MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY

Air Transportation Management Department

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Head of the Department
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“__–___” ____2020

MASTER THESIS
(EXPLANATORY NOTES)

Theme: «Organization and technology of special categories of cargo transportation by air»

Done by: Alisa S. Domina

Supervisor: Dr. Ivannikova V.Yu., Associate Professor

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Kyiv 2020

Міністерство освіти і науки України
НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ

Кафедра організації авіаційних перевезень

ДОПУСТИТИ ДО ЗАХИСТУ
Завідувач кафедри
_____Юн Г.М.
«__ _ ___»__ _____2020 р.

ДИПЛОМНА РОБОТА
(ПОЯСНЮВАЛЬНА ЗАПИСКА)

ВИПУСКНИКА ОСВІТНЬО-КВАЛІФІКАЦІЙНОГО РІВНЯ «МАГІСТР»

Тема: «Організація і технологія перевезень спеціальних категорій вантажів повітряним транспортом»

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Київ 2020

NATIONAL AVIATION UNIVERSITY

Faculty of Transport Technology

Air Transportation Management Department

Major (specialty): 275.04 “Air Transport Technology”

APPROVED BY
Head of the Department
_____Yun G.M
“__–___” ____2020

TASK

of completion the Master thesis

Alisa S. Domina

1. Theme of the master thesis entitled “Organization and technology of special categories of cargo transportation by air” was approved by a decree of the Rector’s order № 2401/ст. of October 17, 2019.
2. Term performance of thesis: from 10.09.2019 to 10.01.2020.
3. Initial data required for writing the master thesis: theoretical provisions for the design of transport and technological schemes for the delivery of special cargoes, volumes of air cargo transportation, analysis of the transport infrastructure of Ukraine; project proposals for improvement of transportation technology schemes of delivery of perishable goods.
4. Content of the explanatory notes: theoretical provisions for the design of transport and technological schemes for the delivery of special cargoes, volumes of air cargo transportation, analysis of the transport infrastructure of Ukraine; project proposals for improvement of transport and technological schemes of delivery of

perishable goods with participation of different types of transport, analysis of imports and exports in Ukraine.

5. List of the mandatory graphic materials: schemes of cargo warehouse of Boryspil airport, performance indicators of Ukrainian transport, volumes and structure of air cargo transportation, analysis of imports and exports in Ukraine, assessment of the quality of transport infrastructure use, forecasts of the market of fruits, transportation technology schemes of transportation of fruits by different modes of transport, cross-docking warehouses, calculation of economic efficiency.

6. Planning calendar

№	Assignment	Deadline for completion	Mark on completion
1.	Collection and processing of statistical data	10.09.2019 – 02.10.2019	done
2.	Writing of the theoretical part	03.10.2019 – 27.10.2019	done
3.	Writing of the analytical part	28.10.2019 – 25.11.2019	done
4.	Writing of the design part	26.11.2019 – 20.12.2019	done
5.	Writing of the introduction and summary	21.12.2019 – 30.12.2019	done
6.	Execution of the explanatory note, graphic materials and presentation	8.01.2020 – 15.01.2020	done

7. Date of the task giving out: January 19, 2020.

Supervisor of master thesis (project)_____ Ivannikova V.Yu.
(signature) (surname, name)

The task was accepted for completion _____ Domina A.S.
(signature) (surname, name)

ABSTRACT

Explanatory note to the master thesis entitled “Organization and technology of special categories of cargo transportation by air” consists of 104 pages, 17 figures, 14 tables, 52 references.

Key words: MARKET OF FREIGHT TRANSPORTATION, SPECIAL CARGO, PERISHABLE GOODS, TRANSPORT TECHNOLOGIES, TRANSPORTATION TECHNOLOGY SYSTEM AND SCHEMES.

Object of study: processes of transportation of special cargoes with the participation of different types of transport.

Subject of study: assessment of the quality and technology of perishable goods transportation during import and export in Ukraine, suggestion of the solutions for transportation technology system improvement.

The purpose of the thesis is to develop transport and technological schemes for the delivery of perishable goods and calculate their effectiveness.

Research methods: in the thesis methods of induction and deduction, a systematic approach, methods of statistical and economic analysis, methods of developing technological maps, methods of calculating the cost and modeling of the interaction of modes of transport (road and aviation) when transporting fruit from Turkey in Ukraine are used.

Theoretical and methodological approaches to the development of transport and technological schemes for the delivery of perishable goods, the interaction of modes of transport and the integration of the transport system of Ukraine were studied, the duration and cost of delivery were calculated on the principle from a fruit enterprise to the final consumer, and the transport economic effect was calculated outside.

Thesis materials are recommended to be used in the activities of the Ministry of Infrastructure of Ukraine, transport and distribution companies that are engaged in the transportation of perishable goods.

CONTENT

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LIST OF ABBREVIATIONS

IATA – International Air Transport Association;

ICAO – International Civil Aviation Organization;

SE – state enterprise;

UIA – Ukraine International Airlines;

KBP – Kiev Boryspil International Airport;

ISO – International Organization for Standardization;

ATP – Agreement on the international carriage of perishable foodstuffs and on the special equipment to be used for such carriage;

TTS – transportation technology system;

SRS – specialized rolling stock;

PG – perishable goods;

WP – ‘‘White Paper on Food Safety’’, written by the Commission of the European Communities;

INTRODUCTION

Air Transportation Management Department				*NAU 20.05.04 001EN*			
Done by:	*Domina A. S..*			*INTRODUCTION*	*Letter*	*Sheet*	*Sheets*
Supervisor:	*Ivannikova V.Yu.*				*D*	*9*	*4*
Standards Inspector	*Shevchenko Yu.V.*				***FTML 275 ОП-202Ма***		
Head of the Department	*Yun G.M.*						

Relevance of the topic. In the context of market relations, relations between the enterprises both domestically and in international commodity exchange have expanded, which has significantly increased the share of aviation transport, especially in the carriage of certain groups of goods. First of all, it concerned the delivery of large volumes of import-export food and raw materials for their production, to which most perishable goods belong. The need for their timely delivery to terms dictated by demand requires increased efficiency in organizing the delivery process. However, transport costs that affect the final cost of production should not be increased, since this socially significant group of goods represents a particular concern related to the health and development of the nation.

Unlike other branches of infrastructure, transport products do not have a physical form, but they are material in nature, because in the process of moving goods, material resources are involved, rolling stock is worn, and funds for its maintenance and labor of workers and employees are used.

For the efficient use of the country's resources, the organization and technology of transportation of special categories of goods by air and the design of transportation technology schemes for the delivery of goods and the optimization of their functioning are extremely important.

When arranging the delivery of special, and in particular, perishable goods, it is necessary to focus on the following principles:

- ensuring that the terms and cost of delivery of goods are acceptable to customers;
- ensuring high accuracy of compliance with the established terms of delivery of special cargoes, expanding the scope of door-to-door and just-in-time principles;
- use in technologies of cargo transportation technologies that provide optimization of movement of freight flows, coordination of processes of transportation and warehousing;
- efficient use of existing transport infrastructure by improving the productivity of vehicles;

- ensuring energy savings by switching transportation to less energy-intensive modes of transport;
- reducing the number of traffic accidents, preventing road congestion by switching traffic to other modes of transport, etc.

In the development of technology, the task is to identify the specific patterns of the production process in order to establish and use in practice operations that require the least time and material resources.

Studying the technology of freight and commercial work at a specific facility allows us to improve the individual operations necessary for the performance of work, and their sequence. These works can be carried out by designing transport and technological delivery schemes.

Transportation of special goods is carried out on various routes, which are selected depending on the location of production and consumption points, the size of consignments, the conditions and requirements for deliveries, the carrying capacity of vehicles and the location of transport enterprises. From the point of view of cybernetics, transportation is a controlled process, from the point of view of organization - a multi-level decision-making process; from the procedural point of view, it is a multifaceted process of the active work of people.

The purpose and tasks of the research. To achieve the goal, the following tasks were set and solved:

- classification of special cargoes was examined and the main requirements for their transportation were identified;
- main theoretical and methodological approaches to the design of transport and technological schemes for the delivery of special cargoes from the point of view of the systematic approach are investigated;
- the market of freight transportation in Ukraine is analised, the share of perishable goods and tendencies of their development are determined;
- the role and place of aviation transport in the system of freight transportation of Ukraine is investigated;

- state of the transport infrastructure of Ukraine and ways of its integration for optimization of import and export are analyzed;
- methodological approaches have been developed and calculations of various transportation technology schemes of delivery of perishable goods on the example of fruit delivery from Turkey to Ukraine have been carried out;
- the economic effect of the implementation of the project proposals is calculated.

Object of the research. Processes of transportation of special cargoes with the participation of different types of transport.

Subject of the research. Assessment of the quality and technology of perishable goods transportation during import and export in Ukraine, suggestion of the solutions for transportation technology system improvement.

Methods of the research. Various methods of scientific research were used to solve these problems, including induction and deduction methods, systematic approach, methods of statistical and economic analysis, expert methods for fruit consumption in Ukraine, methods of calculating the cost of freight road and air transportation, modeling of interaction of modes of transport using cross-docking, routing methods.

The practical significance of the results. The main purpose of the transportation of special cargoes is to ensure the appropriate level of transport customer service in the process of carrying out volumes of cargo transportation at a specified time with optimal use of labor, material and financial resources.

The aim of the master thesis proecting is to generalize, systematize, expand and consolidate theoretical and practical knowledge on the interaction of various modes of transport during the transport of special goods, as well as the development of rational transportation technology schemes for the delivery of perishable goods in international traffic.

1. THEORETICAL PART

1.1. General characteristics of special categories of cargo and requirements for their carriage

Cargo is property that is transported or to be transported by air, land, sea (river), except for postal items and other requisites carried under an international postal agreement and baggage carried under passenger.

Special cargoes include those requiring special storage and transportation conditions. Specific requirements are placed on their condition, packaging and packaging. Special cargoes are stored and transported in accordance with special rules with the specifics of the specified temperature, sanitary, fire, quarantine and other requirements. Such cargoes include:

- outsized;
- long;
- heavy;
- perishable;
- fragile;
- high-value;
- hazardous.

Perishable cargo – are cargoes of plant and animal origin, that are liable to deterioration without maintaining a certain temperature and humidity, and therefore require special storage and transportation conditions.

Perishable goods include most foodstuffs, the suitability of which is limited by certain terms and temperature conditions for their production, transportation and storage.

Perishable goods are divided into the following groups:

- products of animal origin - meat of various animals and poultry, fish, caviar, milk, eggs, etc.;

- products of vegetable origin - fruits, berries, vegetables, mushrooms, etc.;

- processing products - dairy products, various fats, frozen fruits, sausages, cheeses, etc.

Perishable goods include a group of perishable products, in which in case of violation of temperature conditions and terms of sale creates an environment for reproduction of microorganisms that can cause spoilage of products and acute intestinal diseases and food poisoning of people. These include: meat, fish, cheese, semi-finished vegetables, milk, boiled sausages, culinary products [1].

Perishable goods may be classified to indicate generally the classification of any cargo in this case:

- solid, liquid or bulk by physical and chemical properties. Solid in turn can be piece or bulk;

- under conditions of carriage - those which do not require the use of specialized rolling stock (SRS); such that require special sanitary and temperature regimes, and therefore there is a need for a SRS that takes into account the particularities of the cargo;

- on urgency of transportation - those requiring short delivery times, cargoes with the possibility of long term of their transportation.

However, the classification of perishable goods must give priority to the indications of origin of the cargo and the related temperature classification.

Depending on the method of temperature treatment perishable goods are divided into:

- fresh or cool without changing their normal state;

- cooled (to a temperature in the range from + 4 ° C to -6 ° C);

- frozen (temperature range from -7˚C to -18˚C);

- deep-frozen (temperature below -18˚C);

- heated (with a temperature higher than the ambient temperature).

A frozen product is a product whose temperature is not higher than -6˚C and its biochemical processes are virtually stopped. The water in this product turns to ice. The product to some extent loses its taste and aromatic properties but retains its nutritional value.

In the refrigerated product, the temperature in the thickness ranges from 0 ° C to -4 ° C, which only slows down the activity and biochemical processes.

For each type of perishable cargo, there is a permissible minimum and maximum temperature regime in which the process of undesirable quality changes is slowed down, which is especially important to know in the case of long-distance international traffic.

The quality, activity of microbiological and biochemical processes in the products, and accordingly the shelf life, are affected by the water content. The meat content of water is in the range of 58-78%, in milk - 88%, in bread - 35-50%.

The complexity of transportation and storage of perishable goods is that they are continuous biochemical and physiological processes, the intensity of which depends on both the properties of the cargo and the environmental impact.

Good-quality perishable goods are allowed for carriage which do not lose their properties when transported within the terms stipulated by the aircraft schedule.

The most important role at the stage of delivery of perishable foods belongs to the transport container, which is an independent transport unit and is intended for the transportation, storage and storage of products. In accordance with the requirements of preservation of integrity and quality, established by regulatory documents, most perishable food products are submitted for transportation in consumer packaging. Transport packaging must comply with the requirements of ensuring the preservation of these products, which must be observed during their packing, loading, transportation (at a set temperature), unloading, as well as the possibility of performing these operations and stacking in a mechanized manner. For the transportation of perishable foodstuffs, according to the established technology of their production, in advance of packing in transport containers, they are pre-packed or packed in paper or plastic bags, put in glass or metal jars, bottled in glass or polymer bottles, etc.

Transport containers carrying perishable goods must be in good working order, durable, dry and clean, and have no foreign odor. This container may belong

to any organization involved in the delivery of perishable products. Perishable foodstuffs must be presented in good packaging and in accordance with the requirements of state standards and specifications before transportation. Requirements for packaging and packaging of food products are regulated in accordance with applicable law. For the transport of perishable foodstuffs, specialized types of containers may be used: isothermal containers, glacier containers and refrigerated containers. For liquid and bulk food use tank containers. Specialized containers intended for the carriage of perishable foodstuffs must conform to the type and physico-chemical properties of the products being transported and to maintain their quantity and quality. The inner walls of containers, including the floor, ceiling and doors, shall be made of non-corrosive materials and shall not be susceptible to external influences which could damage the products or even make them harmful to human health.

Only good-quality perishable products are allowed to be transported by air, which do not lose their properties when transported within the time limits stipulated by the schedule of airship traffic. Perishable consignments are accepted for carriage on presentation by the sender of quality certificates or veterinary certificates. As a rule, such cargo is transported with escorts from the sender or receiver, direct flights without overloading. Perishable cargo must be brought to the airport of departure immediately before the moment of loading of the aircraft, but not later than three hours before departure and to such extent that it can be dispatched simultaneously.

It is necessary to take into account the properties of the goods and the possibility of their mutual reaction when co-located. In terms of compatibility, all loads can be divided into three groups:

1) goods with aggressive properties (moisture, heat; poisonous, containing germs; radioactive, etc.)

2) prone to corrosive properties (deteriorated by dust, exposed to moisture, heat, microorganisms, radioactive radiation, etc.)

3) neutral.

It is prohibited to transport food together with other goods that may cause them to be damaged, for example:

- fish frozen and chilled;
- salted fish, caviar, fish;
- dried and smoked fish and dried fish concentrates
- Meat chilled and frozen;
- smoked meats and smoked sausages;
- cheeses of all kinds;
- fruits that have strong aromas (lemons, oranges, tangerines, melons);
- vegetables with a sharp smell (onion, garlic);
- yeast;
- margarine.

The transport of frozen goods together with chilled or cooled chilled meat and chilled meat is also not allowed.

All PG are transported under different conditions of acceptance to the carriage shown in Table 1.1[2].

Table 1.1.

Conditions of carriage of perishable goods

№	Goods	Conditions of acceptance to carriage
1	2	3
1.	Vegetables and fruits	These cargoes must be fresh, not contaminated, not moist, properly shaped, free from mechanical damage, free from disease and agricultural pests. Vegetables and fruits that are overripe, flabby, rotten, and frozen are not allowed in the carriage. It is not allowed to transport in refrigerated refrigerators with tomatoes. Cherries and cherries should have a stem. The cherry without the stem is allowed to be transported for no more than one day. Fresh grapes are allowed to be transported with normally

		ripe dried berries.

Continuation of the table.1.1.

1	2	3
2.	Meat	The carcasses of cattle and other large animals must be trimmed in longitudinal halves or quarters; carcasses of pigs - on longitudinal half carcasses or whole carcasses without heads; lamb and small animal meat must be presented with carcasses without heads. The carcasses must be carefully treated and cleaned, free of bruises and contamination by blood, the contents of the gastrointestinal tract or any foreign matter; not have a fringe in the cervical part, as well as on the inside and outside of the carcasses; do not contain residues of internal organs (mutton and goat are allowed for transportation with the presence of kidneys and kidney fat). Ice and snow are not allowed on the surface of the carcass. Frozen meat blocks must be wrapped in parchment, parchment, parchment, cellophane and other transparencies and packed in containers or boxes of corrugated cardboard. When cooled down, meat is transported, subject to cooling for at least 6 hours and having a surface covered

		with a crust of drying, with a temperature in the thickness of the muscles from +4 to +12 degrees. WITH. Chilled meat should have a dry surface with a crust of drying, with no trace of mold, moisture.
3.	Meat smoked products, sausages	They are transported in luminaire boxes. The loin and brisket covered with a protective layer are carried in tight boxes. The bacon is carried in packs of three - six halves in each, lined with a strong sacking and tied on both sides with a sturdy soft rope. Bundles are stacked in a body one on one in three - four tiers. Beef and lamb corned beef and tongues are presented for transportation in barrels with a salinity period of at least 10 days.

Continuation of the table.1.1

1	2	3
4.	Rabbit carcasses	Transported only in frozen condition, packed in boxes. Carcasses should be skinless, heads and internal organs except the kidneys, and have no traces of mold, mucus and moisture.
5.	By-products	They are transported only in frozen condition, packed in clean boxes or cardboard boxes, in sacks of cloth or Kraft paper or horned balls. By-products should be fresh, clean and free from spoilage.
6.	Poultry carcass	It is transported in frozen and cooled state, packed in boxes. In the cooled state the broken bird is transported in boxes with lumps. Broken bird with signs of mold, mucus, odor of fermentation and moistened surface is not allowed for carriage.
7.	Endocrine Raw Materials	It is transported in frozen state, packed in tight boxes. Boxes with endocrine raw material are lined on all sides with frozen meat as cold ballast with no gaps

	(Pancreas, Thyroid, Other Glands)	between places.
8.	Eggs	Packed in lattice boxes with wood shavings or special cardboard boxes with displaced or corrugated linings. Egg products (mélange, protein, yolk) are transported in tightly sealed jars, packed in tight boxes.
9.	Dairy products (cream, cheese, sour cream)	Curd cheese and frozen cheese are packed in board boxes. Dairy and lactic acid products are unloaded immediately after the refrigerators or non-specialized vehicles are delivered to the place of unloading. Butter is transported in boards, plywood or cardboard boxes and in barrels, melted butter - in barrels. Cheeses are carried in boxes, cuttings and in wooden drums.

