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**THE ROLE OF TRANSFORMATION
CENTERS IN THE MULTIMODAL
FREIGHT TRANSPORTATION SYSTEM**

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Abstract. Transformation centers, as objects of transport infrastructure integrated with a complex of warehouse facilities, perform the most important functions in a multimodal freight transportation system. The article examines the effectiveness of transformation centers that implement effective interaction of transports in a multimodal transportation system. The stages of the logistic approach in choosing the location of transformation centers are investigated. It is determined that transformation centers, being the basis for the creation of macrological transport and storage systems of the appropriate level, perform the functions necessary to smooth out irregularities, inaccuracies in production turnover, consumption, and functioning of modes of transport. The main point of view is investigated and analyzed, which provides for the implementation of transformation centers in the form of an integrated transport terminal infrastructure in order to optimize the stages of movement of material flows in the logistics chain. 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 creation of means of an integrated transport terminal infrastructure of a concentrated system for the movement of material cargo flows.

Key words: multimodal cargo transportation, transformation center, material flows, transport and warehouse complex, transport and logistics chains, container terminal, automated container terminal management system.

Introduction. 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.

Materials and methods. In water transport, the decisive factor in the development and formation of container transport terminals (Fig.1), which are variations of transformation centers,

was the formation of complexes of means of transportation, centralized cargo transportation systems. The structure of the marine container terminal is shown in Fig. 1 and includes various zones for carrying out loading and unloading operations with container ships. The efficiency of the terminal is determined primarily by the resources of the berth.

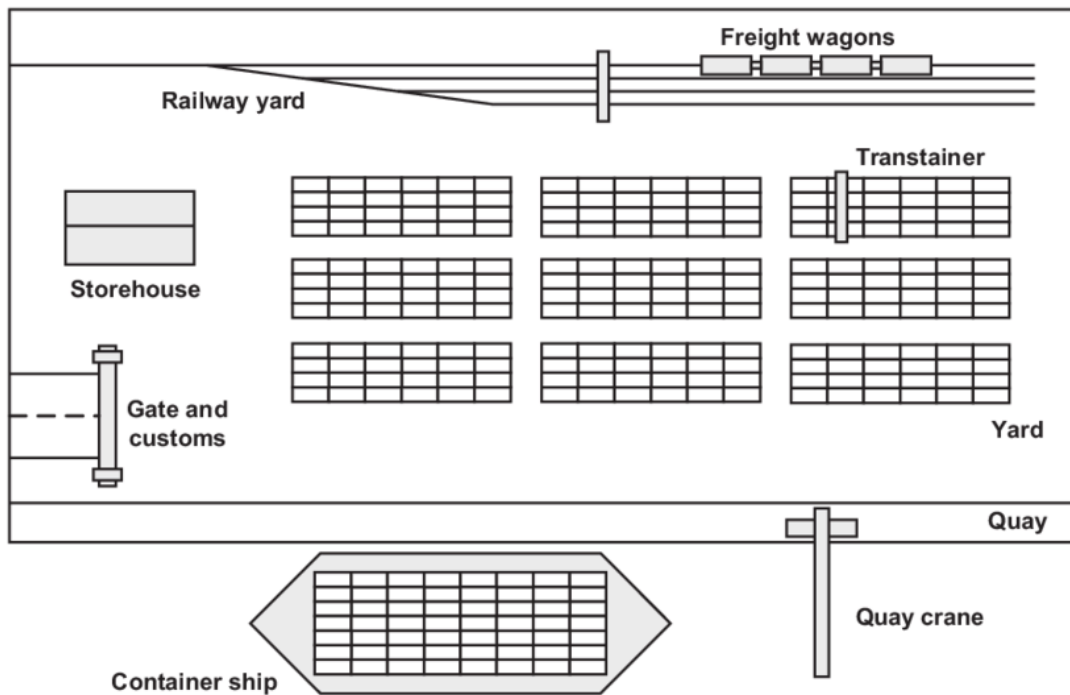


Figure 1 - Structure of the marine container terminal

The marine container terminal, being the center of transformation in the implementation of the responsible tasks of the multimodal transportation system, implements the main solutions for optimizing mutually beneficial partnership between various types of mainline and local transport. The complex of technological cycles of terminals provides for the implementation of import, export and transit production transport processes

