IMPACT OF CAR FLOW DISORGANIZATION ON CAR FLEET MANAGEMENT METHODS

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ABSTRACT

The methodological approach of professor P. A. Kozlov [e.g. 3, 4] to study the interaction of flow and channel is applicable to empty car flows in the transport system. Analysis of the current stage of transport market development in environment characterized by surplus of fleet, shows that eliminating disorganization of empty car flow through their routing by owners of rolling stock will improve the quality of services provided to shippers of Kuzbass region. It is easier to manage organized car flow for both the carrier and the owner of the cars. This article uses an unconventional approach to improve the utilization of rolling stock. The objective of the author is to study stages of transport market development, disorganization of car flows, dependence of routing on disorganization of car flows. To do this, the author uses analysis, comparative method and evaluation approach.

Keywords: disorganization, channel, bunker, three stages of development, car flows, Kuzbass region, car turnover.

Background. *Structural units of JSC «Russian Railways», and industry expert scientific community have been trying to solve the problem of efficient use of rolling stock. There is an urgent issue of surplus of gondola cars on the network of the carrier, which has a negative effect on all participants in the transport rail market, operational and economic performance of the rolling stock is reduced. The goal is to reduce the load on the infrastructure of the carrier and to improve the quality of rolling stock use. This purpose, in particular, is committed to the methodological approach of the scientific school of professor P. A. Kozlov, according to which currents of car flows are moving in a channel having its organizational and management schemes. Moreover, ratio of currents, organized by the operator, which are characteristic of new market environment and disorganization of car flows is of particular relevance.*

Objective. *The objective of the author is to study stages of transport market development, disorganization of car flows, dependence of routing from disorganization of car flows.*

Methods. *The author uses analysis, comparative method and evaluation approach.*

Results. *Disorganization of car flows is ratio of the number of cars ordered by criteria of car flow, to their total number in the current of a certain direction. In other words, the author proposes the concept of disorganization as a degree of car flow separateness.*

Considering the car flow disorganization on the criterion of car's belonging to the operating company that is the most important in universal transportation, we can give an analog comparison with the Soviet system, the inventory fleet. Former inventory park on the criterion of car's belonging was fully organized, but with the transfer of gondola cars fleet to operating companies disorganization repeatedly increased, the transport network can no longer cope with such a lightly managed car flow. The table 1 shows operating parameters of gondola cars fleet on the West-Siberian Railway during formation of private operating companies, and Pic.1 shows areas of emergence of fleets of empty cars.

The total loading of gondola cars of working fleet on the network of the carrier is 510 000 gondola cars per month, the daily average of 17 000 cars per day, of which 40% (7 000 cars / day) – loading of the West Siberian Railway of Kuzbass region. Loading of Kuzbass region is aimed at both the domestic market and export to the ports. Operating domain Northwest-Kuzbass in this sense is the most revealing. Daily from Kuzbass to ports of October Railway about 1 000 cars are shipped, and to the West in general (West – Railways to the left relative to the West Siberian railway) more than 1 500 cars are shipped, depending on the needs of production. The table 2 presents data on the entry of empty gondola cars on the West-Siberian Railway in the first half of 2014.

Disorganized car flow at the entrance to the region of Kuzbass cannot be distributed, mixed routes need to be sorted, or created at the station, where there are applications for all operators on the train. Some operators will exceed loading plan agreed in the application form GU-12, others will underfulfill it.

Scheme of empty cars formation areas
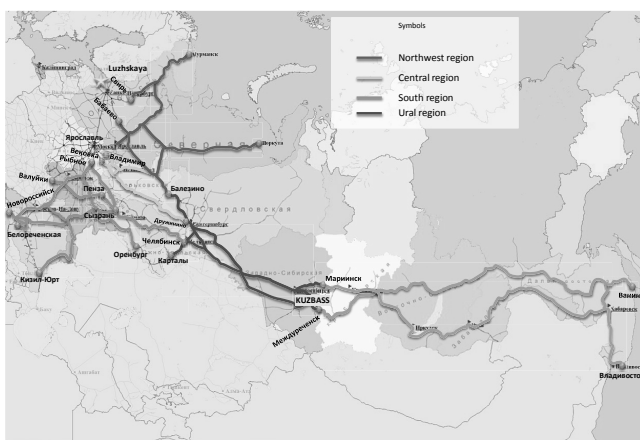
Pic. 1. Scheme of empty cars emergence areas.

