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## TO THE QUESTION OF FLOWING PROCESSES INTERACTION IN THE LOGISTICS OF TRANSPORT-FREIGHT COMPLEXES OF ENTERPRISES

**Summary.** In the article the questions of identification of structure and parameters of material flow and associate with it documentary and informative flows are considered and the principles of their co-operation, representing a basis for optimization of process of material traffic in the logistic transport-freight complexes of enterprises, are exposed.

## К ВОПРОСУ ВЗАИМОДЕЙСТВИЯ ПОТОКОВЫХ ПРОЦЕССОВ В ЛОГИСТИЧЕСКИХ ТРАНСПОРТНО-ГРУЗОВЫХ КОМПЛЕКСАХ ПРЕДПРИЯТИЙ

**Аннотация.** В статье рассмотрены вопросы идентификации структуры и параметров материального и взаимосвязанных с ним документального и информационного потоков и выявлены принципы их взаимодействия, представляющие основу для оптимизации процесса материалодвижения в логистических транспортно-грузовых комплексах предприятий.

### 1. UP-TO-DATE STATE OF QUESTION. STATEMENT OF A TASK

In modern conditions, at unstable deliveries, uneven feed and minimum supplies of raw material storage, the decision of transport problem of metallurgical enterprises is impossible without more close co-operation of work of transport and production on all stages of advance of van flow.

This problem is displayed most sharply in the points of co-operation of railway transport and production workshops carrying out unloading-loading of carriages of external park (EP) through transport-freight complexes (TFC). The analysis of process of processing of carriages going under loading showed that at present up to 70% duration of their turn falls on the delivery of raw material and shipping of the prepared products [1].

Consequently, on the given stage the question of increase of efficiency of management by a transport on a new technological and informative basis becomes essential. Conception of a new approach consists in the use of principles of logistical management by the way of analysis and exposure of technological and informative disproportions and losses which conduce to growth of transport costs [2].

Logistical approach is based on community of production interests of participants of process and is one of the most effective instruments of management of material traffic on industrial enterprises. Nevertheless, the analysis of research works and scientific and technical publications on these questions, conducted in the last few years, showed that some theoretical aspects of the examined

problem are studied and lighted up not enough. In particular, the question of interaction of flowing processes is insufficiently investigated [2, 3].

Identification of structure and parameters of material traffic and associate with it flow processes and exposure of principles of their co-operation, as basis for optimization of process of material traffic in the logistical TFC of enterprises is the objective of the work.

Logistical co-operation of the flows built on community of production interests must have an uniting economic basis. The flowing presentation of circulating capital, firstly offered in the work [4], is taken as such basis.

Developing separate positions of the indicated work conformably to the operating conditions of the TFC enterprises, we will consider the following questions related to the objective of the work: kinds and structures of logistical flows, correlation of the «flow – flowing process» and the principles of optimization of interactive flowing processes.

## **2. MODEL AND ALGORITHM OF OPTIMIZATION OF INTERACTIVE FLOWING PROCESSES**

In intraindustrial logistic system a number of subsystems «industrial shop» and "transport", working within the limits of TTK on uniform economic result functions, and their interaction is connected not with finished goods transfer, and with transfer of raw materials and semifinished products, that is financial streams in this case are absent.

In connection with specified in industrial activity of the enterprises different types of flows are the object of logistical operations. The material, documentary and informative flows are selected in production activity of enterprises. The material flow is the basic object of research of logistics. Therefore the questions of functional essence of material flow are examined with the purpose of selection of its features which allow to define approaches to the management by the given flow individually, and also and the whole complexes of flows.

From the positions of common economic approach the freights, goods, wares and material values are understood under the material flow, that is the part of circulating capital in a material form, examined in the process of application of different logistical operations and attributed to the certain temporal interval. The subsystem of material flow must provide concrete users by material resources in the set time, in a necessary amount and the set quality, and management by a subsystem must realize the indicated requirements.

Presently on industrial enterprises two independent flows function in informative space: documentary flow, with the use of paper mediums accompanying the freight on a path from a producer to the user and providing the transmission of vehicular and financial arrangements between them, and also the informative flow directed on the traffic control of material and documentary flows. Thus, motion of the flows of load, as well as related to it the documents and informative resource, is characterized by the division in space and in time.