Along with this, the support of the complex of technological cycles of terminals by a number of auxiliary operations is being implemented:

- preparation of plans and recording of time and schedule stages for all stages of complex technological cycles of the terminal;
- monitoring of technical conditions and readiness of containers for transport operations;
- providing a range of services to the clientele, payment and financial services;
- elimination of errors and shortcomings in transport operations

In the system of multimodal cargo transportation, the logistics concept assumes the need to locate and establish transformation centers as transport terminal complexes, warehouse complexes of seaports in order to create the effect of enhancing the positive results of the interaction of factors characterizing the optimization of the processes of advancing material flows in logistics chains. This systematic approach acts as the main criterion for the implementation of common strategic goals of macrolological systems of all levels. Figure 2 shows the technological cycle of the cargo terminal, acting as a kind of transformation centers.

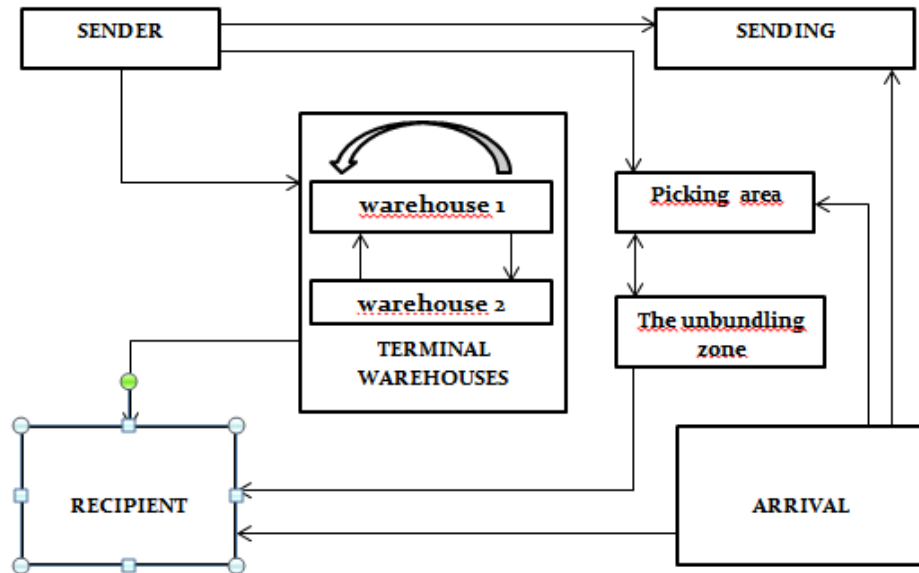


Figure 2 - The technological cycle of a cargo terminal acting as a kind of transformation centers

Cargo flows in any direction at the terminal flow through a connected chain of technological elements: a marine cargo front, a warehouse, a rear cargo front and internal terminal transportation systems connecting them. The representation of the terminal in the form of a link in the movement of cargo flows is shown in Figure 3.

The values of the calculated volumes of cargo handling of cargo flows are determined in the following sequence:

The volumes of average monthly cargo handling of individual cargo flows are calculated using the formula:

$$Q_{aver.} = (Q1, + Q2 + ... + Qi) / n \tag{1}$$

where: Q_i – the values of the monthly volumes of cargo handling of cargo flows, tons;

n – the number of months for cargo transshipment of cargo flows, according to the obligations established by the agreement.

