Economic Evaluation of Variants of Allocation of Functions and Zones of Control Between the Staff in Logistics Systems

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Abstract— **Technical and technological development of logistics systems leads to the necessity for revision of staff's functions. Some functions could be given to the machines. That's why the staff can do many different functions. We can determine the problem of rational allocation of functions and zones of control between the staff, while we can't overload the staff and must provide the best conditions for logistic systems' indications.**

Keywords — economic evaluation, capital expenditur, additional operating costs, evaluation of effectiveness of efficiency, evaluation of measure's efficiency, logistics systems.

I. Development of modern systems

When large logistics objects are created, there is the necessity for allocation of functions and zones of control between the staff without excess of permissible standards of wokload [1-12].

Usually the post of the assistant or the operator is added in case of excess of permissible standards of workload. But there is no theoretically explained decisions for allocation of functions and zones of control between them. It leads to the realization of not the best and hardly corrected project decisions. And that's why there can be workload, difficulties and mistakes in the staff's work. Working time expenses for coordination of the staff's activities aren't considered. Meanwhile evaluation and forecast for the condition of the system and instructions for assistants aren't considered, too.

So then there is the necessity for method of allocation of functions and zones of controls between the staff in logistic systems depending on permissible standards of wokload, features of object, technology, sizes of loading and discharge [13-19].

II. Theoretical positions

Project decisions of this research are one-stage and they require one-time costs. These project decisions keep constant results and they have small value of calculation horizon (not

more than 3 years), that's why discounting of results isn't strongly recommended for being done, because there are not reliable forecasts of pricing.

Integral effect (net income – NI) is determined by the formula:

$$S_i = \frac{S - S_d}{E} - K_d,$$

S – the saving of operating costs;
S_d - extra operating costs;
K_d — extra one-time costs;
E – discount rate.

The index of cost-effectiveness S_κ is determined by division of the amount of result by the size of costs (Capital expenditures):

$$S_\kappa = \frac{S - S_d}{E \cdot K_d},$$

If S_i > 0, than S_κ > 1, that means the project is economically efficient.

Internal discount rate (income) is:

$$E_{in} = \frac{S - S_d}{K_d},$$

The time period of cost recovery is determined by the formula:

$$T_c = \frac{K_d}{S - S_d},$$

Kd - extra one-time costs;
S – the saving of operating costs;
S_d - extra operating costs.

The project is efficient, if the time period of cost recovery is not more 6,7 while E=0,15.

III. Method of calculation

One-time costs. Costs for projects works according report data K_{pr}.

Costs for the professional training of the staff:

$$K_{pr} = (N \cdot C) \cdot 10^{-3} \text{ thousand rubles.,}$$

N – number of operating staff, prepared for training

C – costs for training of one operating worker, rub.

Costs for buying, setting and installation of equipment of automated workplace for workers of logistics objects:

$$K_o = K_{AW} + K_b + K_{CC} + K_i,$$

K_{AW} – costs for buying and setting automated workplace;

K_b – costs for computer systems for workplace;

K_{CC} – costs for increasing of communication channels;

K_i – costs for power supply devices

Current costs. The fund of time-bonus base salaries of logistic systems' staff is consist of permanent part (tariff rate per hour), bonus part and compensations:

$$AFS = (S_t + K_{bp} + K_{com}) \cdot k \cdot 12 \cdot 10^{-3} \text{ thousand rubles.,}$$

S_t – tariff rate per hour;

K_{bp} – bonus part;

K_{com} – compensations.

k– coefficient of payments for social needs.

Depreciation:

$$E_{extra} = (E_m + E_{com} + E_{extra}) \cdot 10^{-3}$$

E_m - depreciation charges for equipment;

E_m - depreciation charges on the communication line;

E_{extra} - additional depreciation.

Expected saving of current costs, calculation of factors' evaluation in suggested measures' system. Saving according to increasing of railcars' transit, because of the acceleration of the turnover of common number of railcars.

$$K_{tr} = U \cdot Q \cdot 24 \cdot \gamma_{тр} \cdot e_{r-w} \cdot 365 \cdot 10^{-3} \text{ rubles}$$

U – average work of all railcars per day;

Q – the turnover of one railcar per day;

24 – number of house per day;

γ_{tr} – coefficient of the acceleration of the turnover of common number of railcars because of increasing of transit;

e_{r-w} – consumption rate for 1 railcar and 1 worker.

Every variant of allocation of functions and zones of control is provided extra number of transit freight trains. It considers not exceeding of permissible load of the operating staff.

The saving of the fund of salaries:

$$\Delta E = (V_2 - V_1), \text{ rubles}$$

V_2 – the fund of salaries of the operating staff for now;

V_1 – the fund of salaries of the operating staff for the proposed variant of allocation of functions and zones of control.

Reduction of operating costs because of increase of traffic's safety.

The condition of not exceeding of maximum acceptable level of workload is kept as a result of realization of proposed variants of allocation of functions and zones of control. Overload can lead to the fatigue of the staff, and it can be lead to professional illnesses of the staff, that's why more their mistakes can be in their work [20-25].

$$Э_b = C_k \cdot \varphi \cdot \beta \cdot 10^{-3} \text{ thousand rubles}$$

C_k – losses because of the operating staff's mistakes;

φ – coefficient of losses because of workers of organization of train traffic;

β – coefficient of losses because of defective work of the operating staff.

