

UDC 629.46

## Sarantuya Yu. A study on reducing idle time of local wagons

**Sarantuya Yu.**

Master of Science in Engineering  
Railway Institute, Ulaanbaatar, Mongolia

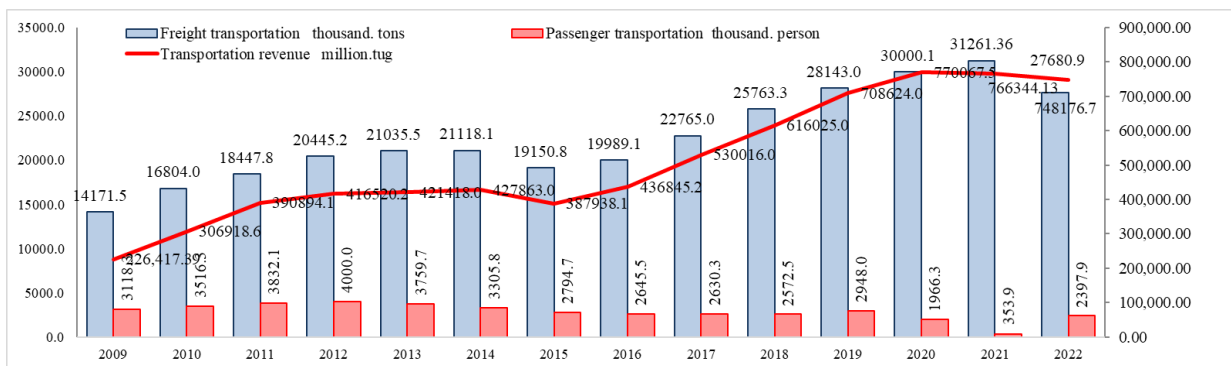
**Abstract.** This paper investigates the percentage of freight and passenger transportation by railway over the past 14 years, playing a vital role in the social and economic development of Mongolia. To address the average idleness of wagons per one operation of freight and overcome barriers to achieving transportation volume and railway development goals by 2030, this study investigates the unloading dynamics at all stations of the UB Railway JVC over the past decade. The study examines the efficiency of shunting locomotives utilized in disassembling and placing unloaded wagons on branch tracks at stations with high unloading demand. Additionally, it conducts operational analysis by marshalling trains based on destination stations, cargo receivers, and branch line zoning to explore the potential reduction of local wagon idle time, impacting the average idle time per one freight operation.

**Key words:** transported freight, local wagons, shunting locomotives, branch tracks

Рецензент: Мартеха Александр Николаевич – кандидат технических наук, доцент.  
Доцент ФГБОУ ВО «РГАУ-МСХА им. К.А. Тимирязева»

### Introduction

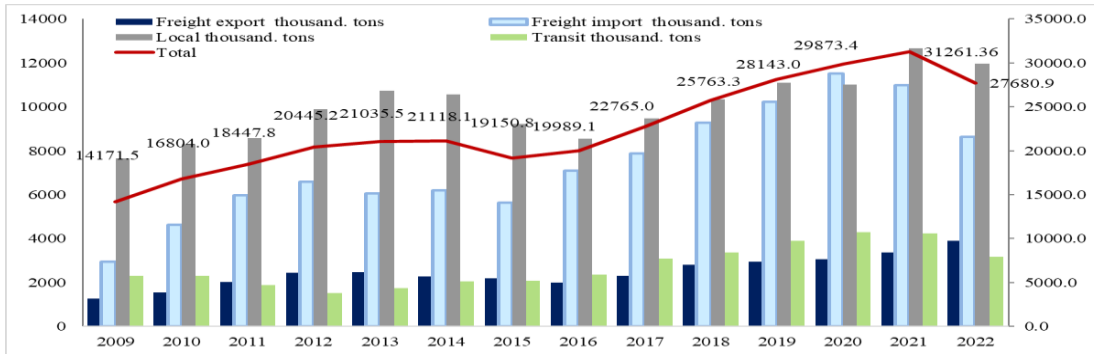
In 2021, railway transport significantly contributed to our country's freight transportation sector, with a record-breaking 31.2 million tons of cargo transported, marking a 4.2 percent increase from the previous year, and Decreased in 2022 due to the epidemic.