Continuation of the table.1.1

1	2	3
10.	Canning products	Transported in tin and glass containers, packed in sturdy cardboard or board boxes. Banks must be enclosed so that their transfer is impossible
11.	Icecream	Transported in metal cans and boxes. In the summer, the shipper adds 0.75 - 1.0 tonnes of dry ice to each refrigerated refrigerator.
12.	Fish	Frozen fish, depending on their appearance, are packed in wooden or cardboard boxes, dry barrels, packages (for sturgeon fish), baskets and boxes. The chilled fish is transported in boxes or barrels of tubers. A layer of clean crushed ice should be placed on the bottom and on each row of fish. Sturgeon or salmon fishes are only packed in boxes. In the cooled state it is allowed to transport fish fresh not lower than the first grade. The fish and herring salts are transported packed in barrels, boxes and jars of white tin. Cold smoked fish is packaged in boxes of boards,

		cardboard boxes and baskets of wicker, as well as in metal containers, barrels of tubers. Barrels and boxes should have holes at the ends. Hot smoked fish is packaged in wooden, plywood and cardboard boxes, metal containers and boxes made of solid cardboard or wicker. Cold-smoked baled products and sun-dried oil are transported in boxes.
13.	Yeast bars	Wrapped in paper and presented for transportation in wooden boxes; in each box stack bars of the same packaging by weight, one batch and date of production. Boxes should be clean and have no odor.
14	Grape and fruit wines - berry	Carried in barrels or bottles packed in boxes; barrels with signs of leakage to transport are not allowed. The temperature mode of transportation of wine is set by the shipper, about which it makes a mark in the freight waybill

End of Table 1.1.

1	2	3
15.	Live plants, flowers, tubers, fruits, seeds	They are accepted for carriage only after the shipper submits permits and quarantine certificates, issued by the Ministry of Agriculture Inspection for Plant Quarantine, to each consignment.

The carrier must deliver PC (perishable cargo) on time. Delivery terms are calculated from the moment of completion of loading and processing of documents until the arrival of the vehicle to the consignee. Delivery time is indicated in the consignment note.

The rolling stock which has been released from the goods shall be cleaned, washed and sanitized by the consignee of the cargo residues in a timely manner with a notice in the consignment note.

One of the notable points of transportation of perishable foodstuffs by air is the loading of similar products that require the same temperature level. In case of

failure to fulfill any conditions, goods that can damage each other should not be loaded into the same containers / suitcases. Especially at the beginning of transportation it is important to observe key hygiene standards and potentially hazardous products should be removed as far as possible, however, the existing cold chain conditions in air transportation should not be violated. This means that during transportation, storage and transfer, the required temperature must be provided at the same level to protect products.

Before loading products into the aircraft, the collected samples will be checked by independent laboratories; products that are hazardous to the health of flight personnel must not be loaded. On the other hand, different products must be isolated from each other during loading; In addition, these containers, suitable carriers / cases should be kept clean, cool and closed for the duration of the operation. In addition to this clause, if for reasons of control it is necessary to remove products from containers / boxes and analyze them, only small quantities of products should be removed, and the remaining products should be stored in a refrigerator. Thermal control circuits must be switched on at a temperature of 4 to -40 ° C in the cooling system of air transport devices. Especially fish, meat, milk, fresh fruits, vegetables and other food products should be evaluated differently and put into operation separately; besides, processed foods may never be held together with fresh foods.

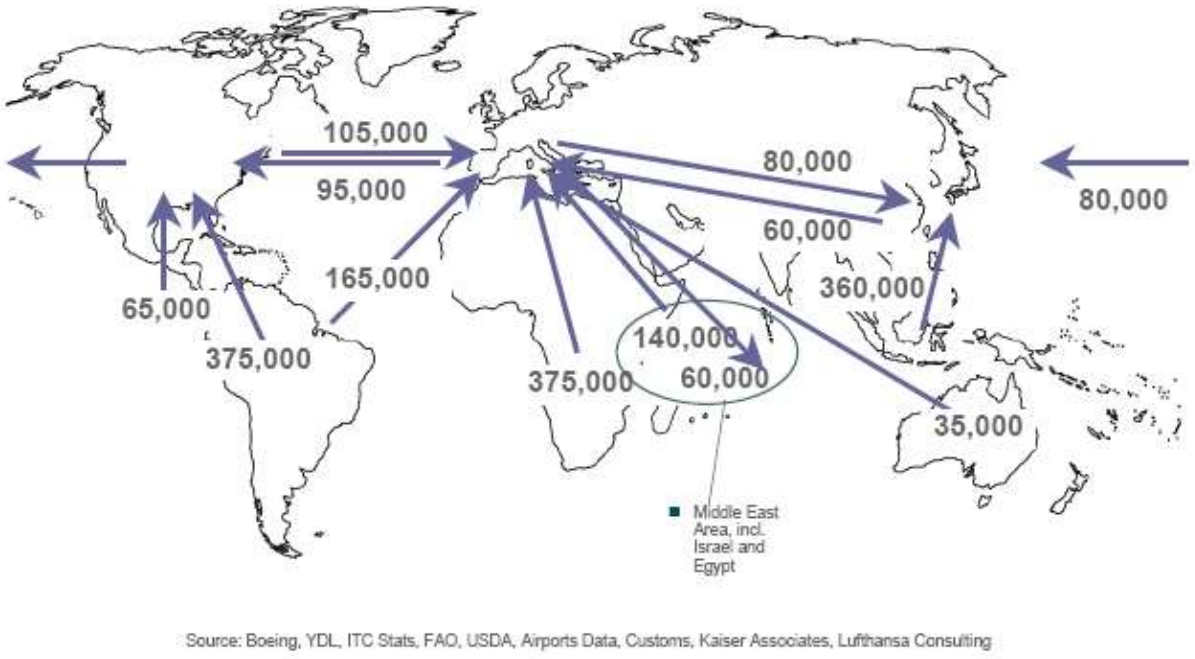


Figure 1.1 Perishable Goods Transportation in the World

1.2. Important Factors on Perishable Foods Transportation and Food Logistic Systems

International carriage of perishable foodstuffs (ATP Convention)

The transportation of perishable goods is a specific transportation. Especially these materials can be damaged and damaged during transportation. Therefore, they can lead to economic losses and environmental loss. At the same time, these materials can cause increased medical costs. Therefore, states need legal arrangements related to the transport of perishable goods. In accordance with this legislation, transport equipment has determined that it is insulated and refrigerated or mechanically refrigerated. The convention defined the technical characteristics of these trailers and trucks.

On the other hand, the contracting parties to this convention have agreed on similar test methods and vehicle standards. However, the contracting party will accept applications from other contracting parties in accordance with the ATP Convention.

Refrigeration Techniques According to ATP Conventions

In the past, various methods of refrigerating trucks have been used. These include hold-over plate systems, ice, ice and salt, dry ice, cryogenic systems, and mechanical refrigeration. Today, however, mechanical refrigeration is the predominant type. Trailers refrigerated with cryogenic refrigerants, usually liquid carbon dioxide (CO2) or nitrogen (N2), have been used to some extent over the past three decades, but they are not as popular as trailers refrigerated mechanically.

Mechanical Refrigeration

Mechanical cooling works by absorbing heat at one point and distributing it to another. This is achieved by circulating the refrigerant between two points. The refrigerant collects heat through the coil (evaporator) inside the cargo area and removes it through another coil (condenser) from the outside. The refrigerant is circulated through the system using a compressor, which is driven by a gasoline, diesel or electric engine.

Cryogenic Refrigerants

Cryogenic (low-temperature) refrigerating systems, which use liquid or solid carbon dioxide (CO_2) or liquid nitrogen (N_2), are available for highway trailers. They are used primarily in delivery operations requiring one-day or less transit time, since supplies of liquid cryogens are not available at truck stops. Benefits of the cryogenic systems are that they have fewer moving parts to maintain and replace, and also allow quick recovery of thermostat set-point temperature after delivery stops. Liquid cryogenic systems usually operate by having the liquid refrigerant in pressurized tanks. A temperature-sensing element inside the trailer activates a controller which releases the liquid refrigerant through a spray nozzle at the ceiling of the trailer. The liquid CO_2 or N_2 spray flashes into gas as it hits the warmer air in the trailer, absorbing the heat. When the desired temperature is reached, the sensing element sends a signal to the controller to shut off the flow of refrigerant. In another type system, the liquid CO_2 is circulated through a coil or plate heat exchanger and the vaporized gas vented outside. A third type of system stores CO_2 snow in a full length ceiling bunker and cools as the snow melts [3].

Ice

Ice is a very important tool for absorb of heat and also enables to maintain dampness in loads of perishable produce. The main disadvantage for ice are its volume and weight, which cuts down on the payload; the difficulty and expense of implementing ice enroot; the need for watertight packaging when applied as top-ice; and the damage some perishable goods cause when contacted by ice. Slush-ice or crushed blown over the top of produce loads is used to refrigerate and maintain high levels of dampness for certain products. As noted that "top-icing." Some loaders might apply the crushed ice or slush ice to individual pallet loads or in individual boxes of product (package-ice) before loading.

1.3. Connections between standards and technologies in perishable goods transportation

A correct food safety policy must be based on an integrated approach, that is throughout the whole food chain 'from farm to fork' and across all food sectors.'' These words are taken from the introduction to the ''White Paper on Food Safety'', written by the Commission of the European Communities. Transports are involved in the food production and distribution chain and are partly responsible for the safety and quality of food. Studies of food temperature during the cold chain show a more or less controlled increase in temperature during transportation, which is associated not only with loading and unloading, but also with the storage temperature in the refrigerator compartment.

Missing to comply with temperature restrictions in one link of the cold chain influences negatively the quality of food, and in some cases deterioration can be so heavy that food safety is also compromised.

The provisions of ATP only deal with food safety; this is the reason why the list of Annex 3 embraces only meat and meat offal, fish, milk and dairy products, butter, game, poultry and rabbit. However, there are many other food- stuffs whose quality and also safety could suffer from inadequate transport conditions. Among

the food products which are not included in the Annex 3 of the ATP, there are some widespread foodstuffs like fruits and vegetables, minimally processed ready to use vegetables ripened cheese, and a large number of prepared dishes (mainly pasta, sweets or creams) not containing meat or milk and normally stored and transported in controlled or modified atmosphere or under vacuum.

Fruit and vegetables

Some delegations at the WP 11 have been recommending for many years the introduction of fruit and vegetables in the ATP list of perishable foodstuffs. The proposal has not yet been accepted, because the quality issue is not yet considered in the ATP, which only deals with safety. In the case of fruits and vegetables, food is generally dis- carded by the consumer because of its poor quality before it becomes unsafe, therefore there is less need for stringent controls in terms of food safety. However, fruits and vegetables are foodstuffs with a high value added, which are sensible in a great extent to storage conditions, and for which the impact of poor transport conditions in terms of cost is not negligible. Furthermore, it must be taken into ac- count that this kind of perishable foodstuff can suffer as much from low temperature (below its minimum recommended storage temperature) as from high temperature. This is a common practical problem for the transport of temperature-sensible goods in the cold season, which has recently been subject to increasing attention due to a growing interest on heated vehicles (Radulescu, Lohan, & Higgins, 2005) [4].

Vehicles for the transport of fruits and vegetables should have these main characteristics:

- A heating system for compensating for low external temperatures;

- The possibility of rapid air movement, to take advantage of the ‘‘evaporative cooling’’ of the goods, of the air exchange with the external ambient, and to avoid gas concentration build up.

Such vehicles could also be less thermally insulated, be- cause the internal temperature is on average higher than that prescribed by the ATP for chilled foodstuffs. In fact, while negative temperatures are required for some vegetables,

high temperatures are required for equatorial products like bananas, and other products like cucumbers, chilli (Panozzo & Minotto, 2003). However, this would lose an opportunity for reducing the energy consumption of the refrigerating system in the case the ambient temperature is higher than the storage temperature.

Minimally processed ready to eat fruit and vegetables

The bacterial growth in minimally processed vegetables is not negligible, even using treatments for reduction in growth. Fig. 1 shows the number of bacteria (colony- forming units) in lettuce leaves untreated and treated with negative ions and ozone (Amendola, Fedele, & Panozzo, 2005).

Diced or sliced vegetables are much more sensitive to bacterial infections, since the cut areas can be easily contaminated. Furthermore, the exposed surface of the diced or sliced vegetable is larger in comparison with that of the uncut product, and consequently the speed of deterioration is increased.

The shelf life of minimally processed vegetables is clearly influenced by the temperature either from the quality point of view, or from that of microbial proliferation (Ahvenainen, 1996; Francis & O'Beirne, 2005; Jacxsens, Devlieghere, & Debevere, 2002; Tournas, 2005). Therefore, transport becomes a crucial phase, especially when considering the very brief shelf life of this kind of product.

1.4. A systematic approach to the design of transport and technological schemes of cargo transportation

Cargo transportation is a complex multifaceted process of purposeful activity of people, which ensures satisfaction of demand for cargo transportation. From the standpoint of cybernetics, transportation is a managed process; from the point of

view of the organization - a multilevel decision-making process; from a procedural point of view, it is a multifaceted process of active human activity.

The main purpose of transportation is to provide an adequate level of transport services to customers in the process of carrying out the volume of transportation of goods at a fixed time, through the optimal use of labour, material and financial resources.

Any transportation technology can be represented as a functional dependence on certain parameters, for example, formula 1.1:

$$TT = TT\{t_1, t_2, ..., t_9\} \tag{1.1}$$

where $t_1, t_2, ..., t_9$ - the number of system characteristics of individual technological processes of transportation that include: performance indicators - volume of transportation, freight turnover, travel time; conditional characteristics of vehicles - type of vehicle, weights: those characteristics of vehicles that affect the speed of delivery of cargo, economic and environmental characteristics of the vehicle; target characteristics of loaders (items) - type of loaders, commercial characteristics of missile defence and others. All technological processes of transport technology $TT = TT\{t_1, t_2, ..., t_9\}$ have their own system characteristics, characterizing in the space of production indicators and in time their functioning. The general scheme of optimization of transport technologies is presented in Fig. 1.3.

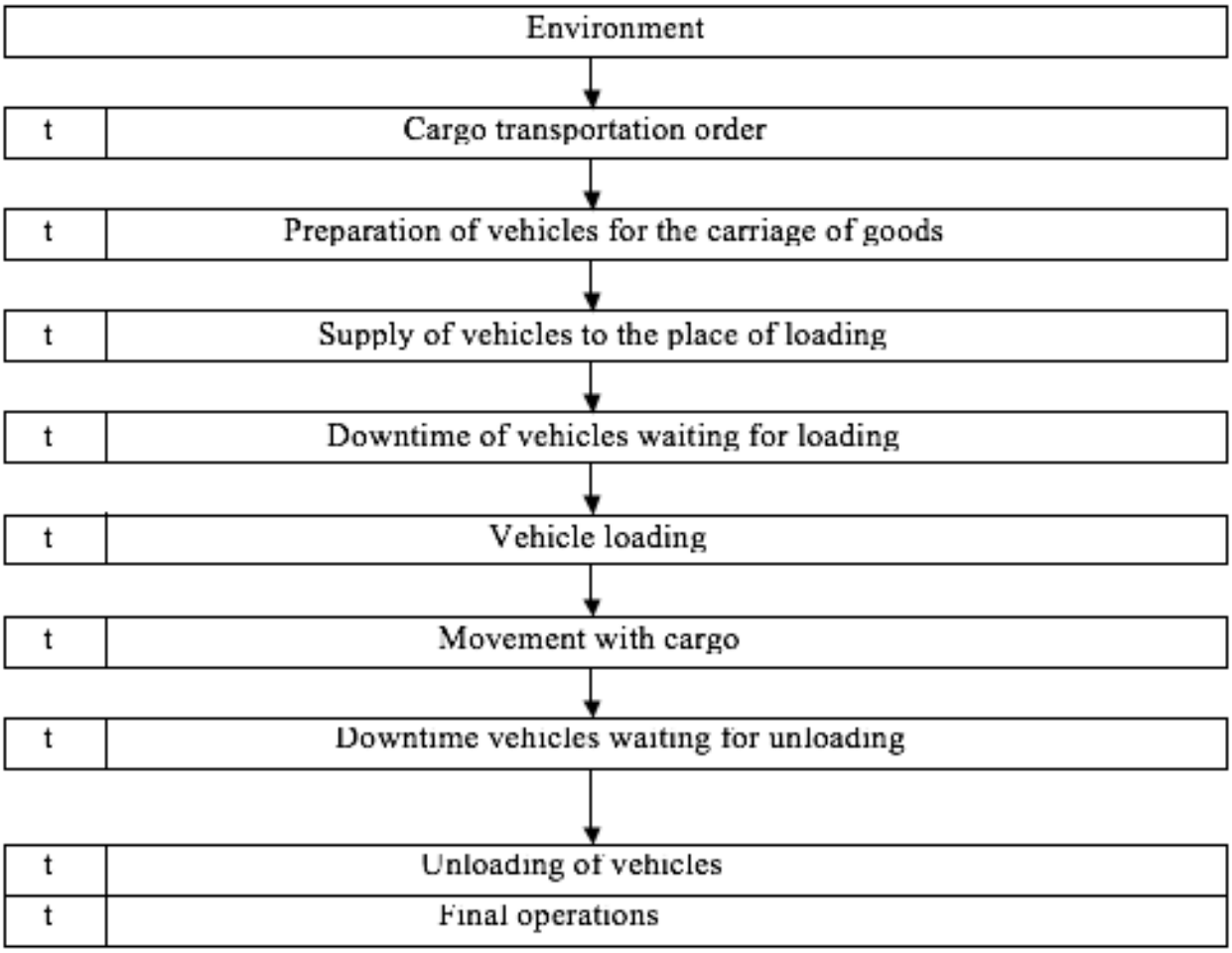


Fig. 1.2. Structural diagram of the algorithm of transport technology

Each constituent element $t_1, t_2, ..., t_9$ described by relevant models $M_t^{(1)}, M_t^{(2)}, ..., M_t^{(9)}$, which reflect the patterns of functioning of individual technological processes of cargo transportation [5].

The conducted researches confirm that technological operations $t_2, t_3, t_4, t_5, t_6, t_7, t_8$ largely depend on the coordination of the joint work of transport companies and consumers of transport services (shippers and consignees) [6].

