

Electronic scientific and practical journal

# INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

**#5 (2021)**  
**February '21**



**WWW.SMART-SCM.ORG**

**ISSN 2708-3195**

**DOI.ORG/10.46783/SMART-SCM/2021-5**





Electronic scientific and practical publication in economic sciences

ISSN 2708-3195

DOI: <https://doi.org/10.46783/smart-scm/2021-5>

Released 6 times a year

№ 5 (2021)  
February 2021

Kyiv - 2021

**Founder:** Viold Limited Liability Company

**Editor in Chief:** Hryhorak M. Yu. – Doctor of Economics, Ass. Professor.

**Deputy editors-in-chief:** Koulyk V. A. – PhD (Economics), Professor.  
Marchuk V. Ye. – Doctor of Tech. Sci., Ass. Professor.

**Technical editor:** Harmash O. M. – PhD (Economics), Ass. Professor.

**Executive Secretary:** Davidenko V. V. – PhD (Economics), Ass. Professor.

**Members of the Editorial Board:**

SWIEKATOWSKI Ryszard – Doctor of Economics, Professor (Poland);

POSTAN M. Ya. – Doctor of Economics, Professor;

TRUSHKINA N. V. – PhD (Economics), Corresponding Member of the Academy;

KOLOSOK V. M. – Doctor of Economics, Professor;

ILCHENKO N. B. – Doctor of Economics, Ass. Professor;

SOLOMON D. I. – Doctor of Economics, Professor (Moldova);

ALKEMA V. H. – Doctor of Economics, Professor;

Henryk DŹWIGOŁ – PhD (Economics), Professor (Poland);

SUMETS O. M. – Doctor of Economics, Ass. Professor;

STRELCOVÁ Stanislava – PhD (Economics), Ass. Professor, (Slovakia);

RISTVEJ Jozef (Mr.) PhD (Economics), Professor, (Slovakia);

ZAMIAR Zenon – Doctor of Economics, Professor, (Poland);

SMERICHEVSKA S. V. – Doctor of Economics, Professor;

GRITSENKO S. I. – Doctor of Economics, Professor;

KARPENKO O. O. – Doctor of Economics, Professor;

PATKOVSKYI S. A. – Business practitioner.

The electronic scientific and practical journal is registered in international scientometric data bases, repositories and search engines. The main characteristic of the edition is the index of scientometric data bases, which reflects the importance and effectiveness of scientific publications using indicators such as quotation index, h-index and factor impact (the number of quotations within two years after publishing).

In 2020, the International Center for Periodicals (ISSN International Center, Paris) included the Electronic Scientific and Practical Edition "Intellectualization of Supply Chain Management" in the international register of periodicals and provided it with a numerical code of international identification: ISSN 2708-3195 (Online).

Recommended for dissemination on the Internet by the Academic Council of the Department of Logistics NAU (No. 7 of February 26, 2020). Released 6 times a year. Editions references are required. The view of the editorial board does not always coincide with that of the authors.

t.me/smart\_scm  
facebook.com/Smart.SCM.org  
twitter.com/ScmSmart

DOI: <https://doi.org/10.46783/smart-scm/2021-5>  
e-mail: [support@smart-scm.org](mailto:support@smart-scm.org)

тел.: (063) 593-30-41  
<https://smart-scm.org>

## Contents

INTRODUCTION	5
<b>HRYPHORAK M.Yu.</b> Doctor of Economics, Associate Professor, Head of Logistics Department National Aviation University (Ukraine), <b>Henryk DŹWIGOŁ</b> PhD DSc, Associate professor, Professor - Organization and Management Silesian University of Technology in Gliwice (Poland), <b>TRUSHKINA N.V.</b> PhD (Economics), Associate Professor, Senior Research Fellow, Regulatory Policy and Entrepreneurship Development Institute of Industrial Economics of the National Academy of Sciences of Ukraine (Ukraine), <b>SHKRYGUN Yu.O.</b> Postgraduate of Industrial Economics of the National Academy of Sciences of Ukraine (Ukraine) <i>SUBSTANTIATION OF EXPEDIENCY OF THE COMPLEX APPROACH FOR SUPPLY CHAINS MANAGEMENT IN THE COVID-19 CONDITIONS</i>	6 – 25
<b>ROMANENKOV Yu.A.</b> Doctor of Technical Science, Professor, Professor of Management Department National Aerospace University "Kharkov Aviation Institute" (Ukraine), <b>Yashar RAHIMI</b> Software Engineering Department of National Aerospace University "Kharkov Aviation Institute" (Ukraine), <b>DANOVA Mariia</b> PhD (Technical Science), Associate Professor, Associate Professor of Software Engineering Department of National Aerospace University "Kharkov Aviation Institute" (Ukraine), <b>FEOKTYSTOVA Olena</b> PhD (Technical Science), Associate Professor, Associate Professor of Management Department National Aerospace University "Kharkov Aviation Institute" (Ukraine), <b>SHOSTAK I.V.</b> Doctor of Technical Science, Professor, Professor of Software Engineering Department of National Aerospace University "Kharkov Aviation Institute" (Ukraine) <i>APPROACH TO INTELLECTUALIZATION OF COMPLETE SUPPLY CHAIN MANAGEMENT PROCESSES USING FUZZY EXPERT SYSTEMS</i>	26 – 39
<b>HRYPHORAK M. Yu.</b> Doctor of Science in Economics, Associate Professor, Head of Logistics Department of National Aviation University (Ukraine), <b>SHEVCHUK L.V.</b> Students of Logistics Department National Aviation University (Ukraine) <i>EFFICIENCY OF "LEAN MANAGEMENT" APPLICATION IN BUSINESS PROCESSES MANAGEMENT OF REFRIGERATION EQUIPMENT SUPPLY CHAIN DURING THE COVID CRISIS</i>	40 – 52
<b>SUMETS O.M.</b> Doctor of Economics, Professor, Professor of National University of Pharmacy (Ukraine) <i>EVALUATION OF THE INVESTMENTS EFFICIENCY IN THE DEVELOPMENT OF THE KEY COMPONENT OF THE SUPPLY CHAIN</i>	53 – 61
<b>SEMERIAHINA M. M.,</b> Senior Lecturer of Logistics Department, National Aviation University (Ukraine), <b>HRYPHORAK M. Yu.</b> Doctor of Science in Economics, Associate Professor, Head of Logistics Department of National Aviation University (Ukraine) <i>THE ROLE OF THE AIRLINE AS A LOGISTICS PROVIDER IN THE PASSENGER TRAVEL CHAINS INVOLVING AIR TRANSPORT</i>	62 – 79

UDC 656.7:005

DOI: <https://doi.org/10.46783/smart-scm/2021-5-5>

JEL Classification: L93, M16, O18.

**Received:** 26 February 2021

**Hryhorak M. Yu.** Doctor of Science in Economics, Associate Professor, Head of Logistics Department of National Aviation University (Ukraine)

**ORCID** – 0000-0002-5023-8602

**Researcher ID** –

**Scopus author id:** 57208222758

**Semeriahina M. M.,** Senior Lecturer of Logistics Department, National Aviation University (Ukraine)

**ORCID** – 0000-0001-7490-6874

**Researcher ID** – S-7158-2018

**Scopus author id:** –

## THE ROLE OF THE AIRLINE AS A LOGISTICS PROVIDER IN THE PASSENGER TRAVEL CHAINS INVOLVING AIR TRANSPORT

**Myroslava Semeriahina, Mariia Hryhorak.** *"The role of the airline as a logistics provider in the passenger travel chains involving air transport".* The article is devoted to the classification of air carrier as a logistics provider. Therefore, in the outsourcing pyramid of logistics providing, the place of the air carrier was determined taking into account its business model: legacy, low-cost, hybrid. Based on this, insourcing pyramid of airline logistics services involving air transport was developed and varieties of 3PL providers were identified: 3<sup>-</sup>PL, 3PL, 3<sup>+</sup>PL air carriers. 3<sup>-</sup>PL air carrier is a logistics provider that provides a range of services within the air supply / travel chain. 3PL air carrier is a logistics provider that provides a range of services in the full supply / travel chain, when booking individual components of such a chain is carried out through the websites of the air carrier and its partners. 3<sup>+</sup>PL air carrier is a logistics provider that provides a range of services in the full supply / travel chain, when booking such services is carried out integrated through the air carrier's website, and business processes are performed by the air carrier and its partners.