IV. CALCULATION OF EXPECTED ECONOMIC EFFICIENCY

Baseline data.

Consumption rates:

- costs for one operating worker's training, 15000 rubles.
- costs for buying and setting automated workplace, 20000 rubles
- costs for supplying workplace by computer systems of EC, 10000 rubles
- costs for increasing of communication channels, 5000 rubles
- costs for improvement of power supply devices, 2000 rubles
- consumption rate for 1 railcar and 1 worker, 372,3 rubles.

Indicators of stations' work

- average workload of railcars per day, 875 railcars;
- workload of all railcars, 4,2 days;

Expert's evaluations of increasing of indicators of operational work

- coefficient of acceleration of workload of railcars because of increasing of transit, 0,9;
- losses because of wrong work of the operating staff of station, 25000 rubles;
- coefficient of losses because of workers of organization of train traffic, 1,01;
- coefficient of losses because of defective work of the operating staff, 1,011;
- tariff rate of the station attendant per hour, 91 rub/h;
- tariff rate of the operator per hour, 71 rub/h;
- bonus part, 10%;
- compensations for night-time work, 8%;
- coefficient of payments for social needs, $k_{SN} = 1,307$.

Depreciation charges

- Depreciation charges for machines 12%;
- Depreciation charges for communication lines 5%;
- Extra depreciation charges 2,5%.

Number of necessary operating staff

- Number of the trainable operating staff, 4 persons.

Determination of one-time costs. Expenditures for scientific projects and other projects K_{pr} are taken according reports 50000 rubles. Expenditures for professional training of extra staff and new ones:

$$K = (4 \cdot 15) \cdot 10^{-3} = 60$$

N – number of the operating staff, 4 persons

C – costs for training of one operating worker, rub.

Costs for buying and setting equipment:

$$K_o=20000+10000+5000+2000=37000 \text{ rubles}$$

The annual fund of salaries (AFS) of the attendant of the station and the operator.

Hourly rate of the attendant of the station is 91 rub/h and the operator's one is 65 rub/h now. Next calculation is average month salary of both (15 shifts, 12 hours each):

$$AFS=(3_{st}+K_{pr}+K_{comp}) \cdot k_{SN} \cdot 12 \cdot 10^{-3}=$$
$$(16380+1310,4+1638)+(11700+936+1170) \cdot 1,307 \cdot 12 \cdot 10^{-3}=397600 \text{ rubles.}$$

Depreciations

$$E_{extra}=(E_m + E_{com} + E_{extra}) \cdot 10^{-3} = (12000+5000+2500) \cdot 10^{-3} =17500 \text{ rubles}$$

Evaluation of efficiency of proposed activities

Economy according to increase of transit of railcars' traffic per year because of acceleration of all freight railcars:

$$K_{tr}=875 \cdot 4,2 \cdot 24 \cdot 0,9 \cdot 372,3 \cdot 365 \cdot 10^{-3}=29109500 \text{ rubles}$$

Each variant of allocation of functions and zones of control has extra work, which can be done by some workers in his newly free time. And it doesn't overload the staff. The increasing of number of operations leads to increasing of station's work quantity.

Economy according to reduction of the fund of salaries. For the purpose of economy of the fund of salaries we can add functions of getting instructions and routes problems to the operator's job descriprion instead of hiring 2 extra workers. Then the workload of the attendant is 675 minutes, and the workload of the operator is 502,3 minutes, it is less than working norms. Economy of the fund of salaries ΔE will be

$$\Delta E=((231940,8+231940,8) - (231940,8+180964,8)) =799200.$$

Reduction of operating costs because of increasing of traffic's safety. The condition of not exceeding maximum permissible level of workload is done as a result of realization of proposed allocation of functions and zones of control. Reduction of operating costs because of increasing of traffic's safety is:

$$Э_b =25 \cdot 1,01 \cdot 1,011 \cdot 10^{-3} =25500 \text{ rubles.}$$

Next results were got as a result of the evaluation of economic efficiency (table 1)

TABLE I. THE INDICATORS OF THE PROJECT.

Indicators	Amount of thousand rubles.
Capital expenditures	97
Additional operating costs	415,1
Evaluation of the effectiveness of the proposed activities 1	824,7
Evaluation of the effectiveness of the proposed activities 2	29109,5

Integral effect (net income) is:

$$Э_{int} = \frac{824,7-415,1}{0,15} - 97 = 2633,6$$

The profitability index E_i:

$$E_i = \frac{824,7-415,1}{0,15 \cdot 97} = 28,1$$

Internal rate of return (profit) is:

$$E = \frac{824,7-415,1}{97} = 4,2.$$

Time of payback of the project:

$$T_o = \frac{97}{824,7-415,1} = 0,23 \, year$$

CONCLUSION

The duration of implementation of operators' algorithms is determined on the basis of algorithmization of functions of control.

The method of calculation of the operating staff's workload while allocation of functions and zones of control between them. It is done on the basis of rules according to types of logistic objects and workload.

Set of criteria for evaluation of variants of allocation of functions and zones of control was expanded.

This method of allocation of functions and zones of control between the staff can be used on different objects of transport taking into account characteristics of technology of work.

Acknowledgment

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