**Figure 1. The freight transported by Railway over the past 14 years**

In 2020, export freight experienced a significant increase of 12.1 percent compared to the previous year, while container train travel along the main line showed a remarkable rise of 59

percent. However, due to the epidemic, local passenger transport was suspended, resulting in a decline of 33.3 percent and 47.9 percent in passenger turnover compared to the previous year.



**Figure 2. The percentage of freight transported by Railways**

Although the rise in freight transportation volume (Figure 1, 2) enables the fulfillment of the plan to transport 41.1 million tons in 2025 and 56.7 million tons in 2030, as outlined in the long-term program for the development of the UB Railway JVC until 2030 (Compendium of the Reform and Development Program of UB Railway JVC- 2030 Reports, Published in 2017, p. 55), achieving these goals requires the gradual implementation of technical and technological progress and modernization efforts. This includes initiatives like expansion and enhancement of the foundational infrastructure, the construction of a new station and level crossing, a two-track entrance, a second main line, marshalling yards in line tracks, and modernization of the locomotive fleet. Consequently, the introduction of new technology and the reduction of average wagon idle time per load operation are closely tied to the local wagon idle time at the station. To address this, a functional study has been conducted on the proposed technology to be implemented on wagons upon arrival at the station.

### Results of Research and Development

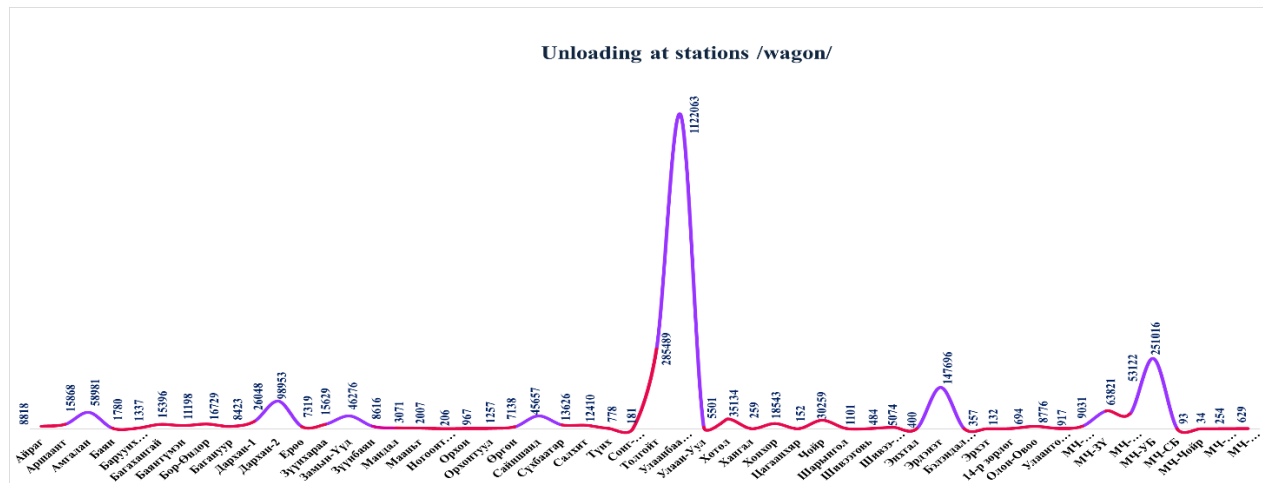
Wagons used for various freight operations such as loading, unloading, transshipment, sorting of small parcels, and handling containers, are termed local wagons. These wagons are categorized based on the specific freight operations as follows:

- Local wagons arriving loaded and leaving empty
- Local wagons arriving empty and leaving after loading
- Local wagons arriving with cargo, then reloaded and leaving the station
- Local wagons arriving with containers or sample cargo for sorting

Wagons are classified into single cargo operations or dual cargo operations (loading and unloading), depending on the number of cargo operations they undergo. This encompasses a range of activities, including, placing wagons at the loading point, distributing them at various loading and unloading points, transferring for dual operations of freight, collecting and setting wagons on station tracks after unloading, cleaning, washing, and sanitizing wagons, conducting technical and commercial inspections before loading, transferring cargo from one wagon to another, positioning wagons on the branch track owned by a company for small parcel sorting and retrieving them etc.

