TRANSPORT AND MOBILITY

UDC 69

Altansukh T., Jamsran G. The current situation of the Ulaanbaatar Railway track distance service system

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Abstract. *Ulaanbaatar Railway, which operates rail transportation within Mongolia, has more than 16,000 employees. More than 3,100 employees are ready at any time of the day or night to maintain the track facilities, which is the basic structure of the railway, to ensure traffic safety. The organization is responsible for the safe transportation of thousands of lives and property worth billions of tugriks. Most road maintenance and repair work requires a large amount of manual labor, which is time-consuming, labor-intensive, productive and quality-intensive, and the regular work of road workers requires special vigilance in terms of the safety of continuous train service, which poses a very high risk to life and health. Thus, there is an urgent need to make work easier, increase the level of mechanization and improve the organization of labor management. The goal is to determine ways to reduce costs in the road sector, increase the level of mechanization and automation and free workers from dangerous and risky work and determine labor standards and organization of road work.*

Keyword*: brigade, mechanization, repair, maintenance, service.*

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I. INTRODUCTION

Over 80 years of development, the railway transport industry in Mongolia has carried out technical reforms. But depending on the investment, the conditions of the railway do not fully correspond to current requirements.

Today, repair work on the main structure is carried out by a semi-mechanized brigade. The organizational form of these railway track repair jobs is characterized by high labor intensity, low productivity, high workplace risk and high operating costs that must be addressed.

Over the past 5 years, the freight capacity of our country's railways has increased from 27.68 to 32.25 million tons. However, 766 km of the main railway track needs reconstruction. Therefore, improving the organization of railway track repair work has become an important issue for ensuring train safety and labor safety.

This article examined the current state of the railway industry, the organization of road repair work and the factors influencing them. The features and indicators of organizing work on repairing railway tracks in foreign countries were also studied.

II. DESCRIPTION OF METHODOLOGY

To solve the problem, a methodology was used to determine the level of mechanization of railway tracks.

Mechanization of production is the replacement of manual labor with machines, which is one of the main directions of introducing scientific and technological progress into production. The gradual introduction of mechanization is an important source of increasing labor productivity, increasing the output of industrial products, and saving labor costs. The level of mechanization of the main production is determined by the level of mechanization of labor SMT, the level of mechanization and automation of the production process Unpp.

$$\text{Smt} = \frac{\text{Chm}}{\text{Ch}} * 100\% \qquad (2.1)$$

Here: Smt - level of labor mechanization %

Ch_m - number of workers engaged in mechanized labor (persons)

Ch - total number of production workers (persons)

$$\text{Umpp} = \frac{\text{Tk} - \text{Tr}}{\text{Tk}} * 100\% \qquad (2.2)$$

Here: Umpp - level of mechanization and automation of production, %.

Tk - labor costs in the main production (persons/hour)

Tr - manual labor costs in the main production (persons/hour).

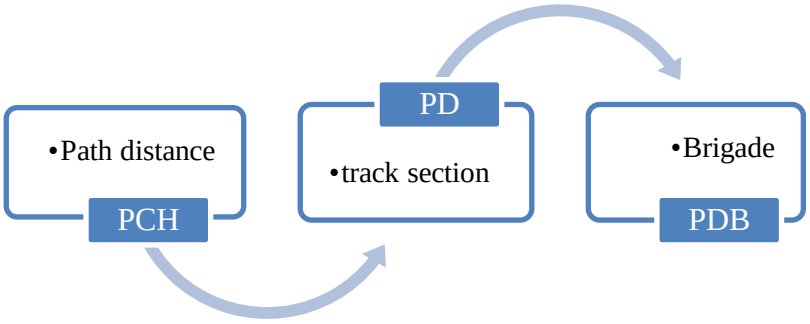
III. RESEARCH SECTION

A total of 4 accidents and 3669 minor safety violations were recorded in UBTZ in 2011-2023.

The state of organization of repairs on sections of track distances today:

1. A brigade of 12 workers maintains tracks with a total length of 24 km with 4-10 turnouts.
2. 2 brigades of 20 workers maintain tracks with a total length of 27-30 km with 25-30 turnouts.

3. 3 brigades of 25 workers service tracks with a total length of 38-45 km with 20-47



turnouts [1].

Figure 1. Organizational model of the current content of railway track units

Railway track maintenance works are carried out with manual labor. When calculating the workload, most of the work is for the installation of wooden blocks 55,684 people/hour (28.7%), the sealing of roads with electric screeds 34,681 people/hour (17.9%), and the replacement of wooden sleepers 19,127 people/hour. (9.87%), na pereuplotnenie sleeper – 16358 chel/chas (8.44%). [2].

