Modernization of the Transport Valuation Methods in Technological Means of Transport

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Abstract: Mongolia is importing and using machinery and equipment from developed countries in order to transport raw materials and minerals in mining, road and construction industry. In our country, there is no scientific based calculation of the cost per ton kilometer had developed in the frame of using heavy haul trucks.

In this paper, we are introducing our research that has conducted by using methodology of the scholars from developed countries.

Cost evaluation methodology was adopted and according to the condition of Mongolian road, construction and mining industry. On our new methodology constant and variable cost, costs related to loading and unloading are added.

In order to calculate the total cost, it is necessary to measure required loading and unloading time on each truck depending on their capacity.

We took the trucks such as HINO, CAT769D, HOWO, HYUNDAI to study and measure loading and unloading tasks.

The cost evolution was made by using the calculation software based on the developed methodology.

Data of loading and unloading process of construction materials was collected by using methods chronometric and expert analysis.

Finally average time required for transporting one ton material is calculated.

Key words: Expense, Road, Construction, cost, normative.

1. INTRODUCTION

The machines and equipment in construction and road in our country are imported from the market of developed country according to the market regulation and they are exploited widely. It is important to exploit the machines made by progressive technology and techniques properly adjusting them to the condition our country, to exploit them according to the given operation technology and to make choose and exploit properly according to their capacity.

The main goal of the technology is the general correct calculation methods to determine per t/km cost of the technological mean of transportation including the total necessary fixed and variable costs into it. Determining of per t/km cost of the technological mean of transportation is based on the current valid and basic norms and normative.
2. DISQUISITION

Machinery and equipment by Caterpillar (the USA), JBC (Britain), Hyundai, Daewoo (Korea), Komatsu, Hitachi (Japan), Volvo (Sweden), Liebher (Germany) and Russian and Chinese machinery and equipment are exploited in Mongolia. The exploitation modernization of the imported machinery and equipment above and the determination of per t/km costs provides with the possibility to effective exploitation of the machinery.

There had not been any detailed and used valuation of per t/km costs of machinery, equipments and technology in our country until 2000. However, the first methods to value per t/km cost of technological means of transportation exploited in the construction and road works was worked out and used in 2002. The calculation by this methodology is fairly complicated. According to these methods, the machine operation principle is divided too detailed, too many load rates were determined, per t/km working time was divided, also the load transportation expense were divided into all acts (driver’s salary, wear and depreciation, fuel expense, shift expense, repair and technical maintenance, expenses of the current repair, maintenance material expense, lubrication expense, taxation, insurance, extra expense) and after that per t/km expense calculation is interpreted. The recent per t/km valuation of technological mean of transportation in Russian Federation is comparatively easier.

The goal of our research is to adjust these methods of per t/km expense calculation of technological mean of transportation to the condition in our country and to make a decision on programming the calculation.

Our research base is the detailed valuation of the machinery and equipment costs that are widely used in the special use of construction and road works.

It is required to determine the necessary amount of per t/km expense calculation of technological means of transportation in the construction and road works and to calculate the time of some actions (for example, loading and unloading of the required loads).

The excluded costs of loading and unloading by machinery were included.

The study of methodology derived from the research on the recent valid per t/km valuation of the technological means of transportation in foreign countries gives opportunity to adjust this technology to the condition in our country and to have principle to program the calculation.

The formula to determine per t/km expense of technological mean of transportation is shown in the following way.

\[ Q = \sum_{i=1}^{n} f(E_i) \]  

(1)

Here, \((c)\) –kinds of expense.

These kinds consist of machinery wear depreciation, repair and technical maintenance, fuel and lubrication materials, shift supplement, expense of easy wear spear materials, tax, insurance, driver’s salary, assistant salary, and extra expense.

All these expenses can be divided generally into fixed expense and variable expense.
\[ Q = \sum_{i=1}^{n} f(E_i) = \sum_{i=1}^{n} f(C_i + V_i) \]  \hspace{1cm} (2)

Here:  
- \( C_i \) - fixed expenses  
- \( V_i \) - variable expenses

There is possibility to determine these expenses, but it is difficult to calculate some expenses connected with the time. It is necessary to include the per unit expense of loading and unloading without turning up the technology means of transportation of minerals and raw materials into the separate calculation. The percentage of the loading and unloading must be determined in the expense calculation. The time can be determined by the research of chronometrical and expert methods.

