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**ASSESSMENT OF THE  
EFFECTIVENESS OF THE  
FUNCTIONING OF TRANSFORMATION  
CENTERS IN TRANSPORT  
AND LOGISTICS SYSTEMS**

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**Abstract.** Optimization of the network of transformation centers is one of the conditions for the effective functioning of the macro-logistic system. Acting as links in logistics chains, transformation centers perform the most important functions of promoting material flows between the elements of production processes, commodity circulation and consumption. The article studies and reveals the role of transformation centers, which implement the most important tasks of mutual cooperation of trunk and local modes of transport. The stages of logistic approach in choosing the variant of transformational centers location have been investigated. It has been determined that the transformation centers, being the basis for the creation of macro-logistic transport and storage systems of the corresponding level, perform the functions necessary to smooth the unevenness, inaccuracy of production, consumption and modes of transport turnover. The logistic concept which assumes the necessity of transformational centers as transport terminal complexes, warehouse complexes to create positive results of interaction of factors characterizing optimization of processes of advancement of material flows in logistic chains has been analyzed. The results of the study showed that in maritime transport, the main factor in the development of transport container terminals, as varieties of transformation centers - is the formation of complexes of means of transportation of centralized systems of movement of goods. Currently, the system of container transportation is among the most rational methods of technology and organization of multimodal cargo transportation. The concept of this system is based on the fact that it is proposed to transport cargo flows in a single cargo unit-capacity mixed modes of transport. In the conditions of functioning of the local transformation center, in addition to the implementation of complex logistical operations for the processing of material flows, operations for the development of preparatory processes of products for production consumption in the end are performed. This determines the representation of transport and warehouse systems of transformation centers as varieties of flexible production and logistics systems.

**Key words:** transformation centers, material flow, transport and storage system, logistics chain, container terminal, automated container terminal management systems.

**Introduction.** Topicality of the work. The stages of material flows advancement between the elements of the processes of production, commodity circulation and consumption are provided by the transformation centers of transport spheres, which are the most important links of logistic chains. The specific weight of shipments between transformation centers of different levels reaches 60~80% in the total amount of transportation. Stability of economy and economic

relations, large technological capacities focused on optimization of transportation allow to develop and, most importantly, to observe necessary modes and coordinated schedules of work, to establish centralized operative management of material flows. Transformation centers of regional and local levels are the basis for the creation of appropriate transport and warehousing systems.

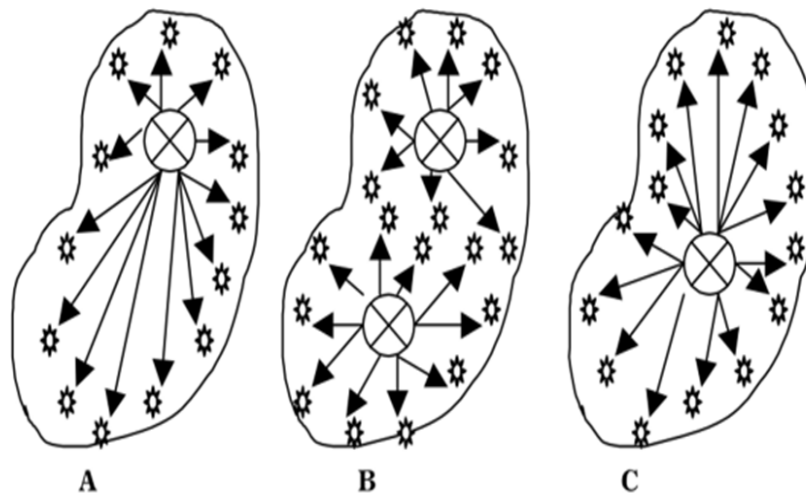
The condition for the functioning of transformation centers is the possibility of their location in the nodes of concentration of the main cargo flows of the city, district, region. World experience shows that 40 to 60% of cargo is transported through the transformation centers of the local level, and 70-80% of all cargo is transported through the regional transformation centers.

Interaction between the mainline and local transport is carried out through transformational centers of the regional level. Interaction between local public transport and corporate (departmental, individual) transport is carried out through local transformation centers [1,2].

As a rule, transformation centers for transformation of material flows have appropriate systems of storage and processing, which are based on a complex of warehouse facilities. Therefore, highlighting the most important elements of the material flow management systems, they are called transport and warehouse systems.

**Materials and methods of research.** With the known parameters of the material flows passing through the macro-logistic system (local, regional, etc.), the value of the total logistics costs will vary depending on the location of the transformation center. The reason for this is the direct dependence of the total transportation costs for the promotion of material flows from the generating transformation center in the area to the destinations of material flows.

Figure 1 shows an illustration of the location of the transformation centers.