It was studied the websites of airlines in order to find out the providing level of modern global passenger airlines operating on legacy, low-cost and hybrid business models and to identify the main trends among air carrier to ensure a complete passenger travel chain. The main feature of the world's air carriers is that most of them provide services at the level of 3PL-provider, and only the world's leading air carriers provide the organization of the passenger travel chain at the level of 3<sup>+</sup>PL-provider.

The generalized scheme of providing for a passenger travel chain involving air transport for the purpose of definition of a role of each type of logistics provider and their collaboration in such chains was constructed. For example, 3<sup>-</sup>PL, 3PL, 3<sup>+</sup>PL air carriers can involve 2 PL-companies in the performance of business processes in the passenger chain. At the same time, the air carrier of 4PL-level will involve performers from 2 PL 3<sup>-</sup>PL, 3PL levels in the processes of the travel chain. On the virtual 5 PL platform, the passenger will independently choose performers from different levels of providing according to their own needs.

**Keywords:** logistics provider, air carrier, passenger travel chain, 3<sup>-</sup>PL provider, 3<sup>+</sup>PL provider, legacy business model, low-cost business model, hybrid business model.

**Мирослава Семерягіна, Марія Григорак. "Роль авіакомпанії як логістичного провайдера в забезпеченні ланцюгів подорожі пасажирів за участі повітряного транспорту".** Стаття присвячена проведенню класифікації авіакомпаній як логістичного провайдера. В зв'язку з чим в піраміді аутсорсингу логістичного провайдингу було визначено місце авіакомпанії з врахуванням її бізнес-моделі: традиційна, лоу-кост, гібридна. На основі чого була розроблена піраміда інсорсингу логістичних послуг авіакомпанії за участі повітряного транспорту та виділені різновиди 3PL-авіакомпаній: 3<sup>-</sup>PL, 3PL, 3<sup>+</sup>PL-авіакомпанії. 3<sup>-</sup>PL-авіакомпанія є логістичним провайдером, що надає комплекс послуг в межах авіаційного ланцюга постачання / подорожі. 3PL-авіакомпанія є логістичним провайдером, що надає комплекс послуг в повному ланцюгу постачання / подорожі, при цьому бронювання / замовлення окремих складових такого ланцюга здійснюється через сайти авіакомпанії та її партнерів. 3<sup>+</sup>PL-авіакомпанія є логістичним провайдером, що забезпечує комплекс послуг в повному ланцюгу постачання / подорожі, при цьому бронювання / замовлення таких послуг здійснюється інтегровано через сайт авіакомпанії, а виконання за участі авіакомпанії та її партнерів.

Досліджені сайти авіакомпаній з метою з'ясування рівня провайдингу сучасних світових пасажирських авіакомпаній, що працюють за традиційною, лоу-кост та гібридною моделями та виявлення основних тенденцій серед авіакомпаній щодо забезпечення повного ланцюга подорожі клієнта. Головною особливістю світових авіакомпаній є те, що більша їх частина надає послуги на рівні 3PL-провайдера, і лише найбільш провідні світові авіакомпанії забезпечують організацію ланцюга подорожі пасажирів на рівні 3<sup>+</sup>PL-провайдера.

Побудована узагальнена схема провайдингу для ланцюга подорожі пасажирів за участі повітряного транспорту з метою визначення ролі кожного логістичного провайдера в таких ланцюгах, а також їх взаємодії. Наприклад, 3<sup>-</sup>PLP, 3PLP, 3<sup>+</sup>PLP можуть залучати компанії 2 PL-рівня до виконання процесів в ланцюгу подорожі пасажирів. В той самий час авіакомпанія 4PL-рівня буде долучати до виконання процесів в ланцюгу подорожі виконавців з 2 PL 3<sup>-</sup>PL, 3PL рівнів. На віртуальній 5 PL платформі пасажир буде обирати самостійно виконавців з різних рівнів провайдингу відповідно до власних потреб.

**Ключові слова:** логістичний провайдер, авіакомпанія, ланцюг подорожі пасажирів, 3<sup>-</sup>PL-провайдер, 3<sup>+</sup>PL-провайдер, традиційна модель, лоу-кост модель, гібридна модель.

**Мирослава Семерягіна, Марія Григорак. "Роль авиакмпании как логистического провайдера в обеспечении цепочек путешествия при участии воздушного транспорта".** Статья посвящена проведению классификации авиакомпаний как логистического провайдера. В связи с чем в пирамиде аутсорсинга логистического провайдера было определено место авиакомпании с учетом ее бизнес-модели: традиционная, лоу-кост, гибридная. На основе чего была разработана пирамида инсорсинга логистических услуг авиакомпании с участием воздушного транспорта и выделены разновидности 3PL-авиакомпаний: 3<sup>-</sup>PL, 3PL, 3<sup>+</sup>PL-авиакомпаний. 3<sup>-</sup>PL-авиакомпания является логистическим провайдером, предоставляющая комплекс услуг в пределах авиационной цепи поставки / путешествия. 3PL-авиакомпания является логистическим провайдером, предоставляющая комплекс услуг в полном цепи поставки / путешествия, при этом бронирование / заказ отдельных составляющих такой цепи осуществляется через сайты авиакомпании и ее партнеров. 3<sup>+</sup>PL – авиакомпания является логистическим провайдером, обеспечивающей комплекс услуг в полном цепи поставки / путешествия, при этом бронирование / заказ таких услуг осуществляется интегрировано через сайт авиакомпании, а выполнение – при участии авиакомпании и ее партнеров.

Исследованы сайты авиакомпаний с целью выяснения уровня провайдера современных мировых пассажирских авиакомпаний, работающих по традиционной, лоу-кост и гибридной моделям и выявление основных тенденций среди авиакомпаний по обеспечению полной цепи путешествия клиента. Главной особенностью мировых авиакомпаний является то, что большая их часть предоставляет услуги на уровне 3PL-провайдера, и только ведущие мировые авиакомпании обеспечивают организацию цепи путешествия пассажира на уровне 3<sup>+</sup>PL -провайдера.



*Построена обобщенная схема провайдинга для цепи путешествия пассажира с участием воздушного транспорта с целью определения роли каждого логистического провайдера в таких цепях, а также их взаимодействия. Например, 3<sup>+</sup>PLP, 3PLP, 3<sup>+</sup>PLP могут привлекать компании 2 PL-уровня к выполнению процессов в цепи путешествия пассажира. В то же время авиакомпания 4 PL-уровня будет привлекать к выполнению процессов в цепи путешествия исполнителей с 2 PL 3<sup>+</sup>PL, 3PL уровней. На виртуальной 5PL-платформе пассажир сможет выбирать самостоятельно исполнителей из разных уровней провайдинга в соответствии с собственными потребностями.*

**Ключевые слова:** логистический провайдер, авиакомпания, цепь путешествия пассажира, 3<sup>+</sup>PL-провайдер, 3<sup>+</sup>PL-провайдер, традиционная модель, лоу-кост модель, гибридная модель.

**Introduction.** The criticality of logistics supply chains is an important part of the successful implementation of logistics business processes in accordance with the eight rules of logistics "8R" (right product, right quantity, right quality, right time, right place, right customer, right cost, right information). Building optimal supply chains, their organization and further control of all stages is a complex multi-purpose task that requires effort in most cases by more than one company. Such logistics chains will include a large number of performers and it is their well-organized and coordinated work allows to create perfect supply chains from the logistics view point.

