Distribution of Mongolian Mineral Resources, Transportation and Logistics Analysis

Erdenechimeg E.[a]1, Asralt B.[b], Khurelbaatar G

[a]*Asian Infrastructure Research Institute, Ulaanbaatar, Mongolia*
[b]*Transportation department, MTS of Mongolian University of Science and Technology, Ulaanbaatar, Mongolia*

Abstract

Mongolia has vast mineral resources. But they are non-renewable resources, so we should seek proper use and appropriate measures such as putting environmental protection and to advance value-added products into the world markets with optimum prices at the forefront. Considering these thoughts this study identifies the ways to reach third country markets, the implementation of required development policies to resolve the railway, transportation and logistics issues and the development of future Mongolian mineral resource and mining industries.

Keywords: Mineral resource transportation; Railway; Transportation demand; Railway transportation outlook; Sea-access

1. Introduction

Mongolia ranks 7th in global resources with around 1170 known deposits and over 10'000 known occurrences of 80 different types of mineral resources (Mineral Resources Authority of Mongolia, 2017). These include: 1619 t gold, 227'000 t silver, $36.3x10^6$ t copper, $660x10^6$ t iron ore, 5.9 $x10^6$ t zinc and 250 $x10^6$ t petroleum resources. Deposits with large resources include Erdenet, Oyu tolgoi, Tsagaan suvarga, Gatsuurt, Tavt, Asgat, Mungun under, Bayngol iron ore, Tumurtei, Tumurtei ovoo and Bargilt deposits. Mongolia has discovered around 300 coal deposits from 15 coal basins. And, a total $9.8x10^9$ t coal resources from $175x10^9$ t inferred coal resources are guaranteed. The largest coal deposit of Tavan tolgoi has $7x10^9$ t JORC compliant coal resources (3 billion coking coal and the remaining are good quality thermal coal) estimated. Out of the 6-7 known deposits and occurrences from 14 petroleum basins only the Zuunbayn and Tsagaan els deposits are in exploitation (Mineral Resources Authority of Mongolia, 2017).

Infrastructure and transportation especially rail transportation is important for both domestic and international trade. This study analyzes the outlook and future trends of mineral resource transportation in correlation with Government railway and mining policies. The study includes a matrix analysis of total 54 deposits (15 strategic deposits and 39 potentially strategic deposits) to classify the deposits by order of significance. The matrix analysis evaluates the internal (mining parameters) and external (infrastructural, economic, environmental, socio-political and legal parameters) factors. The matrix analysis results helped develop the regional mine development plan. In correlation with this plan the current rail transport demand and future outlook of rail transport until 2043 were estimated by the ArcGIS and EMMA software programs to produce a recommendation for the implementation of railway development. These also include ways to connect with third country markets and sea-access.

2. Current and future outlook of the mining industry

The mineral commodities price rise in 2007 brought in large foreign interests of mining and exploration in Mongolia. This resulted in rapid development within the industry with mining producing 20% of total GDP in 2005. However in 2012 and 2013 these statistics decreased to 17.8% and 16.6% respectively. The mining sector provides 69% out of the total industrial sectors and mineral commodities account for approximately 90% of total exports (National Statistical office, 2013).

Consensus in 2013 showed 401 economic entities actively operating within the mining sector out of the registered 728. By August 4th of 2014, 1590 individuals and economic entities held 2798 active licenses (12.0 million hectare area), of which were 1349 for mining and 1449 were for exploration (Mineral Resources Authority of Mongolia, 2014).

Mongolian economy is too dependent on the mineral resources sector which could entail huge risks. The establishment of controlled sustainable mineral extraction, especially for mineral commodity exports to manufacture

* Corresponding author. Tel.: +0-000-000-0000 ; fax: +0-000-000-0000 .
E-mail address: erdenechimeg@hotmail.com

value-added products that meet international standards at optimum market prices are necessary as Mongolian mineral resources are non-renewable.

The basis of the industry development lies in the support and developments for infrastructure, ecology, geology and the future plan developments in accordance with state policies and socio-political factors. In this regard a matrix analysis of total 54 deposits (15 strategic deposits[1] and 39 potentially strategic deposits) was conducted. The matrix analysis evaluates the internal (mining parameters) and external (infrastructural, economic, environmental, socio-political and legal parameters) factors to classify the deposits in order of significance in correlation to the factors. The mining factors assessed by 6 groups of 18 inquiries and the infrastructural factors are assessed by 2 groups of 16 inquiries. The mining and infrastructural factor evaluation results were ranked “excellent”, “good”, “moderate” and “bad” by order of significance (Table 2.1). Table 2.2 shows the most significant factor for the mining and infrastructural assessment.

[1] The Gatsuurt gold deposit was still considered a potentially strategic deposit at the time of study.

Table 2.1. Mining and infrastructural assessment results of matrix analysis.