The degree of deviation is calculated, which establishes the dispersion of individual quantities:

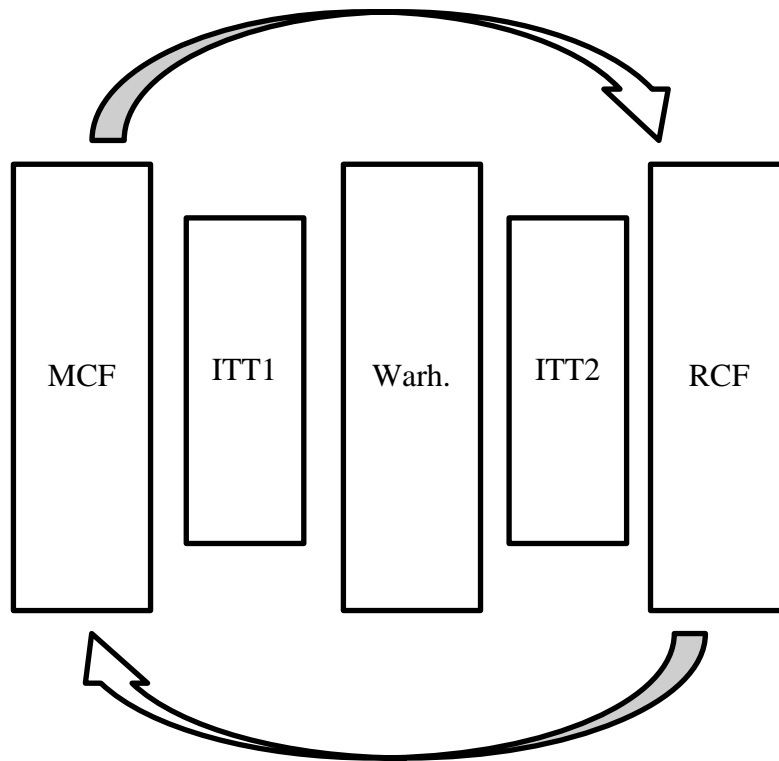
$$P = ((Q1^2 + Q2^2 + ... + Qn^2) / n - Q_{jn}^2) * n / (n-1) \tag{2}$$

According to the parameters $n - 1$, the values of confidence probabilities (V_b) are established, used to establish the maximum and minimum values of confidence intervals of monthly cargo handling volumes:

$$Q_{max} = Q_{jn} + V_b * (P/n)^{0,5} \tag{3}$$

$$Q_{min} = Q_{jn} - V_b * (P/n)^{0,5} \tag{4}$$

For all cargo flows, in order to analyze estimates of the numerical values of the parameters of the cargo base of terminals by stages of transshipment of cargo flows, according to the plan of interactions of adjacent modes of transport, the values of confidence intervals for the volume of cargo handling of cargo flows are applied.



MCF - marine cargo front, ITT - internal terminal transportation, Warh. - warwarehouse, RCF - rear cargo front.

Figure 3 - Terminal as a chain of cargo flows

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].

Results. 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.

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.

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 [3-5].

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. Transformation centers, performing the functions of elements of the logistics supply chain, are concentrated in the centers of concentration of material flows and are aimed at forming the acquisition of material cargo flow through mainline transport (Fig. 4). The main function of transformation centers with regional status is the implementation of mutually beneficial partnership of local and mainline transports. The functions of local transformation centers are the implementation of mutual cooperation between local public transport and corporate transport. In accordance with the demands of consumers, modern conditions for the development of market relations dictate the insufficiency of using only direct functions for the transformation of material flows. In the context of the functioning of the local transformation center, in addition to the implementation of complex basic logistics operations, additional functions are performed at the stages of developing operations for the readiness of transport cargo flows for production consumption in electronic form. This determines the representation of transport and warehouse systems of transformation centers as varieties of flexible production-logistic systems [6,7].