Thus, technological processes $t_1 - t_9$ can be represented as:

$$
\begin{aligned}
t_{1j}^{(i)} &= t_{1j}^{(i)}\left\{Q_j^{(i)}, \tilde{T}_j^{(i)}, C_j^{(i)}\right\};\\
t_{2j}^{(i)} &= t_{2j}^{(i)}\left\{N_j^{(i)}, q_j^{(i)}, \tilde{Q}_j^{(i)}, \tilde{T}_{1j}^{(i)}, C_{1j}^{(i)}\right\};\\
t_{3j}^{(i)} &= t_{3j}^{(i)}\left\{N_{1j}^{(i)}, q_{1j}^{(i)}, \tilde{Q}_{2j}^{(i)}, \tilde{T}_{2j}^{(i)}, C_{2j}^{(i)}\right\};\\
t_{4j}^{(i)} &= t_{4j}^{(i)}\left\{N_{2j}^{(i)}, q_{2j}^{(i)}, \tilde{Q}_{3j}^{(i)}, \tilde{T}_{4j}^{(i)}, C_{3j}^{(i)}\right\};\\
t_{5j}^{(i)} &= t_{5j}^{(i)}\left\{\tilde{Q}_{4j}^{(i)}, N_{3j}^{(i)}, q_{3j}^{(i)}, \tilde{T}_{5j}^{(i)}, C_{4j}^{(i)}\right\};\\
t_{6j}^{(i)} &= t_{6j}^{(i)}\left\{\tilde{Q}_{6j}^{(i)}, N_{4j}^{(i)}, q_{3j}^{(i)}, \tilde{T}_{6j}^{(i)}, V_j^{(i)}, C_{5j}^{(i)}\right\};\\
t_{7j}^{(i)} &= t_{7j}^{(i)}\left\{\tilde{Q}_{7j}^{(i)}, N_{5j}^{(i)}, q_{4j}^{(i)}, \tilde{T}_{7j}^{(i)}, C_{6j}^{(i)}\right\};\\
t_{8j}^{(i)} &= t_{8j}^{(i)}\left\{\tilde{Q}_{8j}^{(i)}, N_{6j}^{(i)}, q_{5j}^{(i)}, \tilde{T}_{8j}^{(i)}, C_{7j}^{(i)}\right\};\\
t_{9j}^{(i)} &= t_{9j}^{(i)}\left\{\tilde{Q}_{9j}^{(i)}, N_{7j}^{(i)}, \tilde{T}_{9j}^{(i)}, C_{8j}^{(i)}\right\};
\end{aligned}
\qquad (1.2)
$$

where $t_1 - t_9$ - accordingly technological processes TT, that are being implemented i-j types of transport on the i-th interval;

$Q_j^{(i)}$ -j, the volume of transportations to be made by the j-th mode of transport on the (i)-th interval of time;

$\tilde{T}_j^{(i)}$ - time, transportation of j-th mode of transport (s);

$C_j^{(i)}$ - the cost of transportation performed by the j-th mode of transport on the (i) th interval of time, taking into account the costs of marketing research;

$N_j^{(i)}$ - the number of vehicles of the j-th name that are required for the carriage of goods on the (i)-th interval;

$q_j^{(i)}$ - the average load capacity of the unit of the vehicle of the j-th name on the (i)-th interval;

$\tilde{Q}_j^{(i)}$ - the capacity of vehicles of the j-th name required for the carriage of goods on the (i)-th interval;

$\tilde{T}_{1j}^{(i)}$ - the time required to prepare the vehicles of the j-th name on the (i)-th.

$C_{1j}^{(i)}$ - the costs necessary for the preparation of the j-th vehicles for the carriage of goods on the (i)-th interval;

$N_{1j}^{(i)}$ - the number of vehicles of the j-th name submitted to the place of loading at the (i)-th interval;

$q_{1j}^{(i)}$ - the average load capacity of the unit of vehicles of the j-th name submitted to the place of loading at the (i)-th interval;

$\widetilde{Q}_{2j}^{(i)}$ - power of vehicles of the j-th name given to the place of loading at the (i)-th interval;

$\widetilde{T}_{2j}^{(i)}$ - the time of submission of vehicles of the j-th name to the place of loading at the (i)-th interval;

$C_{2j}^{(i)}$ - the cost of submitting vehicles of the j-th name to the place of loading at the (i)-th interval;

$N_{2j}^{(i)}$ - the number of j-th vehicles waiting to be loaded on the (i)-th interval.

$q_{2j}^{(i)}$ - the average load capacity of the unit of vehicles of j-th name, which are waiting for loading, on the (i)-th interval of time;

$\widetilde{Q}_{3j}^{(i)}$ - the capacity of vehicles of the j-th name that are waiting for the load at the (i)-th interval;

$\widetilde{T}_{4j}^{(i)}$ - time of loading of vehicles of j-th name on (i)-th interval of time;

$C_{3j}^{(i)}$ - costs (losses) associated with the idle time of vehicles of the j-th name on the (i)-th interval;

$\widetilde{Q}_{4j}^{(i)}$ - power of vehicles of the j-th name that are under load on the (i)-th period of time;

$N_{3j}^{(i)}$ - the number of vehicles of the j-th name that are under load on the (i)-th period of time;

$q_{3j}^{(i)}$ - the average load capacity of the unit of vehicles of the j-th naming under load at the (i)-th interval;

$\widetilde{T}_{5j}^{(i)}$ - the load time of vehicles of the j-th naming on the (i)-th interval;

$C_{4j}^{(i)}$ - the cost of loading the vehicles of the j-th naming on the (i)-th interval;

$\widetilde{Q}_{6j}^{(i)}$ - capacity of vehicles of j-th name, which carry goods on the (i)-th interval of time;

$N_{4j}^{(i)}$ - the number of vehicles of the j-th name occupied by the carriage of goods on the (i) th interval;

$q_{3j}^{(i)}$ - the average load capacity of the unit of vehicles of the j-th name occupied by the carriage of goods on the (i)-th interval;

$\widetilde{T}_{6j}^{(i)}$ - the time of delivery of goods by vehicles of the j-th name on the (i)-th interval;

$C_{5j}^{(i)}$ - the cost of transportation of goods by j-th mode of transport on (i)-th interval of time;

$\widetilde{Q}_{7j}^{(i)}$ - power of vehicles of the j-th name, waiting to be unloaded, at the (i)-th interval;

$V_{j}^{(i)}$ - speed of delivery of cargo by j-th mode of transport on the (i)-th interval of time;

$N_{5j}^{(i)}$ - the number of vehicles of the j-th name, waiting to be unloaded, at the (i)-th interval;

$q_{4j}^{(i)}$ - the average load capacity of the unit of vehicles of the j-th name, which are waiting to be unloaded, at the (i) th interval;

$\widetilde{T}_{7j}^{(i)}$ - idle time of vehicles of the j-th naming awaiting unloading at the (i)-th interval;

$C_{6j}^{(i)}$ - the cost (loss) of downtiming vehicles of the j-th naming awaiting unloading for the (i)-th period of time;

$\widetilde{Q}_{8j}^{(i)}$ - the power of the unloaded j-th naming vehicles on the (i)-th interval;

$N_{6j}^{(i)}$ - the number of unloaded j-th namig vehicles per (i)-th period of time;

$q_{5j}^{(i)}$ - the average load capacity of the vehicles of the j-th name being unloaded on the (i)-th interval of time;

$\widetilde{T}_{8j}^{(i)}$ - downtime of vehicles of the j-th naming under demerger on the (i)-th interval;

$C_{7j}^{(i)}$ - the cost of unloading vehicles of the j-th naming on the (i)-th interval;

$\widetilde{Q}_{9j}^{(i)}$ - volumes of transported goods by j-th mode of transport on the (i)-th interval of time;

$N_{7j}^{(i)}$ - the number of vehicles of the j-th naming used for the carriage of goods on the (i)-th interval;

$\widetilde{T}_{9j}^{(i)}$ - time of registration of freight and other documents (customs clearance of goods, etc.) for the i-th mode of transport at the (i) th interval of time;

$C_{8j}^{(i)}$ - the cost of performing the final TT operations implemented by the j-th mode of transport at the (i) th interval.

Systematic efficiency of freight transportation depends to a large extent on the functioning of all components of the implemented logistics channel [7].

The quality of transportation depends on the time of waiting for the carriage of goods from the manufacturer, the time of transportation, ensuring the safety in the process of transportation, the time of waiting for unloading, the time of storage in the warehouse during transportation.

The efficiency of transportation is determined by the following indicators: the cost of storage of goods from the manufacturer; cost of freight transportation; the cost of storing cargo at warehouses during transportation; revenues from freight transportation; revenues from freight forwarding activities and other services provided in the process of transportation; profit from cargo transportation, forwarding operations; profitability of transportation; fund transfer of fixed assets of transport enterprises and the like.

The presented criteria of quality and efficiency of freight transportation take into account the specific features of the functioning of all logistics units' channel, allow you to generate many relevant optimizations and controls.

Minimizing the size and, requires the formulation and solution of many problems: studying the demand for products and creating the necessary production and technical capacity for production and sale of products; conclusion of contracts for the supply of products; choice of the scheme of transportation of production to the customer; choice of methods and optimization of levels of stocks of products and manufacturers taking into account characteristics of supply and demand. In order to solve many of the presented tasks and other related tasks, there is a need to develop and study appropriate models.

Conclusions for the theoretical part

The transition of Ukraine to a new phase of sustainable socio-economic growth, the course for European integration requires the advance development of the entire transport system of the country, as well as the introduction of new progressive technologies of cargo delivery on a door-to-door and "on-time" basis. The complexity of transportation and storage of perishable goods is that they are continuous biochemical and physiological processes, the intensity of which depends on both the properties of the cargo and the environmental impact. For each type of perishable cargo, there is a permissible minimum and maximum temperature regime in which the process of undesirable quality changes is slowed down, which is especially important to know for long haul operations that are characteristic of international traffic. Perishable goods transportation requires specially designed transportation technology delivery schemes.

The basis for the delivery of perishable goods is the organization of a transport component, which can be represented by different modes of transport. The only process of transportation is a set of transport processes of the respective modes of transport, which interact with each other. When carrying out the transport process with the participation of several modes of transport, which determine the

formation and implementation of the processes inherent in each of them, the requirement of organizing coordinated, coordinated work of related modes of transport is especially important.

2. ANALYTICAL PART

2.1. Analysis of the dynamics of freight traffic in Ukraine

An important condition for the formation of international transportation technology schemes for the delivery of perishable goods is to ensure the same capacity of all links in the infrastructure. In order to assess the state of transport infrastructure in Ukraine, we will analyse its use.

In 2018, the freight turnover of transport enterprises decreased by 3.4% to 331.6 billion tonne-kilometres. According to the State Statistics Committee, cargo transportation by water transport decreased by 4.5% - up to 5.6 million tons. The volume of foreign freight transport decreased by 5%. The cargo turnover of the water transport enterprises decreased by 20% - up to 3.396 billion tonne-kilometres [8].

Freight transportation by rail decreased by 5% - up to 322 million tons. Including freight transportation in internal communication and export decreased by 3.5% - up to 267,6 million tons.

The freight turnover of railway enterprises decreased by 2.9% to 186.3 billion tonne-kilometres.

Freight transport by road increased by 5.8% - up to 186.7 million tons. Cargo turnover of road transport enterprises increased by 2% - up to 42.339 billion tonne-kilometres.

Cargo transportation by air transport increased by 19.7% - up to 0.1 million tonnes. Cargo turnover of enterprises of aviation transport increased by 24% - up to 341.4 million tonne-kilometres.

In January-June 2019, Ukrainian transport enterprises increased the volume of cargo transportation by 8.2% compared to the same period of 2018 - up to 328.5 million tons.

In particular, freight transport by rail decreased by 1.2% - up to 156.8 million tons. Including freight transportation in domestic communication and export decreased by 0.6% - up to 129.9 million tons.

According to the State Statistics Committee, freight transportation by water, in turn, increased by 13.9% to 2.5 million tons. In the total volume of cargo transportation by water transport foreign made 49,3%. The volume of foreign freight transport decreased by 1.8%. The cargo turnover of the water transport enterprises increased by 0.3% - up to 1.547 billion tonne-kilometres.

Road haulage increased by 28.6% to 112.3 million tonnes. The turnover of road haulage enterprises increased by 13.7% to 23.217 billion tonne-kilometres.

In addition, freight transport by air transport increased by 0.7% - to 0.04 million tons. Cargo turnover of enterprises of aviation transport decreased by 2.9% - to 148.96 million tonne-kilometres.

Table 2.1

Volumes of cargo transportation by Ukrainian transport in 2018

	Cargo turnover		**Transported goods**	
	million tons km	In % to January - April 2018	million tons	In % to January - April 2018
Type of transport	**110163,7**	**102,8**	**218,7**	**109,1**
Railway	61835,4	98.7	104,6	98,7
Automobile	14950,9	113,9	72,8	133,6
Maritime	903,4	98,9	36,3	128,7
Aviation	99,4	111,9	5	108,4

The distribution of transportation of cargo by mode of transport is presented on a Fig.2.1.

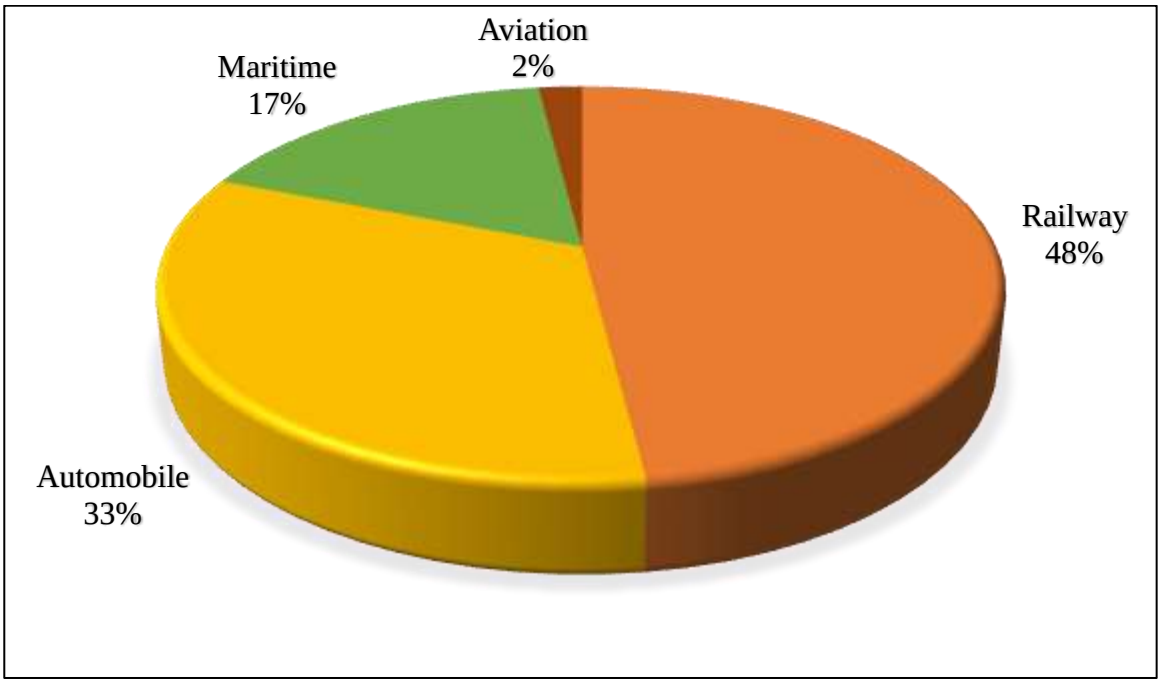


Fig.2.1. The volume of freight transportation by type of transport according to the results of 2019 year

Aviation industry statistics in 2019 indicate its steady development.

Between January and June 2019, 28 domestic airlines operated 47.8 thousand commercial flights (against 46.2 thousand over the same period last year) on the passenger and freight transportation market.

On fig.2.2 presented the dynamics of freight traffic by months of 2019 compared to 2018 year.

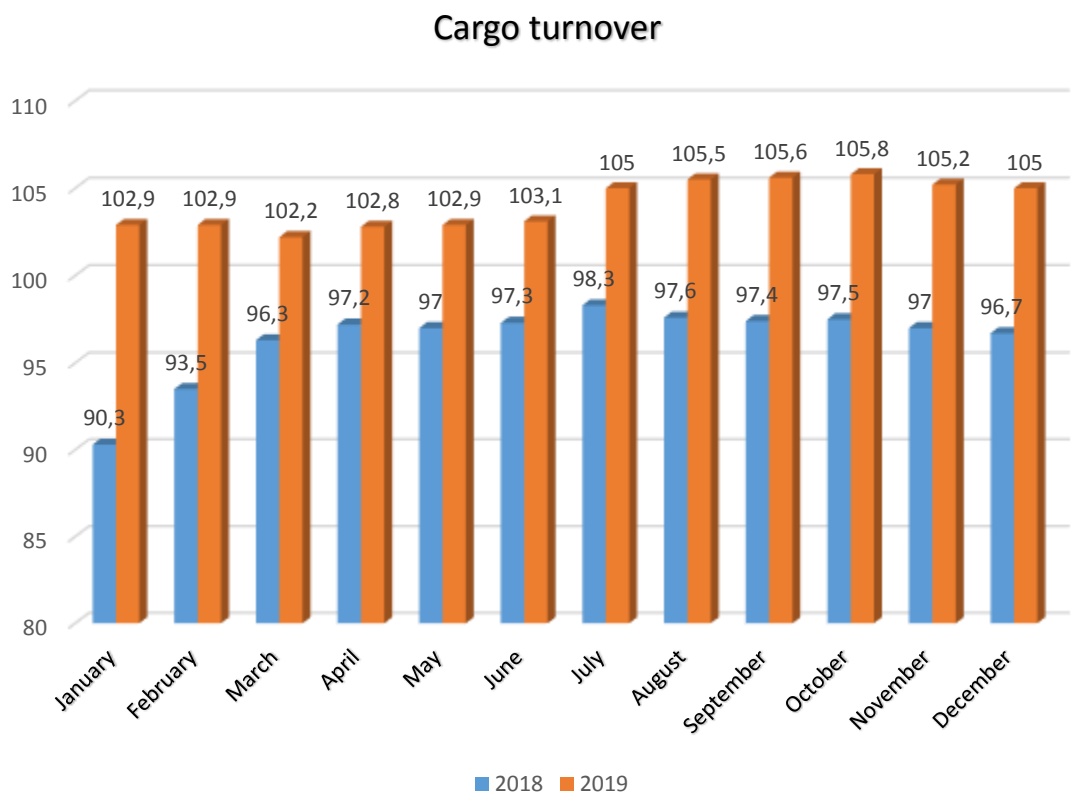


Fig.2.2. Dynamics of freight traffic volumes for the months of 2018 and 2019 years, thousand tons

As it can be seen from this graph, freight volumes during 2019 year is tended to increase. Compared to 2018 year, freight volumes increased significantly in 2019.

Throughout its history, Ukraine has been at the crossroads of world trade routes and has been a kind of hub and an important hub for Europe to Asia. Although data from the State Statistics Committee show an increase in transit flows (Table 2.2), which is a consequence of the recovery of countries after the economic crisis, given the state of roads, extremely long customs procedures, outdated rail transport many domestic and especially foreign carriers refuse to travel through Ukraine, and use alternative international routes. So you can only guess how many thousands of tons of transit cargo has already passed Ukraine in 2019 [9].

Fig.2.3 Global transit ways

The share of intermodal transportation of goods by Ukraine for 2019-2025 should grow from 0.5% to 10%.

Table 2.2

Transit freight transportation for January-March 2019

	Transit cargoes transported in January-March 2019, thousand tons	in% to January-March 2019 year.
Raiway	14383,70	121,2
Roadway	1118,11	115,5
Maritime	1515,61	346,3
Aviation	0,49	226,7

It is nice to note that the volume of transit by air and sea modes of transport has increased.

However, experts say, the potential of the country's geopolitical and geo-economic position is underutilized. The imbalance between export and import flows and modes of transport is significant. Export and transit depend on bulk and bulk cargo by rail and sea. Imports include manufactured goods, which are mainly transported by road and in containers. This is quite inefficient because the return phase is empty and the capacity to strengthen traffic flows is limited.

2.2. Analysis of freight traffic through Boryspil Airport

According to the State Aviation Service of Ukraine, in 2018 the transportation of goods and mail through Ukrainian airports increased by 7.8% to 56.4 thousand tons. For the 1st quarter of 2019, postal cargo transportation increased by 5.7% year-on-year to 13.5 thousand tons [10].

The amount of cargo handled at Boryspil International Airport is presented in table 2.3 for June and the 2nd quarter of 2018-2019 years.