Considering air supply chains, it should be noted that a significant role in such chains is played the time of delivery, because mostly air carriers transport goods with special needs (perishable, valuable and urgent). In most cases, the main task of air carriers is limited to ensuring air delivery from the departure airport to the destination airport, during the organization and implementation of which must comply with the rule "8R" in full.

The aviation industry itself is a pioneer of innovative solutions among all modes of transport, just mention the first computer reservation systems in the 1960s or the transition to electronic document management among participants in aviation freight supply chains (e-freight). Implementation of e-freight began with the use of e-AWB in 2010 and in January 2021, according to IATA publications, 71.3% of air waybills were used electronically [1].

The aviation community's initiatives continue to improve and, based on e-freight, the Digital Cargo program has been launched

to ensure the openness and transparency of door-to-door cargo movement. Note that all IATA programs are aimed at simplifying collaboration, standardization of procedures and transparency of the air cargo movement process with the participation of all parties in the air supply chain.

In addition, IATA initiatives are aimed at transforming the collaboration of participants in the air passenger chain, mostly now they are focused on simplifying the process of check-in and various types of state control through the use of biometric data of passengers.

Airlines from all over the world take an active part in all initiatives as leading participants in aviation cargo supply and passenger delivery chains. In this case, the role of airlines may vary only from the executor of the transportation process and to the organizer of the aviation chain of cargo delivery or passenger travel.

**Analysis of recent research and publication.** The role of logistics providers in supply chains is widely studied by as Ukrainian scientists: Hryhorak M.Yu. [2], Revutska T.V. [3], Kostenyuk Yu. B. and Kapitonets M.V. [4], Sharchuk T.V [5], Danyliuk T., Yushchyshyna L. and Mokhniuk A. [6], Glazun V.V. [7] and others, as well as foreign scientists: Fadile L. & Oumami M. & Beidouri Z [8], Hertz S. and Alfredsson M. [9], Bolumole and Yemisi A. [10], Jayaram J. and Tan K.-C. [11] and others.

In the publications, the researchers organized the classification of logistics providers and defined the role of each type of logistics providers, with a total of five main types of logistics providers, where first-level providers provide organization and

implementation of logistics business processes themselves, and fifth-level provider provides organization, coordination and control of all logistics processes, while not taking a physical part in their implementation, compared to other types of logistics providers, i.e. he is an intelligent think tank of supply chain management. In addition, it was studied the current state of logistics provider development and identified trends for their development [2, pp. 95-103; 4, pp. 120-121; 5, pp. 775-777; 6, pp. 59; 7, pp. 6-7; 8, pp.64-66].

Also, considerable attention is paid to the study of the mechanisms of information interaction of logistics providers with other participants in the supply chain [3, pp. 191-192].

Note that most foreign publications are aimed at studying the activities of 3PL-providers, which are the most common in today's market. At the same time, the largest number of recent publications, such as [12, 13] and others, are aimed at research of assessing the level of service provided by logistics providers in supply chains, including aviation.

The role of the air carrier as a participant in the supply chain, like the carrier in any mode of transport, in most scientific publications is traditionally considered only from the standpoint of the direct operator of air transport. The main role of the logistics provider, which provides complex of services, belongs freight forwarding companies, which in turn took on the status of logistics companies. At the same time, as noted by Revutska T.V. [3, pp. 190] most foreign companies entering the market of logistics services in another country (Ukraine), begin their journey from the providing of one or more logistics services and then diversify their activities to comprehensive logistics services providing. It should be pointed out that among Ukrainian logistics companies this way of development is the most common and allows logistics companies to enter the market with small initial capital.

At the same time, the transformation from a highly specialized logistics company to

the level of a complex services logistics provider for air carriers is proved by Litvinenko S.L. [10, pp. 55-56]: talking about transformation of cargo air carrier engaged in the carriage of oversized and heavy cargoes, from the level of 2PL-providers (carrier that carries out only the carriage of goods by air) to the level of 3PL-providers (logistics provider-air carrier, which provides comprehensive door-to-door services). However, such a transformation is carried out by the air carrier of oversized and heavy cargoes only in specific cases, i.e. air cargo carrier is remaining 2PL-provider and only sometimes provides comprehensive logistics services, which only temporarily transfers him to the level of 3PL-provider [10, pp. 61-62].

**The purpose and objectives of the study.** Summarizing research on the current classification of logistics providers, it should be noted that in scientific publications, airlines play the role of air carrier only and are not considered as major players in the logistics market that can provide a wider range of services in supply chains. Therefore, the purpose of the study is modelling the role of the airline as a logistics provider from the second level to the fifth level of providing with the definition of its functional obligations to customers in supply chains and travel chains. To achieve this goal, the following research objectives are defined:

1) determining the place of each type of logistics companies in the pyramid of logistics outsourcing in supply / travel chains and building an insourcing pyramid of logistics services by airlines with a description of the range of services in accordance with modern levels of logistics providing;

2) analysis of existing practical examples in planning and organization of travel chains via air carriers and their partners;

3) development of a scheme of passenger travel chain providing with the participation of air transport, which will reveal the interaction between different levels of logistics providers.

**Basic material and results.** Determining the role of each logistics provider in supply



chains or passenger travel chains on the basis of a common pyramid of logistics outsourcing, we detailed the types of logistics companies that may correspond to a particular level of logistics provider in air supply chains and air passenger travel chains in Fig. 1. In addition, attention was paid to the air carrier like the main logistics provider, whose role can vary from 2 to 5 PL-level, in the inverse insourcing pyramid (see Fig. 1).

The main feature of outsourcing and insourcing pyramids is that the outsourcing pyramid reflects many possible logistics operations and specialized logistics companies, and with the upward movement of the pyramid reflects the services of a wider range of logistics companies involved in the providing of services for clients-companies. While the insourcing pyramid focuses on the growth of quantity of logistics business processes that can be performed by one logistics company (in our case, the air carrier), thus starting with only one logistics business process, namely air transportation and ending with full virtualization of the supply chain and travel chain management.

Note that these pyramids are appropriate both for the supply chain and for the travel chain involving air transportation, because the operations carried out during the delivery of passengers or cargo can be performed as by specialized companies (service is provided only cargo or mail or passengers) and by companies that provide comprehensive or integrated services for passenger, cargo and mail.

Let's analyze in more detail the pyramid of outsourcing and insourcing. 2PL-providers are defined:

- terminal providers that handle air cargo and provide storage and / or transshipment of air cargo from one mode of transport to another (one of which is

necessarily air) or provide terminal passenger services;