Then from the position of common economic approach, under the documentary flow we will understand the part of the circulating capital in the form of negotiable, custom and vehicular instruments, examined in the process of application of different logistical operations to this capital and related to the certain interval of time. A similar definition gives the presentation of informative flow as the part of the circulating capital considered in the same terms of material traffic.

The accepted definitions ground to examine the co-operation of material, documentary and informative flows on the common methodological basis – through the presentation by their constituents of the circulating capital. Thus it is possible to use the parameters of duration of motion of flows as an instrument of optimization.

Thus, the logistical chain of the material traffic of TFC enterprise is multilayer flow or integrate flow process which is characterized at presence of general economic basis by a different structure and division of component flows in space and in time.

Conditionally this integrate flow process can be represented as vector-scalar components which form the examined logistical chain. Between the examined processes there is the functional

intercommunication, represented by horizontal communications, and interdependence which is reflected by vertical communications:

$$\left. \begin{array}{c} a_1 \rightarrow a_2 \rightarrow \dots \rightarrow a_n \\ \Downarrow \quad \Downarrow \quad \quad \quad \Downarrow \\ u_1 \rightarrow u_2 \rightarrow \dots \rightarrow u_k \\ \Downarrow \quad \Downarrow \quad \quad \quad \Downarrow \\ g_1 \rightarrow g_2 \rightarrow \dots \rightarrow g_e \end{array} \right\} \quad (1)$$

where « $a_i \rightarrow$ » — an element of chain of material flow in a knot ( $a_i$  — value of flow; « $\rightarrow$ » — the vector of moving of flow, compared in course of time and distance of moving;  $i = 1, 2 \dots, n$ ); « $u_i \rightarrow$ » — an element of chain of information about material flow ( $u_i$  — volume of information; « $\rightarrow$ » — addressee of information transfer;  $i = 1, 2 \dots, k$ ); « $g_i \rightarrow$ » — an element of chain on drafting and transmission of documents about material flow and its moving ( $g_i$  — number or volume of document; « $\rightarrow$ » — address of transmission of document;  $i = 1, 2 \dots, e$ ); « $\Downarrow$ » — direct and reverse communications between technological processes with material, informative and documentary flows.

Multilayer structure and specific features of integrate flow process substantially complicate the task of optimization of interaction of components of its flows. The examined task requires search of new approaches to its decision.

The analysis shows that for development of method of interaction of flowing processes in TFC it is necessary to explore in detail the «flow-flowing process» correlation. In modern works on logistics the mixing and identification of notions of the «flow» and «flowing process» takes place, which it is necessary to delimit.

Flow is the directed motion of the aggregate of homogeneous objects, and motion, which is carried out in space of three variables – spatial, temporal and quantitative, - is the basic sign of flow. Such categories as a trajectory, length, initial and final points are used for the spatial measuring of flow, for temporal measuring – duration; for quantitative measuring – volume, tonnage etc.

In the special literature the successive change of the states, stages of development at reaching some result is understood under a notion of flowing process. For the reflection of qualitative state transitions within the limits of logistical flow it is necessary to enter the notion of phase space, and the flowing process is to examine in space of four variables – spatial, temporal, quantitative and phase variables. Thus under phase transition of flowing processes it is needed to understand qualitative transformation of economical flowing process within the limits of one form of flow or from one form to another and to present it as a certain change of the added cost which can be appraised through cost indexes reflecting it.

Otherwise speaking, the notion of the «flow» to a full degree corresponds to a notion of the «technology», which characterizes the method of influence (treatment, processing) upon raw materials, materials and semi-finished items. By analogy with the «flow» the notion of «flowing process» is a technological process that is aggregate of operations changing the state, properties, form or sizes of articles of production [5].

Thus, obviously, that phase space of every logistical flowing process is a technological basis, determining the parameters of spatial, temporal and quantitative signs which can be realized in the concrete variant of technological process and can regulate the size of the added cost.

Differentiating the notions of the «flow» and «flowing process» within the framework of the developed method of interaction of flowing processes, we will note that a logistic integrate flowing process is the consecutive change of the every flowing process states within the limits of one form of the flow or at transition from one form of flow to another. The chart of logistical flowing technological process of the TFC enterprise is presented on fig. 1.

