

## РОЗВИТОК ХОЛОДНОЇ ЛОГІСТИКИ В УКРАЇНІ

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**Висвітлено поняття холодної логістики, визначено мету розробки, ключові елементи та етапи організування холодового ланцюга. Розглянуто частку швидкопсувної продукції в загальному обсязі вітчизняного роздрібного товарообігу. Розвиток вітчизняної холодної логістики розглядається з позиції впровадження інтелектуальних систем моніторингу швидкопсувних товарів у режимі реального часу.**

**Ключові слова:** холодна логістика, холодовий ланцюг, асоціація, охолоджені товари, температурний режим.

## COLD CHAIN DEVELOPMENT IN UKRAINE

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**This article provide the concept of cold chain, define the purpose of development, key elements and stages of organizing refrigeration circuit. The share of perishable products in total domestic retail trade is revealed. The development of the national cold chain is regarded from the standpoint of implementation of intelligent systems for monitoring of perishable goods in real time.**

**Key words:** Cold Chain, cooling circuit, association, cooling products, temperature control.

**Problem formulation.** It is essential for companies that manufacture or distribute products that require the use of special temperature conditions to ensure their safety and freshness at any time of year, because it affects the health of consumers. The problem of storage and prompt delivery in Fresh mode can be solved by turning to 3PL-operator that offers complete solutions and guarantees high quality. Cold Chain logistics requires from operator precise work of continuous monitoring and compliance regime temperature +2 ° C ... +6 ° C at all stages of processing of goods, beginning from taking and ending with shipment to the final consumer.

Cold Chain is a young type of business cooperation, which in Ukraine is gradually take European appearance. The problems of functioning cold chain is related to many market players and often can be not solved by the efforts of one company only. Following this temperature control at all stages of the movement of goods from the producer to the commercial shelf can be resulted by regular monitoring, which is impossible without coordinated interaction of all participants in the chain, as well as the unification of standards cold storage and transportation.

**Analysis of current research outputs and publications.** Cold logistics as a new direction of ensuring the needs of consumers is an interesting object of the many scientists and entrepreneurs.

E.V. Krykavsky and N.V. Chornopyska interpret the definition of «cold chain» as maintaining the required temperature throughout the logistics chain. They note that the cold Chain is particularly relevant

for the pharmaceutical market, which is actively moving towards biotechnology. If other medicines are sensitive to temperature changes by about 40 %, biopharmaceutical products require strict temperature limits at all 100 %. If at least one «cold chain» link unreliable even at one criterion, all efforts are useless. The World Health Organization recognizes that 25 % of vaccines is delivered to the consumer via the depraved failure temperature conditions during storage and transport [1].

Nicholas Pavlovsky, Project Manager Fresh-Raben Logistics company in Ukraine, said that: «... thanks to modern integrated logistics solutions, such as unique to Ukraine system of modular cargoes loads can be collected for manufacturers (distributors) dairy products, fruits, vegetables as well as be serviced distribution center for retailers in stock under one roof. This mutually beneficial trilateral cooperation allows to simplify, reduce the cost and expedite all logistics processes. However, the "cold" is only a link between market participants. The quality and safety of the product for the consumer depends on the united efforts of all participants in the chain in compliance with the continuous temperature control».

Given point of view is shared by Michal Yanikovski, director of supply chain, Metro Cash & Carry: «... solving this problem and guarantee to the consumer freshness and quality of refrigerated and frozen goods could be only via industry consolidation – an alliance of manufacturers, logistics providers, retailers and leading supplier of equipment and technology. The important role plays dialogue and the construction of public authorities, veterinary and sanitary services. The purpose of this discussion is not only upgrading the legal framework in line with modern technology in the field of cold chain, but also achieving maximum transparency in the performance of government regulations without exception all market participants» [4].

According to Eugene Golub, director of logistics and supply in «Danone» company: «... in the absence of a strong national provider, the majority [companies] organize logistics by own efforts, which is costly enough, and can not affect on price of the product. In particular, the dairy sector is transported in compliance with proper temperature control only at 20–30 %».