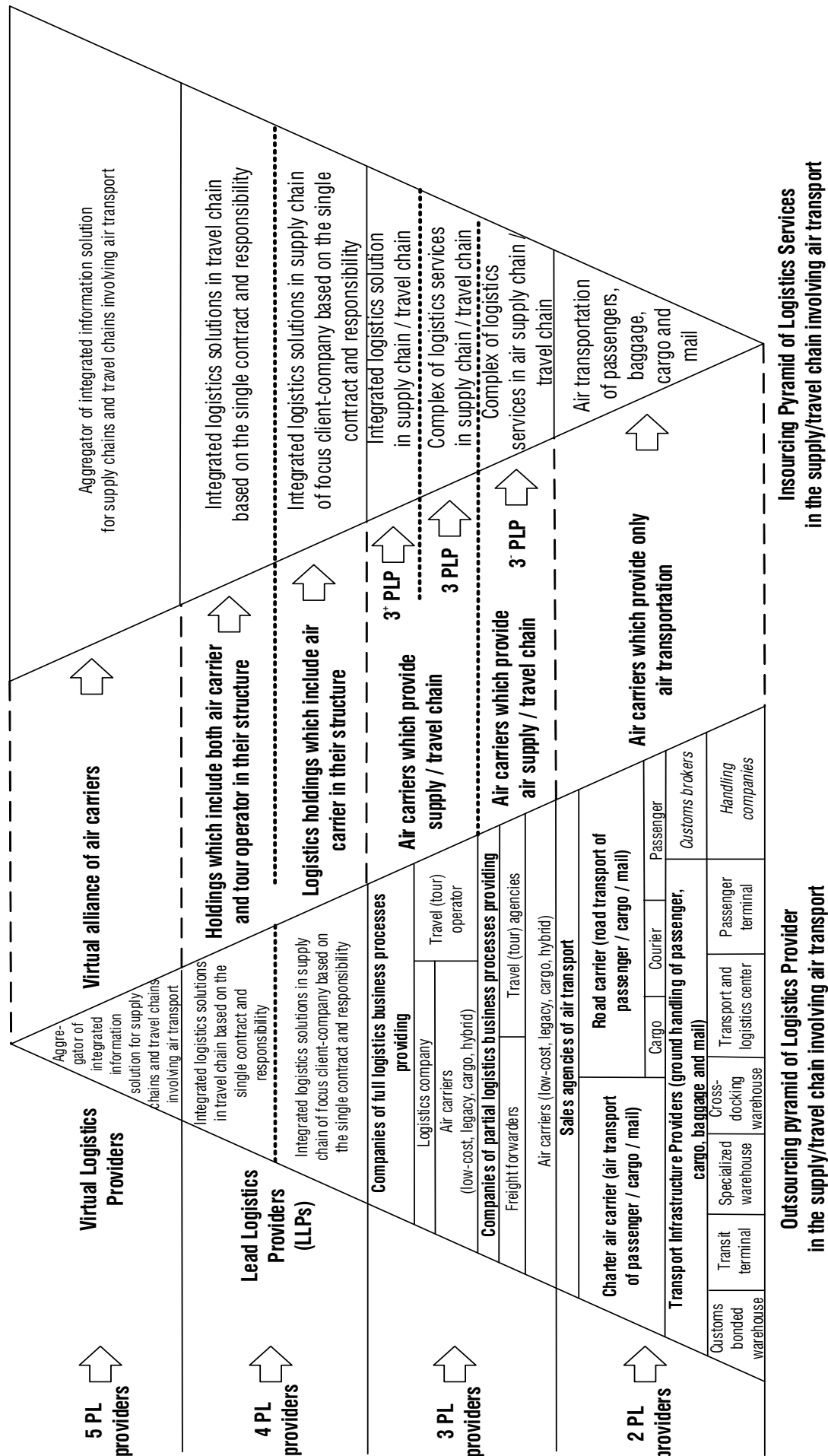
- airlines that are air carriers and carry out the main logistic operation of transportation of cargo mostly over long distances. Among all the air carrier models that exist, 2PL-providers are charter air carriers. The reason for referring to the 2PL-level is that, traditionally, in the organizational structure of such air carrier model there are no units that provide passenger and cargo services at airports, including base airports. So the logistics business operation provided by such air carrier is only air transportation;

- road carriers that transfer passengers, cargo and mail on the route "original point – departure airport / destination airport – final point". Such carriers in the supply chain scheme with air carriage participation are mandatory, as they ensure the delivery of "first and last mile" in the supply chain and travel chain by scheme "door to door";

- agencies of air transportation sales provide the customer with the booking and sale of a passenger tickets or air cargo space and may be provided by specialized companies IATA accredited;

- handling companies are a common type of specialized companies that carry out ground business processes of passenger and cargo services during the organization of air transportation. Namely, for example: handling companies can passenger check-in and accompany passengers from the terminal to the aircraft for air passenger travel chain or they can ensure the delivery of goods from the cargo terminal to the aircraft and loading of cargo into the aircraft or unloading from it for cargo supply chains;

- customs brokers are important participants in the customs clearance of goods in the organization of international supply chain.



Figures 1 – Outsourcing and insourcing pyramids of logistics services involving air transport

A broad basis was used to map 2PL providers in the outsourcing pyramid. This shows, first of all, that such providers can provide separately from each other all type of business processes in passenger travel chain and supply chain, but they need corrective action on the interaction between the customer in the travel / supply chains involving the air transportation.

At the same time, if we consider the insourcing pyramid of the air carrier logistics services, the pyramid was specifically pointed downwards. It should indicate the narrow specialization of the air carrier and consists only passenger, cargo and mail transport organization, as well as monitors only this business process in the full passenger travel chain and the full cargo supply chain. For example: 2PL air carriers, as described above, include charter air carriers or air carriers that act as a "actual carrier" according to an aircraft exchange agreement under the Montreal Convention 1999, operating on the principle of "airport of departure (aircraft) – airport of arrival (aircraft)" both in cargo supply chains and in passenger travel chains. In such cases ground support before and after air transportation is provided by the organizer of such charter flights or by the air carrier acting as "contracting carrier".

Considering the level of 3PL in the framework of the outsourcing pyramid, special feature is logistics services complex provided by such providers. Accordingly, such companies can provide only partial support for logistics business processes. For example, it may be freight forwarding services, including both the organization and control of land and air transportation (freight forwarding companies) in the supply chain.

In our opinion, 3PL providers are the better part of air carriers that independently carry out air transportation, or even for this purpose use other airlines under the aircraft exchange agreement as described above, and also provide independently or, again, use other 2PL companies to provide ground support during organization of air transportation at the airports of departure

and arrival. At the same time, considering the passenger travel chain, it is possible to identify travel agents as 3PL-providers (3PLPs), because they sell a travel packages. The travel agencies are classified as 3PLPs by us, because their travel packages include air transportation and transfer (these two services are logistics services), hotel accommodation and other attractions (complex services) against sales agencies of air transportation (2 PLPs), which sell only one service (air transportation is one logistics service). But travel agencies are companies with partial support of logistics business processes, because they do not provide creation and accompanying of the passenger travel chain. This is done by the tour operators, that is why they are attributed by us to companies with full support of logistics business processes. Tour operators provide the creation of not only tourist travel chains, but also business travel chains, as well as conference travel chain, etc.

Air carriers, acting as a 3PLP, can also not only provide services for partial support of logistics business processes (i.e. in our case ground handling at airports of departure and arrival), but also provide "door-to-door" delivery with using of 2PLPs. This experience is common among the better part of legacy and cargo air carriers (operating flights on a regular basis). For example, on the websites of legacy passenger air carrier you can book a hotel room, car rental or a transfer "from the door" of original point to the airport of departure and / or from the airport of arrival "to the door" of the final point. While on the websites of cargo air carriers you can book the delivery of cargo "from the door" of consignor to the airport terminal and / or from the destination airport "to the door" of consignee.

We propose different categories of air carriers at the 3 PL level, depending on whether the air carrier provides partial or full support of logistics services. Performance of standard logistics business processes only in the air supply chain are done by 3-PLP-air carriers. For example: the air carrier provides full ground handling of passengers, cargo and

mail in airports, i.e. airline provides a range of services for passenger, cargo and mail from the time of their departure airport arrival until the time of their destination airport leaving. At the same time, part of such logistic operations can be performed by air carrier itself and part of them is provided by contracted 2PLPs. In this case, the air carrier, in our opinion, can be attributed to the 3-PLP, which provides a range of services in the air cargo supply chain and / or in the air passenger travel chain. Among such air carriers are the better part of airlines of legacy and hybrid models.

If we can book a range of logistics services in air carrier website or air carrier's partner websites including such services like transfer delivery and storage and handling of goods in warehouses (if we talk about cargo), we must talk about another category of air carriers. Such air carriers are 3PLPs, i.e. air carriers provide complex logistics services in the supply / travel chain. Air carriers that can provide a range of logistics services in the supply / travel chain can be airlines of both freight and legacy and hybrid business models.

In the case when the air carrier provides the opportunity to book an integrated range of services directly on its website, we can talk about a higher level than just 3PL, i.e. it is already an intermediate level between 3 PL and 4 PL, respectively, we refer it to 3<sup>+</sup>PL.

Speaking about 4PL providers, it should be noted that leading logistics providers have skills set and sufficient technical and information equipment (including advanced software) to provide integrated logistics solutions in supply chains for certain focus companies due to their evolutionary development.