Table 2.3

Amount of cargo transported through Boryspil International Airport in 2018-2019 years

Indicators	**June**		*Dev. %*	**2nd quarter**		*Dev. %*
	2018	**2019**		**2018**	**2019**	
Handled cargo, kg	**3 257 833**	**2 973 389**	***-9%***	**9 780 329**	**9 322 754**	***-5%***
Arrived, kg	2 038 724	2 050 382	*1%*	6 416 635	6 437 725	*0.3%*
Shipped, kg	1 219 109	923 007	*-24%*	3 363 694	2 885 029	*-14%*

Table 2.4

Amount of export and import of cargo transported through Boryspil International Airport in 2014-2019 years

Indicator	2014	2015	2016	2018	2019
Cargo, tons	25058,25	24222,779	30064	33967	37457,45
Rate of growth	-7%	-3%	24%	3,11%	3,15%
Export, tons	7450,29	8001,69	10522,4	12785,45	13458,7
Specific weight	29,7%	33%	35%	35,7%	36%
Rate of growth	2%	7%	31%	32%	33%
Import, tons	17607,9	16221,1	19541,6	21456,3	24567
Specific weight	70,3%	67%	65%	70,3%	74,7%
Rate of growth	-11%	-8%	20%	23%	27%

There was a sharp decline of cargo transportation by 7% in 2014 and by 3% in 2015. In 2016 there was an increase in the amount of cargo by 24% and further cargo turnover began to increase by 3,11% in 2018 and by 3,15% in 2019.

Over the analyzed period the amount of export cargo increased annually, especially significant growth rates by 35,7% were observed in 2018 and by 36% in 2019. Another situation was with import cargo. In 2014, there was a decrease by 11% of cargo volumes. Then there was a significant increase by 20% in 2016 and by 27% in 2019. In general, the cargo traffic volume increased by 56% over the analyzed period [11].

In the cargo flow structure, the share of export and import cargo is 35% and 65% respectively. The cargo flow of arriving cargo is 2 times more than the cargo flow of departure cargo. Such distribution of cargo flow reflects the trends of Ukraine's economy development. The little part of transfer cargo can be explained by insufficient number of flights which makes it impossible to provide the choice of the optimal route, insufficient service in the cargo terminal, complexity of customs clearance and handling of transfer cargo.

The dominating share of cargo air traffic was performed due to international flights and accounted to 99%, the rest of cargo – 1% was carried by domestic flights.

The largest share of freight traffic was made by the following airlines in 2019: UIA – 38,1%, Turkish Airlines – 21,2%, European Air Transport – 12,5%, Silk Way West - 10%.

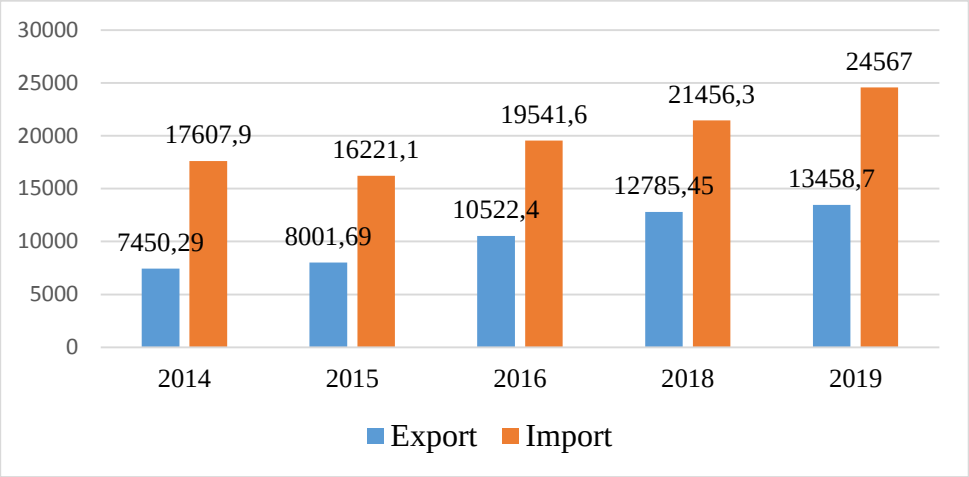


Fig.2.4. Dynamics of export and import of cargo transported through Boryspil International Airport for the period of 2014-2019, tons

Let's consider Percentage of different types of goods transported through Boryspil International Airport (Fig. 2.5).

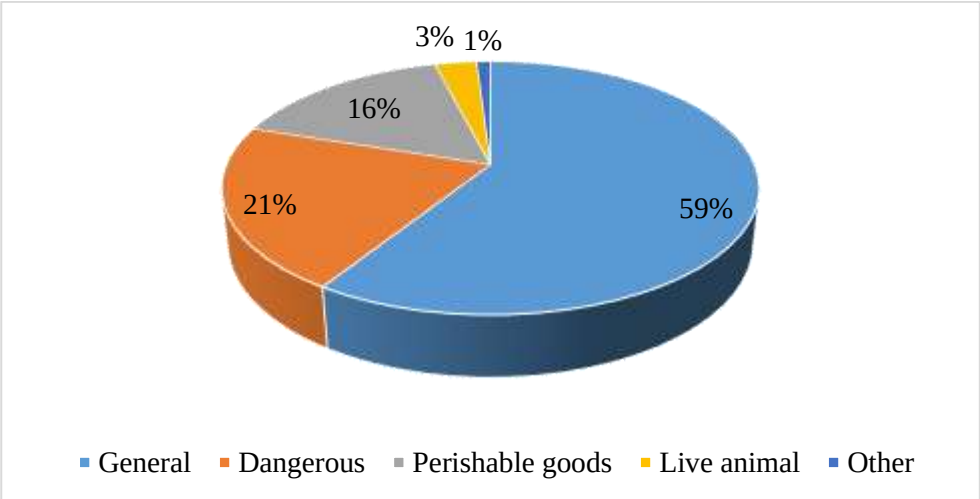


Fig.2.5. Percentage of different types of goods transported through Boryspil International Airport in 2019 year

Based on the data presented on the Fig. 2.5 it can be concluded that the lion's share of the freight flow is general cargo. Dangerous goods and perishable goods also account for a large portion.

The analysis of cargo flow on the basis of cargo packing (see table.2.5) shows that the majority of cargo departures from the airport is transported "in bulk", ie in the form of separate unpackaged cargo places. The share of transport in containers and pallets is 40%. This is due to the fact that not all carriers can provide cargo transportation in containers, but it is possible to see the rapid increase in the volume of transport in containers and pallets.

Table 2.5

Cargo structure of Boryspil airport by type of packaging

Means of packing	% of total traffic
Containers	25
Pallets	15
In bulk	60

An analysis of the structure of the consignment of consignments shows that most of the consignments are in the range of 100-200 kg, then there are categories up to 45 kg (these are mostly small consignments), and the categories of 200-500 kg. (see Fig. 2.6)

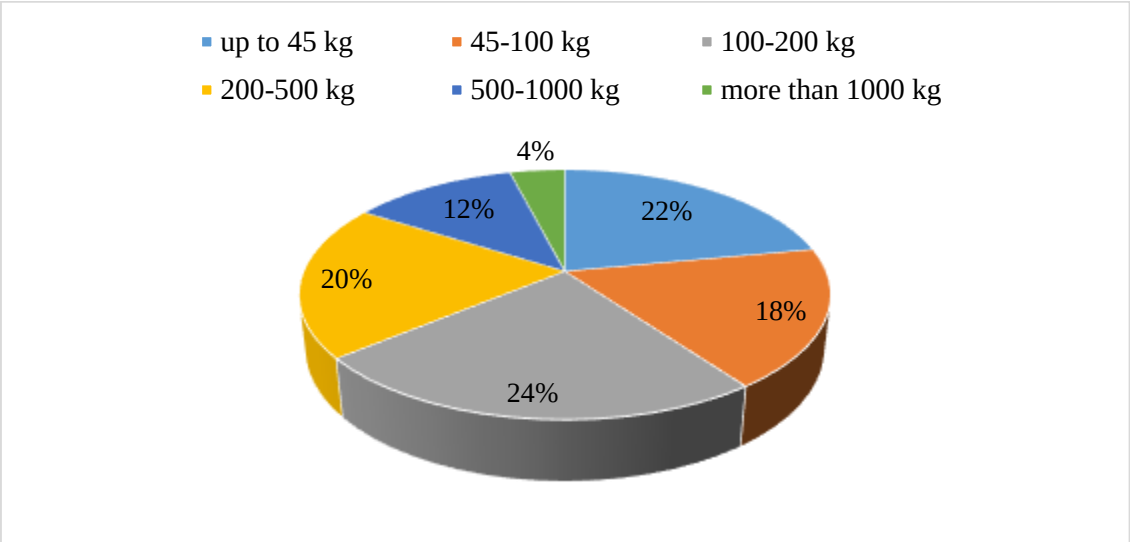


Fig. 2.6. Breakdown of turnover by size of lots in 2019

Therefore, 84% of shipments have a weight of up to 500 kg, which indicates that there is an overall general tendency for small party shipments. The consequence of this situation is an increase in the cost of handling cargo and an increase in the flow of documentation.

Table 2.6 contains data on the volume of freight transportation, which requires a temperature regime.

Table 2.6

Dynamics of transportation of cargoes that need to comply with the temperature regime through the Boryspil Airport

	2014	2015	2016	2017	2018	2019
Perishble goods	548292	598508	646634	707393	745973	817468
Plants and flowers	277672	433776	382435	426568	489767	532695
Medication	3870319	4101924	3636981	3633425	5405009	3457414

The above data indicate that the demand for transportation of goods with temperature is unstable, however, in 2018 and 2019 there was an increase in the volume of transportations of plants and flowers, and the volume of transportation of perishable goods continues to grow [12].

2.3. Analysis of Boryspil International Airport cargo terminal and investigation of perishable cargo storage conditions at the terminal

Boryspil is the largest airport in Ukraine in terms of cargo handling and mail. The existing cargo infrastructure of Boryspil was formed in the late 1960s and early 1970s. It was designed to handle approximately 40 tons of cargo per day. Today it is 110-120 tons per day.

Cargo terminal of Boryspil International Airport State Enterprise represents a set of buildings and structures, which are intended for handling of export and import cargo and for placement of service personnel, means of mechanization and vehicles. Total area of the cargo terminal is 14580 m^2. Total area of the warehouses (for cargo holding up to 90 days according to the Customs Code of Ukraine) is 5072 m^2 with capacity of 2686 pallet/cells or 805,8 tons for general cargo. This area includes:

- warehouse with heating (temperature is not lower then +5C) – 2769 m^2, capacity: 1,772 pallet/cells or 531,6 tons;
- warehouse without heating – 2303 m^2, capacity: 914 pallet/cells or 274,2 tons [1].

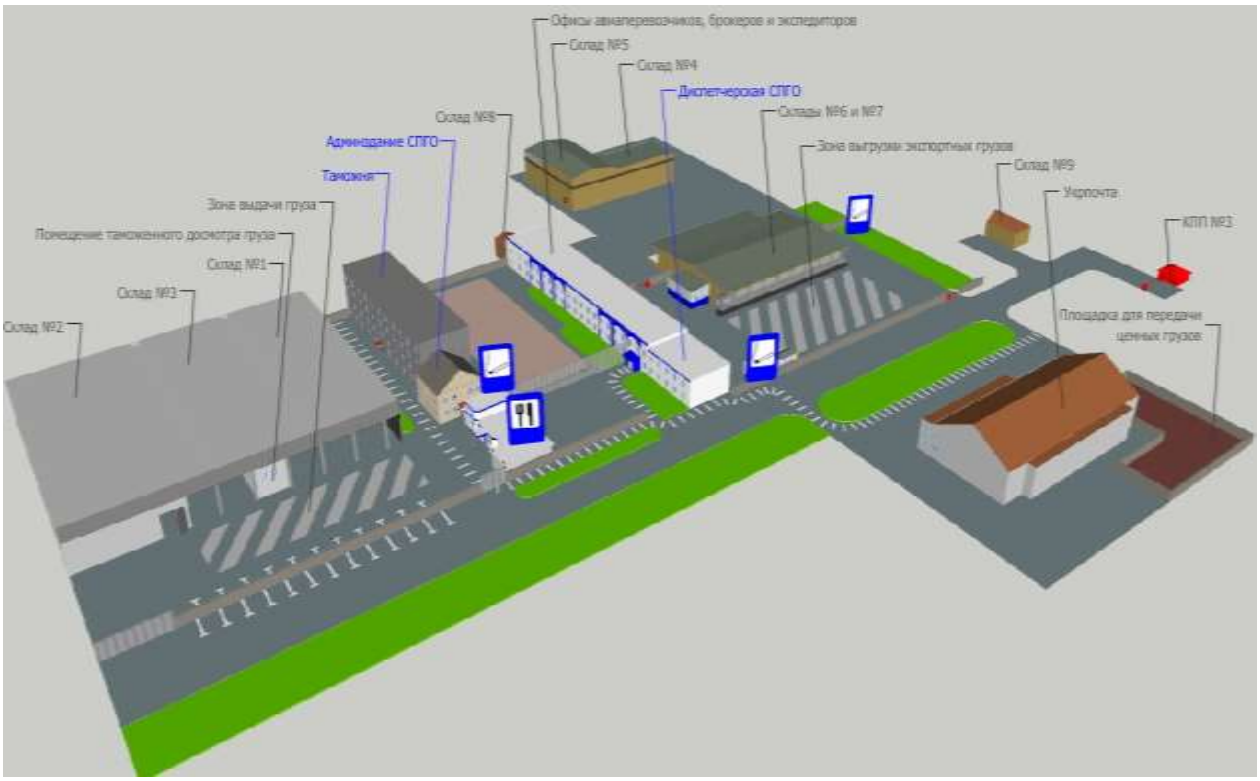


Fig.2.7. Scheme of Boryspil International Airport cargo terminal

The cargo terminal structure includes the following temporary storage warehouses (see fig.2.7) [13]:

1. Warehouse №1 (“Limex”) – warehouse for automated handling of cargo in the ‘Import’ mode. Total area is 1480,4 m^2. The warehouse is intended for the reception, storage and delivery of oversized cargo to the recipient, which is allowed for transportation by air. The storage capacity is 1200 pallets / cells or 360.0 tons. Natural ventilation. The warehouse is equipped with an automated fire extinguishing system; central heating, providing a temperature inside the warehouse of at least 5 ° C; surveillance cameras; electronic scales.

2. Warehouse №2 - warehouse for mechanized handling of cargo in the “Import” mode. The warehouse is not heated and has an area of 1047,3 m^2. Cargo handling is carried out using electric and diesel forklifts. Storage of goods is carried out on standard pallets with their placement on tiered racks. The storage capacity is 376 pallets / cells or 112.8 tons. The warehouse is equipped with an automated fire extinguishing system; surveillance cameras; two electronic scales for weighing cargo.

3. Warehouse №3 - warehouse for mechanized handling of cargo in the “Import” mode. The warehouse is heated and has an area of 434,1 m^2. Warehouse is intended for placement of damaged cargo on standard pallets with placing them on tiered racks. The capacity of the warehouse is 372 pallet/cells or 111,6 tons. The warehouse is supplied with automated system of the fire fighting; central heating, which provides the temperature inside the warehouse not less than 5C°; electronic scales.

4. Warehouse №4 - warehouse for mechanized handling of dangerous goods and perishable cargo in the “Import”, “Export” and “Transit” modes with the area 279,5 m^2, which has several premises for separate placement of dangerous and perishable goods. Dangerous goods are placed in two separate premises with the aim of separate storage of incompatible goods. Perishable cargo is placed in

cooling cameras with medium temperature range of +2 to +10C ° (volume of chambers is 189 m^3), or in freezing room with medium temperature range of 0 to -15C° (volume is 47,5 m^3).

5. Warehouse №5 - warehouse for mechanized handling of cargo in the "Import" and "Export" modes. The warehouse is not heated and is intended for placement of cargo on rack systems. The area is 527,4 m^2. Cargo handling is carried out with the use of electric and diesel forklifts. The capacity of the warehouse is 325 pallet/cells or 97,5 tons.

6. Warehouse №6 - warehouse for mechanized handling of cargo in the "Export" and "Transit" modes (407,1 m^2). The capacity of the warehouse is 100 pallet/cells or 30 tons.

7. Warehouse №7 - warehouse for mechanized handling of cargo in the "Export" and "Transit" modes (382,9 m^2). It is intended for placement of export and transfer cargo on the floor. The capacity of the warehouse is 100 pallet/cells or 30 tons.

8. Warehouse №8 - specialized warehouse for valuable cargo storage. The warehouse is heated and has the area of 11,6 m^2. The warehouse is equipped with security systems in accordance with the requirements of preservation of valuable goods.

9. Warehouse №9 - specialized warehouse for radioactive dangerous goods. The warehouse is not heated and is intended for placement of dangerous goods of 7^{th} class. The area is 18 m^2. The warehouse is equipped with burglar and fire alarms. It is intended for placement of export and transfer cargo on the floor.

Covered area of 295,2 m^2 is intended for placement and storage of cargo on rack systems.

Open area of 300 m^2 for mechanical handling of heavy and bulky loads [16].

Other facilities located on the Cargo Terminal territory:

- Kyiv Customs authorities (Boryspil Airport Customs Station);
- Sanitary and Quarantine post of Sanitary and Epidemiological Station;
- Ecological control post;

- Plants quarantine post;
- Veterinary station of State Veterinary Control Department;
- representative offices (general agents) of airlines and shipping agencies [18].

Cargo terminal is fenced by concrete fence that has 5 technological exits and 5fire prevention exits for vehicles.

Means of internal warehouse and apron mechanization available in the cargo terminal are presented in the table 2.7. [14].

Table 2.7

Means of mechanization available in the cargo terminal

Name of special transport and means of apron mechanization	Number of units
Diesel towing tractor Jst-30	5
Electric towing tractor	7
Tractor “Foton-454”	9
Covered cargo trolley ТГК 1500	13
Covered cargo trolley ТЕГ 1,8	30
Diesel forklift	1
Mercedes Benz Sprinter 208CDI	1
Diesel forklift with platform	1
Electric forklift	16
Electric stacker	1
Container trolley 7,0-tons	44
Passenger and cargo car “Gazel”	1
Cargo car АПК-10	8

Security control of mail and cargo is carried out by employees of security cargo transportation control department in the temporary storage warehouses №6 and №7 or by ASS Dog Training Center staff using specially-trained dogs (under unusual circumstances).

Radiation control is carried out by using special electronic devices ("Frameworks"), which are located at the entrances and gates to the territory of a cargo terminal.

Cargo terminal territory is constantly monitored by Aviation Security Service through video surveillance [15].

The organizational structure of cargo terminal is presented in the appendix B.

Cargo terminal provides the following services:

- terminal maintenance and storage of general and special cargo (dangerous goods of 1-9th categories, live animals (on the day of departure / arrival), human remains, perishable cargo, heavy goods, weapons, medicines, valuable cargo);
- acceptance of goods to the warehouse and delivery from the warehouse;
- loading/unloading of cargo and passenger aircraft;
- formation of transport documentation;
- control on air cargo security;
- informing of customers about the status of the cargo.

The basic processes of cargo handling during export and import of goods are presented in Fig. 2.8. and 2.9. It should be noted that all these processes meet the quality standards [17].

Consider the storage conditions at Boryspil Airport, cargoes that require temperature.

Perishable goods carried under medium and low temperature conditions are very sensitive to changes in ambient temperature. Violation of storage conditions in a few hours may result in loss of cargo. Therefore, in the cargo complex of the airport it is necessary to provide suitable conditions for storage of cargoes at medium and low temperatures. Considering the duration of cargo handling processes, the perishable perishable cargo in the cargo complex may exceed 24 hours. Leading international airports provide storage facilities for perishable goods, which are equipped with refrigerators.