- A - with one transformational center located on the outskirts of the district;
- B - with two transformational centers located in places of concentration of consumers;
- C - with one transformational center located in the center of gravity of demand for logistics services.

Figure 1 - Options for the location of transformational centers in the service area:

If option A is chosen, one should be prepared for the fact that transportation costs for delivery will be maximum due to the fact that the transformation center is located on the outskirts of the district. If option B is chosen, which involves the presence of two transformational centers, as close as possible to the places of concentration of consumers, in this case the transportation costs for the promotion of material flows will be minimal. At the same time, the creation of an additional transformational center in the service area will require significant investments and subsequent operating costs, the total of which may significantly exceed the economic efficiency obtained from reducing the radius of the vehicles' mileage. In all likelihood, option C, which provides for the

location of the transformation center in the geographical center of the served area, will prove to be the most attractive.

The logistic approach in selecting the option for the location of the transformation center requires the following steps:

1. Conducting a study of the market conditions of logistics services.
  2. Formalization of strategic goals of the logistics system (local, regional).
  3. Development of forecasts of the state and parameters of material flows through a given macro-logistic system. Forecasting of quantitative and qualitative parameters of inventories in the logistics system, as well as in individual sections of the logistics chain.
  4. Development of a conceptual material flow management system.
  5. Drawing diagrams of the dislocation of material flows within the logistics system.
  6. Determination of criteria and system of logistics service parameters with the establishment of the lower bound. Development of a program for improving the logistics service to consumers.
  7. Implementation of the choice of the option of the location of the transformation center.
- The decision should be made on the basis of aspiration to minimize the reduced costs.

Warehousing facilities, between production and transport, transport and consumers, perform the most important functions necessary to smooth the unevenness, inaccuracy of turnover of production, consumption, functioning of modes of transport. Given this, in the processes of promotion of the material flow through logistics chains, the presence and functioning of transforming forms and parameters of material flows, which provides for the presence of warehousing at the macro-logistic level [3,4].

The logistic concept assumes the necessity of location and establishment of transformation centers as transport terminal complexes, warehouse complexes of universal purposes of branch, regional systems of warehouse processing from the point of view of the system approach to create the effect of amplification of positive results of interaction of factors characterizing optimization of processes of advancement of material flows in logistic chains. This system approach acts as the main criterion for the implementation of unified strategic objectives of macro-logistic systems of any level.

Solutions to the problems of establishing and determining the rational ways of dispersal of transformation centers are performed in the presence of several consumers of material flows. With regard to the application of transformation centers, representing flexible production and logistics systems for the transformation of material flows, it is necessary to fulfill the conditions of presence of flow processes with the observance of system integrity of objects, which implies the union into a single logistics system of consumers of material flows and transformation centers, implemented in the form of a planned-organized set of elements of flow processes that form a micrologistic system. This unification involves organizational, economic, technological and technical integration of the structural components of the flow process on the principles of implementing common goals [5].

***The results of the study.*** Transformation centers, being the most important links in logistics chains, are concentrated in the nodes of the main cargo flows and should focus on the formation of material flows through the mainline transport. The main function of the transformation centers of the regional level is the realization of mutual cooperation of trunk and local modes of transport. The functions of the local transformation centers are the implementation of mutual cooperation of local common-use transport and corporate transport.

In accordance with the demands of consumers, the modern conditions of development of market relations dictate the insufficiency of using only the direct functions of transformation of material flows.

In the conditions of functioning of the local transformation center, in addition to the implementation of complex logistical operations for the processing of material flows, operations for the development of preparatory processes of products for production consumption in the end are performed. This determines the representation of transport and warehouse systems of transformation centers as varieties of flexible production-logistic systems [6,7].

On water transport, the decisive factor in the development and formation of transport container terminals, which are variations of transformation centers, was the formation of complexes of means of transportation, centralized systems of cargo movement. In modern conditions of development the system of container transportation is currently one of the effective methods of technology and organization of mixed cargo transportation (fig.2). The concept of this system is formed in that it assumes the transportation of cargo flows from the initial to the final points in a single cargo unit-capacity (container), transferred in the transshipment areas from one mode of transport to another.