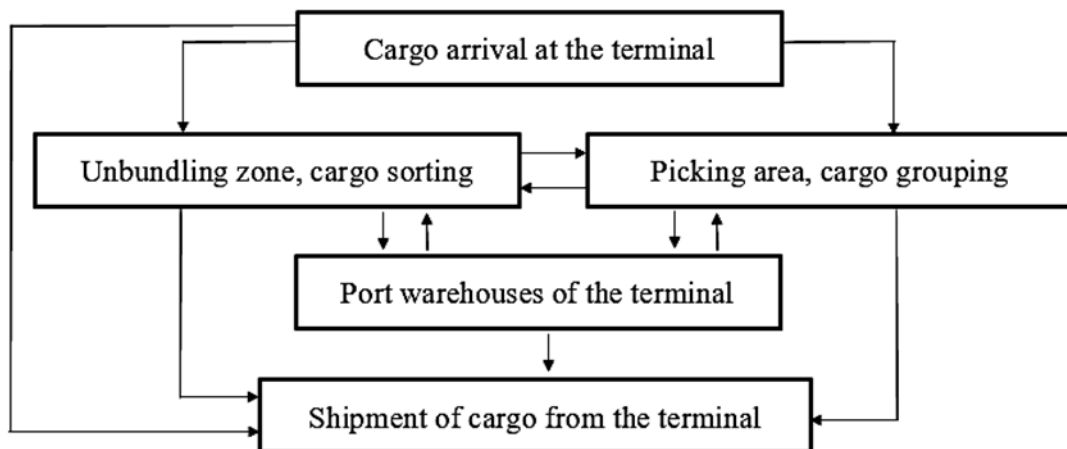


Figure 4 - Transport port container terminal in the role of transformation center

In transport activities, the operation of port container terminals in comparison with the transport and warehouse infrastructure provides for the implementation of auxiliary operations together with the involvement of automated container terminal management systems (ACTMS)

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.

Discussion. 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 automated system provides an opportunity to manage the work of transshipment equipment, transport and personnel, control the movement of containers, and also contributes to the rapid planning of tasks for personnel, taking into account the current situation. In general, this determines the increase in the capacity of the container terminal.

The calculation of the maximum number of cargo flows processed in the conditions of container port terminals is performed according to the formula:

$$P_{pr} = 24 \times E_n \times K_{tech} \text{ (m / day)} \quad (5)$$

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

$$E_n = N_y \times P_3 \quad (6)$$

here: N_y - the number of complex automechanized technological machines of the cargo berth ;
 P_3 - operating capacity of one mechanical unit.

$$P_3 = P_m \times T_{gr} / T_{om} \quad (7)$$

here: 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:

$$N_o = Q_{mec} / 30 \times P_{day} \times K_{met} \times K_{zan} \quad (8)$$

here: Q_{mec} - the design turnover of the tonnage of the cargo berth , t/month;
 P_{day} - the number of overloaded loads per shift , t/day;
 K_{met} - monthly time indicator of cargo berth operation according to weather conditions;
 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].

In modern conditions of development of transport production, the logistics transformation center, being a functional element of the transport infrastructure, combined with a warehouse complex, implements solutions to the most important tasks of optimizing effective route schemes for the movement of cargo flows. Generates rational volumes of shipments and ensures compliance with the time limits for the 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.

