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# To Solve the Challenges of Coal Export Issues by Marine Terminals in the Primorsky Region by Analysis of Cargo Handling Technology

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**Abstract.** since 2010, the stevedoring companies in the Primorsky region have been actively increasing the volumes of coal handling due to growing demand for coal production (in 2.5 times) in the countries of the Asia-Pacific region.

At ¼ 2020, in the context of the stagnation of the global economy, the demand for coal remained stable in the countries of the Asia-Pacific region. Thus, in order to maintain the positions of the Russian Federation in the coal markets of the Asia-Pacific region countries, it is necessary to have due understanding of the handling capacities efficiency, the quality of coal processing services and the environmental impact in the seaports of the Primorsky region. Despite the fact that the closed coal handling technology at the specialized coal terminal used by JSC «Vostochny Port» is considered the most effective, the most local stevedoring companies use non-specialized coal handling technology by clamshells.

## 1. Introduction

The transport industry of Primorsky Krai occupies a leading position in the regional economy, its main component is seaports. Most of the port infrastructure was created in the Soviet era of the 20th century. The specifics of the range of processed goods were traditionally represented by fish products, general and construction cargo, which is part of the provision of northern delivery to Kamchatka and Chukotka, container cargo, as well as, of course, export coal. Due to the high demand for coal products in the countries of the Asia-Pacific region, since 2010, the stevedoring companies of the Primorsky Territory have been actively increasing the volume of coal transshipment.

The problem is that today there is a need to modernize the transport infrastructure of the port and industrial complexes (PPK), without this it is impossible to gradually develop entrepreneurship in the region, to ensure coherent logistics schemes within the state as a whole.

The development of port infrastructure in Primorye is an important economic task, the solution of which should be carried out within the framework of the state policy on the socio-economic development of the territories with the involvement of business through the organization of effective public-private partnership (PPP).

The efficiency of a large business is mainly determined by the efficiency of the coordination of labor, commodity and financial flows, which ensure the stability of the business over time. Profit for this type



of business is not an end in itself, since its dominant goal is the very existence of the company, as well as the growth of its value.

Large business, in order to ensure its stability in relation to labor flows, seeks, on the one hand, to minimize human participation in the production process, and on the other – to create a certain margin of stability with the undoubted simplification of labor. In this sense, large capital is a generator of both explicit and implicit unemployment. In support of this, we can cite changes in the number of employees in certain industries of Russia that produce single products, such as the electric power industry, oil production, gas and coal industries.

Concretizing the concept of policy in relation to entrepreneurship, by policy we mean a system of measures as a certain reference point for the development of a competent, scientifically based business management system.

In relation to the term "regulation", there are also many interpretations, and some authors, such as V. V. Klavdienko [5] S. A. Dolbina [6], identify regulation and management. This position is shared by a number of other authors, describing state regulation as indirect management through laws and regulations, as well as stimulating the initiative of the subjects of management themselves. I. Z. Fatkhutdinov approaches the definition of regulation somewhat differently [7]. He believes that regulation is the function of management to study changes in environmental factors that affect the quality of management decisions and the effectiveness of the company's management system and to take measures to bring the parameters of the management system to the requirements of the external environment [7].

At the same time, a number of authors, with whom we can agree, strictly distinguish the concepts of regulation and management. Thus, R. A. Korenchenko, N. V. Galkina believe that regulation is the process of restoring the normal exercise of functions by various elements, parts of an organization, or the suppression of dysfunctionality in its elements. Emphasizing the differences between regulation and management, he also points out that if regulation is mainly aimed at eliminating the causes and the deviations themselves, then management takes into account and evaluates, first of all, changes in the external environment in which the organization is located [8].

The author adheres to the position stated by E. M. Korotkov that regulation is a management function that ensures the equilibrium state of the institutional entities of the economic system [9]. Noteworthy is the position of V. N. Mochalnikov, who notes that regulation, along with monitoring, forecasting, planning, coordination, control, etc., is one of the management functions, the essence of which is to make operational changes in the course of implementing programs and activity plans [10].

Considering one of the industry areas, we can say that at present, the activation of the role of our state is manifested in increasing the status of maritime transport and infrastructure policy.

As an example, we can cite the leading maritime countries (USA, EU, Japan, China, etc.), where the issues of the development of the maritime transport system are regularly considered at the highest state level, including through the preparation of reports on the state and trends in the development of maritime transport. The maritime transport policy of these countries is an integral part of the economic policy and the national security system.

**The task of the study** is to analyze the real picture of the problems of solving the issues of coal export by sea terminals in the Primorsky Territory through the analysis of cargo transshipment technology (coal). In 2019, the volume of coal processing in Russian ports increased by 9%, compared to the same period in 2018, and amounted to 175.94 million tons. At the same time, the share of the Far Eastern basin in 2019 was 56% – 98.82 million tons, which is 8% higher than in 2018 – 91.10 million tons.