Former Minister of Agrarian Policy and Food of Ukraine Mykola Prysyzhnyuk stated that over 50 % of vegetables grown in the country do not get to the end user due to the lack of an effective system of food logistics. In this context, the priorities of the ministry are construction of wholesale markets of agricultural products and vegetable stores, as well as the revival of product logistics based on Ukoopspilka network [6].

**Article objectives.** This article provide the concept of cold chain, define the purpose of development, key elements and stages of organizing refrigeration circuit.

**Presentation of main materials.** A steady scope increase in transporting of food, meat, dairy and fish industry by commercial transport was seen during 2009–2013. The average annual growth rate of freight volume is 10 %.

According to the analysts at Pro-Consulting, especially actively exploring automobile cargo of food was observed in 2011, 2012, when transportation volumes reached 10.12 million tons. According to Pro-Consulting in 2012 commercial enterprises increased their automobile cargo transportation by 6.7 % to 13.7 million tonnes, indicating a growth in consumer demand for logistics operators [10].

Transportation majority of foods require a certain temperature. This especially applies to the carriage of perishable, dairy, frozen foods. The key feature in delivery products that require temperature control is the need to adhere strictly to the temperature control throughout the logistics chain, from the factory assembly line to the end user.

The main factor that affects work of logistics operators is a consumer demand. There is a growing consumer demand for Fresh-products, and as result share of «temperature» goods in the structure of annual cost increases in Ukrainians grows. In 2010, the share of spending on fresh produce was 61.3 % and in 2012 it increased to 65.1 %. In monetary terms, on the basis of 2012 year research «temperature» products spending accounted for 1153 USD. per month per household, which is 2 % more than in 2011 [10].

Quality, variety and price of «temperature» product categories determines the level of the modern retail distribution network and logistics service quality. That's why many retailers are paying great attention to the quality of supplying chain of Fresh-products.

In the modern trade channel the share of «temperature» goods is from 20 % to 35 % of total turnover in the network and varies between operators (due to the strategy and the format of the network) and varies depending on several factors, including seasonality.

For the first 9 months in 2013 the proportion of Fresh-products structure sales increased to 33 % compared to 32 % for 9 months in 2012. During the first 9 months in 2013 the volume of retail trade «temperature» product increased by 12 % and amounted to 39.5 bln. (for 9 months in 2012 – 35.2 billion) in Ukraine [10].

The majority of manufacturing companies organize logistics by their own efforts, which requires significant expenditures and affect the price of the product. As a result, in the production of dairy products only 20–30 % of the goods transported in compliance with the proper temperature.

«Cold» chain is relatively new type of business. In Ukraine, where the industry is poorly developed, its services are not used properly due to the high cost of setting up logistics facilities, lack of adequate state financial support, which limits the possibilities of fully effective modern materials and equipment. The real demand for high-tech logistics services (planning, management, control of all logistical operations of the client company) on the Ukrainian market will arise only after the process of consolidation in the retail trade, including «shop at home» in a production environment.

Association «Cold Chain Ukraine» (Ukrainian Cold Chain Association, UCCA) was established to consolidate the efforts of all interested parties in the development of the industry, bringing together the leading players in the market to address common challenges, which include bringing the Ukrainian veterinary standards, sanitary and environmental control in logistics refrigerated and frozen goods in accordance with international standards, use and dissemination of best international and domestic experience to improve the effectiveness of each section of the supply chain, as well as the creation of a national center of expertise as a logistics refrigerated and frozen goods that are intended to protect the interests of Ukrainian consumers [2].

Association «Ukraine Cold Chain» is an industry professional association of manufacturers and distributors of chilled and frozen products, suppliers of refrigeration equipment, logistics operators and owners of cold storage, transportation companies and retail chains in Ukraine. The Association was incorporated in February 2011 and brings together over 25 leading Ukrainian participants of the cold chain market. Creation of the Association is a rare example of self-regulation the sector in Ukraine. Steps for the implementation of standards and controls aimed at protecting the interests of the end user, come from the most market participants anticipating actions and initiatives of government auditors [9].