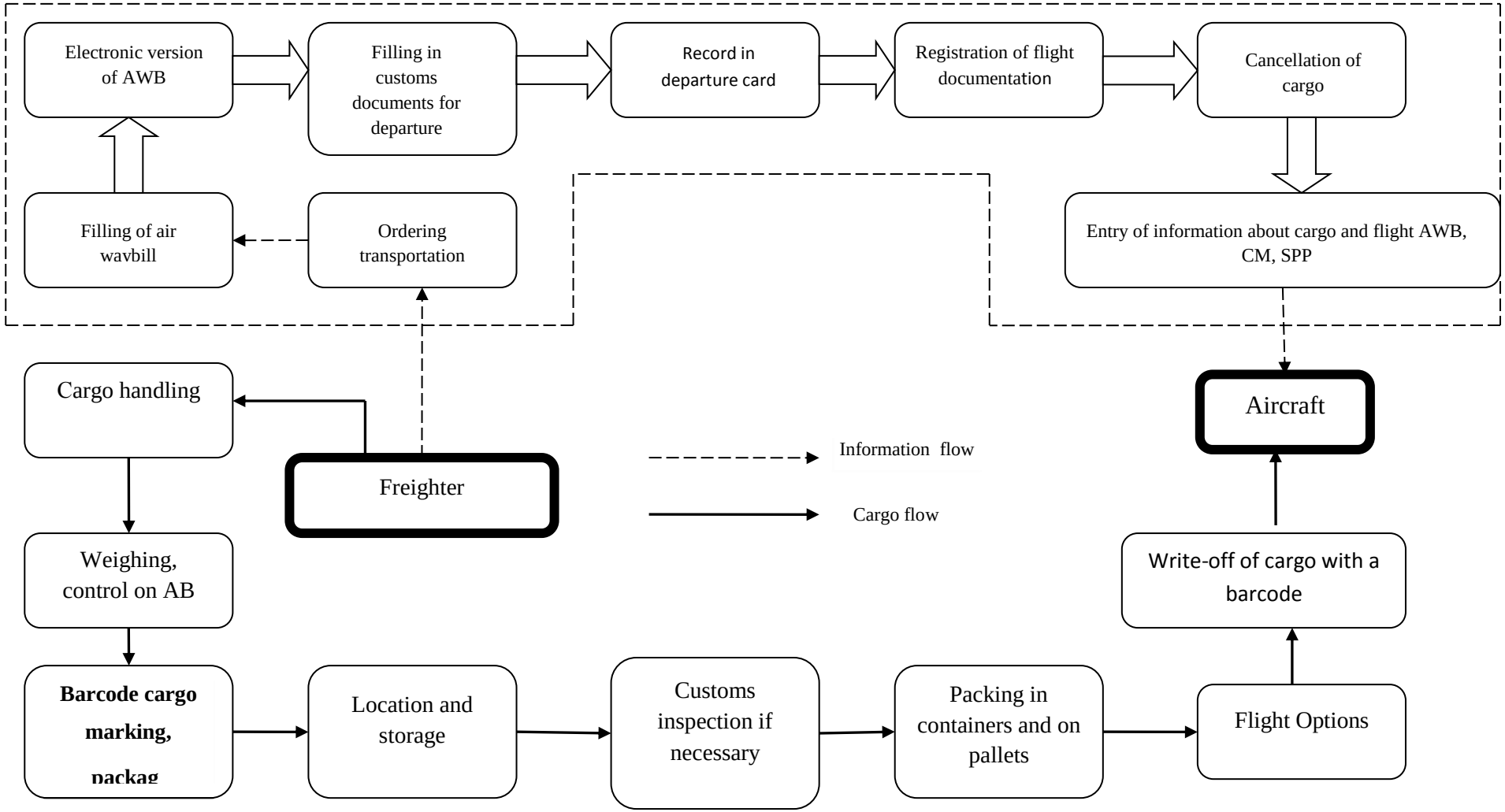


Fig. 2.7. Processes of cargo departure from the airport

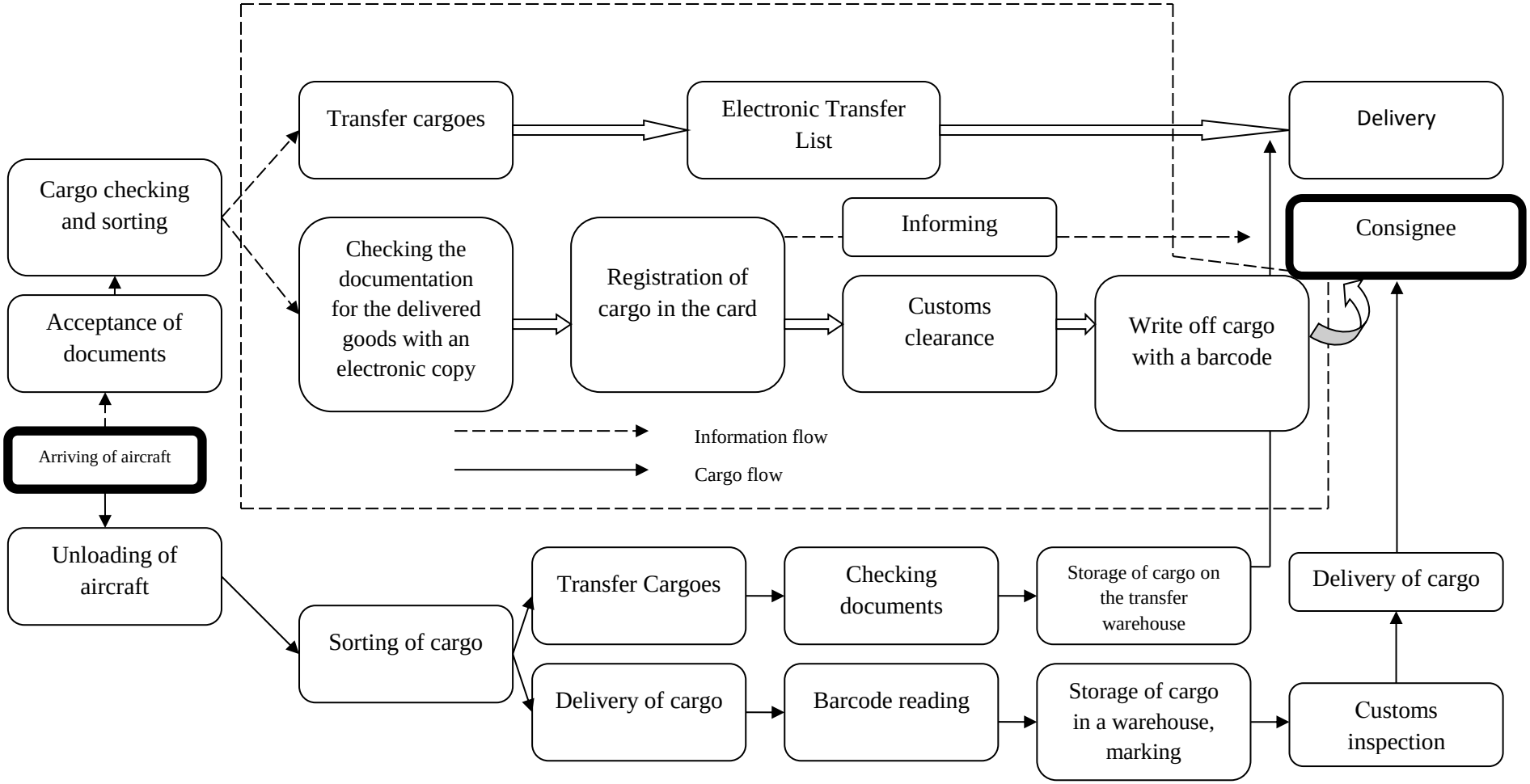


Fig. 2.8. The processes of servicing cargo arriving at the airport

Medium temperature refrigeration chamber is designed to store pre-refrigerated foods. Freezing a certain amount of food is also acceptable, but the daily rotation of the product should not exceed 1/100 of the camera's volume.

Foods with a high water content (iced fish, etc.) should be placed in a refrigerator in a sealed container.

Refrigerator consists of a set of panels: side, ceiling, floor. The camera panels consist of outer and inner shells made of food metals: aluminum, galvanum or galvanized steel. The thickness of the panels is 100 mm. The joints of the panels are sealed with a sealed gasket. The internal covering of the floor panels is made of galvanized steel, which withstands a distributed load of 1000kg / m2 [19].

The locking system of docking and assembly of panels makes it easy and quick to mount and disassemble the camera. The doors are suspended on the hinges with a torsion device, which allows self-covering. On the inside, the yard is equipped with a soft seal [20].

In a low-temperature chamber to prevent the creation of frost, a wire electric heater is installed in the special groove on the perimeter of the doorway.

The cooled volume is illuminated by a lamp located on the door of the camera and switched on from the outside by a portable switch with illumination located on the panel in the door opening.

The camera is equipped with an automatic evaporator thaw control system.

In medium-temperature systems, the evaporator thaws due to external heat when the compressor is automatically switched off, in low-temperature systems, the heaters are commanded by the program timer and temperature relay. The frequency of this process is determined by the setting, depending on the operating mode.

The refrigerator is designed for use in normal climatic conditions, namely: relative humidity no more than 65%, ambient temperature no higher + 35%. The thermometer is programmed on 2 scales: Celsius and Fahrenheit.

Installation of refrigerating chambers allows to ensure the integrity of perishable cargo under any external temperature conditions, to provide long-term

storage of perishable cargo, to improve the quality of service of the clientele, to eliminate cases of damage to cargo due to violation of storage regimes.

2.4. Analysis of the subjects of the freight market in Ukraine

Nowadays, there are about 4,000 freight forwarding companies operating in the Ukrainian market (companies registered in Ukraine, including their branches in the regions), including more than 3,000 carriers and 1,000 freight forwarders (operators or agents), this is the vast majority. Companies that specialize in providing logistics outsourcing services make up no more than 1% - a notable characteristic of the current level of development of this segment of the logistics market. In the world, by contrast, this segment is very developed. According to experts, as early as 2018, US companies outsourced about 56% of logistics costs, companies in Western Europe and Asia-Pacific - 81% and 60%, respectively [21].

The highest level of competition is emphasized in the segment of freight forwarding services, which is associated with a large number of companies working in the field of freight transportation, and the achievement of a relative balance between supply and demand in the market.

In the segment of integrated logistics, the development of which began only in recent years, demand is significantly ahead of supply. Increasing competition is expected only in the medium term, after the introduction of new warehouse space and the increase in the supply of storage and distribution of goods. The logistics sector in Ukraine is characterized by non-consolidation. This is the business of a considerable number of relatively small companies with limited resources. For example, the turnover of the largest Ukrainian operators is less than $ 100 million, and European logistics companies have an average mouth of about 1 billion euros.

Thus, it can be noticed that Ukrainian operators are operating in a large, growing market of freight forwarding services, and logistic outsourcing is still only a plan [22].

Unlike Ukrainian operators, there are three types of Western companies that can be clearly identified:

1) logistics operators focused on the sectoral supply to firms that primarily need a wide distribution of goods (B2C sector) or supply chain design (B2B sector), offering flexible services, flexibly adapting to the needs of customers and integration with it. These include FM Logistic, Exel, Ceva Logistics, etc .;
2) mainly freight forwarding companies providing a wide range of simple goods transportation services, primarily for industrial enterprises; their main priority is geographical expansion. Examples are Schenker, Kuehne & Nagel. For companies of both types, own assets are not the basis of business (own park provides no more than 10% of revenue);
3) highly specialized (least common) companies engaged in segments whose work is related to their own assets (for example, companies specializing in the transportation of oversized cargo, offshore container lines, etc.: Moller-Maersk Group, etc.).

Today, the main players in the Ukrainian market of complex logistics services are:: Raben, Schenker, Kuehne&Nagel, Fiege, FM Logistics, Lux Logistics, AsstrA, Komor - C, Fordon, Maksayev, UVK.

Gradually, they build warehouses, and are equipped with the latest technology and competition is shifted towards a favorable location of warehouses (porches, directions). Delivery times, coverage areas and the range of services provided will remain among the main areas of competition, even with a developed logistics system, as these are common competition parameters worldwide. Table 2.8. represented data of warehouses area and location of storage facilities, and Fig. 2.9. and 2.10. shows the price dynamics for storage and handling services.

Table 2.8

Warehouse assets of the main companies of complex freight transportation service

	DTZ	Colliers	UVK data			Regions
			Actually operate	Plans	Sublease	
Raben	55400	29800	29800	32600		Ring Road, Brovary
Schenker	11200	10000	21200			Vyshneve
Kuehne&Nagel	55000	53000	35000	20000		Kyiv, Gostomil
Fiege	19815	20000	20000			East Gate Logistic
FM Logistics		23000	13000	85000		Boryspil district
Lux Logistics		17000	0	17000	7000	Dnipro
AsstrA	11200	10000	10000			Sofiivska Borschagivka
Комора - С	25000	57000	60000	100 000		Brovaru
Fordon	30300	25000	25000		10000	MLP Chayka
Maksan					20000	Odessa
UVK	40000	40000	40 000	49000		Brovary, Capital Highway

Therefore, the above data indicate that logistics companies already have a strong infrastructure to provide comprehensive cargo and cargo transportation services internationally and domestically [23].

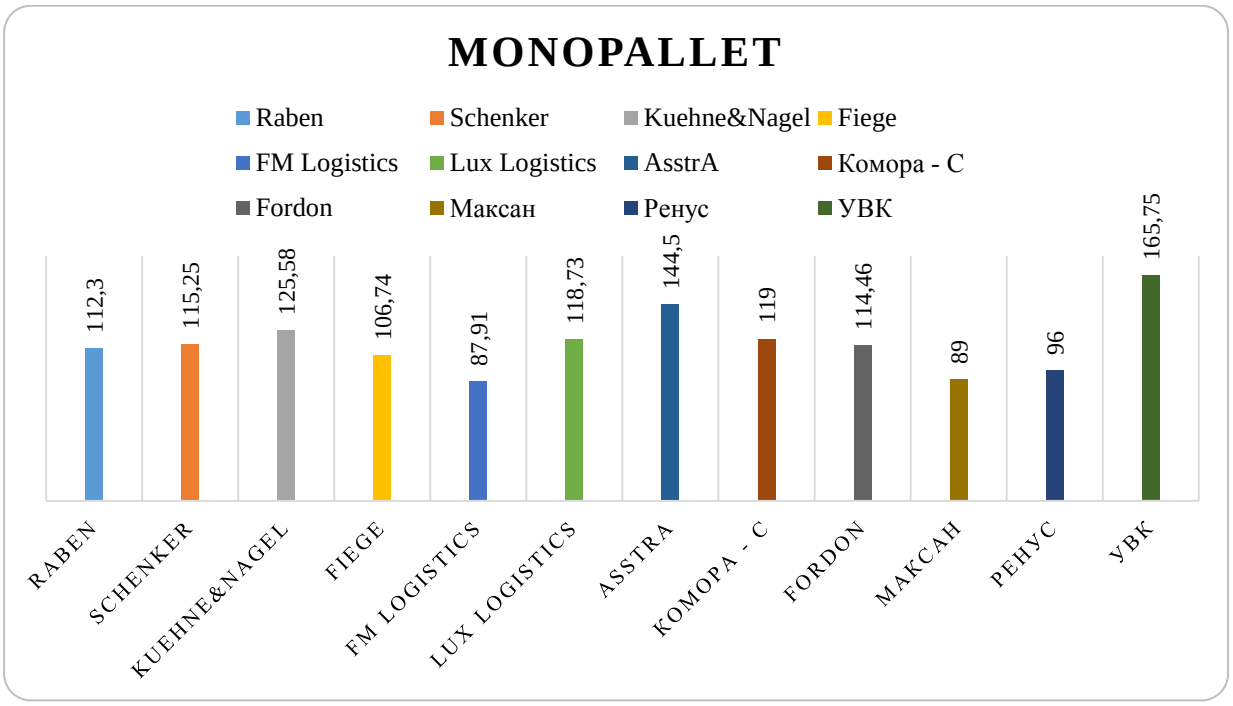


Fig. 2.9. The cost of storing 1 pallet space per month, UAH

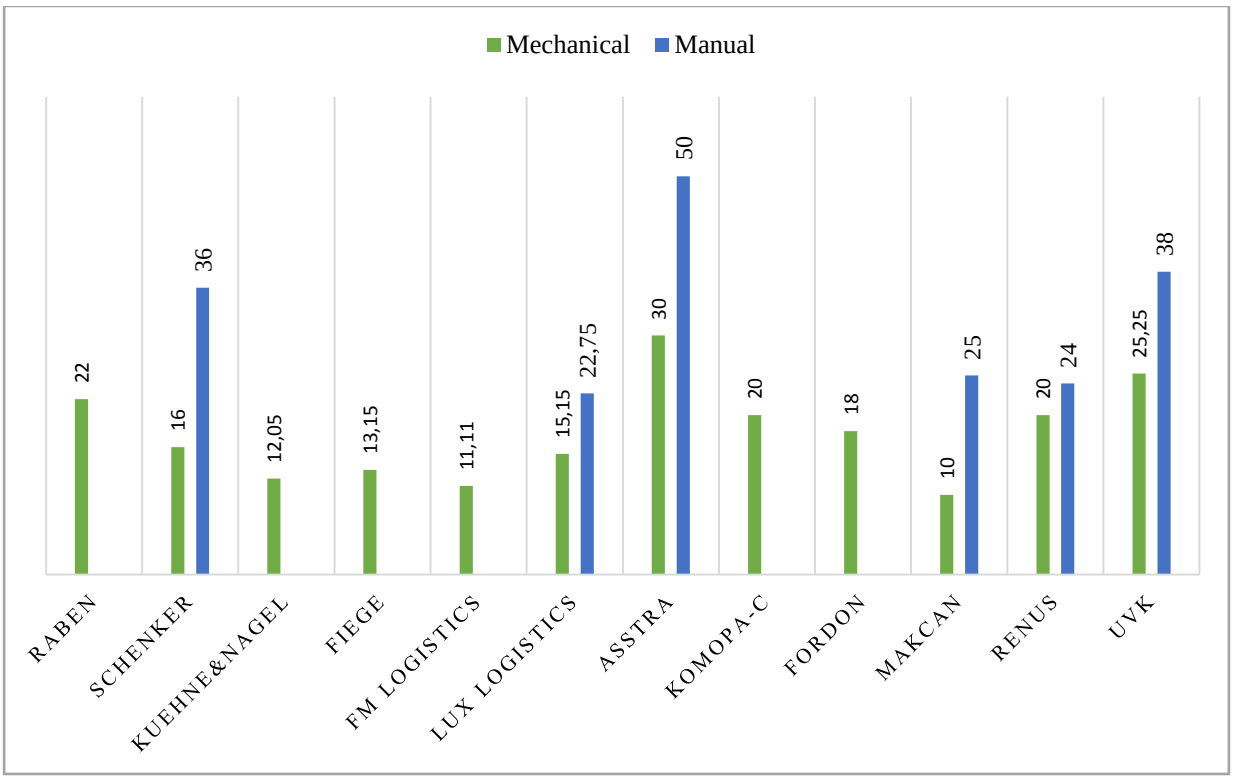


Fig. 2.10. The cost of unloading / loading 1 pellet, UAH

Thus, the analysis shows that in Ukraine the market of complex logistics services and the presence of companies that can provide quality services in the field of freight transportation of perishable goods.