Operations on local wagons, depending on the organization of work, type of cargo, and the location of stations and sidings, are conducted on both public and special branch tracks.

According to a survey of wagons arriving at the station of UB Railway JVC for loading and unloading operations (Figure 3), there has been a significant increase in freight activity over the last ten years. The survey indicated a notable rise in unloading operations at major stations, with Ulaanbaatar handling 1,122,063 wagons, Tolgoit 285,489 wagons, MCh-UB 251,016 wagons, Erdenet 147,696 wagons, Darkhan-2 98,953 wagons, MCh-Zuud 63,821 wagons, MCh- Tolgoit 53,122 wagons, Zamyn-Uud 46,657 wagons, Sainshand 45,276 wagons, Khotol 35,134 wagons, and Choir 30,259 wagons.



**Figure 3. Unloading at all stations of UB Railway JVC /increase over the past 10 years/**

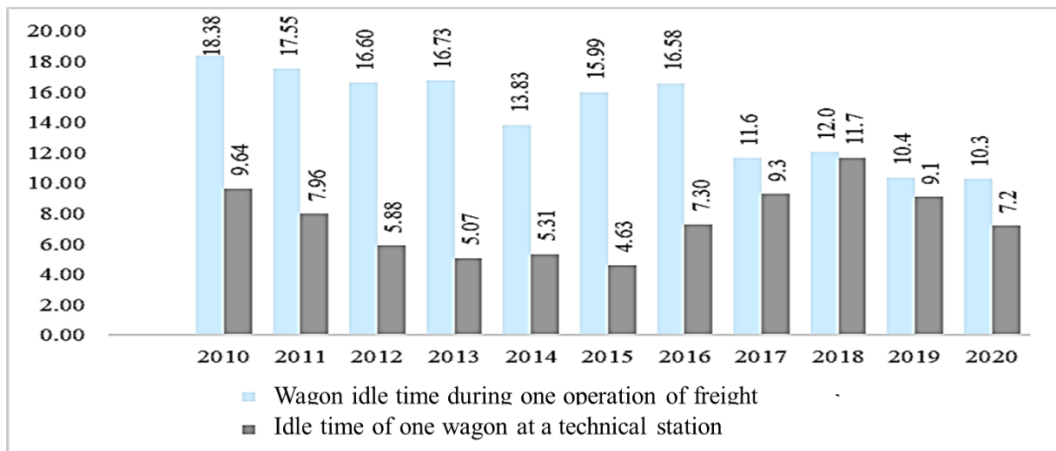
At Ulaanbaatar station, there is a hump with marshalling equipment for disassembling trains. However, at all other stations, trains are marshalled only upon arrival. After technical and commercial inspections, loaded wagons are separated using unloading branch tracks and receivers. Shunting work is then conducted using shunting sidings. Table 1 presents data on the number of shunting locomotives and their total hours of operation at stations where shunting work is conducted on shunting sidings.