Currently, 15 stevedoring companies are engaged in coal transshipment in the Primorsky Territory, they can be classified into three types of technologies:

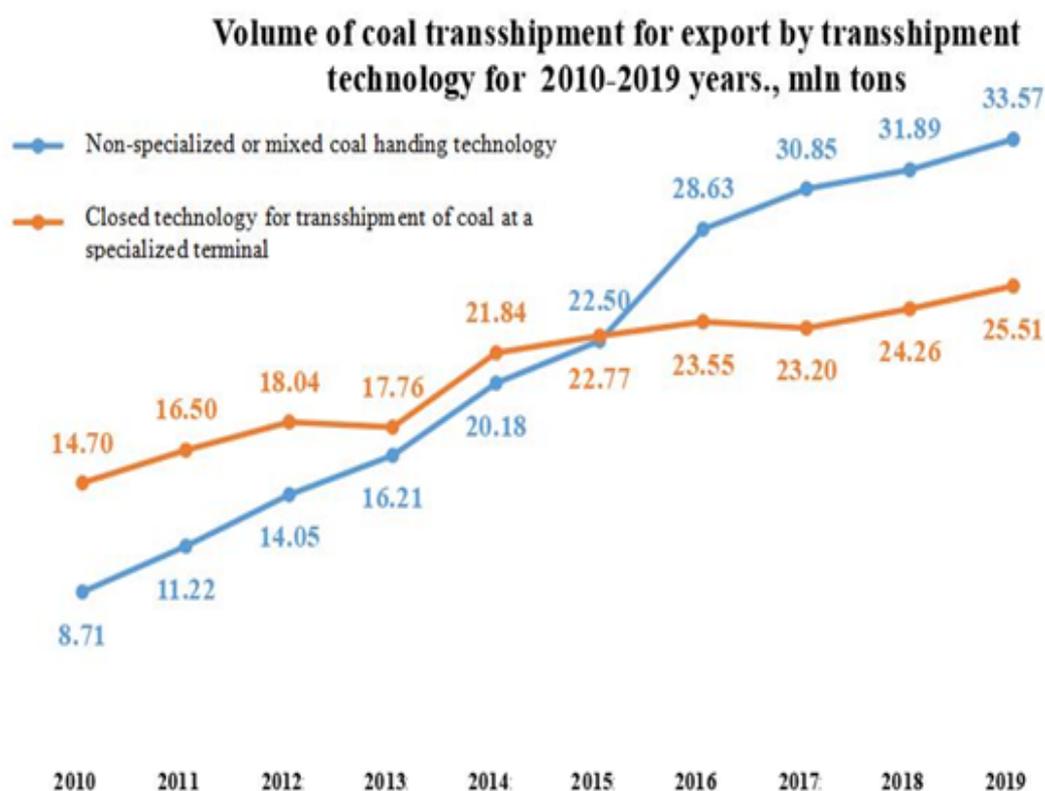
1. Nonspecialized technology of coal transshipment (in bulk using cranes or manipulators equipped with grabs, some partially with conveyor loaders), which is represented by Nakhodka enterprises: JSC "Nakhodka Commercial Sea Port", LLC "Attis Enterprise", JSC "Port of Vostochny Vorota-Primorskiy Zavod", LLC "Geomar", LLC "Port of Livadia", JSC "Astafiev Terminal", JSC "Dalmormontazh", LLC SK "Small Port", LLC "East Ural Terminal", LLC "Vostochny lesnoy port", LLC "Vostochnaya

Stevedoring company". As well as PJSC "Vladivostok Commercial Sea Port" and JSC "Vladivostok Sea Fishing Port".

2. Mixed coal transshipment technology-JSC "Commercial Port of Posyet", using a car dumper for unloading and grabs for loading cargo.

3. Closed technology of coal transshipment at a specialized coal terminal. JSC "Vostochny Port" in Nakhodka city district.

Over the past 10 years, the cargo turnover of coal in the ports of Primorsky Krai has increased by about 2.7 times, if in 2010 the sea terminals of Primorsky Krai handled 23.41 million tons, then by the end of 2019, the total cargo turnover of ports in the region amounted to 59.08 million tons. Including at sea terminals with non-specialized or mixed coal transshipment technology, the increase was 4 times, from 8.71 million tons to 33.57 million tons. In turn, at the only specialized coal terminal in the Primorsky Territory with a closed coal transshipment technology, cargo turnover increased 1.7 times during the period under review from 14.70 million tons in 2010 to 25.51 million tons in 2019. (Figure 1).



