

# Influence of logistics factors on architecture of Logistics Centers

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**Abstract.**Logistics factors determine types of Logistics Centers and their architectural solutions. Globalisation, rapid growth of trade and ecology change modern Logistics Centers, complicating their structure, requirements, interactions with big cities, and diversifying their functions. Such logistics factors as means of transport, kinds of goods, roadways can't be ignored in conditions of modern overloaded and polluted big cities

## 1 Introduction

One of the primary tasks of the Transport Strategy of the Ministry of Transport of the Russian Federation is stated in the following way: development of large transport hubs, logistics and distribution centers at the interface between different means of transport. Innovational concepts and modernization are critical to the transportation system as a whole as well as particular transport objects [1]. Global trade growth, intensive development of internet-based technology and technical devices modify the marketplace and the sphere of transport, precisely distribution sector. Nowadays business is the most sensible to changes: it solves problems on site, locally, taking into account only its own interests and ignoring interests of social and urban environment development. At the present stage the transport sector requires considerable changes, upgrading and innovations. Revision of the existing system is needed with due regard to its historic development and current tendencies for traffic adaptation and urban environment improvement.

## 2 Background

Transport logistics started its explosive development in the 70s of the XX century. At that period producers supplied most retail shops directly. In the 80s retail shops started to centralize their supplies with the help of new distribution centers, that were under those retail shops' own control. Since the 90s a global logistics strategy started to work. In the framework of this strategy many retail companies developed import centers to receive and process goods. Since 2000s along with e-commerce development complex logistics operations started to be performed electronically.

Logistics net became more complex and extensive. Home delivery, that required development of urban environment logistics, was gaining its popularity. Globalization gave

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boost to international trade which increased 50 times in the period 1950-2000 [2]. Cities grew, and so did consumption.

Traditional warehouses – elements of historically formed logistics network – are being displaced from city and even from its suburbs. They satisfy neither modern production performance requirements nor ecological requirements any more, they don't possess architectural expressiveness and don't fit urban environment. Absence of urban-planning solutions of logistics functionality turn business towards the way of development which is the most convenient for them but not for the city. Thus logistics moves to the outskirts and takes commerce with it to the outskirts.

In 2000s first hypermarkets appeared in Russia. The guiding principle in their location for business became cheap land of outskirts as well as a possibility of location of large warehouses and organizing of shop that sells small wholesale. The main idea of such shops is that good aren't presented on counters but placed in stocks and pallets simply in the halls of a shop. As examples, IKEA and LeroyMerlin etc. can be named.

First such stores appeared in the XIX century in the United States of America: a still underdeveloped but steadily overgrowing ranchos and different farms. The workers at those farms needed from time to time to refill their subsistence stores, and stores of other kinds. Thus, they had to cover long distances to the nearest towns and cities, wasting hours and trying to buy as much necessary things as they could at one time. As a result hypermarkets that resembled warehouses appeared in the suburbs of big cities mainly with the aim to meet the needs of the inhabitants of outskirts. The hypermarket below cities with their large assortment attracted citizens too. Access to hypermarkets wasn't a problem due to overall automobilisation [3]. Only today here is understanding that building of hypermarkets has global consequences. Orientation of some hypermarkets on the goods that are not only typical for suburban areas but also on goods that are specific for the center of city creates a certain threat for urban infrastructure [4, 5].

One of the factors that makes hypermarkets in Russia, and particularly in the Southern Federal District, acceptable is deterioration of warehousing stock, its network and absence of centralized concept of distribution, when traders continue to solve logistics questions by means of their own warehouses and other buildings with the similar function.

Taking into account lobby of business and these conditions of unsystematic transport-logistics nets a number of problems are evident in the urban infrastructure.

Hypermarkets provoke people to drive in a car instead of a walk by foot to buy essentials. Consequently it leads to traffic jams and overload of roads with cars from city to hypermarkets in suburbs and on their way back home. In the latter case the same traffic jams are formed by the multiton trucks that drove along the same main roads to city warehouses. Both type of transport – cars and trucks – pollute the air to different extent with harmful emissions of CO<sub>2</sub>. Besides trucks damage roadway.