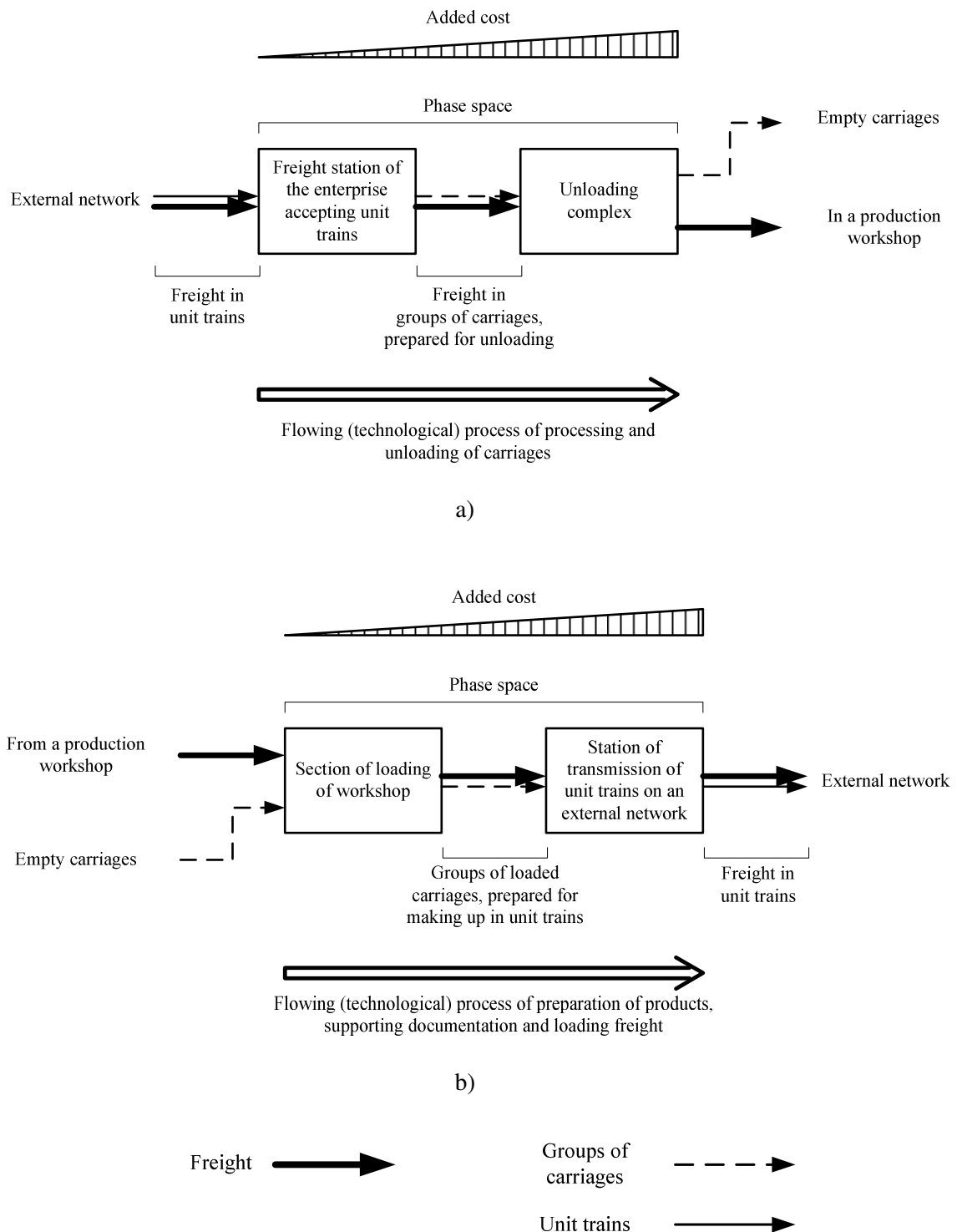


Fig. 1. Chart of logistical flowing process of the TFC enterprise: a) at the delivery of raw materials; b) at shipping of the prepared products

Рис. 1. Схема логистического потокового процесса ТГК предприятия: а) при приеме сырья; б) при отгрузке готовой продукции

In a transport-freight complex it is necessary to count by the boundaries of logistical flowing process to count the phase space, where the change of the state of flow within the limits of one form of flow (technological process) or at transition from one form of flow in other (transformation of material

flow into financial flow) takes place. Thus the processes of various forms of circulating capital come forward as an economic flowing process.

