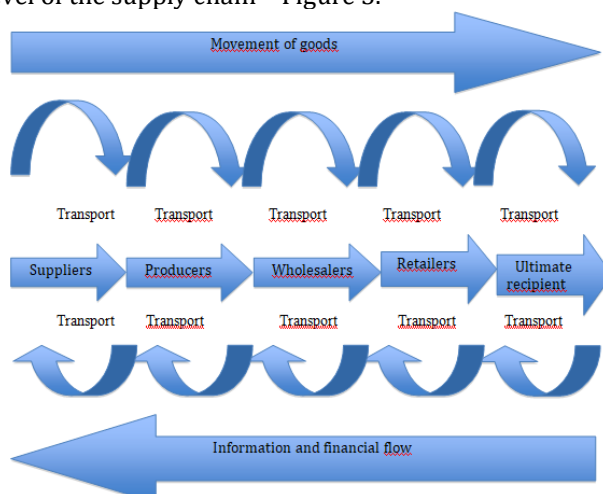
### The importance of air transport in the supply chain

The 21<sup>st</sup> century raises growing challenges for transport which come from a growth of production and key competences leading to cooperation in the production and to an increase in the level of specialization. Development of transport has a crucial impact on economic growth of the country. When we consider transport as a sector of national economy, then it includes measures and actions closely related to the carriage of goods and services. However, from the logistic point of view, transport is an activity which is

directly responsible for movement of goods within the supply chain. In case of movement of goods, the main transport task is to deliver stores to the production or finished products to the recipient.

The main transport's role in the supply chain is movement of materials, primary and finished products between differently located enterprises. The essence of functioning the above-mentioned supply chains is delivery of ordered products to the purchasers and also elimination of disparities related to the time and space.

A basic element of proper functioning of the supply chains is transport. It is estimated that transport issues constitute almost 80 % of all logistic function. Transport need occurs at each level of the supply chain – Figure 5.



**Figure 5. Transport in the supply chain  
(Own elaboration)**

Another factor that determines functioning of the transport, being one of links in the supply chain, is road infrastructure which enable functioning of the enterprise and individual entities in the economy. Road infrastructure enables goods to be transported and allows supply chains to operate efficiently. It also has a considerable influence on transport costs which stand at 40 % of total costs in logistic operation (Kauf & Tłuczak, 2015, pp.113-118).

## Conclusion

The role of air transport in the supply chain results from functions that it performs in the processes of production and exchange. Transport allows products, materials and semi-finished products to be delivered after being connected in the process of production. It is also necessary in the stage of exchange in which produced finished products are delivered to sales coverage and then to the ultimate customers. It is a bond that connects all links of the supply chain, determining their efficiency of functioning.



## References

- Chakuu, S., Kozłowski, P., & Nędza, M. (2012). *Podstawy transportu lotniczego [The basics of air transport]*. Kraków-Rzeszów-Zamość: Wydawnictwo Akademickie.
- Ciesielski, M., & Długosz, J. (2010). *Strategie łańcuchów dostaw [Strategies of the supply chain]*. Warszawa: PWE.
- Kauf, S., & Tłuczak, A. (2015). *Badania rynkowe w zarządzaniu łańcuchem dostaw [Market study on the supply chain management]*. Warszawa: Difin.
- Kisperska-Moroń, D., & Krzyżaniak, S. (2009). *Logistyka [Logistics]*. Poznań: Biblioteka Logistyka.
- Łaniewski, F. (2016). *Wybór gałęzi transportu. Obliczanie stawek przewozowych [Choice of transportation branch. Calculating shipping rates]*. Retrieved from <http://slideplayer.pl/slide/428717/>.
- Majszyk, K. (2016). *Transport: Tony w chmurach. Ożywienie cargo [Transport: Tons in clouds. Cargo recovery]*. Retrieved from <http://biznes.gazetaprawna.pl/artykuly/951955,transport-tony-w-chmurach-ozywienie-cargo.html>.
- Mindur, M. (2009). *Transport Europa – Azja [Transport between Europe and Asia]*. Warszawa - Radom: PiB.
- Murphy, P.R.jr., & Wood, D.F. (2011). *Nowoczesna logistyka [Modern logistics]*. Gliwice: HELION.
- Neider, J. (2015). *Transport międzynarodowy [International transport]*. Warszawa: PWE.
- Rossa, G. (2008). *Wydarzenia w historii lotnictwa [Events in aviation history]*. Retrieved from <http://www.eioba.pl/a/1tet/wydarzenia-w-historii-lotnictwa>.
- Rucińska, D., Ruciński, A., & Tłoczyński, D. (2012). *Transport lotniczy. Ekonomia i organizacja [Air transport. The economics and organisation]*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego.
- Słowiński, B. (2008). *Wprowadzenie do logistyki [Introduction to logistics]*. Koszalin: Wydawnictwo Uczelniane Politechniki Koszalińskiej.
- Stefaniak, P. (2016). *Luka w lukach – jak jest z polskim cargo lotniczym? [Luka in the gaps – as is with the Polish air cargo]*. Retrieved from <http://www.wnp.pl/artykuly/luka-w-lukach-jak-jest-z-polskim-cargo-lotniczym,286089.html>.
- Szymonik, A., (2013). *Zarządzanie zapasami i łańcuchem dostaw [Stock and supply chain management]*. Warszawa: Difin.
- Wasilewska-Marszałkowska, I. (2014). *Spedycja we współczesnych łańcuchach dostaw [Forwarding trade in modern supply chains]*. Warszawa: CeDeWu LLC.
- Wieczorek, Ł., (2016). *Nie sądzę, żeby było tylu chętnych przylecieć samolotem obejrzeć żubry [I do not think there are so many willing to come by plane to see the bison]*. Retrieved from <http://www.tvn24.pl/wiadomosci-z-kraju,3/lotnisko-na-podlasiu-referendum-w-sprawie-budowy-portu-lotniczego,707629.html>.
- Witkowski, J. (2010). *Zarządzanie łańcuchem dostaw. Koncepcje. Procedury. Doświadczenie [Management of the supply chains. Conceptions. Procedures. Experience]*. Warszawa: PWE.

## Websites

<http://www.transportbezgranic.pl>