2.5. Assessment of the efficiency of use of the transport-logistical infrastructure of Ukraine and quality assurance of cargo transportation in the international connection

In 2018 year, Ukraine ranked 69th out of 160 countries in logistics performance in the World Bank's Logistics Performance Index (LPI) in 2018 year [24].

The country is badly affected by the lack of development of transport infrastructure. According to World Bank experts, Ukraine's private sector can save up to 3% of GDP per year on logistics costs, improving border and customs procedures and taking measures to counter corruption.

High costs associated with a limited, poorly maintained road network, financial condition and management of public railways, poor capacity and unreliability of ports. Poor logistics and a lengthy border crossing procedure create significant barriers to trade, preventing Ukraine from fully realizing its potential as a transit hub and obliging it to incur significant economic costs. Also, the main obstacles to logistics are insufficient and expensive warehouse capacities, complex regulatory documents that regulate export-import operations, corruption practices at the border.

Small exporters and especially small importers face disproportionate costs and a disproportionately long waiting time at the border, which is the main problem of foreign trade operations. As a result, the domestic market of Ukraine has to maintain 3 or 4 times more storage capacity than necessary.

According to the survey results, shortcomings in the business climate, transport infrastructure, insecurity and corruption at the borders do not allow Ukraine to increase its transit potential. Under these factors, from 2014 to 2016, Ukraine dropped in the Logistics Performance Index from 61th to 80th placeUkraine has a very open economy and the development of exports is a prerequisite for its rapid recovery. However, this process is hampered by the difficulties associated with the underdeveloped logistics potential of the country.

Due to imperfect transit policy, Ukrainian exporters will lose up to 3% of GDP [26] in the current year alone. It will take at least 5 years for Ukraine to eliminate losses, during which the government is recommended to stimulate inflows into

transport infrastructure and simplify customs procedures. There is a lack of warehouses for perishable products with a supported temperature regime. But the main drawback is corruption at the border. Combating it will solve up to half of all problems encountered by exporters. This is relevant for small and medium-sized companies, while large exporters use a simplified customs control procedure and have no problems booking Ukrzaliznytsa wagons.

In the market of logistics services there is a steady tendency of increase of requirements of consumers in relation to their completeness and quality. It is established that the key parameters of quality of logistic customer service are:

– time from receipt of the order by the supplier to delivery of products to the consumer;

– guaranteed reliability of delivery under all conditions;

– real possibility of delivery at the customer's first request;

– availability of necessary supplies in the logistics system;

– stability of logistical support of clients;

– maximum compliance of orders with customer requirements;

– the progressive degree of availability of order fulfillment in the existing logistics system;

– convenience of placing the order in the logistics system;

– early confirmation of the order accepted for execution;

– objectivity of prices for logistics services;

– regularly informing customers about the level and structure of logistics service costs;

– availability in the logistic system of opportunities to provide commodity loans to regular customers;

– high efficiency of technology of cargo processing at warehouses and other transformational objects of logistic system;

– ensuring high quality packaging of marketable products;

– the progressive possibility of batch and container transportation.

Let us consider in more details the indicators by which international experts have evaluated the efficiency of Ukraine's transport infrastructure. The LPI [28] highest point is 5, rating consists of indicators of quality of customs administration, quality of infrastructure, ability to organize competitive offers (the price of shipment-delivery), quality of services, quality of tracking, control of delivery and the last component - an indicator of timely delivery. In fact, this rating very clearly demonstrates the degree of development of the logistics service and gives a comprehensive interstate comparative characteristics on a 5-point system (1 - the lowest figure, the 5th highest) (Table. 2.9).

Table 2.9

Top performing lower-middle-income economies, 2018

	2018		2016		2014		2012	
Economy	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Vietnam	39	3.27	64	2.98	48	3.15	53	3.00
India	44	3.18	35	3.42	54	3.08	46	3.08
Indonesia	46	3.15	63	2.98	53	3.08	59	2.94
Côte d'Ivoire	50	3.08	95	2.60	79	2.76	83	2.73
Philippines	60	2.90	71	2.86	57	3.00	52	3.02
Ukraine	66	2.83	80	2.74	61	2.98	66	2.85
Egypt, Arab Rep.	67	2.82	49	3.18	62	2.97	57	2.98
Kenya	68	2.81	42	3.33	74	2.81	122	2.43
Lao PDR	82	2.70	152	2.07	131	2.39	109	2.50
Jordan	84	2.69	67	2.96	68	2.87	102	2.56

On Fig. 2.11 graphically presents an assessment of the quality of logistic efficiency of Ukraine.

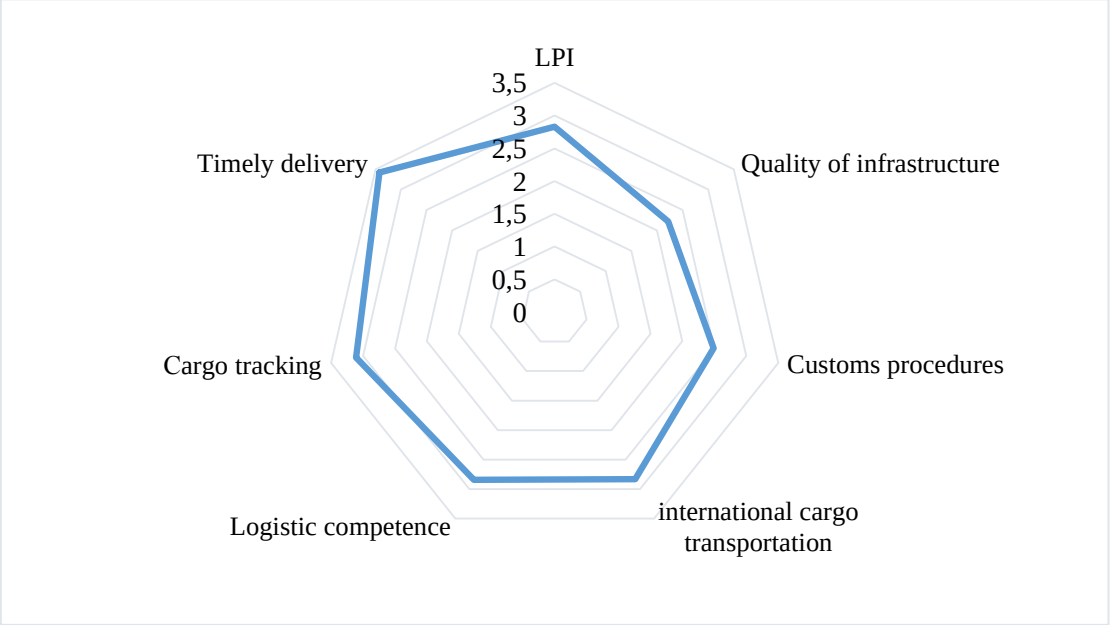


Fig. 2.11. Quality Assessment of Logistics Service of Ukraine by the World Bank

Based on this study, we can conclude that Ukraine is still far from European standards. But there are still some changes in the formation of a unified state logistics system and the introduction of new technologies [27].

Conclusions for the analytical part

The analysis of freight traffic in Ukraine showed a tendency to constant growth. In 2019, Ukrainian transport enterprises increased the volume of cargo transportation by 8.2% compared to 2018 - up to 328.5 million tons. Over the analyzed period the amount of export cargo increased annually, especially

significant growth rates by 35,7% were observed in 2018 and by 36% in 2019. Another situation was with import cargo. In 2014, there was a decrease by 11% of cargo volumes. Then there was a significant increase by 20% in 2016 and by 27% in 2019. In general, the cargo traffic volume increased by 56% over the analyzed period.

3. DESIGN PART

3.1. Methodical approaches to the design of transportation technology schemes for delivery of perishable goods

The basis of cargo delivery is the organization of the transport component, which can be represented by different modes of transport. The only process of transportation is a set of transport processes of the respective modes of transport, which interact with each other. When carrying out the transport process with the participation of several modes of transport, which determine the formation and implementation of the processes inherent in each of them, the requirement of organizing coordinated, coordinated work of related modes of transport is especially important.

The modern form of organization of transport processes is the transportation technology systems (TTS) [30], which in a special way unites the local physical objects that are included in the system. Physical objects are represented by a complex of technical devices of one or more modes of transport with the appropriate set of necessary operations, in particular, at the beginning-end and transit points, taking into account the processing and storage of cargoes.

Transportation technology systems must be managed for the realization of their main function - delivery of cargo on the client's terms.

For the implementation of TTS functions must be developed on the following principles:

- the principle of efficiency, which means the need to find the shortest distance of transportation, reducing material damage in the event of loss or damage of cargo, determining the cost of shipment, the choice of vehicle and packaging in accordance with the specifics of the cargo, etc .;

- the principle of saving the resources of consumers (the principle of the least cost), which requires the choice of a transport-technological scheme of delivery of cargo, which would reduce the transport component in the total cost of goods;

- the principle of safety, which means identifying major risks in transportation and developing measures to prevent or reduce it;

- the principle of shared responsibility, that is, the development of rules for the interaction of different actors of the transport process in the overall traffic flow;

- the principle of active and passive adaptation to operating conditions, which requires the selection of vehicles, objects of transport infrastructure, routes that would be most adapted to the type of cargo and traffic flow parameters;

- the principle of compensation or control of the bottleneck, which involves the replacement of rolling stock, containers and equipment, locations of loading and unloading operations, etc.

Guarantee of stability and controllability of TTS [32] in accordance with the above principles is information support of the transport process, which can be classified as follows:

1) pre-project information flow - a set of information that allows you to design (calculate) the system of cargo transportation. Typically, these are applications and contracts with the customer of transportation, which contain a detailed description of the cargo, its transportation characteristics, selected mode of transport, analysis of operating conditions in the region of transportation, features of the transport network and its indicators, customer requirements, delivery time, as well as knowledge of the rules of transportation , packaging and packaging;

2) advance information flow that allows you to prepare the transport process with minimal risk of failure. It is preparation in a specific period of shippers for the shipment of goods and their acceptance by the carrier, carrying out loading and unloading works, registration of accompanying transport documentation;

3) accompanying (synchronous) information flow for receiving, transmitting and delivering cargo. Such information shall include information on the timing and duration of loading and unloading operations on the route of loading, stops on the route, as well as clarification of the timetable for movement with the cargo owner and forwarders;

4) aftereffect - information about the operations performed to report, control and adjust the information in subsequent transport processes. Information of this

kind is feedback, that is, information for analysis and control over the volume and quality of work performed, as well as the quality of customer service.

In order to develop algorithms for improving the processes of perishable cargo transportation, it is necessary to consider the transport process as a whole, detail the transport technologies and information processes that accompany them.

The basis of designing transport and technological schemes of perishable goods transportation is:

- effectiveness research;
- choice of optimal schemes of transportation with participation of different types of transport;
- minimizing the costs and risks of damage to the product.

When developing transportation technology schemes it is necessary to define:

- reasonable organizational and technical decisions on preparatory works;

- technological ways of carrying out transportation and loading and unloading works;

- additional special facilities and non-standard equipment;

- proposals for modernization of operating terminals, loading and unloading sites, etc.;

- technical and economic evaluation;

- coordination of terms of execution of preparatory and transport works.

Cargo transportation involves the widespread use of logistics methods and models that ensure the coordination of the operation of individual TTS processes based on systemic performance criteria.

The tasks that are solved by the logistics and transport system and the development of its strategy can be divided into three groups.

The first of the groups is related to the formation of market areas of service, the forecast of material flows, their processing in the maintenance system and other work in the operational management and regulation of flow.

The second group is the task of developing a system of organization of the transport process (plan of transportation, plan of distribution of type of activity, plan of formation of cargo flows, schedule of movement of vehicles, etc.).

The third group is inventory management at enterprises, firms, warehouses, inventory placement and their servicing by vehicles, information systems.

The optimization and solution of these problems, which is especially relevant in the market, depends on the specific situation, conditions and requirements for an efficient logistics system, as well as on the problems associated with ensuring the production of raw materials and semi-finished products, eliminating bottlenecks in the technology of delivery of various types of products to the points of production, warehousing and sales [41].

Therefore, it is necessary to organically combine transport with production, to transform them into links of a single system "production-transport-distribution".

The new approach to transport as part of a larger system or logistics chain needs to be considered in various aspects. From the point of view of studying the efficiency of the operation of particular modes of transport, freight between points of departure and destination (eg from one train station to another, from port to port or from terminal to terminal) is of interest. From a logistical point of view it is necessary to analyze the whole process of transportation as a whole, from the shipper to the consignee. When considering the interests of the clientele, it is necessary to take into account not only the transportation of the main types of transport [39], but also the processing, storage, packing and unpacking, submission of materials to the machines in the shops and all the related information accompanying the material flow. This approach contributes to the optimal circulation of transport services, since the quality of transportation is largely reflected in the overall costs, which increases the cost of transportation, in terms of specialization and production cooperation. The study of the use of transport cannot be confined to the scope of individual logistical connections. They should be considered in the logistics system - from the primary supplier to the end consumer, including the intermediate stages.

The movement of material flow is carried out on the basis of a technological process, which begins from the moment of organization of acceptance of the goods for transportation and ends with the moment of receipt by his client. Preparation of cargo for transportation is important. It must be in transportable condition, ie packaged in standard packaging, labeled, stocked, etc. Carrying packing and piece cargo by rail only by rail, the consignor shall affix a mark not less than ten to each consignment, ie to indicate the name of the consignment and destination, the railway, the consignee, and the order number [47].

The quality of transportation depends on the time of waiting for the carriage of goods from the manufacturer, the time of transportation, ensuring the safety in the process of transportation, the time of waiting for unloading, the time of storage in the warehouse during transportation.

The efficiency of perishable cargo transportation is determined by such indicators as freight transport in general, which is presented on a fig. 3.1.

For perishable goods transportation, speed, flexibility and reliability are of particular importance.

Service speed is the amount of time it takes to complete an order.

Service flexibility means the firm's ability to adapt to customer requirements. Depending on these requirements, the provider may decide to use non-standard service methods. The supplier plans flexible distribution to meet the specific needs of the consumer.

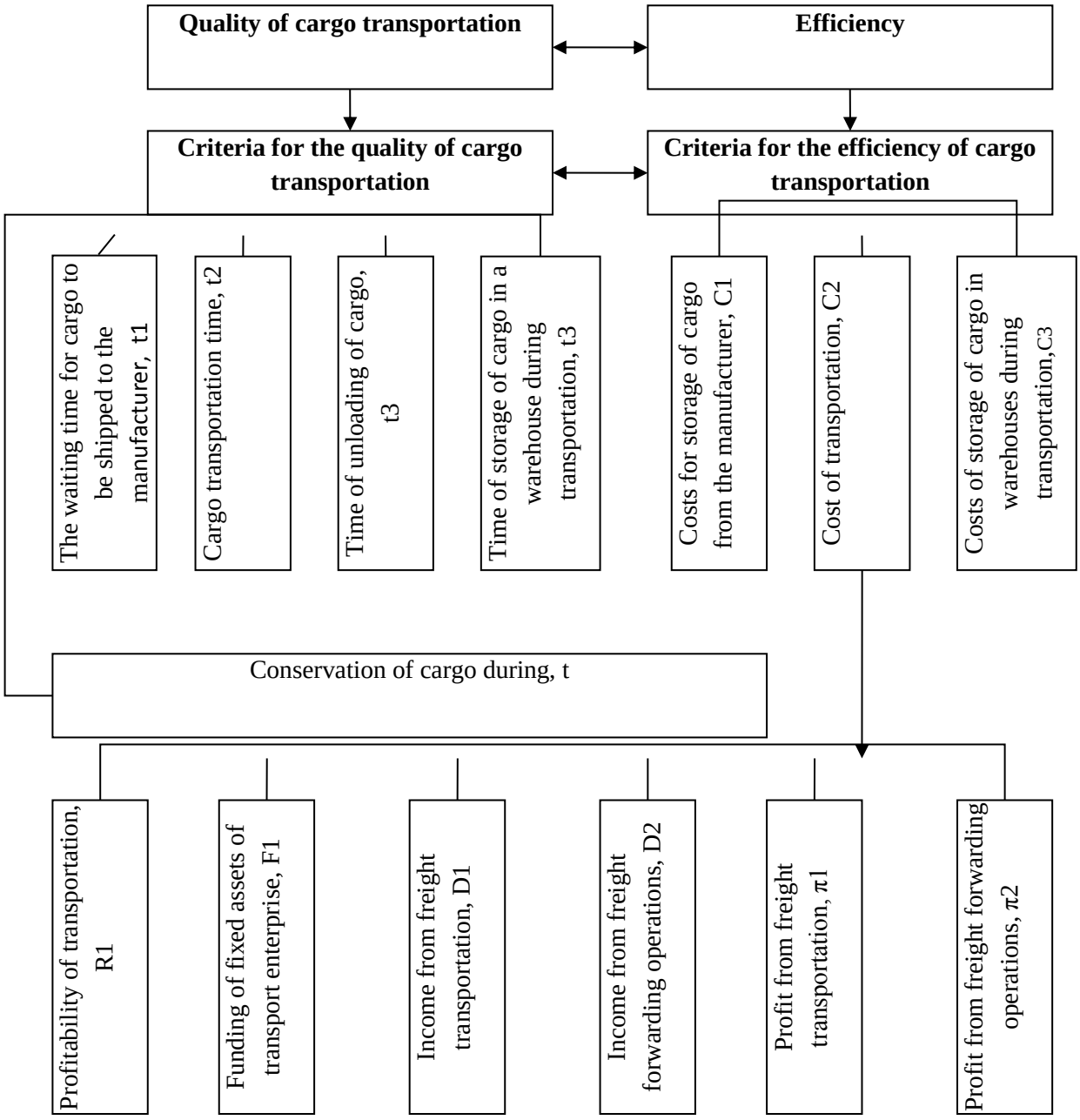


Fig. 3.1. The structural diagram of the main indicators of quality and efficiency of transportation of perishable goods

One important indicator is the persistence of the order cycle. Stability, fixed on a large number of cycles, allows you to compare the actual performance with the planned.

Service speed is important, but time stability is the most important indicator. Firms depend on their suppliers to reduce inventory and at the same time establish

higher levels of product availability for their consumers. This means that operational stability is very significant. To maximize logistics, individual organizations have the potential to be flexible in their operations. Quality of service is the firm's ability to execute orders without errors. When processing and executing orders, businesses and organizations must consider all of the above indicators [38].

Any company or any business has to store the product until it is sold. Storage needs to be organized because production and consumption cycles rarely coincide. Many agricultural commodities are seasonally produced, although there is a constant demand for them. The organization of warehousing of products allows to avoid these contradictions. A rational organization of warehousing has a direct impact on the economy of enterprises, since the loss of materials during storage, the cost of handling and warehousing operations increase the cost of production.

The need for storage of goods until the moment of their sale is due to:

a) the presence of a wide range of consumers, the cost of many types of material resources;
b) insufficient warehouse turnover of certain types of products for industrial and technical purposes;
c) increase of the minimum norms of transit shipment, which leads to an increase in stocks of means of production in the public economy;
d) further development of means of production;
e) implementation of progressive forms of customer service by supply and distribution organizations;
f) increasing the technical and organizational level of bases and warehouses and reducing due to this cost of warehouse processing of cargo, which creates real opportunities for reducing warehouse margins and reducing the gap between transit and warehouse storage.