According to the Director of the Association «Cold Chain Ukraine» there are differences in availability of cold storage regions of Ukraine. The problem is in absence of the proper accounting of cold storage in Ukraine. The Association currently conducts audit of cold stores in the region and soon will present this information to the public [4].

Ukraine does not have a national system of distribution refrigerated goods, only with the advent such system, change will come in the industry and farmers could fully guarantee the quality of their product. The situation changes if to the market enter the player with serious intentions, willing to invest heavily in the sector (about 50 million), create a national system for cold chain, warehouses and wait for the return his/her investment for 2–3 years, until unit costs will be acceptable due to the scale of production.

Organization chain cold chain requires significant amounts – for the implementation of monitoring temperature, refrigeration units in warehouses, refrigeration installation ramps in stores, refrigerated fleet renewal and others. Ukraine, according to Director of International Programs Global Alliance for cold chain U.S. (GCCA) Richard Tracy, needs millions of dollars in investment. «As a rule, – says expert – investments in this area are dealing with international funds – IFC, EBRD. They give money on very good conditions, better than banks» [8].

Today volumes of cold and chilled products is very segmented, and therefore the cost of service is very high. There is a substantial amount that can attract other professional operator who would come to Ukraine and began to develop standards. The minimum required today for the domestic market "cold" goods warehouse is about 25 thousand m<sup>2</sup>. To complete this task one need «to collect at least three major companies that agree to work together to under one» roof.

Demand for a quality logistics in Ukraine comes only from the most critical domestic and foreign manufacturers, but no pressure received from the consumer, and investments in the sector will not come, not be set up warehouses and transport infrastructure, and the goods and will be stored and processed in

violation of the temperature parameters, giving a competitive advantage only unscrupulous marketers. Solving this issue can be organized via only intra-unification of standards and delivering key messages about the importance of temperature control to the user. An important role can play building a dialogue with the state veterinary and sanitary services. The purpose of this dialogue is to become not only update the legislative framework in line with modern technology in the field of cold chain, but maximum transparency to the edicts of government all parties without exception chain.

To move «cold» issue off the ground, as convinced of the Association of the cold chain can the power retail. As firstly retail says: «Grant me the quality of product delivered». Next step, the manufacturer refers to the carrier: «how can you ensure me that my product was delivered quality?». Then standards start to appear. Critical mass needed to change it 4-5 trading networks. After all, if the store will eventually not take the product, the manufacturer will have to comply with the rules.

As for the Ukrainian legal framework for the industry, it should be emphasized that being formed in the middle of last century, it largely does not correspond with reality. Just take one example: it is forbidden to carry in a refrigerator meat and fish, even if they are vacuum packed. That's because standards is outdated, when the rules of transportation were created vacuum packed boxes doesn't exist. In order to consolidate volumes ought to carry the products of two temperature groups – 2–6 °C and 0-4 °C together – at a temperature of 2–4 °C, as modern refrigeration equipment helps maintain the temperature to within a degree. But carrier can't do this. Given the above, the Association of cold chain Ukraine has set itself the following objectives:

1. Developing and implementing common industry-standard cold chain in Ukraine on the international experience.
2. Providing conditions for effective cooperation, the early exchange of information between members of the Association, direct access to information about cold chain for all stakeholders.
3. Improvement Ukrainian standards in line with international requirements, interaction with government regulators and lobbying market participants.
4. Creation in Ukraine of the National Centre of expertise as a logistics refrigerated and frozen products.
5. Involvement of the national cold chain logistics market to foreign investment

Food quality depends on the temperature of storage and transport to the consumer. Adherence to a given temperature at all stages of the movement of goods from producer to trade shelf, and hence their safety for the consumer, may only be achieved as a result of the concerted action of all participants refrigeration supply chain, which is as follows: manufacturer – transport – storage – transport – retail network. Deviation from set parameters for each of these units makes futile efforts of others.

At a seminar on logistics management was defined the term «cold» chain as the transportation of temperature-sensitive products in the supply chain by means of thermal and cooling methods of packaging and logistics planning for safeguarding supply [3].