**Table 1**

**Total hours of shunting locomotives operation**

Stations	Operation at stations	Operation at sidings	Transference	Mealtime	Hot downtime	Shift handover	Stoppage due to breakdown	TO-2 servicing	Number of shunting diesel
Zamyn-Uud	4631	2765	12	620	865	562	231	325	4
Sainshand	3921	884.7	8.5	274	1096	274	45.2	53.4	2
Choir	1653	3493	56.5	511	509.5	284	30.5	18	1
Baganuur	991	2096	7	274	512	274	35	24	1
Ulaanbaatar	14878	13251	41	1350	0	2700	0	180	4
Tolgoit	4934	5620.5	76.1	420.3	161.5	230	764.3	317.2	3
Zuunkharaa	1563	3295	58	520	264	274	26	25	1
Darkhan	8406	3383.2	202.8	566.7	358.9	548.6	31.2	223.2	3
Sukhbaatar	3640	411	0	234	411	146	0	40	2
<b>Total</b>	<b>44617</b>	<b>35199.4</b>	<b>461.9</b>	<b>4770</b>	<b>4177.9</b>	<b>5292.6</b>	<b>1163.2</b>	<b>1205.8</b>	<b>21</b>

Efficiently diversifying loading and unloading activities, implementing suitable technologies for various types of cargo, coordinating arrivals and departures, and ensuring seamless operations at local wagon stations are essential for minimizing idle time. This requires close coordination between technical and freight commercial operations, as well as alignment with branch track operations and train traffic diagrams.



**Figure 4. Wagon Idle Time**

The total stoppage time of local wagons at a station equals the sum of all operational hours, but it's important to consider potential idle intervals between operations. Idle time, while

waiting for local wagons to be placed and retrieved, can be reduced by enhancing the utilization of shunting locomotives or by effectively coordinating shunting operation.

The freight imports arriving at the local unloading by UB Railway JVC (Figure 2) are distributed with 70% coming through Zamyn-Uud station and 30% through Sukhbaatar station. Most of the cargo imported from China at Zamyn-Uud Station consists of container cargo, construction materials, and other goods.

According to the study on DU-1 specifically the document detailing 957 trains dispatched from Zamyn-Uud station to Ulaanbaatar station from January to October 2019, cargo undergoes a gauge transfer from narrow gauge to broad gauge at Ulaanbaatar station. Subsequently, the trains are marshaled according to their destination, as depicted in Figure 5.