Main performance indicators of Kuzbass region in 2008-2013.

Indicators	2008	2009	2010	2011	2012	2013
Loading a day on average, cars	8 949	8 639	8 597	8 888	9 002	8 943
Loaded total, thousand cars	3 266	3 153	31 137	3 244	3 285	3580
Average loading of coal per day, cars	7 257	7 275	7 188	7 429	7 609	7 600
Reception of cars	12 305	10 919	11 173	11 553	11 802	11 411
loaded	5 213	4 109	4 607	4 982	5 006	4 701
empty	7 092	6 810	6 566	6 571	6 796	6 710
Operating car fleet	23 911	40 123	41 810	43 477	47 451	52 258
Layover of local car	3,92	68,45	68,75	67,04	65,83	74,39
Daily average availability of gondola cars	7 921	8 361	5 752	17 353	21 907	26 241

Entrance of empty gondola cars into the area of West–Siberian Railway

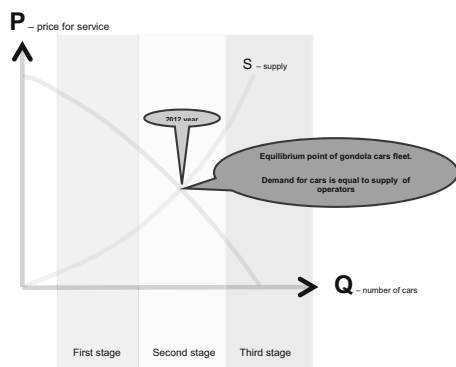| Company	Entrance of empty gondola cars by owners 2014, cars						
Operator / month	January	February	March	April	May	June	average
JSC «PGK»	1294	1389	1437	953	1155	1162	1232
JSC «FGK»	1505	1572	1602	1554	1610	1472	1553
CJSC «NTC»	601	590	427	455	482	559	519
LLC «ZapSib-Transservis»	451	414	313	386	356	332	375
LLC»TK Novotrans»	625	795	859	813	820	856	795
JSC «NPK»	275	290	259	280	270	222	266
JSC «SUEK»	190	170	189	205	200	198	192
LLC «Mechel-Trans»	81	74	71	104	80	77	81
LLC «RG-Trans»	194	200	180	137	142	154	168
LLC «RT-operator»	82	88	71	94	150	267	125
LLC «UGMK- Trans»	295	302	218	342	330	403	315
CJSC «TalTEKTrans»	125	115	117	147	145	151	133
LLC «UVZ-Logistik»	210	200	136	229	233	164	195
Other	832	852	901	805	812	951	859
TOTAL	6760	7051	6780	6504	6785	6968	6808

The system of overall fleet operation when empty cars return is outdated. It is necessary to organize the incoming flow, to manage it. For example, a disorganized stream of car flows in the channel enters the West-Siberian railway. Some operators are clearly «overdone» with the number of cars for loading routine, their fleet is not in demand. In route, moreover, there are more mixed trains with «surplus' operator, it starts to take out foreign amounts, and then cars of another operator, who sent them under its own application form GU-12, become not in demand. A bulk of cars is formed before the loading station, extra car units are sent to adjacent roads. Since trains are mixed (in which there are cars of different operating companies), then they cannot be controlled in unison, it is difficult to identify an operator without applications and set aside extra cars, not the cars of those companies which conscientiously distribute their fleet.

Pic. 2 shows a graph of supply and demand in the provision of transport services by operating companies.

The first stage. Growth of industry. Economic recovery, increasing demand for transportation of goods to ports and enterprises. There is a shortage of cars. Scheme of the carrier's operation at the same time is illustrated by Pic. 3.

With this scheme, all empty car flow after unloading with disorganization ρ_{in1} is accepted for carriage on private tracks (hereinafter – PT) with input disorganization ρ_{in2}. The network operates as a channel, there are no limitations on carrying capacity. The noise of the channel ρ_2 is imposed on the car flow and the car flow disorganization ρ_{out2} gets on private tracks, then with disorganization ρ_{out3} – for loading. At all stage of the transportation process there is no mass gathering of cars. They arrive for loading and are in demand.