The purpose of the development of refrigeration circuit [3]:

- safety and security (most important);
- integrity and trust in the supply chain;
- clear, sturdy chain management, with clearly defined responsibilities of participants;
- tracking product;
- wrapping indication disclosure;
- avoid cross-contamination (eg, products with a pungent odor and very sensitive products, transportation of food in trucks, which previously transported toxic chemicals);
- device with temperature control in the product and in the vehicle.

The key elements of the refrigeration circuit are:

- product – characterized by physical characteristics that require specific temperature and humidity (eg, susceptibility to damage, fragility);
- origin / destination – the appropriate place where temperature sensitive products produced and consumed. They point to potential difficulties in ensuring the availability of products on the market;
- delivery – available methods and infrastructure for the transportation of products in terms of temperature control.

Organizing refrigeration circuit includes several stages (table 1).

Table 1

**Organization refrigeration circuit stages**

Stage	Characteristic
Preparation of shipment	Devices for the «cold» chain is usually designed to maintain a constant temperature in order to avoid having to bring the goods to the desired temperature.
The choice of type of transport	Depending on the distance between origin country and destination, size and weight of the load, the temperature of the external environment and the degree of dependence on the time factor.
Transfer cargo storage	It is essential to consider the admission requirements and make the final transfer of the goods in storage.
Warranty saving money	Notifying data from temperature sensors and "smart" seals.
Customs procedures	Knowledge of customs procedures to avoid delays.

In working with cold food groups one must follow two basic principles:

1. Corresponding temperature control for each product category (continuous «cold» chain).
2. Controlling shelf life – getting on the shelf, the product must have a minimum of 2/3 shelf life [4].

Compliance with the temperature control to the transportation of products – one of the tasks of cold chain transport. This primarily relates to the requirements for transportation of food, but also important in the transport of dangerous goods, animals, paint products, medicines and so on.

All standard of cold chain has long been developed in western countries. In international traffic requirements for the transportation of perishable products governed by the Geneva Convention "On the International Carriage of Perishable Foodstuffs and on the Special Equipment to be Used for such Carriage" (APR), which provides the minimum specifications for international transport and reviewed annually by the working group (any changes must be taken unanimously). The agreement includes a requirement for manufacturers of body, equipment manufacturers and carriers. According to them, for producers Van – isothermal device thermal conductivity "K" which should be confirmed by tests in specialized laboratories certified:  $0,4 < k < 0,7 \text{ W/m}^2 \text{ }^\circ \text{K}$  in accordance with the required class (tests must be conducted for each of the certificate is valid for 6 years).

In 2007, Ukraine signed the Pacific, but still very few people know what it is, no one controls the compliance and no liability for infringement. [4] No concepts of «isothermal» or «refrigerator», there are no rules for producers body, no certified laboratories. Truck needs only a «medical passport», but you can get in any vehicle, even garbage.

Nowadays in Ukraine is prepared a draft order from Ministry of Infrastructure «Rules of transportation of perishable products in automotive vehicles», harmonized to the international agreement. In addition, requirements for transportation of food products regulated by EU Directive 93/43 and 89/108. The current regulatory instrument in Ukraine is the Ministry of Transport Decree № 363 from 14.10.97 «Rules of transportation of goods by road in Ukraine», Section 29 and Appendix number 18 which are directly related to the cold chain.

Requirements for food safety management systems are regulated by the international standard ISO 22000:2005 «System of food safety management», which includes HACCP (Hazard Analysis and Critical Control Point) system for organizing and ensuring food safety, storage and transportation. In Ukraine from July 1, 2003 is valid national standard ISO 4161-2003 «System of food safety management. Requirements» and on August 1, 2007 came into force the national standard DSTU ISO 22000:2007 (harmonized with ISO 22000:2005).

In terms of transport logistics requirements temperature control transportation is provided, in the first place, from the right choice of the body of the car (van), refrigeration, compliance stowage in the back and organizational measures with the use of monitoring temperature.