It must be also admitted that the combination of two types of transport, cars and trucks, creates a risk of emergency due to the complexity of manoeuvring of trucks in the flow of cars. There are two conclusions: such outskirt concentration of goods that are typical to be sold in the center of city and the goods that are rational to be sold in the suburbs with location of warehouses within city as it all is nowadays is harmful for urban area and the quality of life of citizens. However one can't make it without warehouses in city and without a large assortment of goods in hypermarkets.

### **3 Goods traffic in the modern context**

Profound solution in this situation is difficult to be found: a solution that can turn the situation into advantage for city. But for one modern tendency that is gaining its popularity and is called internet-commerce.

Each day more and more goods are bought in the internet where stores are absent at least in their traditional real sense. In reality such e-commerce is represented by a virtual catalogue and a warehouse. Under the influence of this tendency the so-called order fulfillment centers (OFC) appeared: stores where only devices for electronic access to catalogue is present and an area of measuring out (a warehouse in its essence). For such OFCs offices are rented, but those offices are poorly accommodated for the given logistics tasks. Nevertheless OFCs are highly demanded. Following this tendency there is a possibility to make a purchase electronically practically in every hypermarket. Goods that are ordered from home will be either delivered to home or taken from warehouse of store.

Solution of the above mentioned problems can become distribution of hypermarket goods to city districts to provide accessibility within walking distance or short driving distance on condition of decrease of store space as a result of giving the function of storage to Local Urban Logistics Center. In this case the shelves of the store will be filled with goods only for demonstration. For the whole process it means separation examination/demonstration of goods from their storage which becomes more convenient due to its nearer location.

After familiarization at a real or virtual store goods can be collected in the nearest OFC, which performs all functions of storing, processing and measuring out of non-grocery goods as well as function of supplying stores of a certain city district with grocery goods.

E-shops can rent an office in such OFC for operating, and OFC can perform all logistics services. As a rule almost any space in city can be equipped as a shop. Yet special space is required for storing and processing.

Thus there is the possibility to take away trucks from city. They will only deliver goods to the boarder of city. Along with automobile transport there is railroad, water and air transport. Each type of transport has its own characteristics of volume, speed, distance and respectively its own place in the commodity flow.

Understanding of goods movement in the logistics net from producer to consumer. Logistics networks are growing and becoming more complex. To avoid a chaotic uncontrolled situation profound systematization is needed. It would systematize commodity flows and their main junctions that are logistics centers. The systematization can be achieved by classification of LC (logistics center) according to categories of links between junctions in the framework “continent – region (agglomeration) – city”.

## **4 Logistics net**

As a result a certain system is revealed and this system turns out to be hierarchic, resembling a circulatory system or a tree with its branches when big branches change into little ones but bringing the same volume of nutritional substances as the big ones to each leaf. The same process should take place in goods distribution: it's impossible to supply all consumers only via large “arteries” – they are needed to be enhanced by centers of middle and small sizes. It's connected with different types of supplies, containers, means of transport that move goods in city and long distances. In logistics different layers of the hierarchic system can be presented by large international, regional and local logistics centers [6]. However it's important to understand areas of responsibility or reasons of appearance of a junction of this or that level.

Differentiation of levels is possible on the basis of types of transport. Such differentiation gives an idea of set of terminals, engineering equipment and many other characteristics of this or that junction.

In this context it's useful to turn to innovative works by Otto Frei and his analogue models for material calculations of structural forms. Precisely: experiments with threads that are wound round a plate and form group of threads after contact with water. Depending

on the regulated length of thread a trial model calculates the solution that reduces the length of the thread significantly maintaining the low average bypass factor [7].

The same situation can be seen in logistics – it's not profitable and even sometimes impossible to deliver goods directly from production place to consumption place. There should be a spot where flows unite in large flow and a spot where they separate into small ones. These spots of uniting/separating that should determine the type of logistics network.

Conventional indicator of thread tension can be presented as an optimal distances of goods delivery for transport types as a result of competition. Analysis can show working radius of each type of logistics center. According to the Department of Research of Railroad Transport, Institute of Natural Monopolies volumes of transportation by type of transport are the following: distance up to 1000 km – automobile transport, from 1000 – 3000 km – a zone of competition between different types of transport, more than 3000 km – mainly railroad transport [8].