The more such items, the faster you can deliver the goods to consumers, but the cost increases. The number of storage locations must be decided on the basis of service issues and distribution costs. Some companies store part of the inventory at

or near the enterprise, while others store in warehouses in different parts of the country. The firm may have its own warehouses or rent places in public warehouses. Control capabilities are much higher when a company has its own warehouses. However, warehouses bind capital, and the firm cannot respond sufficiently flexibly to change storage. On the other hand, public warehouses not only charge for rented space by the company, but also provide additional (paid) services (inspection, packing, shipment of goods, invoicing). Utilizing public warehouse services, the firm has a wide choice of storage facilities and types of storage facilities [52].

Businesses use long-term storage and transit warehouses. In long-term warehouses the product is stored for a medium or long time. Transit warehouses receive goods from various enterprises and suppliers and ship them to their destinations as soon as possible.

The presented criteria of quality and efficiency of freight transportation take into account the specific features of the functioning of all links of the logistics channel, allow to form many appropriate optimizations and and management decisions.

Transport users can take advantage of transport technology of transportation in their foreign trade operations. They can expect economic and financial benefits mainly due to the increased attention that transport operators place on cargo in their charge. The effect can be manifested both by reducing the duration of transportation, improving the accuracy of cargo delivery and its safety (especially in transshipment points), and the reduction of direct transportation costs (for example, due to rates that depend on the amount of cargo accepted for transportation) and associated costs. reduced in the use of containers, modern data exchange systems, computerized cargo tracking systems and more.

Transport service providers, in particular transport operators, by offering market-oriented transport operations in the context of international trade, can also benefit immediately from the containerization of transportation and the use of modern data exchange systems, changing marketing strategies and focusing their

activities in a particular niche market, specializing in cargoes on specific directions of transportation by means of conclusion of the relevant commercial agreements with mega carriers and operators of separate in of transport.

The development of transportation influences the intensification of foreign trade, the activation of innovative processes in transport, expands the activities of the transport sector of the economic system of Ukraine, increases foreign exchange earnings, enhances coordination of different modes of transport instead of the usual competition between them [31].

3.2. Design of transportation technology schemes of delivery of fruits product

3.2.1. Development of forecasts of fruit consumption in Ukraine and estimation of material flow intensity

The volume of imports of fruits and nuts in 2018 amounted to $ 526 million, which is 10% more than in 2017 ($ 477 million). This was reported in the press service of the National Scientific Center "Institute of Agricultural Economics".

According to the State Statistics Service, the main supplier of products of this group is Turkey, which imported 239 thousand tons of fruit to Ukraine in 2018. These indicators exceeded the volume of foreign products imported into the country in 2017 by 50 thousand tons. Thus, the share of Turkish imports amounted to 29.6% [45].

In addition, Ukrainian companies made significant fruit purchases in Ecuador (13.1%), Costa Rica (10%), Egypt (6%), Spain (5.1%), Greece (4.4%) and Italy (3.1%). Together, these seven countries formed in 2018 more than 71% of the value of imports of vitamin products.

Most of all, citrus fruits and bananas were brought to Ukraine - they accounted for 2/3 of imports. The first ones were delivered to us mainly by Turkey,

but Ukraine bought bananas mainly in Latin America, in particular Ecuador and Costa Rica.

Recall that at the end of 2018, the negative trade balance of Ukraine increased by 35% to $ 9.8 billion. According to the State Statistics Service, in 2018, the growth rates of exports and imports slowed somewhat. However, we began to sell goods abroad by 9.4% more ($ 4.7 billion), but bought 15.2% more than a year earlier ($ 5.7 billion).

In January-September 2019, due to exotic fruits, the import of fruits and berries to Ukraine more than doubled exports. In particular, in July-September, the country imported a record volume of apples for this period. From the National Scientific Center "Institute of Agricultural Economics" on statistics on imported berries for nine months spent 172 million dollars.

This is 10% higher than last year's figure for the corresponding period. The volume of fruit imports to Ukraine also increased (+ 23%) - up to $ 392 million.

Most of all for the period from January to September 2019, Ukraine purchased:

- citrus fruits - 115 million dollars;
- bananas - 113 million dollars;
- stone fruit and pome seeds (apples, pears, apricots, peaches, etc.) - 53 million dollars;
- grapes - $ 27 million;
- dates, figs, pineapples - $ 27 million.

At the same time, purchases of fruits traditional for Ukraine increased significantly. So, apples and pears - from 4 thousand tons in nine months of 2018 to 25 thousand tons in 2019; apricots, peaches and other stone fruits - from 26 thousand tons to 58 thousand tons.

The Institute’s specialists explained this situation by a decrease in the yield of these fruits in Ukraine, both in quantity and quality [44].

However, the trend of increasing exports of Ukrainian products also remains. For nine months, the country exported frozen fruit for $ 63 million, apples and

pears for $ 14 million, berries for $ 12 million. And the export of walnuts immediately increased by 80% - up to $ 75 million.

The largest market for Ukrainian horticultural products remains the European Union. Among the leading countries, Poland (17.5% of total exports), Turkey (11.3%), France (8.1%), Belarus (6.2%), Italy (5%), and the Netherlands (4.1) %) and Iraq (4%).

Fruit production in Ukraine

Fruits are traditionally referred to as the most valuable and useful food, which contains many nutrients and elements necessary for the human body to function normally. It is also a source of complete vitamins C, B, PP, beta-carotene, minerals and fiber. In general, worldwide demand for fruit is one of the most visible trends associated with the movement for healthy eating and the popularity of vegan culture.

Table 3.1

Structure of production of main types of fruits in all categories of farms in Ukraine (in percentage, %)

Years	Pome crops			stone fruits				
	apple	pear	other	plum	cherry	apricot	peach	other
2014	86,7	12,6	0,7	31,9	48,8	12,6	4,4	2,3
2015	86,7	12,5	0,8	33,6	49,2	11,9	2,8	2,5
2016	87,1	12,4	0,5	35,0	43,1	15,9	3,6	2,4
2017	86,2	13,3	0,5	35,5	43,1	15,4	3,5	2,5
2018	86,3	13,4	0,3	35,5	44,6	14,9	2,9	2,1

Domestic fruit production has stabilized in recent years at the level of almost 2 million tonnes, despite a significant reduction in the area of plantations in the

fruiting age, which was, however, largely offset by an increase in the average yield of their cultivation. However, the factor of unpredictable weather and climate change also exerts its influence.

The increased potential of growing fruits and vegetables was also increased by the state agencies of the steppe zone, where there were no overshoots due to incentives, the period was 1.34 times, and the average yield was 1.93.

Structural analysis of virobnosis of the main types of fruits in the above categories of the state thanks of Ukraine is consistent in significant violation of garden galuz.

On the other hand, in the structure of virocnostia of cereal crops, the apple apple growing up to 86.2%, and in the middle of the vine growing the plum pomata was up to 35.5%.

Analysis of the structure of the viral fruit of the rose in the category of state thanks to inform about the state of the state in the state thanks to the population (Figure 3.2.).

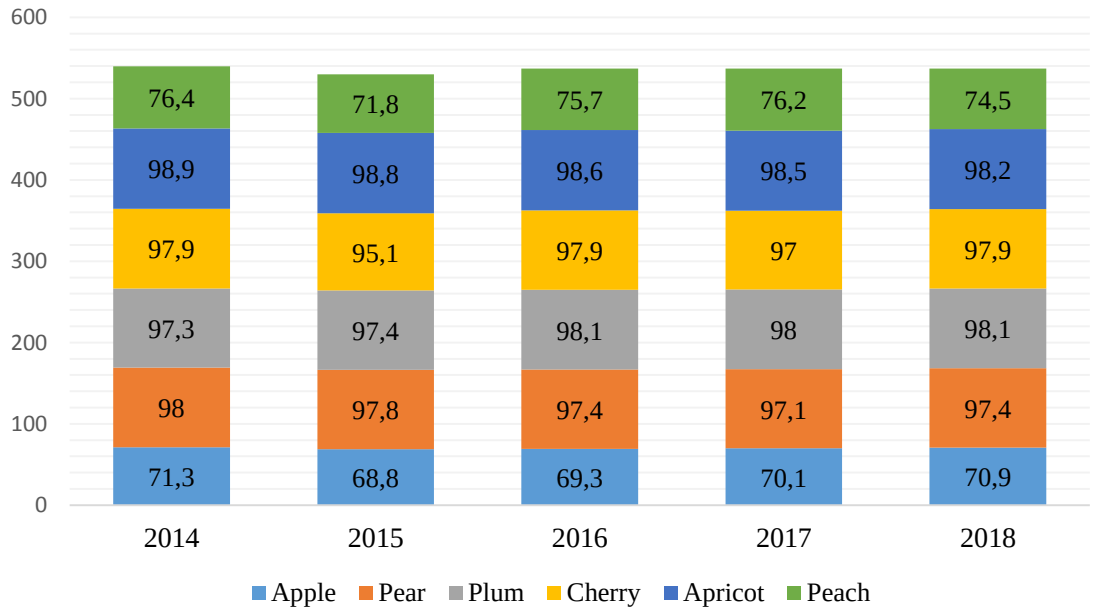


Fig. 3.2. The share of households of the population of Ukraine in the production of different types of fruits calculated according to the State Statistics Service of Ukraine (in %)

Currently, about 73.1% of apples production, 69.8% of pears, 97.4% of plums, 93.9% of cherries are concentrated in households. However, interest in the development of this line of agribusiness in agricultural enterprises of various organizational and legal forms has been increasing recently. After all, it is quite economically profitable, and the income from 1 ha can reach 200-300 or more thousand UAH.

Demand

In the food balance of Ukraine, the demand for fruits is taken into account with berries and grapes. According to the analysis of statistics, the consumption of fruits, berries and grapes has been steadily increasing in recent years, both in absolute terms and per person.

However, the current level of consumption of fruits, berries and grapes per person, which in 2018 reached 52.8 kg, is relatively far from the recommended rational norm of 90 kg. It is in its rise that the potential for growth of the fruit market and sustainable development of the domestic horticultural industry is laid.

Export and import of fruits in Ukraine

The analysis of the customs statistics of Ukraine shows that the export destination is quite economically attractive for domestic producers of fruit.

In particular, during January-September 2018, the average weighted export price of products in the heading "Apricots, cherries, cherries, peaches, plums" reached $ 785.2. And the average price of 1 ton of produce under the heading "Other fruits, fresh" - $ 1682.9.

The geographical structure of fruit exports was characterized by different marketing trends. In particular, in the apples, pears and quince product line, about 42.79% of the export value from January to September 2018 was directed directly to the Belarusian market, 19.92% - Moldova, 9.67% - Sweden, then the rest 27.62% - to other countries of the world.

Imports were also mainly from Poland - 44.58%, the Netherlands - 16.96%, Turkey - 10.23% and the rest of the world - 28.23%.

In the heading "Apricots, cherries, cherries, peaches, plums" about 80.42% of the export value from January to September 2018 was directed directly to the market of Belarus, 10.27% - Moldova, 5.62% - Poland , while the rest is 3.70% in other countries of the world.

These products were imported mainly from Greece - 58.71%, Spain - 25.81%, Turkey - 7.53% and the rest of the world - 7.94%.

In the item "Other fruits, fresh" about 29.81% of the export value from January to September 2018 was directed directly to the Polish market, 27.39% - to the UK, 21.86% - the Netherlands, while the rest 20,94% to other countries of the world.

Imports of these products were mostly from Turkey - 22.83%, Greece - 18.83%, Italy - 13.78% and the rest of the world - 44.56%.

In general, for the domestic fruit producers, their world market is of great interest, since in many countries these products are in high demand.

Price trends

The price situation for fruit and berry crops available on the domestic market is characterized by separate trends of their increase, given the rather difficult weather and climatic conditions of cultivation this year.

The analysis of monitoring data on average prices of agricultural products sold by agricultural enterprises in January-August 2018, compared to the same period last year, shows a marked increase and stabilization in recent months.

The main suppliers of citrus fruits to Ukraine in 2018 were: Egypt - 41.7 thousand tons, Turkey - 39.9 thousand tons, South Africa - 4.2 and Spain - 3.6 thousand tons.

Other citrus fruits - tangerines account for 48.7% of citrus fruit imports to Ukraine in 2018. The share of mandarins in the total import of citrus fruits stably dominates, this is due to the popularity of these fruits in the domestic market, especially during the New Year holidays. The import crisis was 2015, when compared to 2013, the supply of tangerines in Ukraine decreased by almost half:

from 215.7 thousand tons to 112.5. However, in 2018, the import of tangerines increased and reached 164.6 thousand tons. The tangerine consumption season in Ukraine lasts from October to March.

The main supplier of tangerines in 2018, as in previous years, was Turkey - 102.7 thousand tons. Fluctuations in the price level of tangerines (from a peak in early October to a stable decline in April) in the main wholesale markets of Ukraine depended on the seasonality of production in the main exporting countries, the price was consistently high during the first delivery of these fruits to the market. In the New Year period (peak demand), the price ranged from 31-35 UAH / kg [33].

China, Turkey and South Africa have been the main suppliers of grapefruit to the Ukrainian market over the last five years. Total imports of grapefruit from Turkey in 2018 reached 16.9 thousand tonnes or 58.8% of total imports, from China - 8.7 thousand tonnes (30.4%), and South Africa - 2.3 thousand tonnes (8.1%).

On the Ukrainian market, lemons, like other citrus fruits, are consumed in October-February, but there are no sharp changes in the import of these fruits, unlike tangerines or oranges. In 2018, most lemons were imported in December - 6.8 thousand tons, and the least in March - 1.8 thousand tons. As noted above, Turkey is consolidating its leadership position on the world stage, this can be seen in the steady growth in the supply of lemons to Ukraine in 2018 - 37.1 thousand tons, which is almost 71% of all imports of these fruits.

Table 3.2

Dynamics of fruit imports from Turkey, thousand kg.

Name	Import in 2018	
	Quantity, kg.	in % by 2018
Total	2180567,2	1,111

Turkey	1928348,6	1,107

So according to the most pessimistic forecast in 2020, the number of imported fruits will be 4,231,997 kg.

3.2.2. Designing of transport and technological scheme of deliveries of imported fruits to Ukraine

The main problem in the design of transport and technological schemes for the delivery of goods with a short life cycle is the rapid deterioration of goods, so time is the most influential factor in the passage of material flow along the supply chain. Because consumer habits and decisions are not static, they force constant changes in supply patterns in order to meet their needs. In most cases, change is accompanied by a cost component that arises when adaptation and innovation are required. These changes occur in a diverse environment that is both the cause and the consequence of changing human needs and nature. Therefore, the most important parameter in shaping the supply chain of perishable products is the flexibility and speed of response to change.

The supply and marketing of fresh fruits involves the identification of supply chain actors with whom it is important to establish relationships, the processes to be associated with each of the key actors, and the types or levels of integration for each process. The purpose of designing the transport and technological delivery scheme is to achieve maximum competitiveness and profitability of the company, as well as the entire network structure of the supply chains, including the end consumer.

One of the key elements of managing the delivery of perishable goods is a clear knowledge and understanding of how the configuration (construction) [50] of

the transport and technological supply chain is carried out. The three basic aspects of this process are:

1) participants of supply chains - links of transport and technological delivery system;

2) structural coordinates of the delivery chain;

3) different types of relationships between processes within the supply chain.

When identifying supply chain participants, it is necessary to determine who the flowchart is. The inclusion of all types of participants can cause the chains to become overly complex at the expense of participants who connect to the network at deeper levels. In this case, the integration of all the links and processes involved in the supply chain, and in particular the management of them, often becomes unproductive, if at all possible. Therefore, it is important to establish criteria to determine which participants are important for the success of the company and therefore should receive special attention from managers and receive resources from the company.

Participants in the supply chain include all companies or organizations with which the interaction in the process of cargo transportation directly or indirectly occurs (Fig. 3.3.).

First-tier suppliers are organizations where the central company directly purchases goods and services. (ltd. LogisticCenter, freight forwarding companies).

Tier 2 suppliers - Tier 1 suppliers, etc. (fruit warehouses, freight forwarding companies serving the logistics center; carriers operated by freight forwarders)

Third-tier suppliers are second tier suppliers (fruit farms, freight forwarding companies and carriers serving fruit warehouses).

The auxiliary structures of the investigated supply chain of fruits include:

– retail lending banks (VABBank LLC and Raiffeisen Bank Aval LLC);

– transport, freight forwarding agencies (for example, LLC Interlogistikservice, LLC Ukrproduktlogistiks, LLC Global Cross Cargo, Schenker, DHL & GlobalForwarding, UVK, Cargo-Partner, etc.);

– advertising, information and publishing agencies that print marketing literature (RA Media Info, Alpha Center LLC, In-Agro, Blitz Print LLC).

Structural dimensions of the supply chain. This functional chain is a complicated distribution network. When describing, analyzing, and managing supply chains, it is important to consider the structural dimensions of the network: width and length. In fact, it is not possible to determine the exact breadth of consumers in this chain, as it is difficult to trace the entire distribution of fruits, so we will consider the end point of supply - wholesale buyers and distributors with their logistics centers (for example, METRO VIP, Auchan, Furshet, Quiz- Trade, Fozzy Group, etc.). Therefore, the width of the consumer network is 29 units [42].

The length of the supply chain is 6 units (auxiliary units neglected): farmers; fruit warehouses; logistics center; cross-dock; distribution centers, wholesale buyers; the end consumer.

Given the large number of fruit farms, the possibility of problems with the supply of fruit from Turkey is minimized and is not man-made.

The total quantity of fruit delivered from Turkey for the 1st quarter of 2019 amounted to more than 2 million kg, which is 50% of all fruit imports, or about 24 tons of fruit daily.

Table 3.3

Import of fruits in Ukraine for January-March 2019

Naming	Quantity, kg	Cost, Thousand UAH
Orange		
Total	408125	1949
Turkey	330435	1584
Tangerine		
Total	1696134	8807
Turkey	1694347	8787

Lemon		
Total	1116	24
Turkey	1089	23
Banana		
Total	1523	15
Turkey	1487	14
Grapefruit		
Total	469	3
Turkey	459	3

Continuation of the table 3.3

Other		
Total	68256	482
Turkey	266	4
Total	2180567	11388
Turkey	**2028349**	**10417**

Considering that perishable products, it is necessary to have a well-established supply system, which requires rigid planning of volumes, delivery times and delivery conditions, namely temperature. Considering the geographical location, Turkey, logistics infrastructure, and price drivers, much of the transportation is by air and sea.

3.2.3. Design a mixed tranportation scheme of fruit delivery

We propose to deliver fruits from Turkey to Ukraine using mixed transportation, especially road and aviation.

In the general case, the transport and technological scheme of delivery with the participation of road and aviation modes includes a number of stages:

Step 1. Formation of cargo units. The essence of this stage lies in the formation of cargo units and the implementation of the preparatory process for the transfer of products for transport. At this stage, the costs include operating costs and capital investments for stocking cargo, the purchase of pallets and other packages for rent, organizational work related to the formation of packages.

Stage 2. Organization of loading of the formed cargo units on vehicles. This stage forms the interaction of the two main links of the logistics chain: the shipper's vehicles and the consignee's warehouse. To determine the cost of freight work, you must determine the type of material handling equipment and how to perform this type of work.

Step 3. Pick up of cargo to the terminal of the main mode of transport. This stage is called local delivery, provided the delivery is of direct importance: the delivery of the goods directly from the shipper to the consignee. In most cases, as practice shows, it involves a more complex distribution system, which consists of sorting, grouping and redistributing cargo units.

