

The scopes of rational using of road and rail transport while delivering lime bricks in Ukraine

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Abstract – The challenge of transport mode choice is one of core logistics tasks. The plenty of solutions of this task is based on the main features of transport and can not be used for specific situations effectively. Researching of delivery variants of lime bricks is actual seeing rapid development and possibility of using diverse transport packaging.

Equivalent distance calculation allows to determine the scope of using rail and road transport. In contrast to the existing approaches of calculating of equivalent distance, this paper is proposed to use customer's cost as criterion of transport mode choice, including immobilisation cost while transporting goods.

Key words – Customer's cost, road, rail, equivalent distance.

I. Introduction

Each transport mode has its own advantages and disadvantages, as well as road and rail. However, as a rule, these features are common and do not allow to make a coherent decision on the transport mode choice. Factors identification, that influence the choice of road and rail transport modes, will improve the efficiency of the transportation process by choosing rational technology. Generally, cargo sort is the key factor during choosing the transport mode [1, 2]. Based on this revision of the factors of transport mode choice is advisable to carry out research for certain cargo type.

II. Research

Transportation of building materials, as well as any other materials are had its own features. These directly affect to the transport process technology. Simultaneously, timing of building works depend on directly the materials delivery timeliness. As a result of the rapid development of building materials, it is increasing the numbers of transport packaging that could be used for the transportation of these goods. As a consequence of it, there are increasing scopes of rational using of different transport mode, including road and rail. Selecting the rational transport mode will allow to optimize transport costs of transport services customers.

The aim of this paper is to investigate the factors of transport mode choice and to determine areas of rational using of road and rail transport while delivering lime bricks in Ukraine.

As a criterion for the efficiency of the transport mode choice are encouraged to use the customer's cost, which allows to take into account immobilization cost while transporting cargo.

Transportation time of rail as more as by road. Therefore, transportation time is an important one to

considerate in the calculation of the customer's cost for cargo delivery. The inclusion immobilization costs will take into account the delivery duration by road and rail.

The objective function of the researched system is characterized by the following formula:

$$C_{cust} = C_{tran} + C_{Lo-Unlo} + C_{im} \rightarrow \min_{x \in \Omega \subset R^n} \quad (1)$$

$$\Omega : Q_f^+ \leq Q_f \leq Q_f^{++} \quad (2)$$

$$S_{cargo}^+ \leq S_{cargo} \leq S_{cargo}^{++} \quad (3)$$

$$T_{1km}^+ \leq T_{1km} \leq T_{1km}^{++} \quad (4)$$

$$l^+ \leq l \leq l^{++} \quad (5)$$

Where C_{cust} is customer's delivery expenditures, hrn; C_{tran} is transportation cost, hrn; $C_{Lo-Unlo}$ is load and unload operation cost, hrn; C_{im} is immobilization cost, hrn; Q_f is cargo amount, ton; S_{cargo} is cargo cost, hrn; T_{1km} is transportation rate, hrn/km; l is transportation distance, km.

Data of model had been formed by surveying experts and statistical data processing of Corporation "Kharkiv Building Material", which uses a road and rail transport while delivering lime bricks in Ukraine. For the calculation was used programme Microsoft Excel. Automation of calculation makes it possible to determine the value of the customer's cost, depending on the selected transport mode, as well as to carry out the monitoring of other factors model.

The experimental conditions were adopted by the following: transportation is provided within Ukraine, cargo transported into universal vehicles and wagons, the road and rail vehicles' capacity are 20 tons and 40 (60) tons in accordance. The rail wagons are owned by rail enterprises.

Expenditures while transporting cargo by road transport at the site from a rail station to consignee had been calculated based on transportation rate for a work hour.

As shown in Figs. 1 and Fig. 2, customer's cost depends on the transportation distance and changes from transport mode.