Infrastructure	Mining: Excellent	Mining: Good	Mining: Moderate	Mining: Bad
Excellent	**Erdenet** (1.60; 1.78)	Nariin sukhait (1.50; 1.63) Bargilt (1.45; 1.59) Baganuur (1.63; 1.59) Tumur tolgoi (1.53; 1.56)	Ulaan ovoo (1.45; 1.41)	Nalaikh (1.38; 1.32)
Good	Aduunchuluun (1.30; 1.78)	Oyu tolgoi (1.23; 1.66) Chandgan tal (1.33; 1.63) Alag togoo (1.23; 1.61) Tsaidam nuur (1.25; 1.61)	Gurvan bulag (1.30; 1.54) Tsagaan davaa (1.23; 1.49) Dornot (1.30; 1.44) Tumurtei ovoo (1.23; 1.37)	Mardai (1.28; 1.32)
Moderate	Shivee ovoo (1.20; 1.78) Tavan tolgoi (1.20; 1.78)	Boroo (1.00; 1.66) Tsagaan suvarga (1.20; 1.61) Nuurst khotgor (1.03; 1.61) Khuot khonkhor (1.03; 1.59) Talbulag (1.15; 1.59)	Tugrug nuur (1.15; 1.54) Uvdug khudag (bituminous coal) (1.18; 1.51) Uvdug khudag (lignite) (1.15; 1.51) Khuot (1.13; 1.49) Tsav (1.00; 1.46) Baynteeg (1.08; 1.44)	Mogoin gol (1.13; 1.32) Tumurtei (1.20; 1.29) Saikhan ovoo (1.00; 1.27) Naran tolgoi (1.10; 1.24) Janchivlan group deposits (1.05; 1.05) Bayndavaa (1.05; 1.05)
Bad		Tevsh gobi (0.93; 1.63) Mungun undur (0.85; 1.63) Shvden uul (0.85; 1.61)	Shavriin tsaram (0.88; 1.49) Ulaan (0.90; 1.49) Burenkhaan (0.88; 1.49) Zeegt (0.95; 1.44) Tsagaan Tsav (0.93; 1.44) Ongilog nuur (0.73; 1.41) Mankhan uul (0.85; 1.41)	Shiree uul (0.75; 1.34) Khar tarvagatai (0.78; 1.34) Asgat (0.85; 1.32) Tavt (0.75; 1.29) Lugiin gol (0.98; 1.27) Khongor (0.80; 1.22) Khukh adar (0.75; 0.95) Ulaan uul (0.70; 0.93)

Table 2.2. The most significant factors for the mining and infrastructure analysis /ranked highest to lowest, number of deposits affecting/.

	Rank	Factors (Inquiry #)	Deposits
Mining assessment	I	Size of license area (3)	7
		Potential for reserve increase (9)	6
	II	Difficulty of environmental rehabilitation (18)	5
		Ownership of license (1)	4
	III	Whether the operating entity holds the license or not (2)	2
		Reserve ranking /by international standards/ (8)	2
		Foreign code for reserve classification (12)	2
Infrastructural assessment	I	Deposit distance from Ulaanbaatar (23)	14
		How many energy sources (35)	14
		Deposit distance from province center (24)	14
		Distance to nearest border crossing (26)	14
		Distance to industrial and technological park	14
		If the deposit is linked by rail line (28)	13
		Distance to state roads (29)	12
		Whether connected to a power source (34)	12
		Groundwater reserves (32)	10
	II	Site geomorphology (20)	9
		Atmosphere (21)	7
		Whether if the local sum borders with neighboring country (25)	7

III	Difficulty of exploitation regarding environmental and climate issues (22)	4
	Whether if the deposit is connected with either paved or mine roads (30)	2

From the tables above, the 15 strategic deposits could be infrastructurally categorized into capable and incapable. For example: Erdenet, Oyu tolgoi, Shivee- ovoo, Nariin sukhait, Baganuur, Tavan tolgoi, Boroo, Tsagaan suvarga, Gurvanbulag, Dornot and Tumurtei-ovoo deposits could be categorized as infrastructurally capable deposits while the other deposits would be categorized as incapable deposits.

Table 1.3. Mining and infrastructural assessment of matrix analysis, by type of minerals.

Infrastructure	Mining: Good	Mining: Moderate	Mining: Bad
Good	Copper Coking coal Lignite Bituminous coal	Uranium Iron	Lead, Zinc
Moderate	Salt	Gold Silver Zinc, Lead Zeolite Pyrope	REE Tin, Tungsten
Bad		Phosphorite	Copper, Zinc Gypsum Fluorspar

The above table shows that the copper and coal deposits have relatively well infrastructure with good future prospects and the distributional pattern of mineral deposits are related to the infrastructural factors /iron, lead, zinc/.