To our opinion, there is not 4PL-provider-air carrier in its "pure" form at this moment. But large logistics holdings in which structure holds air carrier are 4PL-providers and they can provide integrated supply chains planning and management for their focus companies.

If we consider the passenger travel chain, the creation of an integrated logistics solution for traveller can be done with the help of modern reservation systems in both Global Distribution System (GDS) and Internet Distribution System (IDS). It is possible to create integrated logistics solutions in the passenger travel chain by air carrier staff via GDS, but this task is usually solved by tour operators' staff in the case of providing personalized solutions for customers. GDS doesn't only provide the best option in terms of cost and time for the flight, but also allows to book a car rental, hotel room, etc. in accordance with the specified parameters that are important to the client. In addition to booking, such system allows to do booking confirmation and payment, which helps to build travel chain of the client as a whole.

At the same time, 4PL-provider, in addition to integrated planning, must ensure integrated management and control over the performance of all processes.

The main feature of 5 PL-providers is the lack of material assets to provide logistics processes and the virtual platform to organize and monitor the performance of logistics business processes in supply chains. So, 5 PL-provider can best be described by the term "aggregator of integrated information solutions in supply chain / travel chain". This means that 5 PL-provider is company that manages and administers the virtual information platform on the Internet, which allows all clients (cargo owners, travellers) to find the best options for the organization of their supply chains / travel chains through the selection of optimal performers among 2PL, 3-PL, 3PL, 3<sup>+</sup>PL and 4PL providers, information about which is completely stored on the virtual platform of the aggregator.

The highest level of the insourcing pyramid of air carrier logistics services is defined by us as a virtual airline alliance, i.e. a "brain center" of air carriers for optimal planning of air services. This virtual platform should be integrated with airlines' management systems and optimally plan the use of aircraft, crews and other airline staff,

and most importantly create additional opportunities by expanding the range of services for other logistics operations in the supply / travel chain. Such virtual alliance is a real aggregator, as it receives information from various management systems of airlines, as well as other logistics providers and customers for the implementation of optimal planning and management of supply and delivery chains. So far, there are no such providers in the modern logistics market, including aviation logistics. Given the complete digitalization in the business environment, which contributes to the rapid development of information technology, it is possible in the near future to create new types of logistics companies. The main value of such companies will be knowledge and skills in the supply chain management, as well as the performance of virtual control of all logistics operations. Another important value of such companies will be the analysis and processing of factual data and the creation of up-to-date ranking of logistics providers in supply / travel chains, as well as customer rankings. If we talk about customer ranking, among the criteria of this ranking may be the accurate information about the cargo and in the accompanying documents, timely payment for the services of providers in accordance with the established agreements.

The aviation industry is a leading transport industry for the implementation of latest innovative development in the field of digitization and digitalization. The latter point concerns the creation of new innovative products. In our case it is the virtual platform that accumulates important information to create and ensure the smooth performance of supply / travel chains and where everybody can plan supply / travel chain based on past experience and reliability rating of each logistics provider. Such planning can be carried out via software by the client, where selection of optimum decisions on construction of supply chains will be provided by artificial intelligence with machine learning.

Consider the practical basis of the insourcing pyramid and classify modern airlines according to it.

Most Ukrainian air carriers can be classified as 2 PL-providers, as they perform charter transportation of passengers and cargo. For example, Aero Jet is a shining example of 2 PL-providers in air passenger transportation under charter agreements, as well as providing services ACMI leasing, which includes the providing of aircraft, crew, maintenance and insurance, to other airlines.

So, the 2 PL-providers are such charter air carriers that provide air passenger services as Anda Air, Bees Airlines, Challenge Aero Ukraine, Global Air Company.

Also, 2 PL-providers are airlines that perform charter cargo and passenger transportation as Antonov Airlines, Ukrainian Wings, Unga, Aviation Transport Agency "Kruk", Aviation Company Ukrainian Helicopters, Air Taurus, as well as cargo airlines as Aviation Company Eleron, AeroVis, Vulkan Air, Constanta Airline, Ukraine Air Alliance, aircompany ZetAvia, Maximus Airlines, CAVOK Air, Aircompany Rosavia.

Ukraine International Airlines (UIA) is considered to be the leading Ukrainian air carrier, having the most extensive network of scheduled air routes from Ukraine to the world. This company focuses on the passenger transportation, as well as cargo transportation on passenger aircraft. UIA can be classified as a 3PL provider with a full logistics services in the passenger travel chain, while all other Ukrainian airlines (regular passenger air carriers) provide a full logistics services in a purely air passenger travel chain. Let's explain this position in more detail.

UIA provides a full air logistics travel, consisting of passenger check-in, accompanying passengers on board the aircraft from the passenger terminal at the airport of departure, delivery of checked baggage on board the aircraft, air transportation of passengers and their baggage, accompanying passengers from the aircraft to the passenger terminal destination,



baggage delivery from the aircraft to the passenger terminal, baggage dispensing to passengers. As it is typical of 3PL providers, UIA involves handling companies (2PLPs) according to the ground handling service agreement to perform certain business processes that are not provided independently. In addition, UIA offers on its own website the transition to the websites of rental car agencies and booking.com, thus providing a complex of logistics services in the passenger travel chain.

Such regular passenger airlines of Ukraine as: Azur Air Ukraine, Bravo Airways, YANAIR, SkyUP Airlines, Jonika Airlines, Windrose Airlines, Motor Sich operate according to the scheme of providing only the air passenger travel chain (3<sup>rd</sup>-PLP). At the same time low-cost carrier SkyUP Airlines offers in cooperation with a partner Istanbul Panoramic City Tour tours to Istanbul for three days. Windrose Airlines offers the opportunity to book a hotel through a link to booking.com. Motor Sich is developing booking of transfer service from/to airport now and has hotel booking services with partner booking.com. So, when the transfer service will be put into operation, the airline can be classified as a 3<sup>rd</sup>-PL provider with the complex of logistics services in the passenger travel chain.

Researching foreign air carriers operating regular flights to Ukraine, it should be noted that Azerbaijan Airlines, Air Baltic, Belavia offer the opportunity to organize air passenger travel chain.

Low cost air carrier like Air Arabia, Pegasus Airlines, Ryanair, Flydubai, Wizz Air and legacy carrier like LOT Polish Airlines, Austrian Airlines, Qatar Airways, Lufthansa, SAS Scandinavian Airlines, CSA Czech Airlines, Turkish Airlines, Air France provides the opportunity to book on its own website or on the website of partners such services as hotel booking, rent a car, get a visa or vacation package. KLM does not directly provide online car rent or hotel booking services, but calculate points according to Frequent Flyer Program to passenger for using the services of

their partners, which can be booked online on partners' websites.

For a broader analysis, we will also consider the organization of the passenger supply chain by the leading airlines included in the Forbes rating "Global 2000 The World's Largest Public" by revenue [15]: Delta Air Lines, Southwest Airlines, United Airlines, International Airlines (British Airways, Iberia, Vueling, Aer Lingus), China Eastern Airlines, China Southern Airlines, Air Canada, Japan Airlines, American Airlines, Turkish Airlines, All Nippon Airways, Singapore Airline, Cathay Pacific Airways, Alaska Air, Hainan Airlines, Korean Air, Latam Airlines, JetBlue Airway, Aeroflot-Russian Airlines. It should be noted that this list also includes such airlines as Lufthansa, Ryanair, Air France-KLM, Turkish Airlines, which were previously studied as airlines that operate regular flights to Ukraine.

The research results of services in passenger travel chain, which can be booking on air carriers' websites or with direct link on partners' websites are summarized in Table 1. Thus, the sample of air carriers that offer to book different services in the passenger travel chain amounted to 41 airlines, including UIA and Windrose Airlines as Ukrainian air carriers. The total number of European air carriers is 21 airlines, air carriers of Asian region and the Americas are 8 ones and the Middle East air carriers are 4 ones.