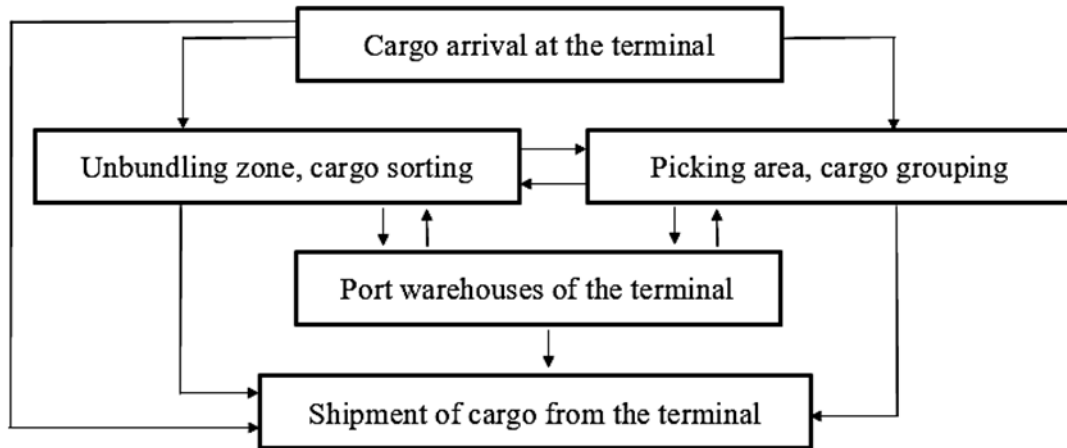


Figure 2 - Transport port container terminal in the role of transformation center

The essential difference between transport port container terminals and transport and warehouse complexes is the presence of light functional operations along with the use of automated container terminal management systems (ACTMS) in transport activities. This automated management complex significantly reduces the narrow issues of production management, which are characteristic of traditional methods of organization in transport and provides:

- preparation, cumulation, processing and transfer of operational information on container cargo flows;
- the establishment of a database of: shippers, consignees, cargo flows;
- reviewing the presence and handling of containers (factors for idle containers, commercial container rental operations, diagnosis and formation of container units for repair);
- search activities in cases of search for lost containers.

The operation of automated container terminal management systems (ACTMS) in the production structure of port container terminals provides a significant reduction in the stages of cargo delivery, reducing downtime of rolling stock, accelerating the turnover of container units [8].

The throughput capacity of a port container terminal is determined by the formula:

$$P_{pr} = 24 \times E_n \times K_{tech} \text{ (m / day)} \quad (1)$$

where:  $E_n$  - freight rate;  
 $K_{tech}$  - ship's technical operation factor.

$$E_n = N_y \times P_\vartheta \quad (2)$$

where:  $N_y$  - number of mechanized installations on the sea cargo pier;

$P_3$  - operating capacity of one mechanical unit.

$$P_3 = P_m \times T_{gr} / T_{om} \quad (3)$$

where:  $P_m$  - average technical capacity of one unit;

$T_{gr}$  - operating time per shift (6.5 hours);

$T_{om}$  - Work shift duration (8 hours);

The calculated need for container terminal berths is determined by the formula:

$$N_o = Q_{mec} / 30 \times P_{day} \times K_{met} \times K_{zan} \quad (4)$$

where:  $Q_{mec}$  - estimated maximum cargo turnover of the quay front, t/month;

$P_{day}$  - intensity of loading and unloading operations, t/day;

$K_{met}$  - the coefficient of utilization of the berth operating time budget for meteorological reasons in the month of highest operation;

$K_{zan}$  - the index of occupancy of berths by ship handling during the month.

Dominant in the conditions of production and logistics systems for the transformation of material flows at the modern stages of development are transformational centers of universal forms, performing processing in addition to container and other inflows of material flows. These transformation centers are inherent in the transport hubs serving the cargo flows of various nomenclatures of multi-branch purposes [9,10].

Under the conditions of non-implementation of the logistics concept, the conducted research on the associations of transport and warehouse systems and productions, demonstrate the presence of the logistics concept at the macro-logistic levels. This optimizes operations on the establishment of effective routing schemes for the movement of cargo flows; the formation of rational volumes of consignments and accurate in time performance of the temporary norms of delivery of cargo flows.

**Conclusion.** Transport port container terminals, as varieties of transformation centers for the transformation of material flows are the most important links in logistics chains and, acting as flexible production and logistics systems for the transformation of material flows, form the basis for the creation of macro-logistic transport and storage systems of corresponding levels, performing the most important tasks of implementing mutual cooperation of main and local types of transport.

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### **КӨЛІК-ЛОГИСТИКАЛЫҚ ЖҮЙЕЛЕРДЕГІ ТРАНСФОРМАЦИЯЛЫҚ ОРТАЛЫҚТАРДЫҢ ЖҰМЫС ІСТЕУІ ТИІМДІЛІГІН БАҒАЛАУ**