Step 4. Consolidation (at consolidation) at the terminal of the cargo units having the delivery addresses of the same destination. At this stage, the terminal carries out work on transport and warehousing operations on the transformation of cargo units and the implementation of cargo works on the main (aviation) transport.

Step 5. Organization of transportation of goods by main types of transport. Determination of freight costs depends on the option of developing a transport scheme.

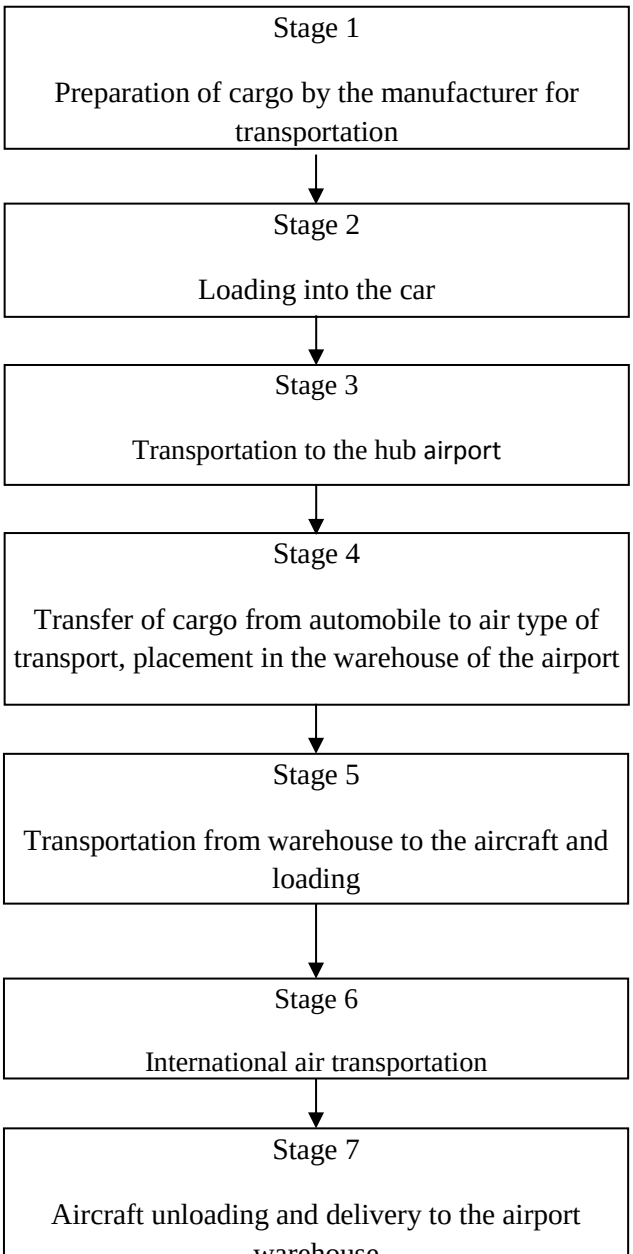
Step 6. Organization of warehousing operations at the unloading stage at the destination terminal.

Stage 7. Organization of export of cargo from the terminal of the main mode of transport and delivery to the warehouse distribution centers

Stages 8. Organization of delivery of cargo from the warehouse distribution complex to the end consumer.

Step 9. Organization of control over the implementation of the delivery process in accordance with the selected transport and technological scheme.

According to the above steps we will present graphically transport and technological scheme of fruit delivery from Turkey to Ukraine, Fig. 3.3.



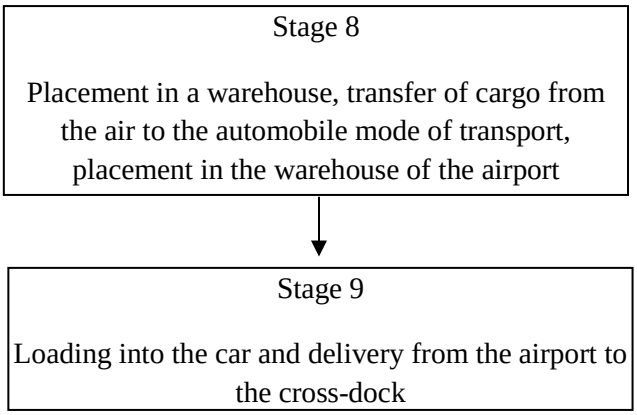


Fig. 3.3. General scheme of delivery of perishable cargo with the participation of road and air modes of transport

Considering the scheme of delivery of fruits that need urgent delivery by mixed road and air transport. The general scheme of such a movement is shown in Fig. 3.11. The fruits of the enterprises ALPEKS TARIM URUNLERI SAN TIC AS and AKAS Tarim Urunleri are delivered by road to the hubs of Istanbul airport (Istanbul), and from there by air to Boryspil airport. Since the cross-docking staff of the company is located at a distance of about 10 km from the airport, it is convenient to deliver the goods to the cross-docking staff, and from there by road transport directly to the distribution network for sale to consumers. That is, fruits are consolidated with those consignments that arrived at the cross-dock by international road traffic.

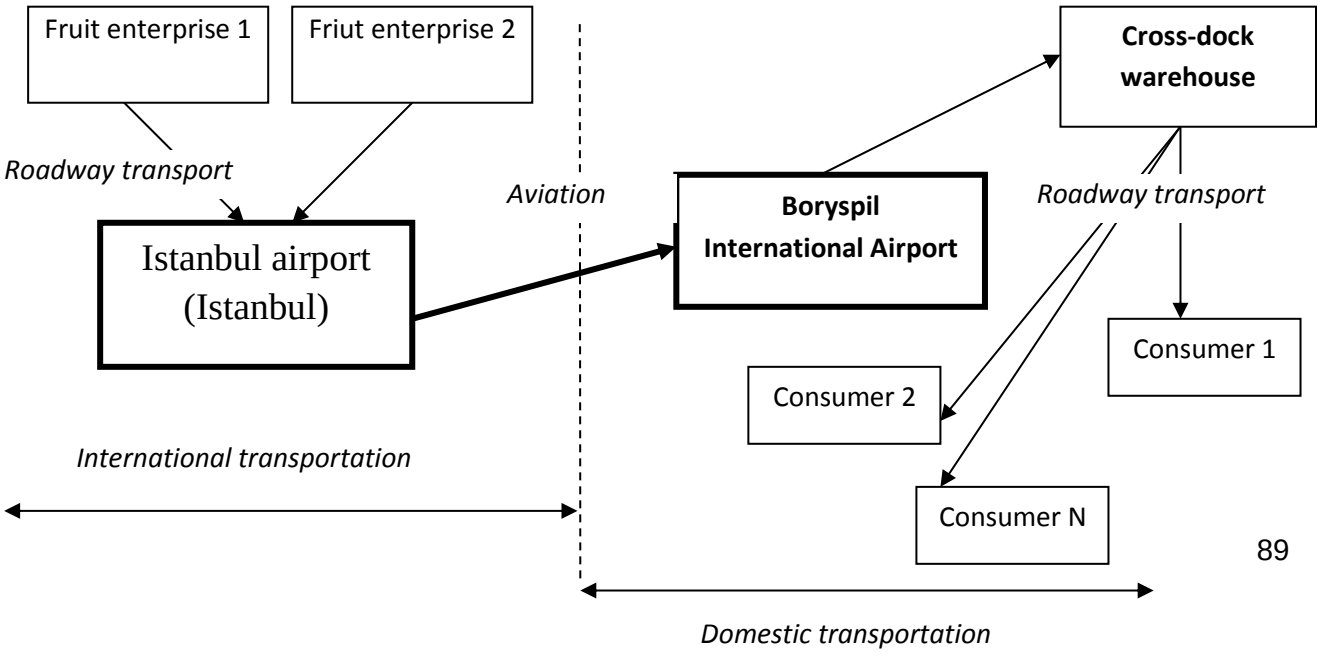


Fig. 3.4. Scheme of mixed road and air transportation of fruit from Turkey

Also its should be note that Istanbul Airport is the main international airport serving Istanbul, Turkey. It is located in the Arnavutköy district on the European side of the city.

The airport currently has one terminal in service for domestic and international flights and four runways are currently in operation. The two 17/35 runways are both 4,100 metres (13,451 feet) long, while the 16/34 runways are both 3,750 metres (12,303 feet) long. Runways 17L/35R and 16R/34L are 60 metres (197 feet) wide, while 17R/35L and 16L/34R are 45 metres (148 feet) wide.

To calculate the cost of road and air transportation according to the scheme "consignor door - airport of departure - airport of destination Boryspil" use the tariffs contained in table. 3.4. We will assume that the minimum shipment is 100 kg.

Table 3.4

Tariff rates and calculation of the cost of transportation of fruit from Turkey to Ukraine

Cost Articles	Tariff	Unit	Cost per 100 kg (Euro)
Airfreight	1,4	Euro/kg	140
Fuel Surcharge	0,65	Euro/kg	65
Security Surcharge	0,11	Euro/kg	11
Temp. Surcharge	0,1	Euro/kg	10
Handling	0,45	Euro/kg	45

Transfer	0,25 Euro/kg	25
Pickup	2 Euro/kg	200
Export document	0,35 Euro/kg	35
Total:		531
Shipping costs per kilogram		5,31

Therefore, the calculations show that the transportation of fruits by road and aviation is not too cheap, but given the urgency of delivery and a guarantee for consumers of freshness of products, this method of transportation is appropriate and necessary.

3.2.4. Calculation of economic efficiency of project proposals

We calculate the economic effect of the clients who will benefit from the transport-technological schemes of delivery of fruit we have designed from Turkey to Ukraine, i.e the so-called off-transport effect.

When transporting perishable goods, the acceleration of delivery affects the acceleration of capital turnover (asset turnover) and the reduction of costs due to cargo damage. We calculate this efficiency.

The calculations showed that the planned scheme of delivery of fruits from the fruit enterprises of Turkey through cross-docking warehouses in Ukraine to cold warehouses in the regions of Ukraine allows to ensure delivery of goods within 2-3 days depending on the region. For comparison, international freight forwarding companies promise to deliver door-to-door delivery, ie from any point of departure from Turkey to any city of Ukraine, within 7-10 days.

It is well-known that expedited delivery is appropriate if the demand for the goods transported at the point of consumption exceeds the supply significantly, ie the goods are deficient, they will be realized immediately without warehousing and related costs. In this case, if the cargo arrives at its destination t days earlier,

it will accordingly be realized t days earlier. As a result, the release of the consignee (in our case fruits distributors), which can be deposited into the bank for interest or put into circulation, will be expedited for the same period. Therefore, the effect of accelerating delivery is calculated by the formula:

$$E = Q * t * e, \quad (3.2)$$

where Q - Sales volume per day, t - the number of acceleration days, e - bank deposit rate.

The total cost of fruit delivered to cold stores in Ukraine is 711 million UAH. Divide it by 365 days and get the amount of money you need per day. Let acceleration be 6 days and bank deposit rate 24% per annum. Then the effect of accelerated delivery of one cycle of consumption will be equal to:

1238,26 thousand UAH * 6 days * 24% /365 days = 4,885 thousand UAH

If 20 fruit consumption cycles are carried out per year, the combined acceleration effect will be equal to:

4,885 thousand UAH * 20 lots = 97,7 thousand UAH

The main imported fruit types are orange and mandarin, the shelf life of which is 30 days, therefore the remaining shelf life of the fruit to eat at a stable temperature environment is 17 days.

We calculate the economic effect of reducing losses at the risk of spoilage of fruits. As we calculated, the average daily consumption of fruits in Ukraine is 41.46 tons. The average shelf life is 20 days. Let us evaluate the reduction in the risk of damage to the product as a ratio of 2.5 days to 10 days. That is, the risk is

0.25%. We calculate the economic effect of reducing losses due to damage to products in one consumption cycle:

1238,26 thousand UAH * 6 days * 0,25 = 18,57 thousand UAH

Multiply it by 20 consumption cycles:

18,57 thousand UAH * 20 = 371,4 thousand UAH

Thus, the total post-transport economic effect of accelerating the delivery of fruits from Turechinna in Ukraine will be:

97,7 thousand UAH + 371,4 thousand UAH = 469,1 thousand UAH

Thus, the calculations showed that, depending on the chosen transportation technology scheme for the delivery of perishable goods, there will be not only various transportation costs, but also the final economic result of customers - consumers of transport services.

SUMMARY

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Air Transportation Management Department				*NAU 20.05.04 002EN*			
Done by:	*Domina A. S.*			*SUMMARY*	*Letter*	*Sheet*	*Sheets*
Supervisor:	*Ivannikova V.Yu.*				*D*	*94*	*5*
Standards Inspector	*Shevchenko Yu.V.*				***FTML 275 ОП-202Ма***		
Head of the Department	*Yun G.M.*						

During performing this master's thesis there were considered issues related to the organization and technology of special categories of cargo, transportation technology system of perishable cargo, aspects of the interaction of modes of transport in the transportation of special cargoes.

Based on the results of the thesis, the following conclusions can be formulated.

The transition of Ukraine to a new phase of sustainable socio-economic growth, the course for European integration requires the advance development of the entire transport system of the country, as well as the introduction of new progressive technologies of special cargo delivery on a door-to-door and "on-time" basis. The complexity of transportation and storage of perishable goods is that they are continuous biochemical and physiological processes, the intensity of which depends on both the properties of the cargo and the environmental impact. For each type of perishable cargo, there is a permissible minimum and maximum temperature regime in which the process of undesirable quality changes is slowed down, which is especially important to know for long haul operations that are characteristic of international traffic. Perishable goods transportation requires specially designed transportation technology delivery schemes.

The basis for the delivery of perishable goods is the organization of a transport component, which can be represented by different modes of transport. The only process of transportation is a set of transport processes of the respective modes of transport, which interact with each other. When carrying out the transport process with the participation of several modes of transport, which determine the formation and implementation of the processes inherent in each of them, the requirement of organizing coordinated, coordinated work of related modes of transport is especially important.

Current technologies such as controlled atmosphere warehousing are a necessity especially for developing countries. An increased shelf life of up to 50% through the use of ethylene control in storage will allow particularly fruit and vegetables to be provided in the countries of origin even outside of the peak

season. This enables peaks driven by crop cycles to be smoothed/spread while making products available for just-in-time delivery to the consumer markets in immaculate, fresh condition throughout a longer period of time. Definitely, such opportunities exist and first attempts to change some of the current business structures have already been made. Whilst, again in the case of flowers, perishable centers have earned good money with value adding services like cutting or bundling, producing countries have recently begun to operate their own facilities close to airports or even within the airport facilities, offering the same specialized services yet at a different step along the value chain. Taking advantage of their normally lower costs, the business prospects and cost saving potentials for retailers are appealing.

The Agreement on the international carriage of perishable foodstuffs and on the special equipment to be used for such carriage (ATP) regulates the international trans- port of some kinds of food, chosen on the basis of food safety concerns. There is however a quantity of other food- stuffs or perishable goods with special requirements for their storage temperature, which are not considered in ATP. It could be very useful to extend the field of applica- tion of ATP to such goods, in order to take advantage of the certification of the refrigerated vehicles about their ability to maintain the correct temperature. In some cases it is still a matter of safety (e.g. prepared dishes, medicinal products, vaccines), in others it is just a matter of quality (e.g. flowers, fruit, vegetables). There are also some particular goods, like movie films and masterpieces, whose transport is often performed following strict climate conditions, but are not yet considered.

Some considerations about the additional costs lead to the conclusion that probably the extension of ATP to other perishable goods can also have a positive economic impact.

Since amendments or revisions of the ATP agreement require the consent of current signatories, some difficulties could be encountered during this process. In this case, rel- evant international rules could be adopted, making refer- ence to the ATP agreement.

The new approach to transport as part of a larger system or logistics chain needs to be considered in various aspects. From the point of view of studying the efficiency of the operation of certain modes of transport, the transportation of goods between the points of departure and destination is of interest. From a logistical point of view, it is necessary to analyze the whole process of transportation as a whole, from the shipper to the consignee. When considering the interests of the clientele, it is necessary to take into account not only the transportation of the main types of transport, but also the processing, storage, packing and unpacking, submission of materials to the machines in the shops and all the related information accompanying the material flow. This approach contributes to the optimal circulation of transport services, since the quality of transportation is largely reflected in the overall costs, which increases the cost of transportation, in terms of specialization and production cooperation.

The analysis of freight traffic in Ukraine showed a tendency to constant growth. In 2019, Ukrainian transport enterprises increased the volume of cargo transportation by 8.2% compared to 2018 - up to 328.5 million tons. Over the analyzed period the amount of export cargo increased annually, especially significant growth rates by 35,7% were observed in 2018 and by 36% in 2019. Another situation was with import cargo. In 2014, there was a decrease by 11% of cargo volumes. Then there was a significant increase by 20% in 2016 and by 27% in 2019. In general, the cargo traffic volume increased by 56% over the analyzed period.

For the development of air cargo transportation, the development of the infrastructure of the Boryspil airport is extremely important. The analysis of the volume of cargo work shows a tendency towards an increase in mail and cargo transportation. At the same time, the dynamics of perishable goods transportation is not stable. The existing freight infrastructure of Boryspil was formed in the late 1960s - early 1970s and was designed to handle about 40 tons of cargo per day. Today the freight turnover in Ukraine is 110-120 tons of cargo per day. In order to

attract new cargo flows, the airport is constantly improving the cargo complex, which creates conditions for the storage of perishable goods.

In terms of global experience and current trends in the development of the global logistics market, Ukraine is at the stage of formation and consolidation of the industry, significantly inferior to the Western countries, both in quality and complexity of services provided by national transport and logistics companies. According to the study, today Ukraine is far behind the Eastern European countries in terms of logistics development (above all in terms of infrastructure quality and range of services offered). The logistics component in the cost of services in Ukraine is 25-30% (for comparison, in developed Western countries it is about 8-10%). The logistics sector finances about 15% of budget revenues from the manufacturing sector, accounting for about 40% of the market in services.

The analysis of the statistics on the volumes of imported fruits and the sales volumes indicate a significant tendency of growth of volumes of consumed fruits in Ukraine due to the popularization of healthy lifestyle and vegan movement. But it has undergone some qualitative changes. In particular, as people become more aware of a healthy lifestyle, which includes better nutrition, there is a rapid increase in public interest in the fresh market. Therefore, the development and development of fruit supply chains in Ukraine is very important. A partner in this project can be a strong supermarket chain present in the domestic market.

Using the methodological approaches considered in the work, in the design part of the thesis, transport-technological schemes for delivering fruits from fruit enterprises in Turkey to Ukraine using automobile and aviation modes of transport were developed and justified. At the same time, in the supply chain are included farmers; fruit enterprises; logistics center; cross dock distribution centers, wholesale buyers; end-user.

When implementing the fruit supply chain, it is advisable to use a cross-docking warehousing scheme, since it provides a 50% reduction in manual labor, a three-fold increase in throughput; higher level of service; significantly higher accuracy of delivery time; 100% correct delivery; supply chain transparency, thanks to an integrated product tracking system; full controllability and management of all internal processes.

The diploma paper was informed that when transported shanty supplies, accelerated delivery of fuel is required to accelerate the turnover of capital (turnover assets) and reduced expenses due to shorter delivery. carried out rozrakhunki showed that in the fallow of the image of the transport-technological scheme of delivery of shvidkopsvsuvnogo plumbing will not be only a few transport Vitrati, but the first and last economical result of the service - with the help of transport services. Successful transport economy is accelerated delivery of fruit from Turkey to Ukraine will be 469.1 thousand UAH.

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