№	ҮБЖД	ЭС	ҮБЖД	Т	ҮБЖД	Т	Армагур	№	Т	Толгойт Илэрэ Интер-Энлэ ХХК	2019.05.26.12.29	Тайм	
16	ҮБЖД	60778123	эс	4	км	23.4	1	Арматур	16.6	76	Толгойт Илэрэ Интер-Энлэ ХХК	2019.05.26.12.29	Тайм
17	ҮБЖД	220426	т	4	км	22.7	1.41	Мэшин механизм	41.16	76	Толгойт Ашги	2019.05.26.12.29	Тайм
18	ҮБЖД	94190980	т	4	км	24	1.12	Чингэлзүг ачаатай	8.79	76	Толгойт Ашги	2019.05.26.12.29	Тайм
19	ҮБЖД	20000568	т	4	км	20.2	1	Чингэлзүг ачаатай	8.79	76	Толгойт Ашги	2019.05.26.12.29	Тайм
20	ҮБЖД	211011	м	4	км	18.5	1	Чингэлзүг ачаатай	8.79	76	Толгойт Ашги	2019.05.26.12.29	Тайм
21	ҮБЖД	221366	м	4	км	18.1	1	Чингэлзүг ачаатай	8.79	76	Толгойт Ашги	2019.05.26.12.29	Тайм
22	ҮБЖД	211805	м	4	км	17.9	1	Чингэлзүг ачаатай	11.7	76	Толгойт Алши	2019.05.26.12.29	Тайм
23	ҮБЖД	20001129	т	4	км	19.6	1	Чингэлзүг ачаатай	11.09	76	Толгойт Сүтэй Богд Бомд Транс ХХК	2019.05.27.00.20	Тайм
24	ҮБЖД	94190659	т	4	км	24	1.12	Чингэлзүг ачаатай	12.65	76	Толгойт Сүтэй Богд Бомд Транс ХХК	2019.05.27.00.20	Тайм
25	ҮБЖД	94190972	т	4	км	24	1.12	Чингэлзүг ачаатай	12.53	76	Толгойт Сүтэй Богд Бомд Транс ХХК	2019.05.27.00.20	Тайм
26	ҮБЖД	210633	м	4	км	17.5	1	Чингэлзүг ачаатай	12.7	76	Толгойт Сүтэй Богд Бомд Транс ХХК	2019.05.27.00.20	Тайм
27	ҮБЖД	20001343	т	4	км	19.8	1	Чингэлзүг ачаатай	10.5	76	Толгойт Сүтэй Богд Бомд Транс ХХК	2019.05.27.00.20	Тайм
28	ҮБЖД	210617	м	4	км	17.8	1	Чингэлзүг ачаатай	10.79	76	Толгойт Сүтэй Богд Бомд Транс ХХК	2019.05.27.00.20	Тайм
29	ҮБЖД	211730	м	4	км	18.1	1	Чингэлзүг ачаатай	10.14	76	Тол Ашги	2019.05.26.23.06	Тайм
30	ҮБЖД	211797	м	4	км	18.4	1	Чингэлзүг ачаатай	9.78	76	Тол Ашги	2019.05.26.23.06	Тайм
31	ҮБЖД	20000063	т	4	км	18.3	1	Чингэлзүг ачаатай	10.22	76	Тол Ашги	2019.05.26.23.06	Тайм
32	ҮБЖД	220632	т	4	км	21.1	1.41	Чингэлзүг ачаатай	41.04	76	Тол Ашги	2019.05.26.12.29	Тайм
33	ҮБЖД	94190550	т	4	км	24	1.12	Чингэлзүг ачаатай	44.11	76	Тол Ашги	2019.05.26.12.29	Тайм
34	ҮБЖД	94190485	т	4	км	25.5	1.12	Чингэлзүг ачаатай	10.35	76	Тол Ашги	2019.05.26.12.29	Тайм
35	ҮБЖД	320283	т	4	км	22.3	1.04	Чингэлзүг ачаатай	46.34	76	Тол Ашги	2019.05.26.12.29	Тайм
36	ҮБЖД	210427	м	4	км	18	1	Чингэлзүг ачаатай	46.34	76	Тол Ашги	2019.05.26.12.29	Тайм
37	ҮБЖД	211052	м	4	км	18.1	1	Чингэлзүг ачаатай	11.75	76	Тол Шингэн	2019.05.26.12.29	Тайм
38	ҮБЖД	211953	м	4	км	18.1	1	Чингэлзүг ачаатай	12.06	76	Тол Ашги	2019.05.26.12.29	Тайм
39	ҮБЖД	94190642	т	4	км	24	1.12	Чингэлзүг ачаатай	7.3	76	Тол Трансгайт	2019.05.26.12.29	Тайм
40	ҮБЖД	94190519	т	4	км	25.5	1.12	Чингэлзүг ачаатай	27.43	76	Тол Пачирдэг ХХК	2019.05.26.12.29	Тайм
41	ҮБЖД	220988	м	4	км	17.0	1	Чингэлзүг ачаатай	13.25	76	Тол Ашги	2019.05.26.12.29	Тайм
42	ҮБЖД	212373	м	4	км	20.4	1	Чингэлзүг ачаатай	6.6	76	Тол Трансгайт	2019.05.26.12.29	Тайм
43	ҮБЖД	210989	м	4	км	18.4	1	Чингэлзүг ачаатай	10.81	76	Тол Сүтэй Богд Бомд Транс ХХК	2019.05.27.17.30	Тайм
44	ҮБЖД	94190816	т	4	км	24	1.12	Чингэлзүг ачаатай	12.65	76	Тол Сүтэй Богд Бомд Транс ХХК	2019.05.27.17.30	Тайм
45	ҮБЖД	211052	м	4	км	18.3	1	Чингэлзүг ачаатай	12.88	76	Тол Интероис	2019.05.26.23.06	Тайм

Figure 5. A piece of document that trains are marshaled by their destination

Trains from that station are not appropriately grouped according to zoning groups and receivers. Consequently, at each station where the wagon is unloaded, shunting operations are performed using a shunting siding on the station track to transfer it to the unloading branch track.