**Андамна.** Трансформациялық орталықтар желісін оңтайландыру макрологиялық жүйенің тиімді жұмыс істеуінің шарттарының бірі болып табылады. Логистикалық тізбектердің буындары ретінде әрекет ете отырып, трансформациялық орталықтар өндіріс, тауар айналымы және тұтыну процестерінің элементтері арасындағы материалдық ағындарды ілгерілетудің маңызды функцияларын орындайды. Мақалада магистральдық және жергілікті көлік түрлерінің өзара ынтымақтастығын жүзеге асырудың маңызды міндеттерін жүзеге асыратын трансформациялық орталықтардың рөлі зерттеліп, ашылды. Трансформациялық орталықтарды орналастыру нұсқасын таңдау кезінде логистикалық тәсілдің кезеңдері зерттелді. Трансформациялық орталықтар тиісті деңгейдегі макрологиялық көлік-қойма жүйелерін құруға негіз бола отырып, өндірістердің, тұтынулардың, көлік түрлерінің жұмысының біркелкі оборостігін, дәлсіздіктерін тегістеу үшін қажетті функцияларды орындайтыны анықталды. Логистикалық тізбектердегі материалдық ағындарды ілгерілету процестерін оңтайландыруды сипаттайтын факторлардың өзара әрекеттесуінің оң нәтижелерін жасау үшін трансформациялық орталықтарды көліктік терминалдық кешендер, қойма кешендері ретінде қалыптастыру қажеттілігін болжайтын логистикалық тұжырымдама талданды. Зерттеу нәтижелері теңіз көлігінде трансформациялық орталықтардың сорттары ретінде көліктік контейнерлік терминалдарды дамытудың негізгі факторы жүктерді тасымалдаудың орталықтандырылған жүйелерін тасымалдау құралдарының кешендерін қалыптастыру болып табылатынын көрсетті. Қазіргі уақытта контейнерлік тасымалдау жүйесі мультимодальды жүк тасымалының технологиясы мен ұйымдастырылуының ең ұтымды әдістерінің бірі болып табылады. Бұл жүйенің тұжырымдамасы бір жүк бірлігінде-аралас көлік түрлерімен сыйымдылықта жүк ағындарын тасымалдау ұсынылғанына негізделген. Жергілікті трансформациялық орталықтың жұмыс істеуі жағдайында материалдық ағындарды қайта өңдеу бойынша логистикалық операциялар кешендерін іске асырудан басқа, өнімнің өндірістік тұтынуға дайындық процестерін әзірлеу бойынша операциялар ақыр соңында орындалады. Бұл трансформациялық орталықтардың көлік-қойма жүйелерін икемді өндірістік-логистикалық жүйелердің түрлері ретінде ұсынуды анықтайды.

**Кілт сөздер:** трансформациялық орталықтар, материалдық ағын, көлік-қойма жүйесі, логистикалық тізбек, контейнерлік терминал, контейнерлік терминалды басқарудың автоматтандырылған жүйелері.

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## **ОЦЕНКА ЭФФЕКТИВНОСТИ ФУНКЦИОНИРОВАНИЯ ТРАНСФОРМАЦИОННЫХ ЦЕНТРОВ В ТРАНСПОРТНО-ЛОГИСТИЧЕСКИХ СИСТЕМАХ**

**Аннотация.** Оптимизация сети трансформационных центров является одним из условий эффективного функционирования макрологистической системы. Выступая в роли звеньев логистических цепей, трансформационные центры выполняют важнейшие функции продвижения материальных потоков между элементами процессов производств, товарных обращений и потреблений. В статье исследована и раскрыта роль трансформационных центров, реализующих важнейшие задачи по осуществлению взаимного сотрудничества магистральных и локальных видов транспортов. Исследованы этапы логистического подхода при выборе варианта размещения трансформационных центров. Определено, что трансформационные центры, являясь основой для созданий макрологистических транспортно-складских систем соответствующего уровня, выполняют функции необходимые по сглаживанию неравномерностей, неточностей оборотов производств, потреблений, функционирований видов транспорта. Проанализирована логистическая концепция, предполагающая необходимость становления трансформационных центров в качестве транспортных терминальных комплексов, складских комплексов для создания положительных результатов взаимодействия факторов, характеризующих оптимизацию процессов продвижений материальных потоков в логистических цепях. Результаты исследования показали, что на морском транспорте, основным фактором развития транспортных контейнерных терминалов, как разновидностей трансформационных центров - является формирование комплексов средств транспортировки централизованных систем перемещения грузов. В настоящее время система контейнерных перевозок входит в число наиболее рациональных методов по технологии и организации мультимодальных грузоперевозок. Концепция этой системы построена на том, что предложено транспортирование грузопотоков в единой грузовой единице-емкости смешанными видами транспорта. В условиях функционирования локального трансформационного центра кроме реализаций комплексов логистических операций по переработкам материальных потоков выполняются операции по разработке подготовительных процессов продукции к производственным потребностям в конечном итоге. Это определяет представление транспортно-складских систем трансформационных центров в качестве разновидностей гибких производственно-логистических систем.

**Ключевые слова:** трансформационные центры, материальный поток, транспортно-складская система, логистическая цепь, контейнерный терминал, автоматизированные системы управления контейнерным терминалом.