Collected statistics, which are presented in Table 2, shows that most air carriers, in addition to booking air flight, offer the opportunity to book hotels and rental car separately, thus ensuring the creation of a complete passenger travel chain.

It should be noted that the Rail&Fly or Bus&Fly service is popular in Western Europe, and most air carriers offer such a service only at the base airport(s) and there is no such service at all by airlines in other regions, although for economy class passengers it may be also a priority in the full travel chain.

At the same time, parking own car is popular on the European and American continents and, in most cases, is provided by direct link to the partner's website.

Table 1 – Services which can be booking on air carriers' websites or with direct link on partners' websites

No.	Air Carrier	Service booking is possible on air carrier's website or with direct link on partners' websites						Service booking is possible on air carrier's website					
		Rental car	Transfer	Rail & Fly	Hotels	Vacation packages	Parking	Rental car	Transfer	Rail & Fly	Hotels	Vacation packages	Parking
1	Air Arabia	+	+		+	+		+	+		+	+	
2	Pegasus Airlines	+	+		+		+	+			+		
3	Ryanair	+	+		+	+	+	+	+		+	+	
4	LOT	+	+		+	+			+				
5	Austrian Airlines	+	+		+		+	+	+				
6	Qatar Airways	+	+		+			+	+				
7	Flydubai	+	+		+	+		+	+			+	
8	Belavia	+		+	+								
9	Lufthansa	+	+	+	+	+	+	+	+				
10	Air Astana				+								
11	SAS	+	+		+			+	+		+		
12	CSA	+	+		+		+						
13	Turkish Airlines	+	+		+			+					
14	EL AL	+			+								
15	Swiss International	+	+	+	+	+							
16	KLM												
17	UIA	+			+								
18	Air France	+	+			+	+	+	+				+
19	Delta Air Lines	+	+		+	+		+	+		+	+	
20	Southwest Airlines	+	+		+	+		+	+		+	+	
21	United Airlines	+	+		+	+		+	+		+	+	
22	British Airways	+	+		+	+		+	+		+	+	
23	Iberia	+	+	+	+	+	+	+	+	+	+	+	
24	Vueling Airlines	+	+		+	+		+	+			+	
25	Aer Lingus	+	+		+	+	+	+	+		+	+	+

End of table 1

No.	Air Carrier	Service booking is possible on air carrier's website or with direct link on partners' websites						Service booking is possible on air carrier's website					
		Rental car	Transfer	Rail & Fly	Hotels	Vacation packages	Parking	Rental car	Transfer	Rail & Fly	Hotels	Vacation packages	Parking
26	China Eastern Airlines				+								
27	China Southern Airlines					+						+	
28	Air Canada	+	+		+	+	+	+	+		+	+	+
29	Japan Airlines	+	+		+	+							
30	American Airlines	+	+		+	+		+	+		+	+	
31	All Nippon Airways	+	+		+								
32	Singapore Airlines	+	+		+	+					+		
33	Cathay Pacific Airways	+	+		+			+	+		+		
34	Alaska Air	+	+		+			+	+		+		
35	Hainan Airlines				+								
36	Korean Air	+	+		+								
37	Latam Airlines	+	+		+			+	+				
38	JetBlue Airway	+	+		+	+					+	+	
39	Windrose Airlines				+								
40	Aeroflot	+	+		+								
41	Emirates Airlines	+	+		+	+						+	

Source: data were collected on the basis of airline websites.

Ryanair and Flydubai do not have a Frequent Flyer Program.

Wizz Air has a Wizz Discount Club membership, which does not provide points.

In general, considering the airlines by region, the most advanced air carriers in providing the possibility of creating a complete travel chain (transfer – air flight – rental car – hotel – rental car – air flight – transfer) are the air carriers of the Middle East and the Americas. However, among the disadvantages is the lack of possibility to order such a travel chain for one booking, i.e.

for each part of the chain is an independent booking. However, 75% air carriers of the Middle East and the Americas offer the possibility to create a complete travel chain in one booking when using booking of holiday / vacation packages, where you can add all the components of the travel chain step by step.

Table 2 – The ratio of air carriers by regions that provide booking of certain components of the passenger travel, except air flight booking (on its own website or with a link to the partner's website), %

No.	Region of Airlines	Rental car	Transfer	Rail & Fly	Hotels	Holiday packages	Parking
1	Total	85	78	10	93	54	24
2	Europe	90	75	20	95	50	45
3	The Middle East	100	100	0	100	75	0
4	Asia	63	63	0	88	38	0
5	The Americas	100	100	0	100	75	13

Let's consider the ratio of air carriers that provide the opportunity to create a complete travel chain on their own website / with a link to the partner's website / the lack of such opportunity (Fig. 2 and 3).

Analyzing the results presented in Fig. 2 and 3, it can be noted that most of the world's airlines simplify the passenger travel chain planning on the main services (options) on their own website or with link to partners' websites in order to create value-added passenger travel chain.

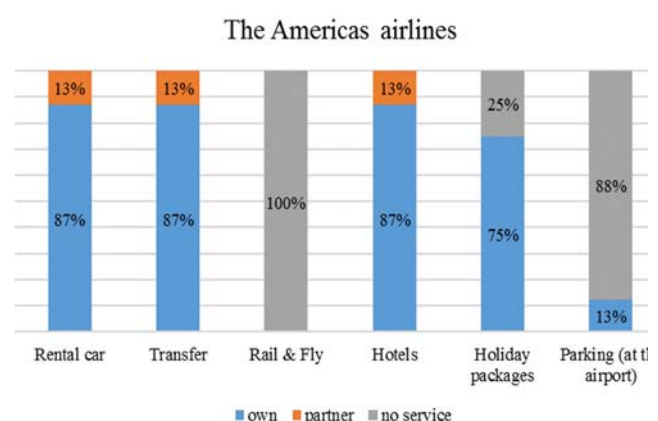
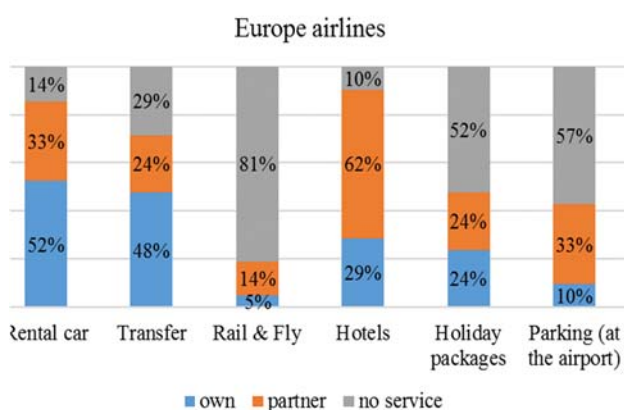


Figure 2 – The ratio of airlines that provide the opportunity to create a complete travel chain on their own website / with a link to the partner's websites / no such opportunity (Europe and the Americas air carriers)

In addition, airlines offer to earn points for frequent flyers according to Frequent Flyer Program to encourage such planning through

their own website or the partner websites of each component of the travel chain.