Then, according to the formula, the level of mechanization of work is calculated:

$$C_{MT}=\frac{34}{269}*100\%=13\% \qquad (3.1)$$

General cost of labor and basic production will be:

Tz =103,037.8*7,083.3=729,847,648.7 person/hour

The cost of manual work on the main production will be:

Tr =101,340*7,083.3=717,821,622 person/hour

Then the level of mechanization and automation of production will be:

$$\text{Umpp} =\frac{729847648.7-717821622}{729847648.7}*100=2\% \qquad (3.2)$$

There are more than 300 types of road repair works. Transportation of materials for railway track, labor and earthworks are carried out using special equipment. However, there is a lack of special techniques for road repair in the railway track repair department. Since railway track repair works are performed in a semi-mechanized way using manual electric and

hydraulic tools, the level of mechanization of labor is 13%, the level of mechanization and automation of production is 2%, and 98% of the work is performed manually.

The following factors affect the cost of planned repair: when one sleeper is damaged, the labor cost of the repair increases by 3.72 per hour [3].

Table 1

Labor costs for damage to one sleeper

№	Railway track repair work	Unit of measurement	Working volume	Labor costs, person/hour	Number of employees
1	Unloading/loading sleepers	sleeper	1	0.462	2
2	Sleeper tip packaging	quantity	2	0.38	2
3	Replacing sleepers	sleeper	1	1.56	2
4	Repeated mowing	pogometer	1	0.23	2
5	Lifting seal	quantity	2	0.56	10
6	Direction of thrust along the path	pogometer	1	0.13	8
7	Laying wooden sashes	quantity	2	0.398	8
Total:				**3.72**	

Labor costs are calculated by comparing the average number of damages identified during 24 car trips over 1 year with the average number of trains traveling along the route over 1 month [4].

Table 2

Labor costs for road maintenance required for 1 km of railway track with wooden sleepers each time one train passes

№	Railway track repair work	Unit of measurement	Working volume	Labor costs, person/hour	Number of employees
1	Track lifting fusion	sleeper	0.85	0.02	10
2	Direction of thrust along the path	pogometer	0.04	0.005	8
3	Repeated mowing	quantity	0.0283	0.0035	2
	Total:			**0.2085**	

Results of the analysis of factors influencing the organization of labor in Path distance:

Factors affecting the organization of work were determined by an expert method with the involvement of 4 heads of subdivisions and 3 engineering and technical workers.

In some cases, it is necessary to estimate influencing factors that are not set in numerical form. In this case, the opinion of professional experts is used.

We received the conclusions of 7 experts for determining the influence of factors x_1, x_2, x_3, ..., on the quality of production. Each analyst ranked the impact of the object in decreasing order. Results are listed in tables and statistical indicators. In the study, the concordance coefficient W was used to determine the degree of reliability of expert opinions:

$$W = \frac{12S}{m^2(n^3-n)}$$

$$S = \sum_{i=1}^{n} \sum a_{ij} - \frac{1}{2}(n+1) \qquad (3.3)$$

The value of the concordance coefficient is within the range of $0 \le W \le 1$, and if it is closer to 1, the opinion of the expert is considered more reliable, and if it is closer to 0, it is considered less reliable. When estimating the coefficient (when $n>7$), the calculation value of the Pearson criterion will be used:

$$X_T^2 = m(n-1)W \qquad (3.4)$$

After finding the value X_X^2 from the table and the value q,f=n-1, under the condition $X_T^2 > X_X^2$, the expert's opinion matches.

Table 3

Expert assessment

№	Factor name	1	2	3	4	5	6	7	∑
1	Productivity of manual labor railway track repair	8	7	5	5	5	8	5	43
2	Lack of railway track maintenance equipment	7	8	6	7	6	8	5	47
3	Railway track repair work is not fully mechanized	6	5	8	7	5	7	8	46
4	Managerial approach	5	6	5	7	5	8	2	38
5	Supply of tools and materials for repair work	6	5	4	2	3	6	7	33
6	Railway track repair technology	8	5	8	7	5	3	3	39
7	Safety	4	5	5	5	6	8	5	38
8	Organization of routine railway track maintenance	7	5	7	8	8	6	1	42
9	engineering education	2	5	3	4	6	8	5	33
10	Equipment integrity	4	3	2	8	5	5	2	29
11	Brigade Commander Skills	6	2	3	5	7	5	2	30
12	Park update	6	7	5	6	7	6	5	44
13	Control system	6	7	6	6	7	5	7	42
14	Supply	3	5	4	2	6	5	1	26
15	Availability of repair shops	6	4	7	6	5	5	4	37
16	Engineers' responsibilities	7	5	6	5	7	6	3	39
17	Hardware backup	5	4	6	6	5	3	4	33
18	Insufficient use of technical and diagnostic tools	5	6	8	7	6	6	5	43
19	Updating the technical condition of railway tracks	6	7	7	6	8	6	7	47
20	Staff shortage	6	5	5	7	5	6	6	40