The reason is that railroad transportation for short and middle distances are more expensive than for the long ones (more than 3000 km). Railroad transport is the most advantageous for long distances, but some kinds of goods, for example, perishables, require fast delivery and that makes air transport the only possible for them

Besides automobile and railroad transport are inseparable from continent, and if there is no rail traffic between continents the only possible ways of shipment are by water or air.

## **5 Elements of Logistics net and a new type of LC**

Thus several elements of hierarchy can be singled out starting from the small to the large: “city – agglomeration”, the second link is “interagglomerational” and the third link is “intercontinental”.

### **5.1 Intercontinental link**

Intercontinental link connects foreign productions and logistics centers with International Logistics Centers, that are situated on the main trade directions and receive large supplies of certain kinds of goods from other countries or continents from long distances and perform customs house's functions. Such LC should have an opportunity to serve all kinds of transport with the following priority order: air transport, sea transport, railroad transport, automobile transport. After customs clearance packaging of smaller supplies is carried out. The small supplies are sent to regional LC by railroad, automobile and water transport. This link is the big artery. The interconnection is carried out by the transport that is meant for big supplies.

### **5.2 Interagglomerational link**

Interagglomerational link is a network of regional LCs that are connected with each other and with international LCs. Regional LCs distribute goods within region or agglomeration to cities'LCs. The important role of regional LC is distribution of goods from trucks and railroad transport to low-tonnage transport that will connect this regional LC with city's LC.

### **5.3 City-agglomeration**

Among the given links the link “city-agglomeration” is the weakest due to complexity of urban logistics network. The point is the following: a typical LC is an industrial object and

to a certain degree can have a harmful effect on urban environment. The most important factor of this effect is heavy truck transport. Trucks cause air pollution, noise, damage of roadway, traffic jams at the entrances of warehouses and streets of cities etc. Many metropolises have laws that regulate and limit movement of trucks completely or partially. In some places such limitation is only on its way.

Meanwhile city planners strive to move LCs out of cities. But it solves one problem provoking another to appear. In this case delivery of goods to consumer and storage become more complex. Besides if all LCs are moved out from city trucks continue to damage roadway of streets and cause traffic jams because goods still have to be delivered to stores and shops. How can growing demand of goods delivery be satisfied taking into account modern tendencies and requirements?

In case of two links (local LC and regional LC) of one “city-agglomeration” level that differ from each other just by their production capacity in the given transport classification, it’s needed to connect them with more safe transport that is more suitable for city – light trucks or light commerce vehicles or vans.

Light trucks don’t have such harmful effect on city environment as large-tonnage trucks and distribute goods among city’s LCs where assembling take place. After that goods are sent to stores and private customs with light trucks that are adjusted to drive within city.

Light trucks are perfect for the connection Local LC – regional LC or the level of “city-agglomeration”, that threads the urban structure with its capillary vessels. This kind of trucks is more maneuverable, require less space, doesn’t need large turn-around areas and doesn’t have big sizes that occupies a lot of space in the city center. Usage of light trucks will lessen the traffic load on streets and will deliver big supplies directly to regions of city at the time when streets are free, for example, at night. Citizens can buy goods after reaching stores by foot or covering a small distance by car rather than crossing whole city area to get to one large open warehouse to buy piece goods.

One more advantage of light trucks is that they require less space for load handling at local LCs. This factor is of vital importance in the restrained conditions of cities. Such local LC can’t afford large spaces: city will require a vertical development of building volume that is not typical for warehouses. However here interesting solutions can be found: city influenced building of such transport objects as parking lots. In the beginning of the XX century parking lots started to transform from flat ground into a multilayer structure with vertical communication in form of spiral or line ramps.

Being placed into a modern city a new type of local LCs receive a number of restrictions that changes completely its designing. Volume-spatial characteristics as well as ecological and transport issues require to be revised. City and modern tendencies impose another approach to architectural expressiveness.

## **6 Conclusions**

Rapid development of trade, increasing consummation, severization of ecological requirements and other modern tendencies require revision of the existing logistics net with its elements. Appearance of a new type of LCs alongside with a set of city-planning measures which is aimed at redistribution of peripheral hypermarkets’ influence should solve a number of problems modern society faced. LC’s architecture should refuse traditional closed utilitarian strictly industrial solutions and develop towards humanization. Modern LCs not only can but must possess architectural expressiveness, reflect modern positive social changes, its evolutionary growth.

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