Estimating the existent possibilities of optimization of flowing process, we will note that at the change of limitations on its parameters, the value of optimum in general case will change. Consequently, the instruments for optimization of integrate flowing process are both the parameters of (concrete) flow itself and flowing process and parameters of flow processes communicated with it.

Otherwise speaking, the optimization of material flow must be carried out not only through the parameters of the same material flow (it often brings to the use of the enough limited instruments and to achievement only one of local extreme results), but also with the use of parameters of all flow processes linked with it functionally.

Thus, management by both separate flowing processes and their aggregate must be estimated due to the parameters of the separately taken flow processes; parameters of integrate flow process and flowing process (that is, at the expense of the integrate flow process and flowing process of circulating capital); limitations on the parameters of flow processes; functional communications between them.

The function of optimization or management by integrate flowing processes can be presented in the following kind:

$$P(t, s, c, \phi) = Z \left\{ \begin{array}{l} [a_1(t, s, c, \phi), a_2(t, s, c, \phi), \dots, a_i(t, s, c, \phi); f_1(a_1, a_2), f_2(a_2, a_3), \dots, f_{n-1}(a_{i-1}, a_i)], i = 1 \dots n \\ [u_1(t, s, c, \phi), u_2(t, s, c, \phi), \dots, u_j(t, s, c, \phi); f_1(u_1, u_2), f_2(u_2, u_3), \dots, f_{k-1}(u_{j-1}, u_j)], j = 1 \dots k \\ [g_1(t, s, c, \phi), g_2(t, s, c, \phi), \dots, g_\xi(t, s, c, \phi); f_1(g_1, g_2), f_2(g_2, g_3), \dots, f_{l-1}(g_{\xi-1}, g_\xi)], \xi = 1 \dots l \\ [V_1(a_1, u_1, g_1), V_2(a_2, u_2, g_2), \dots, V_\beta(a_i, u_j, g_\xi)] \end{array} \right\} \quad (2)$$

where:  $P$  – having a special purpose function of flowing process;  $Z$  – function of optimization of flowing process;  $a_i$  –  $i$ -parameter of flowing process of material traffic;  $f_n$  –  $n$ -function of interaction of flowing processes of material traffic;  $u_j$  –  $j$ - parameter of flowing process of motion of documents;  $f_k$  –  $k$ -function of flowing interaction of the processes of motion of documents;  $g_\xi$  –  $\xi$ -parameter of flowing process of motion of information;  $f_l$  –  $l$ -function of interaction of flowing processes of motion of information;  $t, s, c, \phi$  – temporal, spatial, quantitative and phase the variables accordingly;  $i, j, \xi$  – amount of parameters of flowing processes of material traffic, motion of documents and motion of information accordingly;  $n, k, l$  – amount of functions of interaction of flowing processes of material traffic, motion of documents and motion of information accordingly;  $V_\beta$  –  $\beta$ -function of direct and reverse co-operation of integrate flow processes of material traffic, motions of information and motions of documents.

The executed investigations provide a basis for development of methodology of forming and optimization of logistical chains of material traffic in the transport-freight complexes of enterprises.

### 3. CONCLUSIONS

1. It is determined, that the interactions of flows of logistical chain, built on community of production interests, must have the uniting economic basis. The flowing presentation of circulating capital is taken as such economical basis.

2. A new approach to the decision of task of optimization of co-operation of flow of logistical chain, forming the integrate flow process, is based on its consideration as a flowing process reflecting the qualitative changes of every type of flow. Thus, functioning of flowing process is examined in space of four variables: spatial, temporal, quantitative and phase.

3. The phase space of every logistical flowing process is the technological process of realization of its functions and determining the parameters of spatial, temporal and quantitative signs.

4. Optimization of logistic integrate flow process must be carried out through the parameters of flowing process of material traffic, as well as the parameters of all flowing processes linked with it functionally.

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