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P – price for service

S – supply

2012 year

Equilibrium point of gondola cars fleet.

Demand for cars is equal to supply of operators

Q – number of cars

First stage   Second stage   Third stage

Pic. 2. Chart of demand and offer of transportation services.

The second stage. Market saturation with cars. 2007–2012 years.

Access to the market of independent operators, process of complete transfer of rolling stock fleet to private companies, shippers demand for transportation exceeds supply. Operating companies actively buy cars in leasing, the total fleet increases. Operators distribute cars themselves. Distribution of the transportation market on the principle of « operator carries his own cargo».

With the scheme of Pic. 4 whole empty car flow after unloading with disorganization ρ_{in1} is accepted for carriage with disorganization ρ_{in2}, network is unable to process, ship all accepted for transportation empty car flow, abandoned trains appear. The network starts to work as a bunkerr, an empty gondola car fleet with disorganization ρ_{in2} is transferred to it, all applications for the transportation of loaded cars are accepted, but the network can not realize them – at loading places there is a shortage of gondola cars, at unloading places there are not problems with shipment. The most sensitive issue is abandoned trains with the appointment of cargo to ports.

The third stage. Promising option for the period of fierce competition and surplus of gondola cars fleet (Pic. 5).

Operating companies working on the divided transport market. Opportunity to improve logistics schemes is achieved mainly with change of owner- cargo owner.

At this stage, the carrier introduces methods of fleet management, taking into account the situation

with requests for transportation in the form GU-12, limited admission of cars for transportation. The new system can be represented as a «bunker- channel-bunker».

The first stage option was used with a deficit of the fleet, where the main task is to quickly deliver cars to the loading place, channel capacity is adequate to available fleet, each empty car is accepted for carriage. All car flow can be considered conditionally organized, because at this moment many factors of disorganization are absent (until there is inventory fleet).

The second option appears when the rolling stock is enough, the network becomes a bunker and is not able to handle the whole disorganized stream. There is a need to organize the flow along the line. Bottlenecks are unloading stations (65% – ports), they should be considered as channels. At loading points cars also do not stagnate: the whole incoming car flow is immediately loaded, they also turn into channels. Bunker in the system is a network, limit capacity of which is carrying capacity.

The third stage will come, or, according to experts of JSC «Russian Railways» has already appeared at the fleet surplus when there is an economic downturn, the demand for transport services is lower than supply. Carrier establishes rules of conduct of operators in the transport market. In this case, it is necessary to use the bunker at unloading stations, acceptance of empty cars for transportation and to have a supply of cars of a private fleet at loading stations to prevent the shipment of foreign volumes by competitors operators. Then the network will be a channel.

Pic. 6 demonstrates the channel, where in the first case there is a scheme with disorganized car flow when gondola cars of each owner move by themselves, in the second – cars of the largest operators move in organized currents of car flow. Ordered currents are handled quickly.

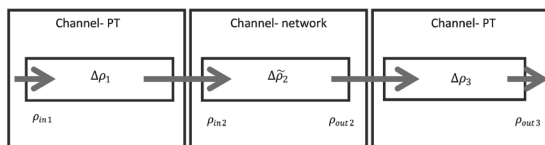*K is a number of cars in the channel with disorganized car flow;*

*K * is a number of cars in the channel with organized currents of car flows;*

$\mathrm{N_i}$ *is a number of currents of car flows;*
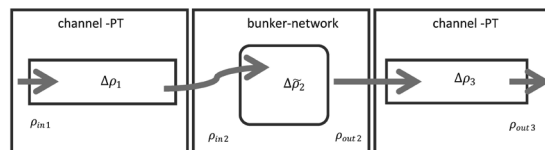
$\mathrm{N_{tot}}$ *is a current with cars of the smaller operators.*

At the organized flow large operators, and they are 80% of the fleet, are present with their own currents in the general channel, and each of them can be speeded up / slowed for efficient fleet management. The other 20% -small operators also benefit, as the organization
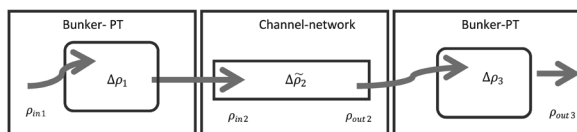
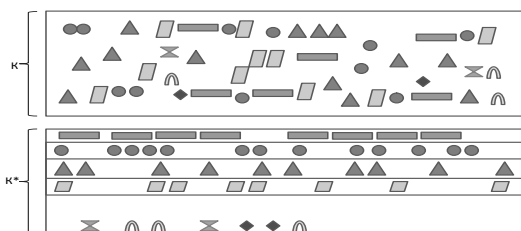**Pic. 3. Scheme of traffic flows at the first stage.**