Similarly the other external factors were evaluated in correlation with the internal (mining) factors. The results of this matrix analysis helped develop the regional mine development plans in tandem with the mining production estimates by the Mongolian Ministry of Mining (Fig 1)

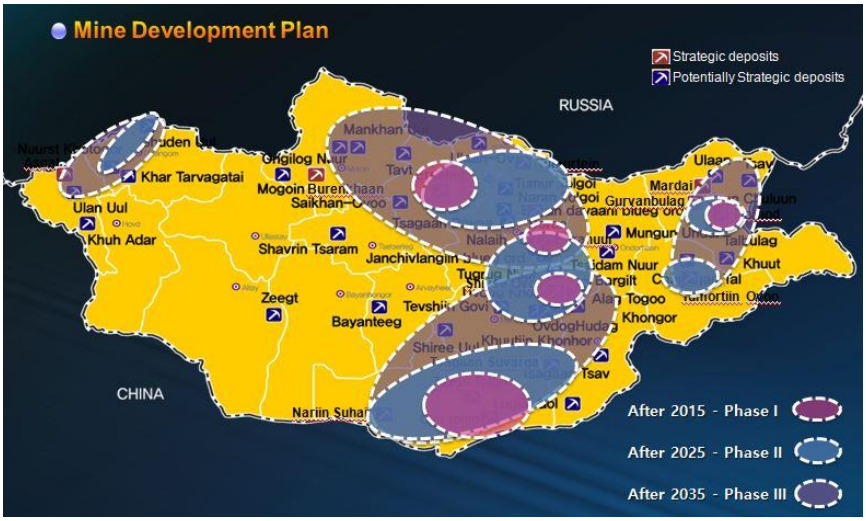

Fig. 1. Regional Mine development plan.

The first phase of the plan is to establish and develop:

- Erdenet-Darkhan region based on the Erdenet, Tumurtei and Ovoot deposits;
- Baganuur region based on the Baganuur deposit;
- Gobisumber-Choir region based on the Shivee-Ovoo and Tsagaan suvarga deposits;
- Umnugobi region based on the Tavan tolgoi, Oyu tolgoi and Nariin sukhait deposits;
- Choibalsan region based on the Aduunchuluun deposit.

3. Current and future outlook of the road and transportation sector

The lack of development in infrastructure, road and transportation means higher transportation and logistics expenses. This is one main cause in hindering the development of the mining industry. Mongolia ranked 119th with 3.1 rating out of 144 countries on the Global competitiveness report 2014-2015 published by the World economic forum. This shows that Mongolian infrastructure is unsatisfactory. There are 4 sub-sectors of transportation operating in Mongolia. These include the road, railway, air and sea transports (Fig 3).

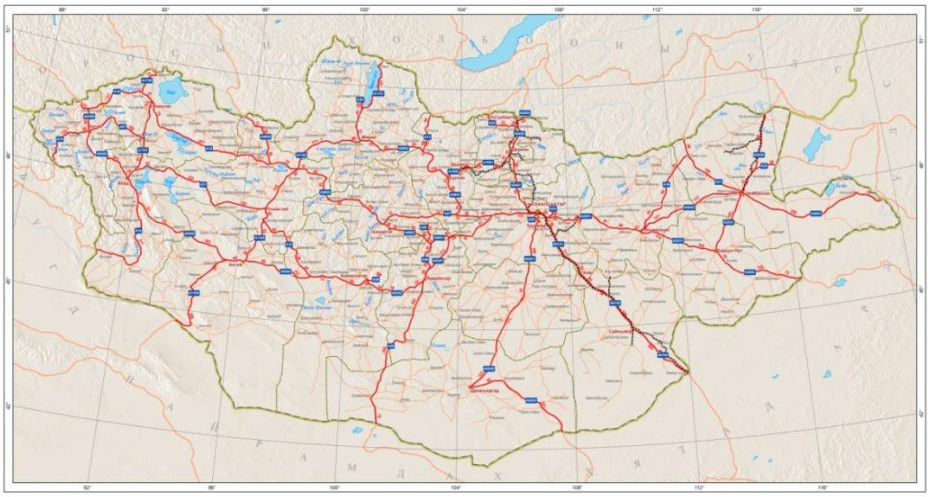

Fig. 2. Mongolian road and railway system.