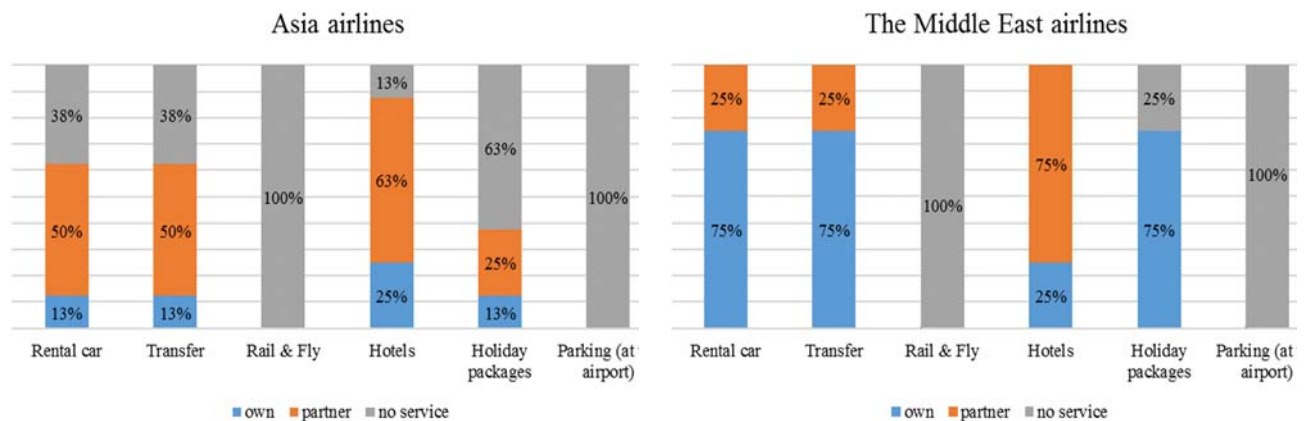


Figure 3 – The ratio of airlines that provide the opportunity to create a complete travel chain on their own website / with a link to the partner's websites / no such opportunity (Asia and the Middle East air carriers)

Ratio of airlines that offer to earn points for frequent flyers for travel chain planning on airline's or their partners' websites is represented in fig. 4.

Research shows that most air carriers encourage their frequent flyers to organize travel chains through the airline and its partners. At the same time, the largest share of carriers from Europe and the Americas, which encourage to plan the entire travel chain in "one click" via the holiday / vacation package service in airline's website.

It should be noted like disadvantages of the better part of world air carriers are unconnected booking services, which requires extra time for the client: at first, passenger books a flight on air carrier website, then he books car rental on air carrier website (website of air carrier's partner), as well as he books hotel room on air carrier website (website of other partner of air carrier). So, he must do three separate booking.

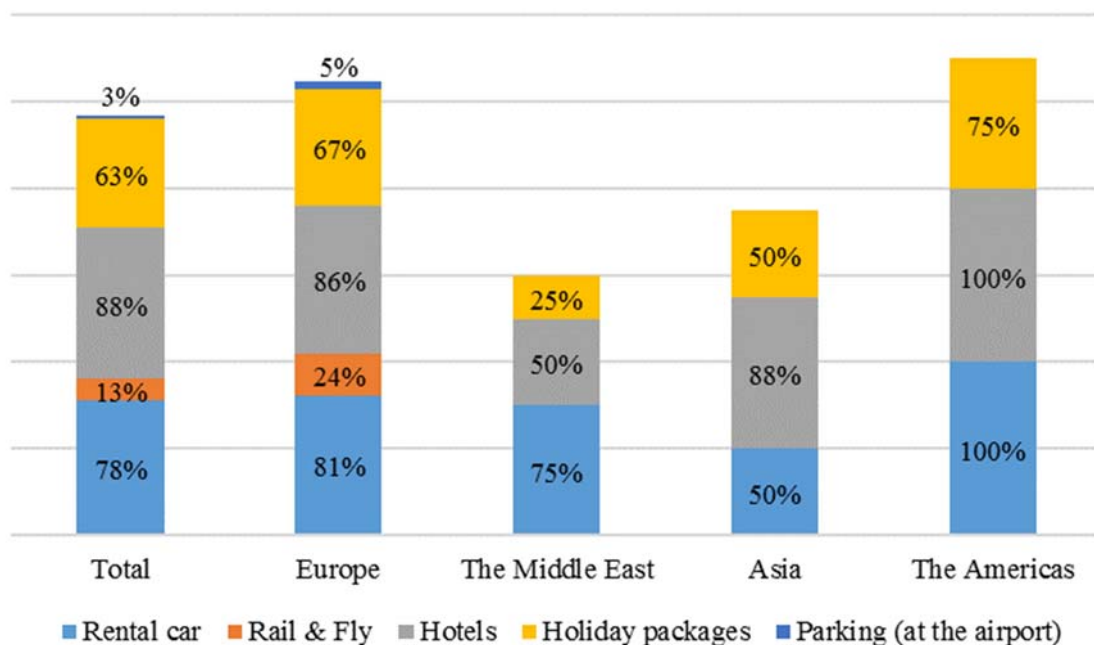


Figure 4 – Ratio of airlines that offer to earn points for frequent flyers for travel chain planning on airline's or their partners' websites



However, some air carriers allow passenger to plan the required travel components at "one click": Air + Hotel, Air + Car and Air + Hotel + Car. For example, Southwest Airlines has all mode of complete set of travel planning options described above. Some of them are presented on websites of British Airways, Iberia, Cathay Pacific Airways, JetBlue, Air Arabia.

In our opinion, the closest to the 4PL-provider are American airlines such as Delta Air Lines and Southwest Airlines, as they provide the opportunity to plan an integrated full travel chain for one booking (one click). But this level (4PL) should be characterized by a single responsibility of air carrier for the full travel chain of their client. So, Delta Air Lines and Southwest Airlines are 3<sup>+</sup>PLP.

At the same time, today there is no company of 5PL-providing, because it must provide: a) integrated travel chain planning, b) a choice from all possible airlines and their partners in full supply chain / travel chain, c) creation optimal full travel chain according to time and cost, c) control of all processes performance and d) ranking of all participants.

The analysis allows to do the interaction scheme between separate levels of providers in passenger travel chain involving air transport (Fig. 5).

In most cases, the air carrier can act as both 2PL-provider and a 3PL-provider.

When air carrier provides:

- only air transportation, it is 2PLP;
- only air passenger travel itself or with partners, it is 3<sup>-</sup>PLP;
- booking and performance of full passenger travel chain itself or with partners, it is 3PLP;
- booking of full passenger travel chain itself and performance of full passenger travel

chain itself or with partners, it is 3<sup>+</sup>PLP (Air Delta, Southwest Airlines, other air carriers, who provide booking of vacation packages on their websites).

4PLP should provide not only integrated travel chain planning, but also integrated management and sole responsibility for all segments of such passenger travel chain.

Turning to 5PLP, we note that this level should be provided by a virtual platform (can be provided by an alliance of air carriers), which will be attended by all airlines and other participants in the passenger supply chain, which will allow the customer performs to choose the best combination of passenger travel chains via integrated planning in one place. So, the difference between 4PLP and 5PLP is, that in the first case, planning can be done on the website (platform) of the interested party (in our case, the air carrier), which primarily offers air transportation on its own flights or flights of partner air carriers. At the same time, on the 5PL-platform, the customer has the opportunity to choose the best options for each segments of passenger travel chain among different airlines and other performers in accordance with the requirements of the trip.

It should be noted that to participate as a performer on the virtual 5PL-platform, all participants in the passenger travel chain must meet the criteria that ensure the quality of their services. Therefore, the entering of a contractor with its services on 5PL-platform requires careful selection, which will ensure the reliability of quality performance of planned, booked and paid services on this platform.