REFERENCES

- [1] Palagin Yu. I. Logistics and supply chain management. Theory and practice. Supply chain management. Textbook. - M.: Prospect, 2015. 224 p.
- [2] Sterligova, A. N. Inventory management in northern supplies. Textbook / A. N. Sterligova. - M.: INFRA-M, 2016. - 432 p.
- [3] Gerami, V. D. Management of animal transport systems. Transport logistics support. Textbook and workshop / V. D. Gerami, A.V. Kolik. - M.: Yurait, 2016. - 440 p.
- [4] Rezer, A.V. Problematic article of the development of the Transport and logistics complex [text] /A.V. Rezer // Transport business of Russia. - 2010. - 12c. - pp. 146-148.
- [5] Apattsev V. I., Logistics transport and cargo systems Alte / System: Textbook for students. in ANIMATION SCHOOL. studies. institutions / V. I. Apattsev, S. B. Levin, V. M. Nikolashin, etc.; edited by V. M. Nikolashin. - M.: Oddelsky center "Academy", 2003. / p. 288 (304 p.) < BR >
- [6] Bodgersox, Donald J. Logistics: Integrated Supply chain : translated from English / Donald J. Bodgersox, David J. Kloss. – 2nd ed. – Moscow : Olymp – Business CJSC, 2005. – 640 p.
- [7] Alibekov, B.I. Logistics of freight transportation of regional transport systems: modeling and management / B.I. Alibekov. – Rostov-on-Don: RSUPS, 2010. – 179 p
- [8] Korol R.G. Terminal and logistics complexes: method. stipend. handbook for a practical course / R.G. Korol, E.I. Garlitsky. Khabarovsk : Publishing House of DVGUPS, 2015. 62 p.: ill.
- [9] Shcherbakov V. V., Logistics and supply chain management: textbook for SPO / V. V. Shcherbakov [et al.]; edited by V. V. Shcherbakov. — M. : Yurayt Publishing House, 2019. - 582 p
- [10] Malikov, O.B. Warehouses and cargo terminals: handbook / O.B. Malikov. – St. Petersburg: Business Press, 2005. – 560 p.

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МУЛЬТИМОДАЛЬДЫ ЖҮК ТАСЫМАЛДАУ ЖҮЙЕСІНДЕГІ ТРАНСФОРМАЦИЯЛЫҚ ОРТАЛЫҚТАРДЫҢ РӨЛІ

Аннотация. Трансформациялық орталықтар қойма құрылыстары кешенімен біріктірілген көлік инфрақұрылымының объектілері ретінде жүк тасымалдаудың мультимодальды жүйесінде маңызды функцияларды орындайды. Мақалада тасымалдаудың мультимодальды жүйесінде көліктердің тиімді өзара іс-қимылын жүзеге асыратын трансформациялық орталықтардың тиімділігі зерттелген. 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 тізбектегі материалдық ағындардың қозғалу кезеңдерін оңтайландыру мақсатында кешенді көліктік терминалдық инфрақұрылым түрінде трансформациялық орталықтарды іске асыруды көздейтін негізгі көзқарасты талдау зерттелді және орындалды. Зерттеу нәтижелері теңіз көлігінде трансформациялық орталықтардың сорттары ретінде көліктік контейнерлік терминалдарды дамытудың негізгі факторы материалдық жүк ағындарының шоғырланған қозғалыс жүйесінің кешенді көліктік терминалдық инфрақұрылымының құралдарын құру болып табылатынын көрсетті.

Кілт сөздер: мультимодальды жүк тасымалы, трансформациялық орталық, материалдық ағындар, көлік-қойма кешені, көлік-логистикалық тізбектер, контейнерлік терминал, контейнерлік терминалды басқарудың автоматтандырылған жүйесі.

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РОЛЬ ТРАНСФОРМАЦИОННЫХ ЦЕНТРОВ В МУЛЬТИМОДАЛЬНОЙ СИСТЕМЕ ГРУЗОПЕРЕВОЗОК

Аннотация. Трансформационные центры, как объекты транспортной инфраструктуры, интегрированные с комплексом складских сооружений выполняют важнейшие функции в мультимодальной системе грузоперевозок. В статье исследована эффективность трансформационных центров, которые реализуют эффективное взаимодействие транспортов в мультимодальной системе перевозок. 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. Исследован и выполнен анализ основной точки зрения, предусматривающей в целях оптимизации этапов перемещений материальных потоков в логистической цепи реализацию трансформационных центров в виде комплексной транспортной терминальной инфраструктуры. Результаты исследования показали, что на морском транспорте, основным фактором развития транспортных контейнерных терминалов, как разновидностей трансформационных центров - является создание средств комплексной транспортной терминальной инфраструктуры концентрированной системы движения материальных грузопотоков.

Ключевые слова: мультимодальные грузоперевозки, трансформационный центр, материальные потоки, транспортно-складской комплекс, транспортно-логистические цепи, контейнерный терминал, автоматизированная система управления контейнерным терминалом.