Mongolian transportation

Road transportation

Road

* Total length: 49,200.4 km:
  - o International road: 4,092.0 km
  - o State road:12,722.0 km
  - o Provincial road: 35,975.0 km
  - o Mine road: 553.0 km

Road type

* Improved road: 8,875.6 km
  - o Paved road: 5,838.2 km
  - o Gravel road: 1,864.8 km
  - o Improved dirt road: 1,172.6 km
* Normal dirt road: 40,324.8 km

Transportation

* Freight: 28,747,5 kt
* Freight traffic: 4,314.0 Mt.km
* Passengers: 304.2 million people
* Passenger traffic: 1,941.9 million people km

Number of Autmobiles

* Total: 384,864
* Passenger cars: 259,309
* Trucks: 89,473
* Buses: 20,400
* Special purpose: 15,682

Railway transportation

Railway

* Total length: 1,815 km
  - o Sukhbaatar-Zamiin-Uud: 1,577 km, 74 stations
  - o Bayntumen-Ereen tsav: 238 km, 6 stations
* Single line broad gauge (1,520 mm)
* Freight capacity: 21-23 Mt
* Max speed (train): Commuter - 90 km/hour; freight - 80 km/hour
* Train turnaround: 4, 5 days
* Locomotive pull: 156 units
  - o Freight locomotive: 120 (48 locomotives are 20 years old)
  - o Substitute locomotive: 36 (28 locomotives are over 30 years old)
* Number of cars in operation: 2,949 (1,760 cars are over 25 years old)
  - o Hopper cars: 1,447
  - o Box cars: 491
  - o Flat cars: 143
  - o Container cars: 448
  - o Other: 420
* Passenger cars: 284 (154 are over 28 years old)

Transportation

* Freight: 21,035.5 kt
* Freight traffic: 12,076.5 Mt.km
* Passengers: 3.8 million people
* Passenger traffic: 1,394.4 million people km

Water transportation

Water

* Total length: 135 km (Selenge lake)

Transportation

* Passengers: 0.011 million people
* Passenger traffic: 0.265 million people km
* The number of registered ships in Mongolia: 3012 (registered permament: 518)

Air transportation

Airways

* Total length: 40,000 km
* Number of Air routes: 79
* Aircraft with the certificate of airworthiness: 25

Transportation

* Freight: 4,063.6 kt
* Freight traffic: 9.6 Mt.km
* International passengers: 441.6 thousand people
* Domestic passengers: 325.8 thousand people
* Passenger traffic: 1,289.1 million people km
* International flights: 92,386
* Transit pass: 85,690
* International landings and take-offs: 6,696
* Domestic flights: 9,772

Electric transportation

* Total length 10,000 km

Pipeline transportation

* Only in urban areas

Source: National Statistical Office, Ministry of Road and Transportation, UBTZ

Fig. 3. Mongolian transportation statistics.

Mongolia is a landlocked country between China to the south and Russia to the north. The only way to connect to third country markets is by crossing either Chinese or Russian borders. And this causes transportation costs dependent on our neighbors.

The Chinese president Xi Jinping state visit of May 8th, 2014 resulted in agreements over important issues of road, transportation and infrastructure and signing the Memorandum of Understanding. The agreements enable and increase the number of authorized use of Chinese seaports that are open to foreign trade to Mongolia. These seaports are the North Chinese regional and Northeastern Chinese regional open trade seaports of Dalian, Jinjou, Yingkou, Qinhuangdao, Huanghua, Huangdao and Tianjin. The previous 1991 agreement only authorized the use of Tianjin Xingang international port.

The principle agreements include no less than 40% tariff discount, customs and VAT exemptions for the Mongolian international transit cargo through Chinese territories and to run transportation of 1/3 of Asia to Europe transit cargo through Mongolian territories. This enables the opportunity to transport the Tavan tolgoi coal through China to third country markets instead of transporting it all to China. The agreement complies upon tariff discount that may lower the tariff more than their domestic tariffs. The Memorandum of Understanding between Ministry of

Road and Transportation of Mongolia and Railway Authority of People's Republic of China on renewal of the 1955 "Mongolia and China Border Railway Agreement" includes the development of 4 (Shiveehuren-Sekhee, Gashuun sukhait-Gants mod, Bichigt Zuun Khatavch, Sumber-Ashaan) new border crosses.

The state visit of the Russian president Vladimir Putin in September 2014 resulted in signing 15 documents which include: Increasing capacity of the main rail line of Ulaanbaatar railway (UBTZ) to an annual capacity of 100 Mt, this is proposed by electrifying the UBTZ line, extending the Salkhit-Erdenet line to the border to the northwest, to open a new railway crossing linking to Kyzyl of autonomous Tuva of Russia which would enable Russian mineral commodities access to China through Mongolia, the construction of "Bogdkhan" rail line to increase rail transportation and the joint venture in establishing a new vertical corridor through Mongolian western regions. The bilateral meet also resulted in a share ownership of the Russian invested North Korean Rajin port. This provides the first time opportunity to own a seaport for Mongolia.

The Russian Government is favorable for the rail transportation of Mongolian mineral commodities, but the issue lies whether if the Russian rail line capacity is sufficient for Mongolian mineral commodity. At present there is only the line of the eastern region which can transport mineral commodities through Russia to third country markets, but this line is too long to be feasible.

4. Estimations for mineral resource transportation outlook

The mineral commodities are transported by either road or rail line. Rail transport plays an important part in mineral commodity exports especially to third country markets. And the study of mineral commodities transportation outlook correlates with state policies on railway development (Fig. 4 and 5).