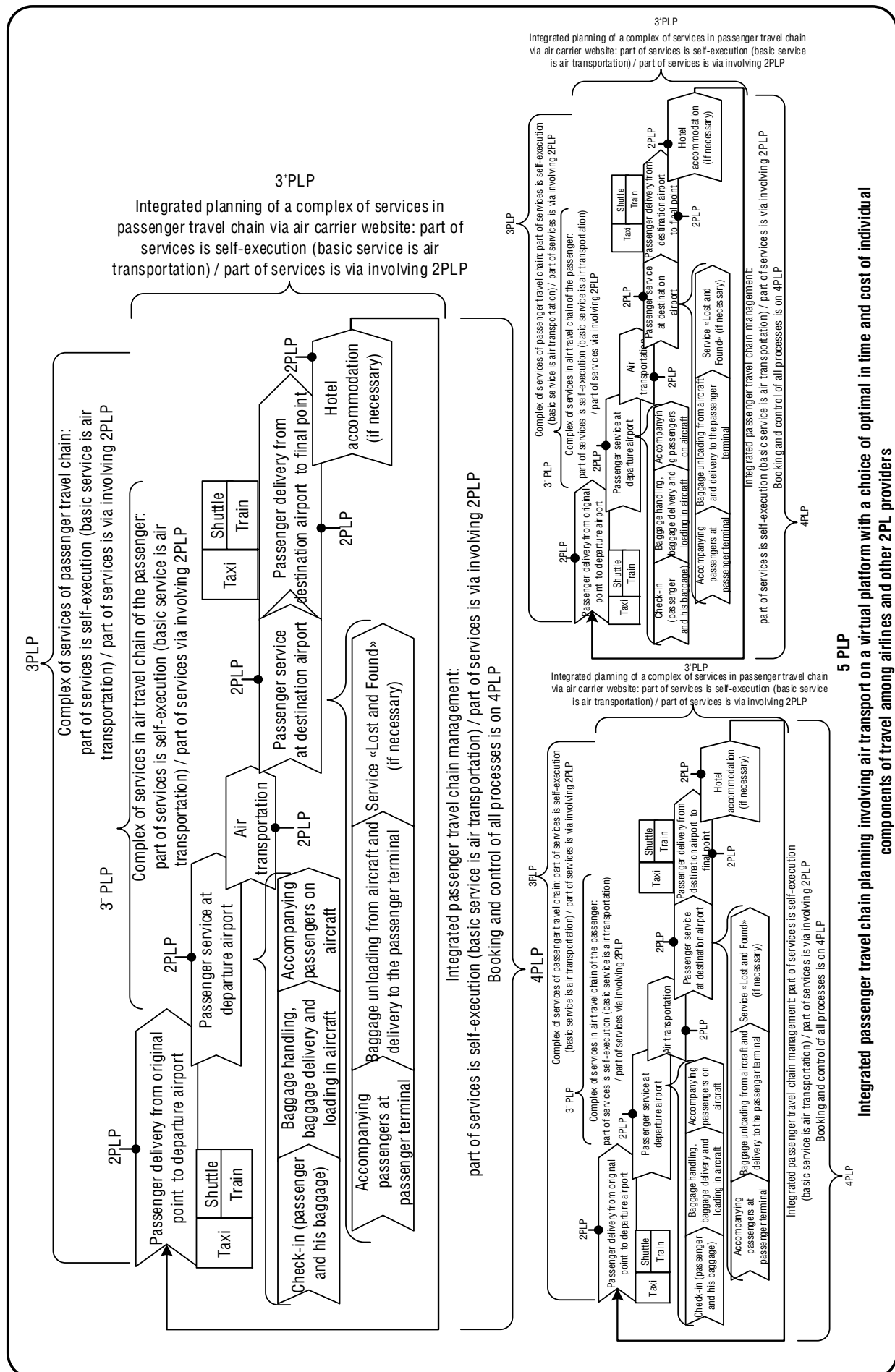


Figure 5 – Scheme of providing for passenger travel chain involving air transport

**Conclusions.** The analysis shows that most international air carriers of legacy, low-cost or hybrid business models actively cooperate with partners to provide a full range of logistics services in the passenger travel chain. According to this passenger can book such service like rental car on website of air carrier and hotel room on air carrier website or partner's website (for example: the most common partner of the air carrier is booking.com or hotels.com).

Ability of booking a range of services through the air carrier's website and by the direct link on partners' sites, the air carriers save customers' time on searching websites to book any other services in the passenger travel chain, thus creating added value for its customer. In this case, the air carrier provides full passenger travel chain together with partners, so this air carrier is 3PLP.

In the case of providing integrated travel chain planning to the client, the air carrier is contracting provider and becomes 3<sup>+</sup>PL-provider.

Acting as an integrator of planning and booking a set of services in the passenger travel chain, as well as the person responsible for the full passenger travel chain, the air carrier is 4PL-provider.

At the same time, the air carrier cannot be 5PL-provider, primarily due to the fact that such a company cannot have material assets, which is a necessary condition for the air carrier (own or leased aircraft). The air carrier can become only one of the performers on the virtual 5PL-platform and thus increase its own sales, as such platform should provide the largest number of customers from around the world.

It should be noted that in order to determine the most optimal role of the air carrier (2PL, 3<sup>-</sup>PL, 3PL, 3<sup>+</sup>PL and 4PL-provider and 2PL or 3<sup>-</sup>PL-provider on the virtual 5PL-platform), it is necessary to conduct an economic assessment for each logistics provider role. This will help to find out for each model of the air carrier the most optimum economic role of logistics provider.

## References

1. e-AWB international monthly report IATA URL: <https://www.iata.org/contentassets/4bc75639b37641ba88f2e81e5516a020/e-awb-monthly-report-r17.pdf>. Date: 02.02.2021.
2. Intellectualization of the market of logistics services: concept, methodology, competence: monograph / M.Yu. Hryhorak. - K.: Sik Hrup Ukrayina, 2017. - 513 p.
3. Revutska, T.V. The main strategies for the development of full-featured providers in Ukrainian market. – Scientific notes. Sectoral, intersectoral and regional economy. – № 14. – 2012. – P. 188-192.
4. Kosteniuk, Y.B., Kapitonets, M.V. Logistics outsourcing in Ukraine: Status and features of development // Economics and organization of management. – 2019 – № 4 (36). – P. 117-125.
5. Sharchuk, T.V. Logistic outsourcing is a way to optimize the management of business processes of the enterprise / T.V. Sharchuk // Bulletin of the National University "Lviv Polytechnic". – 2008. – № 633: Logistics. – P. 772-780.
6. Danyliuk, Tetiana & Yushchyshyna, Larysa & Mokhniuk, Anna. (2019). Logistics outsourcing in the enterprise management system: revenues and expenses of providers. Economic journal of Lesia Ukrainka Eastern European National University. №3. P. 55-62. 10.29038/2411-4014-2019-03-55-62.

- 
7. Glazun V.V. Outsourcing of logistics services: realities and trends [Electronic resource] / V.V. Glazun, S.R. Bondarenko, S.I. Zaporozhchenko // Eastern Europe: economics, business and management: electronic scientific professional publication, 2019. – № 3 (20). – Access mode: <http://www.easterneurope-ebm.in.ua/20-2019-ukr>.
  8. Fadile, Latifa & Oumami, M. & Beidouri, Z. (2018). Logistics outsourcing: A review of basic concepts. *International Journal of Supply Chain Management*. 7. 53-69.
  9. Hertz, Susanne, and Monica Alfredsson. "Strategic development of third party logistics providers." *Industrial marketing management* 32.2 (2003): 139-149.
  10. Bolumole, Yemisi A. "The supply chain role of third-party logistics providers." *The International Journal of Logistics Management* 12.2 (2001): 87-102.
  11. Jayaram, Jayanth, and Keah-Choon Tan. "Supply chain integration with third-party logistics providers." *International Journal of Production Economics* 125.2 (2010): 262-271.
  12. Gupta, A., Singh, R.K. & Mangla, S.K. Evaluation of logistics providers for sustainable service quality: Analytics based decision making framework. *Ann Oper Res* (2021). <https://doi.org/10.1007/s10479-020-03913-0>
  13. Shiang-Min Meng, Gin-Shuh Liang, Kuang Lin, Shiou-Yu Chen Criteria for services of air cargo logistics providers: How do they relate to client satisfaction?, *Journal of Air Transport Management*, Volume 16, Issue 5, 2010, Pages 284-286, ISSN 0969-6997, <https://doi.org/10.1016/j.jairtraman.2010.02.003>
  14. Litvinenko, S.L. Universal mechanisms for optimizing the production and logistics activities of air carriers. – Development of methods of management and administration of transport. – № 1 (58). – 2017. – P. 53-63.
  15. Global 2000 The World's Largest Public. Available at: Companies <https://www.forbes.com/global2000/#7d4c57b9335d> (access date 02.01.2021).