Structurally insulated vans can be made with different technologies with different insulating materials (foam, polystyrene or polyurethane). Choosing the best type of van to provide the necessary set of requirements for the mode of transportation is appropriate to carry out with the assistance of expert consultants as necessary to consider a number of factors, often unknown to the consumer – the thickness of insulation, its density and thermal conductivity, technology assembly of panels, the need for warming the floor of the van, the presence of established embedded elements for the installation of the refrigeration unit, and others. The certificate for compliance with the APR is the most important factor in choosing high-quality products.

It should be noted that the choice of the van can not take place in isolation from the selection refrigeration unit (case of transportation food products that require temperature control to ensure vans without refrigeration unit is not considered at all). Depending on the mode of transportation – distance, number and frequency of stops for unloading prevailing climatic conditions, requirements for temperature and so on various combination of performance and heat conductivity van refrigeration unit cooling capacity. In a number of cases is economically feasible to use the van higher grade (FRC instead FNA), as decreases the intensive work of the refrigeration unit for less heat loss and as a result – fuel savings, which overlaps in a few years difference in cost vans of different categories.

It is known that the transport of perishable foods and medications should be performed in compliance with the appropriate temperature. European regulations require the application in this case special thermo regulators to verify compliance with the conditions of carriage. Unfortunately in Ukraine doesn't exist regulation procedures temperature control. Indeed, some companies are practicing acceptance products with temperature control at the time of arrival. However, often the controls implemented by such means do not meet the purpose, and most importantly, the entire period of transportation is out of sight. In this case, the carrier may be unfair for reasons of economy disable refrigeration equipment and include it only at the entrance to the place of unloading. In addition, much of the Ukrainian carriers park equipped with insulated vans that do not have a certificate of compliance with the International Convention APR, that actually have no evidence of their insulating properties. Thus are prerequisites for the loss of product quality during transportation and moreover, damage to health.

In some cases, the consumer require a necessity of simultaneous transporting products with different recommended temperature regimes. Depending on the volume of freight, transportation duration and frequency of door opening solutions can be used based on the use of special thermo boxes, which placed a load that requires the lowest temperature, or special insulation to partitions in a van that share it on the compartment multi-temperature and split air exchange with the refrigeration unit.

Organizational factors control the requirements of the monitoring system are the temperature conditions (table 2).

*Table 2*

**Devices that are used to control temperature regime during transportation of perishable products**

Device	Features
Mechanical recorders	Exposed to vibration when vehicle is in motion, do not provide the ability to communicate with the computer information systems.
GPS-monitoring system	Designed for internal control by the carrier, the consignee does not have access to their information at the time of receiving the goods, does not provide documentation of traffic conditions at the time of acceptance of the goods and the possibility of production of documents by checking the supervisory authorities do not provide the information the driver during transport.
Logger	Provides the possibility of long recording temperature, but does not own the means of printing a paper document, their use requires the mutual consent of the consignor and consignee, they are not the accessories of the vehicle and do not provide any information to the driver during transport.
Thermo controllers	Specially designed class of devices for temperature control in the back of the vehicle and / or transported cargo, equipped with built-in block devices to print a check with temperature history of travel; This document is delivered with the carrier waybill; information on the history trip remains in the memory at least 1 year.

Director «Raben Ukraine», Boris Khruslov believes that at this stage the most efficient and cost effective way to control the technical temperature in the delivery of goods is installing logger. Loggers – a sensor that records temperature variations throughout the running time. With its small size and being covertly installed on a pallet, it allows you to track changes in temperature.

There is already technology of thermal labels – stickers that change color when noncompliance temperature appear. However, the cost of this label is about 50 cents, which does not allow manufacturers to use technology for reasons of price competitiveness of their products [5].

In some cases, you can hear that this or that company uses the GPS-monitoring or data logger. However, in both cases these solutions do not offer a paper document that can be signed by the receiving party and deliver the goods, and then could be as an argument in the case of disputes.