Fig. 4. Future Mongolian railway development (Source: Ministry of Road and Transportation).

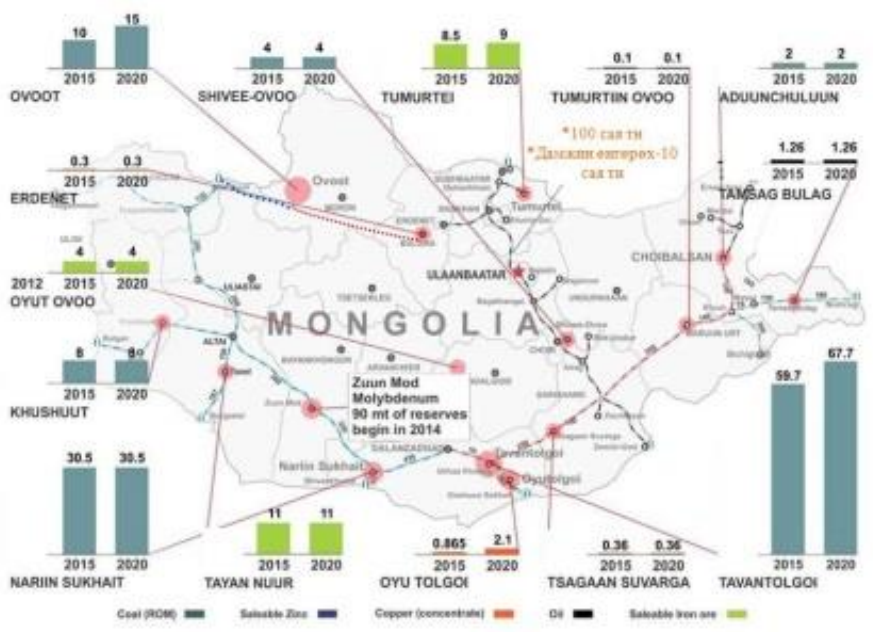

Fig. 5. Railway connections with mineral deposit (Source: Ministry of Road and Transportation).

Currently 51% of total freight transport is international and 49% is domestic freight transport. In 2017 58.9% of total international freight transport was export with 24.1% import and 17% was transit transport. Of all the exports 96.42% went to China and 3.58% was transported to Russia. Iron ore transportation to China accounted for 77.09% of total exports. In 2017 Railway transport revenue increased 4.3 billion MNT or by 1% from its previous year to reach 420.8 billion MNT.

Fig. 6 shows the result of our O/D (commuter and freight transportation) traffic projection processed by ArcGIS and EMMA software based on the information of 2017 total railway transportation. It shows us most of Mongolian foreign trade occurs with China.

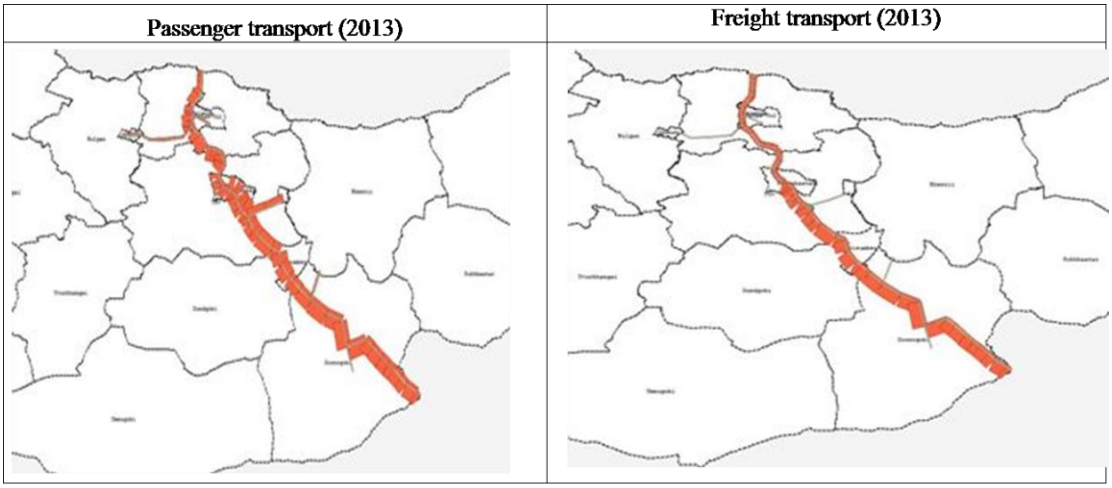

Fig. 6. Passenger and freight railway traffic.