Channel- PT   Channel- network   Channel- PT

$\Delta\rho_1$ $\Delta\tilde{\rho}_2$ $\Delta\rho_3$

ρ_{in1} ρ_{in2} ρ_{out2} ρ_{out3}

Pic. 4. Scheme of car flows at the second stage.

channel -PT   bunker-network   channel -PT

$\Delta\rho_1$ $\Delta\tilde{\rho}_2$ $\Delta\rho_3$

ρ_{in1} ρ_{in2} ρ_{out2} ρ_{out3}

Pic. 5. Scheme of car flows at the third stage.

Bunker- PT   Channel-network   Bunker-PT

$\Delta\rho_1$ $\Delta\tilde{\rho}_2$ $\Delta\rho_3$

ρ_{in1} ρ_{in2} ρ_{out2} ρ_{out3}

Pic. 6. Examples with disorganized car flow (K) and channels with organized currents of car flows (K *)
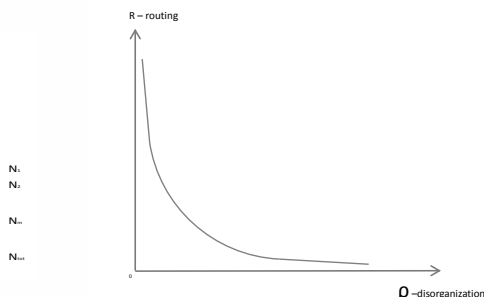
Pic. 7. Dependence of car flow disorganization on routing.

of car flows will lead to an overall increase in the speed of movement of cars in the channel. And $K < K^*$, i. e. channel with organized currents handle more cars than disorganized car flow. At the maximum load it is able to quickly handle cars due to released reserves.

Cars of operators who have denials from shipment or who with intent applied for many cars for loading, may put out of the motion, and the operator at a reduced rate pays for layover of cars on public tracks. Planned layover is profitable for both the carrier and the operator. If possible, the operator can divert part of the current and will manage the process so that not to allow the downtime in gondola cars in trains, put aside motion. Nothing prevents from developing additional forms of relationships with the railway to achieve common goals. For example, to get from it guarantees prohibiting the shipment of own volumes by foreign operators and not filing claims for delay in delivery of the car of the operator to the carrier.

The idea of the author to use a scientific approach to the study of fragmentation on owners of car flows on the example of the operating domain Kuzbass – North-West was actively supported at the Conference on train traffic safety (Moscow, MIIT University, October 26–27, 2013.). The author proposed a more efficient use of the rolling stock by reducing disorganization of incoming flow and via structural changing of empty car flows towards Kuzbass.

In a comparative analysis of three stages of transport market development it is possible to identify the most stable dependences of car flow disorganization from routing. Ordered movement of car flows of operating companies in currents of their own formation reduces disorganization and facilitates the work of the carrier. The higher is the level of routing, the lower is disorganization of car flow (Pic. 7).

Conclusions. Enlargement of car flows and formation of routes according to belonging of cars to the operator enables to order entrance of gondola cars on the West Siberian Railway. Shippers are guaranteed to get necessary rolling stock and loading stations will not be clogged with «garbage» – unused gondola cars of different operators. Loading stations do not have to play the role of marshalling yards and shape for loading by different shippers cars of different operators, they will be able to work accurately and efficiently perform its obligations of the carrier.

Rolling stock operators are interested in routing of own cars and partial consolidation of own rolling stock with other operators to accelerate car turnover. They can forward them to the route, set aside in the layover. There will be control mechanisms for own fleet. If own gondola cars get in mixed route, the ability to manage the fleet for them is reduced to zero. Organization of car flows on the basis of channel methodology will allow, as it seems, to increase daily yield of gondola cars, to strengthen competition in the transport market, to reduce administrative costs created by disorganization of car flows.

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