As depicted in Figure 5, during unloading operations, the train originating from Zamyn-Uud station arrives at UB station and subsequently merges with Tolgoit station. Upon arrival at Tolgoit station, the recipient of the unloading process utilizes "Tol Ashli" wagons on a branch track to reshuffle them using the shunting siding three times before finally placing them onto the unloading branch track.

As indicated in Table 1, the duration of this operation is calculated based on the "Working time at the station" and significantly affects the idle time of local wagons. The working time on the branch track encompasses the period during which the wagons marshaled at the station are placed on the unloading track and retrieved.

On the branch tracks, organizing marshaling and shunting operations by the unloading branch tracks and the recipient for unloading incurs considerable time and expenses for the shunting brigade. The cost of one hour of shunting operation is detailed in Table 2.

**Table 2**

***Cost of one hour for the shunting brigade***

Hourly consumption of the shunting brigade		Uses	Cost /tugrug/
Shunting brigade	Hourly wage or payment of machinists	Hourly wage or payment of machinists	7300
		Assistant Engineman	6800
	Cost of materials for one hour of shunting locomotive operation	Fuel (17litres) /2690/	45730
		Oil (50grams)	915
		Water	50
		Sand	60
	Hourly wage or payment of train shunting operators	Rank YI	9063
		Assistant worker with Rank V	7647
	<b>Total</b>		

Assuming that 40% of the total 44,617 hours worked at the station (Table 1), or 17,846 hours, will be spent on branch tracks for unloading, the cost would amount to 1,384 million MNT.

Therefore, implementing the following measures could potentially improve the utilization of shunting locomotives working at the station, reduce the idle time of local wagons waiting for positioning and retrieval, and minimize the duration of shunting and marshaling. This, in turn, would reduce the average idle time of wagons per freight operation (Figure 4). The measures include:

1. Segmenting the station branch tracks into East zones I and II, Central zones III and IV, and West zone V, respectively. (For example, the case of Tolgoit station in Figure 6.)



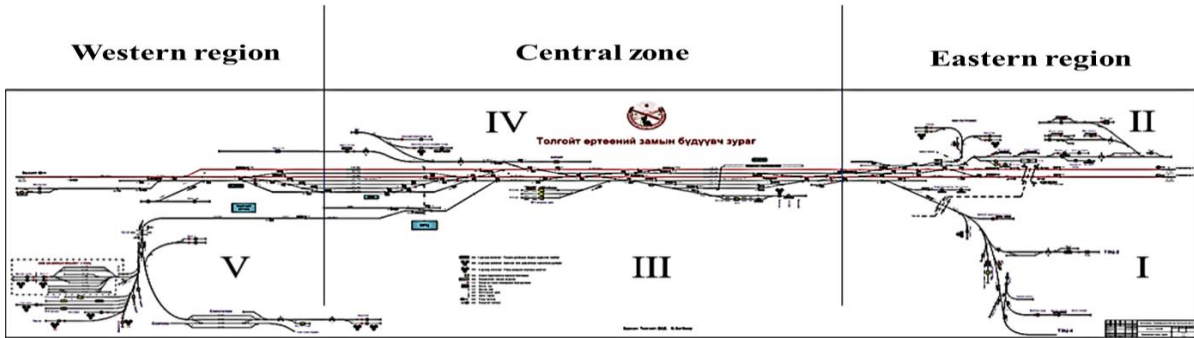


Figure 6. Schematic Diagram of Tolgoit Station Tracks and Sidings Divided into Zones

- The owners of sidings, client companies, and citizens should include the name of the departure station, the receiving siding, and the grouping number for zoning on the cargo documents issued from the station of origin. For instance, documents may indicate Tolgoit station Magnai Trade V- (TLG.MT.V) or station code (76.MT.V), among other possibilities. Additionally, an owner of a siding can also be coded.
- The freight operator at the station where the cargo is loaded into the wagon should input the arrival station, receiving siding, and zoning group number into the ATMS program, following the format illustrated in Figure 7. For instance, Tolgoit station, Altan Taria-I (76.A.Taria.I), etc.