The future rail traffic demand model was estimated to 2043 by selectig the year 2013 as the as year. The mineral commodities rail transportation until 2043 is estimated by daily transportation (Table 4.1 and Fig. 7). The next 30 year outlook of the mineral commodities transportation estimations show increases in the coal, fluorspar, zinc and copper concentrates of Selenge, Uvurkhangai, Khentii, Umnugobi, Dundgobi, Dornogobi and Gobi-Altai provinces. Especially the Chandagan tal coal and Bargilt iron ore deposits of Khentii province; the Tavan tolgoi, Nariin sukhait coal and Oyu tolgoi copper concentrates of Umnugobi province; Uvdug khudag Khuut khonkhor coal and fluorspar exports show a sharp increase in their future trends.

Table 4.1. Estimations for mineral resource transportation outlook until 2043.

Province	Mine	Product	Buyer	2018	2043
Orkhon	Erdenet	Copper concentrate, molybdenum concentrate, refined copper, copper	China, Russia, Third country	1,516.44	1,735.62
Darkhan-Uul	Tumur tolgoi	Iron ore	China	2,739.73	2,739.73
Selenge	Ulaan ovoo	Coal	Russia	5,479.45	1,643.84
	Tumurtei	Iron ore	China	4,657.53	5,479.45
Selenge	Mogoin gol	Coal	Domestic	82.19	82.19
Tuv	Tsagaan davaa	Tungsten concentrate	China	0.62	0.62
	Tsagaan davaa	Tungsten concentrate	Third country	0.62	0.62
	Bayndavaa group deposits	Tungsten concentrate	China	0.03	0.14
Uvurkhangai	Baynteeg	Coal	Domestic	191.78	547.95
Khentii	Chandgan tal	Coal	Domestic	1,369.86	5,479.45
	Bargilt	Iron ore	China	1,095.89	5,479.45
Umnugobi	Tavan tolgoi + other Private	Coal	China	54,520.55	95,890.41
	Oyu tolgoi	Copper concentrate	China	2,465.75	4,383.56
	Nariin sukhait	Coal	China	3,835.62	4,109.59
Dundgobi	Uvdug khudag + Khuot khonkhor	Coal	Third country	3,561.64	9,589.04
	Private (Tuv unegt + Zuun toirom)	Fluorspar concentrate	Russia	663.70	1,818.35
	Tevsh gobi	Coal	Domestic	136.99	136.99
Dornogobi	Tsagaan suvarga	Copper concentrate, molybdenum concentrate	China	360.27	553.70
	Private (Dornogobi Urgun)	Fluorspar concentrate	China	637.67	1,747.04
Sukhbaatar	Talbulag	Coal	Domestic	54.79	54.79
	Tumurtei ovoo	Zinc concentrate	China	273.97	328.77
Dornod	Aduunchuluun	Coal	Domestic	1,095.89	1,643.84
	Tsav	Zinc concentrate	China	2.74	27.40
	Khuot	Coal	Domestic	32.88	32.88
	Ulaan	Zinc concentrate	China	27.40	54.79
Gobi-Altai	Private (Tayn nuur, Gobi-Altai Tseel)	Iron ore	China	8,219.18	8,219.18
	Zeegt	Coal	China	1,369.86	5,479.46
Uvs	Nuurst khotgor	Coal	Russia	136.99	2,739.73
	Khar tarvagatai	Coal	Domestic	273.97	273.97
Total				77,669.86	137,083.49

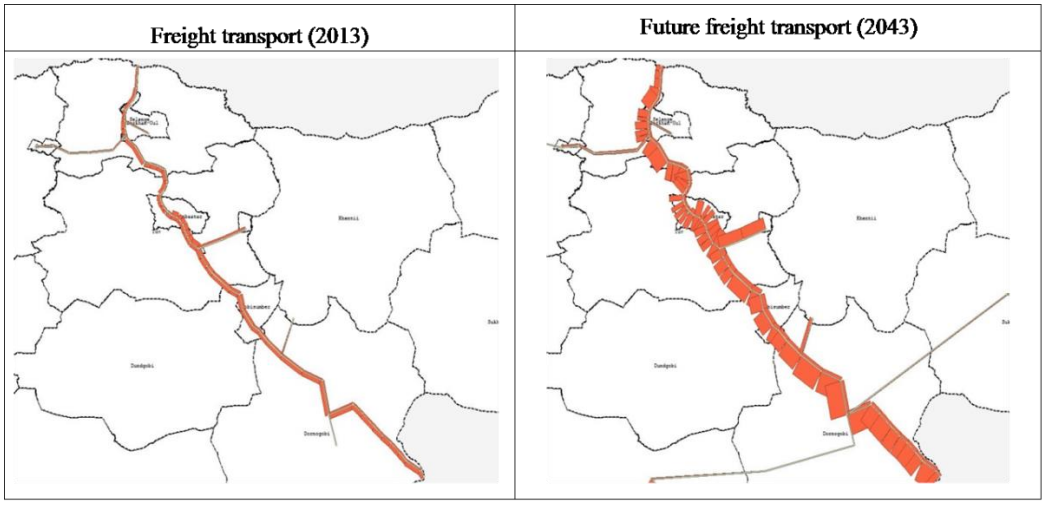

Fig. 7. UBTZ freight transport plan.