Industrial temperature regulators in the back of a van are more efficient solution for use in road transport. Thermo controllers can be used in stand-alone mode as well as in the mode of integration of GPS-monitoring system. Depending on the needs of the customer integration with existing monitoring system or delivery of integrated solutions with GPS-tracker is made. This ensures «paper» reporting for Service Control consignee and the ability of remote on-line monitoring, for example, the controller carrier. Printout temperature check provides complete information about the trip, including record opening doors, thawing refrigeration mode, the output temperature limits for displays up to 4 temperature sensors installed in different parts of the body of the truck. A temperature check is applied to the consignment note as evidence of the carrier conditions of carriage.

Thermo controllers can be equipped with air temperature sensor, contact sensors for controlling temperature in cargo, sensors monitoring the state of the door of the van, the mode of the refrigeration unit. In addition, optional tools give possibility of remote information reading, using software and download data from the memory device. Designed means of communication devices with GPS-trackers user that can be configured according to the communication protocols used by tracker.

The benefits of using thermo controllers:

- completing recommendations for tracking and identification of consignments in supply chains (including in the case of the investigation of incidents of damage to human health);
- consignee interest in the input control to ensure product quality and safety;
- consignee (retail chain) increases sales and reduces the loss of products;
- conscientious carrier gets documented protection against possible claims;
- provider that sends products to implementation, interested in its preservation and maximum sales until the loss of production of consumer properties.

The above convention ATP requires the mandatory presence in a vehicle thermo controllers used in transporting perishable products (special thermo controllers requirements governs the European standard EN 12830). Such type recorders should provide the ability to store information in memory from temperature sensors for the whole traveling time and it's further processing – to a computer or print on your own printer. The resulting document from a certified device is analogous to cash the check, certifying in paper form to the requirements of the customer's temperature. Thus implemented HACCP for tracking movement of cargo and transport conditions.

An example of using thermo controllers in Ukraine is establishing by a consulting company "Logistics consulting center" distributor in Ukraine and Russia thermo controller Transcan, made by English production company Seven Telematics, announced the introduction of devices for temperature control in the back of the vehicle fleet distributor of pharmaceutical products, the company «Medfarkom».

It should also be noted high energy consumption in transportation of perishable products. Optimistic forecasts for cheap energy is not justified. Globally, the world is not ready either to an increase in energy consumption in gross domestic product (GDP), nor to increase in the population (especially the part that does not take or do not effectively participate in the creation of GNP). Therefore, the global economic crisis, the main task for consumer value chain is to reduce costs. For cold chain is the following areas:

1. Reducing the cost of financing creation of logistics facilities (ideally – public funding or reimbursement of capital costs).

2. Reducing overhead costs due to the scope (consolidation of business – the creation of transnational logistics companies that receive lower overheads due to significant discounts on equipment suppliers, builders, programmers, reducing administrative staff, the use of the world's best business processes). In Ukraine this process, not only at the beginning, but in the opposite trend – logistical capacities will not create multinational logistics operators, and manufacturers and suppliers, while in the U.S., Japan, Europe and China are in the final stage of consolidation of logistics operators.

3. Reduction direct energy consumption:

- by reducing the heat using better insulation;
- technologies that ensure minimization of time opening the door and the heat of warehouse equipment and personnel;

- increasing the share of transportation and loading / unloading at night (when the temperature is lower and there is no conventional heating from the sun).
- 4. Reduction of direct salary costs by increasing automation and robotics share in business processes.
- 5. Reduction of losses spoiled, especially food products – by using modern technology and equipment throughout the chain of consumer value [5].

**Conclusions and further research prospects.** Today there is no pressure from consumers, the demand for cold chain in Ukraine is limited and comes only from the most critical domestic and foreign manufacturers. A vicious circle is formed: there is no significant demand for quality logistics, which means no investment in the sector and there is no appropriate infrastructure of warehouses and transportation.

One can break this law starting with the introduction of common standards, which includes the introduction of rules for monitoring compliance with temperature storage and transportation of refrigerated and frozen food refrigeration circuit to improve transparency and strict requirements (primarily retailers to suppliers), enforcement temperature mode. This monitoring system should be accessible, transparent and preferably should operate on-line, in order to provide given temperature to the product. It is advisable to provide direction on the basis of commodity flows FEFO instead of FIFO, which is a further area of research. In the meantime, the grocery market pays by loss production for the delay in cold chain development.

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