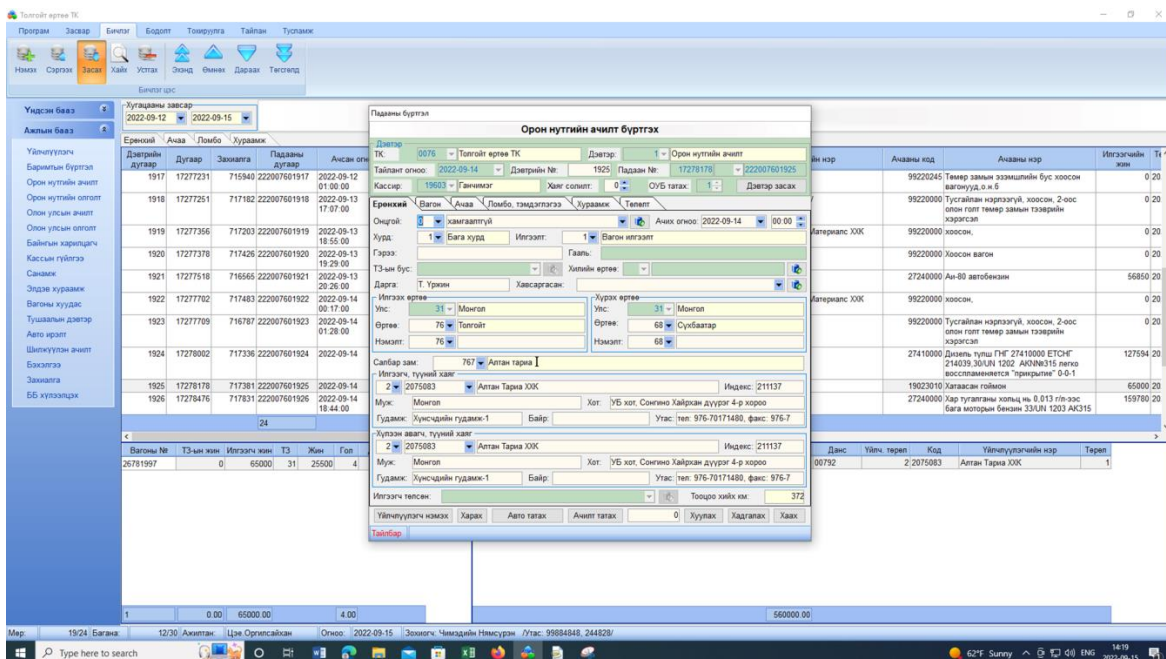


Figure 7. ATMS application used by a freight operator at the station where the freight is loaded into wagons

4. Trains should be marshaled according to destination stations, receiving sidings, and zoning groups as specified in the marshaling plan at the station.

As a result of the preparation conducted in the above sequence, upon the train's arrival at the unloading station, the wagons designated for unloading on the branch track will be retrieved from the station track and arranged on the unloading tracks without requiring additional dismantling and marshaling at the unloading station for each zoning group. This process will lead to a reduction in the number of shunting operations, shunting time, fuel costs of the shunting locomotives, and idle times for wagons.

### Conclusion

In conclusion, implementing measures to marshal trains by sorting shipments at the loading station based on destination station, receiving branch line, and zoning group facilitates the efficient positioning of local wagons on sidings at unloading stations. This approach reduces the need for extensive shunting operations and minimizes time spent at the station, leading to cost savings in terms of shunting brigade expenses and idle times for local wagons. By improving the productivity of shunting locomotives, accelerating car turnover, increasing station throughput capacity, and reducing the average wagon idle time per operation, overall efficiency in railway operations can be significantly enhanced.

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