Mongolian government strategic policy for 2020 railway development seeks to develop the country economy with integrating the connection of mineral deposit exploitations to new rail lines in the eastern and gobi regions and commisioned to develop strategic plans and feasibility studies for the projects. However the construction of new railway systems requires large amounts of investment and has to be economically feasible. This study analyzes the railway traffic increase to 2043 in three stages of short-term (until 2025), mid-term (until 2035) and long-term (until 2043) (Fig 8). The railway development priority analysis was based on annual transportation estimates and other factors (Table 4.2 and Fig 8).

Table 4.2. Prioritized railway development plan.

Railway	Route	Length (km)	Freight transport 2043 (t/km/year)	Rank by amount of freight	Priority order	Development time
Ulaanbaatar Railway (UBTZ)	Bagakhangai - Baganuur	94	188,557.45	1	1	Short-term (until 2025)
	Airag - Bor-Undur	60	82,508.25			
	Sukhbaatar - Zamiin-Uud	1,112	56,949.19			
	Salkhit - Erdenet	164	14,228.32			
	Sainshand - Zuunbayn	47	5,940.96			
	Darkhan - Shariin gol	63	5,422.86			
Mongolian Railway (MTZ)	Tavan tolgoi - Gashuun sukhait	230	160,009.65	2	2	
	Nariin sukhait-Shivee khuren	45	32,970.33	3	3	
	Чойлбалсан - Khuot - Bichigt	320	890.83	4	4	
UBTZ	Arts suuri - Erdenet*	670	428.61	5	5	
MTZ	Choibalsan - Khuot - Numrug	540	527.9	6	6	Mid-term (until 2035)
	Tavan tolgoi - Zuunbayn	400	628.71	7	7	
	Tsagaan suvarga - Zuunbayn	200	430.7	8	8	
	Choibalsan - Khuot - Sainshand	550	1385.01	9	9	
UBTZ	Choibalsan - Ereen tsav	238	125.76	10	10	
MTZ	Railway for the western provinces	3600	188,557.45		11	Long-term

*Transit transport excluded

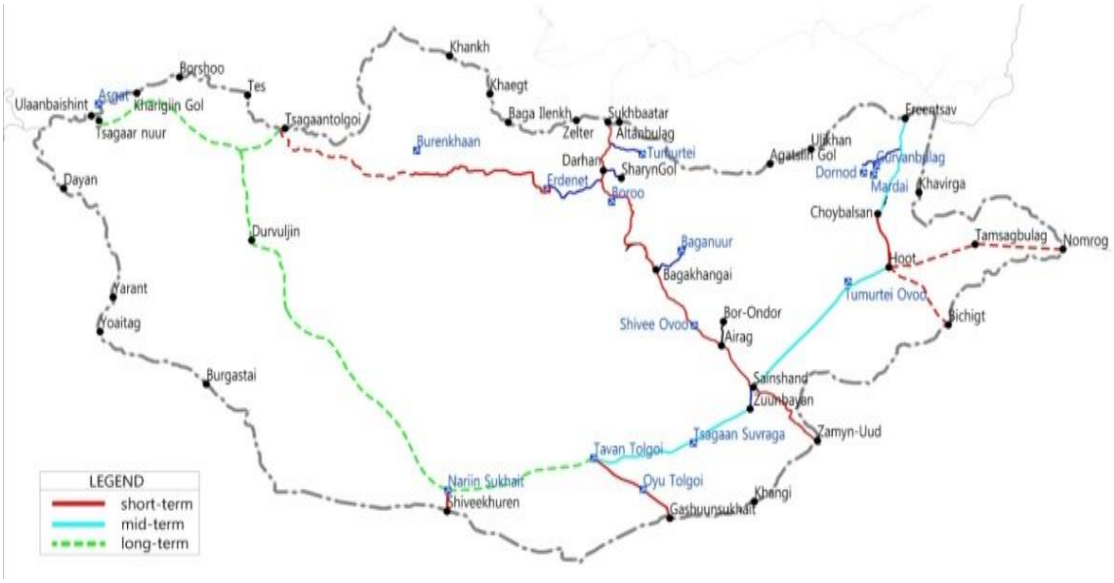

Fig. 8. Prioritized railway development plan.

The Tavan tolgoi - Tsagaan suvarga – Zuunbayn - Sainshand rail line should be established after the construction of the Sainshand Industrial Complex. Otherwise it is economically inefficient.