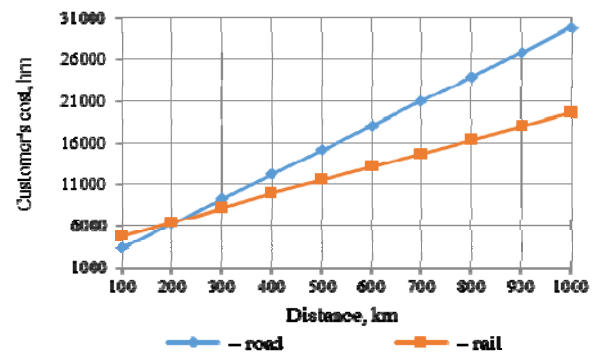


Fig. 1. Customer's costs while transporting cargo by road (A) and rail (Z) in Ukraine without consignee's rail siding, with the transportation distance (cargo amount 40 tons)

In addition to the results illustrated in Fig. 1, when transporting 40 tons of cargo over the distance of no more than 200 km it is appropriate to use road transport, but when transporting 60 tons of cargo it is better to use rail

transport for distance no more 160 km. If transportation distance is more, it is better to use rail transport for building materials transportation in Ukraine without consignee's rail siding.

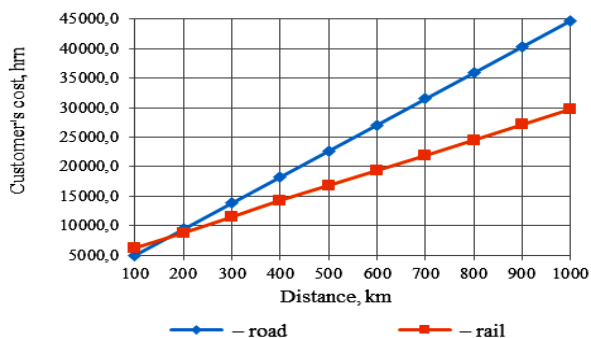


Fig. 2. Customer's costs while transporting cargo by road (A) and rail (Z) in Ukraine without consignee's rail siding, with the transportation distance (cargo amount 60 tons)

The intersection point of two lines indicates the same costs for the customer. This point can be called an equivalent distance point, it means that it is the same for enterprises either to use road or rail transport. As a result of received dependencies it is possible to determine an equivalent distance depending on various selection criteria of road and rail transport. There were made the experiments of the equivalent distance determination depending on different factors as such as cargo amount, transportation rate of road transport. Table 1 presents the equivalent distance values depending on the cargo amount.

TABLE 1
THE EQUIVALENT DISTANCE DEPENDING ON CARGO AMOUNT

Cargo amount, ton	Cargo cost, hrn	Transportation rate of road transport, hrn/km	The equivalent distance, km
with consignee's rail siding			
60	630	14	115
80	630	14	146
100	630	14	110
120	630	14	102
without consignee's rail siding			
60	630	14	160
80	630	14	165
100	630	14	195
120	630	14	180

If cargo amount is rising, the equivalent distance is reducing. That is the scope of rational using of road is falling. If a consignee has an own rail siding, equivalent distance is bigger than whilst consignee do not has own rail siding. Determinations of the equivalent distance depending on transportation rate of road transport are identified in Table 2. If transportation rate of road transport is rising, equivalent distance is reducing. The resulting numeric values can be used in industrial transport companies, who need to transport building materials in Ukraine.

TABLE 2
THE EQUIVALENT DISTANCE DEPENDING ON TRANSPORTATION RATE

Transportation rate of road transport, hrn/km	Cargo cost, hrn	Cargo amount, ton	The equivalent distance, km
with consignee's rail siding			
12	630	40	220
14	630	40	200
16	630	40	100
without consignee's rail siding			
12	630	40	360
14	630	40	280
16	630	40	170

This will select the appropriate transport mode for transportation of building materials based on the criterion of customer's cost, taking into account the costs associated with the funds immobilization during delivering.

Conclusion

The scopes of rational using of road and rail transport have been determined while delivering lime bricks in Ukraine for two variants: with consignee's rail siding and without consignee's rail siding. As a criterion of transport mode choice is proposed to use customer's cost and determined as a result the equivalent distance.

It is rational to use road transport, if transportation distance no more 200 km for average factors value of experiment and provided with consignee's rail siding. However, if consignee do not has own rail siding rail transport rationally to use for distance about 160 km.

The equivalent distance is reducing, when cargo amount and transportation rate of road transport is rising. Further research on the scopes of rational using of road and rail transport may extend factors that affect the equivalent distance.

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