$$S=\frac{1}{2}\cdot 7\cdot(20+1)=73.5$$

$$S=(43-73.5)^2+(47-73.5)^2+(46-73.5)^2+(38-73.5)^2+(33-73.5)^2+(39-73.5)^2+(38-73.5)^2+(42-73.5)^2+(33-73.5)^2+(29-73.5)^2+(30-73.5)^2+(42-73.5)^2+(44-73.5)^2+(26-73.5)^2+(37-73.5)^2+(32-73.5)^2+(33-73.5)^2+(43-73.5)^2+(47-73.5)^2+(40-73.5)=25498$$

$$W=\frac{12\cdot 25498}{7^2\cdot 20^{3-20}}=\frac{305976}{391020}=0.78$$

$$X_T^2=7(20-1)\cdot 0.78=103.74$$

Thus,, $X_T^2= 103.74> X_X^2= 30.14$ - opinions of experts agree. The conditions are evaluated according to the criteria, so the experts are relatively unanimous. According to experts, the following factors have the greatest influence on organization and management.

Table 4

Ranking/frequency factors influencing the organization and management of repair railway tracks

№	Factors	Frequency	Ranking
1	Lack of railway track maintenance equipment	4	I
2	Updating the technical condition of railway tracks	4	II
3	Railway track repair work is not fully mechanized	3	III
4	Park update	3	IV
5	Productivity of manual labor railway track repair	3	V
6	Insufficient use of technical and diagnostic tools	3	VI
7	Organization of routine road maintenance	2	VII
8	Control system	2	VIII

The factor that most affects the organization of work in the railway track repair workshop shows that it is necessary to increase the level of mechanization due to the increase in the number of railway track repair machines and equipment.

In order to optimize the organization of the department's work, the following results were obtained during the individual interview in order to find out the factors affecting the difficulties in the work:

Managment structure

- Responsibilities are often duplicated.
- Complex structure due to low level of automation and mechanization.
- Railway track repair work is carried out manually by 116 road workers.

Railway track repair and maintenance

- Railway track repair and elevator repair work is carried out manually, so the labor intensity is high.
- Railway track repair work is carried out with hand tools, so quality requirements are not fully met and take a lot of time.
- Today's railway track work technology does not fully comply with the standard requirements of other countries, which are carried out using modern equipment.

Operation monitoring

- Activities are not fully standardized.
- Processing of measurement results of railway track diagnostic cars is not fully processed.
- Lack of tools and equipment for detailed control of railway track repair work.

Railway track repair machines and equipment

- There is an urgent need to update the fleet of machines for large and medium-sized repair work, the service life of which is coming to an end.
- There is no unified repair base for railway track repair equipment.
- Insufficient supply of vehicles and technical means for railway track repair work, insufficient supply of spare parts.

Technical condition of the railway track

- 16.7% of the artificial bridge and pipe equipment are deformed.
- 164 km of tracks are overdue for major repairs, which reduces the level of reliability of the railway.
- Steep ascents and descents, many small radius turns, semi-automatic limiters, train speed limit.

Employee skills

- Excessive workload and low levels of professionalism make it difficult to increase productivity.

IV. CONCLUSION

Currently, railway track workers use hand tools to repair and maintain damage and irregularities identified by surveyors and track inspectors. This work is labor-intensive and is carried out in conditions of high occupational safety risks.

In recent years, railway technology has changed, the upper structure of the tracks has been updated, about 60% of the total track size is made of P65 type tracks with concrete pads.

In the next 5 years, about 90% of highways will be concreted, which will make manual road repairs even more difficult and impossible.

The railway track points system is directly related to the salaries of road workers. Therefore, when performing repair work manually, the damage caused to the tracks is eliminated without observing geometric dimensions, and not complete completion of the work is directly related to the skill of the worker.

References

1. Нормы текущего технического обслуживания РЖД России, 1989 г.
2. Отчет о плановом техническом обслуживании ПЧ-6-го на 2018-2020 годы ПО – 1
3. Отчет и исследование о трудозатратах и соответствии требованиям ПЧ-6 на 2018-2020 годы.
4. З.Л Крейнис “Экономика путевого хозяйства” 2006 год.