5. Opportunities of exporting mineral resource products to third country markets

Comparison of other landlocked country developments with Mongolia reveals added value in terms of distance to sea-access, number of neighboring countries, regional infrastructure and economic development. There is about 50% more cost in transportation for landlocked countries compared to sea-access countries, and this result in approximately 60% less trade. A 1995 study revealed that developing landlocked countries spend approximately 2 times more than other sea-access countries exportation revenue for transportation and insurances, and this is 3 times more when compared to developed countries exportation revenue. This shows that the infrastructure and the expenditure for such establishments from point A to sea-ports are important issues for landlocked countries.

The transportation from Mongolia towards the Russian far eastern Vladivostok, Nakhodka, Vostochniy, Zarubino, Posiyet and Vanino seaports impose railway complications, and limit the coal transportation. Annual development plans and huge investments are focused in to increasing Russian sea-port capacities and their infrastructure. The far eastern sea-ports increased their export and imports with Asian and American countries which resulted in an increase of 12.3% to 162.5 Mt freight transport in 2014. Further increases in trade circulation are projected with the Elgin and Elegest coal deposits of Yakutia and Tuva respectively.

Huge investments and infrastructural developments of the Dadong, Dalian, Yingkou, Jinjou, Qinhuangdao, Tianjin and Huanghua coastal sea-ports of Dunbei and Huabei China makes just one of these ports to see more trade than all the Russian far eastern ports combined. At present Mongolia is authorized access to only Tianjin, and it is connected by the trans-Siberian railway of UBTZ. A 50 year agreement was reached for a “Transportation logistics project” at the Tianjin sea-port with 51% Chinese and 49% Mongolian investments.

Mongolia reached an agreement with the Russians to partner in ownership of the North Korean Rajin sea-port. Currently the "RasonKonTrans" a Russian and Korean joint venture is owned 70:30 to the Russian side for the next 49 years. The 56 km rail line of Hunchun to Rajin is improved to a double rail (1520 mm and 1435 mm gauges).

Fig. 9. Mongolian access to sea-ports.

The key to Mongolian development is to promote the continuously increasing regional foreign trade, integrating the regional road and rail transportation systems and at the same time to solve its transportation and logistics issues the most optimum way possible. 80% of Mongolian foreign trade is with northeastern Asian countries and this helps us determine whether the Mongolian transportation system is sufficient. The northeastern Asian regional transportation is expected to increase through Mongolia.

The establishment of new roads and expansions of transportation and logistics will solve a lot of Mongolian socio-economic problems and issues. An integrated and connected transportation system that extends to all corners of Mongolia, and international open border ports will be the foundation for the development of mineral resource, transportation, logistics, agriculture and further industries.

6. Conclusion

Mongolia is too dependent on its vast mineral resources, which are mostly non-renewable resources. This prompts us to seek proper use and appropriate measures such as putting environmental protection and to advance value-added products in to the world markets with optimum prices at the forefront.

This study includes a matrix analysis of total 54 deposits. The matrix analysis evaluates the current and future outlook of mining, production and processing integrated with an infrastructural factor assessments. The mining factors were assessed by 6 groups of 18 inquiries and the infrastructural factors were assessed by 2 groups of 16 inquiries. The matrix analysis yielded a prioritized regional mine development plan.

However the lack of developments in the road, transportation and infrastructure hinders the opportunities of development projects with high transport costs and bad competitive prices. Thus integrating the regional mine development plan and the state railway development policies, we've estimated the 2043 rail traffic using the ArcGIS and EMMA software programs. The phase priority suggestions for the planned rail line development plan were based on these estimations. Rail transportation is important for mineral commodity transport especially to third country markets, so railway development should proceed in economically feasible phases.

The development of these transportation and logistics system would solve a lot of Mongolian socio-economic issues. An integrated and connected transportation system that extends to all corners of Mongolia, and international open border ports will be the foundation for the development of mineral resource, transportation, logistics, agriculture and further industries.

Acknowledgements

Acknowledgements and Reference heading should be left justified, bold, with the first letter capitalized but have no numbers. Text below continues as normal.

Appendix A. An example appendix

Authors including an appendix section should do so before References section. Multiple appendices should all have headings in the style used above. They will automatically be ordered A, B, C etc.

A.1. Example of a sub-heading within an appendix

There is also the option to include a subheading within the Appendix if you wish.

References

Lukinskiy, V.S., Berezhnaya, V.I., 2004. Logistics of truck transport, in "Finance and Statistics" (Ed.). Moscow, pp 367 .
Asrart B., Ariunbayr S., 2009. Logistics management 1, National print UB, pp 349 .
Asrart B., Ariunbayr S., Ganbat D., 2012. Logistics management 2, National print UB, pp 367.
Master plan developmental study results for financing the Mongolian mining and infrastructure sectors, 2014.
National Statistical Office, 2017. Mongolian Statistical Yearbook. Ulaanbaatar, Mongolia.
Mineral Resources Authority, 2017. Mining industry statistics. Ulaanbaatar, Mongolia