The economy effectiveness of the technological means of transportation is determined by the following parameters.
- Creation of the technological means of transportation - \( P_t \), t/km
  - Average run - \( K_{year} \), km  
  - Cost of 1 t.km - \( C_t \), tug/t.km  
  - Own investment, tug/t.km

The t/km of the creation as work performance of the means of transportation without change of year, season, month, days can be determined by the formula below.

\[
P_t = \frac{365 \cdot g \cdot \gamma \cdot V_t \cdot T_c \cdot \beta \cdot L_{cp} \cdot \alpha_n}{L_{cp} + t_{u-p} \cdot V_t \cdot \beta} \]  \hspace{1cm} (3)

Here:  
- the load-bearing capacity of the technology means of transportation  
  - \( g \) – Automobile load-bearing capacity, t  
  - \( \gamma \) - Coefficient of the load bearing capacity exploitation  
  - \( V_t \) - Average speed of transportation km/h  
  - \( \beta \) - Coefficient of the run exploitation  
  - \( T_c \) – Average time of the mean of, h  
  - \( L_{ave} \) – Average distance of the load transportation, km  
  - \( t_{u-p} \) – The time of unloading, h  
  - \( \alpha_n \) – Coefficient of the time exploitation of the mean of transportation

As shown here, the creation does not depend on the distance and time but on load-bearing capacity, coefficient of the load-bearing capacity exploitation, coefficient of the run exploitation, coefficient of the speed exploitation and the load and unload times.

The run can be determined by following formula, km

\[
K_{year} = K_{ave-ht} \cdot \alpha_n \cdot D_h \]  \hspace{1cm} (4)

Here  
- \( K_{ave-ht} \) – average run per time, km  
- \( K_{ave-ht} = T_c \cdot V_{ave-s} \)  
- \( D_h \) – time, hour  
- \( V_{ave-s} \) – average speed of transportation km/h
The average transport at speed can be determined by the time required for the loading and unloading techniques and organization, despite the move of the technological means of transportation.

The costs of the technological means of transportation are the parameter of the effectiveness. The prime cost and per t/km valuation of technological means of transportation of the are determined by machine wear depreciation, fuel and lubrication materials, repair and technical maintenance, shift equipment, fast wear spear materials, driver’s salary, tax, insurance, loading and unloading expense and extra expenses.

Determination of the expense of machine wear depreciation is calculated by per time percent according to the rule by the government of Mongolia.

The expense of fuel and lubrication material is determined according to the normative documents of the technological mean of transportation and it depends on the harsh climate in our country which becomes the reason of extra wear.

The repair and technical maintenance, shift equipment, fast wear spear materials; tax and insurance are determined by the normative by higher government and administrative organizations.

The driver’s salary is determined by the salary system approved in the scale of Mongolia in which the professional degree and art of the driver and professional feature are considered.

In the foreign developed countries, only the loading and unloading are considered as the extra fuel expense and other expenses are not included. We think the necessary expenses have to be included.

Per t/km cost of the technological means of transportation can be expressed by the following formula if we consider the conditions above:

\[ C = S_{dr} + C_F + C_{lab} + C_{rm} + C_{oe} + C_{wd} + C_{ee} + C_{lue} \]  

\[ S_{dr} \] - driver’s salary, tug
\[ C_F \] - fuel spend, tug
\[ C_{lab} \] - lubrication spend, tug
\[ C_{rm} \] - current repair and technical maintenance expense, tug
\[ C_{oe} \] - ordinary equipment expense, tug
\[ C_{wd} \] - wear depreciation, tug
\[ C_{ee} \] - extra expense, tug
\[ C_{lue} \] - loading and unloading expense, tug

The loading and unloading expense is determined in the following way.

\[ C_{lue} = C_{wd} + C_{oe} + C_{le} + C_{ews} + C_{see} + C_{uldr} + C_{rm} \]  

\[ C_{wd} \] - wear depreciation during the loading and unloading expense, tug
$C_{oee}$ - engine fuel expense during the operation of loading and unloading mechanism, tug

$C_{le}$ - lubrication expense of the main engine, tug

$C_{eews}$ - expense of the easy wear spear materials, tug

$C_{see}$ - shift equipping expense, tug

$C_{uldr}$ - driver’s salary during the loading and unloading, tug

$C_{rm}$ - current repair and technical maintenance expense, tug

The main thing in the calculation of these expenses is the determination of the loading and unloading time of each vehicle, in other words, consideration of the load-bearing capacity. For this purpose, it is needed to make research and experiment on the loading and unloading process of HINO, CAT769D, HOWO, HYUNDAI, the technological means of transportation exploited in Mongolia.

3. CONSEQUENCE

Chronometrical and expert analyze and research were made on the way of loading and unloading of construction filling materials of HINO, CAT769D, HOWO, HYUNDAI, the auto unload device as the technological means of transportation in Ulaanbaatar. The mathematical working out was made on the result of research and the average time of loading and unloading of one ton material was determined and as its result the credence variation coefficient found as 0.74 – 0.78.

The loading and unloading expenses were added in the valuation methods of the technological means of transportation of minerals, raw materials and materials in the road construction and mining fields and the valuation was made by the newly worked out calculation using program.

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