**Figure 1.** Volume of coal transshipment for export by transshipment technology for 2010-2019 years., mln tons. Source: compiled by the author.

Nonspecialized terminals (not including the port of Posyet), since 2010, have increased their total cargo turnover by 5.4 times from 5.14 million tons in 2010 to 27.93 million tons in 2019.

The main increase in cargo turnover among the terminals that use non-specialized coal transshipment technology in their production process was due to JSC Nakhodka Commercial Sea Port, LLC East Ural Terminal and JSC Astafiev Terminal.

**Table 1.** Cargo turnover of non-specialized coal transshipment terminals in Primorsky Krai for 2010-2019.

Stevedores	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Transshipment volume growth in 2019/2010
JSC Nakhodka Commercial Sea Port	1,85	2,37	2,45	3,65	5,56	6,17	6,67	6,55	8,17	9,45	5,1
East Ural Terminal LLC	0,00	0,04	0,37	1,11	2,10	3,70	4,13	4,15	4,34	4,56	1,0
JSC Astafiev Terminal	0,00	0,13	0,63	1,00	1,27	1,53	2,13	2,77	2,53	2,95	1,0
LLC SK Small port	1,42	2,51	2,54	2,24	2,61	2,59	2,82	2,84	2,47	2,75	1,9
Vostochnaya Stevedoring Company, LLC	0,00	0,00	0,48	0,41	0,19	0,65	1,23	1,63	1,63	1,58	1,0
Attis Enterprise LLC	0,72	0,73	0,10	0,73	0,77	1,04	1,64	1,72	1,74	1,44	2,0
PJSC " Vladivostok Commercial Sea Port	0,49	0,30	0,55	0,43	0,22	0,08	0,17	0,75	1,24	1,31	2,7
JSC Vladivostok MCI	0,25	0,49	0,81	1,29	1,21	0,44	0,91	1,33	1,47	1,18	4,7
JSC Dalmormontazh	0,00	0,14	0,59	0,45	0,41	0,81	1,09	1,28	1,01	1,01	1,0
JSC Vostochny Vorota Port-Primorskiy Zavod	0,21	0,33	0,47	0,33	0,22	0,32	0,34	0,78	0,81	0,73	3,5
Vostochny Lesnoy Port, LLC	0,21	0,18	0,37	0,21	0,28	0,08	0,32	0,58	0,55	0,44	2,1
Geomar LLC	0,00	0,00	0,15	0,24	0,22	0,04	0,11	0,25	0,27	0,28	1,0
Port of Livadia LLC	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,31	0,36	0,27	1,0
<b>Total nonspecialized terminals</b>	<b>5,14</b>	<b>7,20</b>	<b>9,51</b>	<b>12,09</b>	<b>15,06</b>	<b>17,45</b>	<b>21,56</b>	<b>24,94</b>	<b>26,59</b>	<b>27,93</b>	<b>5,4</b>
Mixed technology of JSC Commercial Port of Posyet	3,57	4,02	4,54	4,12	5,12	5,05	7,07	5,91	5,30	5,64	1,6
<b>Total</b>	<b>8,71</b>	<b>11,22</b>	<b>14,05</b>	<b>16,21</b>	<b>20,18</b>	<b>22,50</b>	<b>28,63</b>	<b>30,85</b>	<b>31,89</b>	<b>33,57</b>	<b>3,9</b>

JSC "Nakhodka Commercial Sea Port" - initially specialized in the transshipment of general and other cargo. Historically, JSC "Nakhodka Commercial Sea Port" has a fairly large berthing and storage front, and at the time of increasing demand for coal products in the countries of the Asia-Pacific region, JSC "Nakhodka Commercial Sea Port" converted its production facilities to grab coal transshipment technology, which led to an increase in the cargo turnover of coal products from 1.85 million tons in

2010 to 9.45 million tons in 2019 (almost 5 times), while reducing the volume of transshipment of other types of cargo.

Also, some similar terminals with non-specialized coal transshipment technology, in order to increase cargo turnover and minimize the negative impact on the environment, are trying to optimize their technological processes. Optimization is carried out through the introduction of mobile conveyors adapted for loading ships, and to minimize the negative impact on the environment, mesh fences made of various types of materials are equipped around the perimeter of the terminals and snow-generating guns and water-watering devices are used.

In addition, it is worth noting the stevedoring companies, whose initial specialization was quite unique and was not associated with the transshipment of general cargo or coal. Such companies include LLC "East Ural Terminal" and JSC "Astafiev Terminal".

LLC Vostochno-Uralsky Terminal-the initial specialization is the transshipment of wood chips using a system of conveyors and loading mechanisms for ships, but since 1998 the production process has been repurposed for the processing of mineral fertilizers. For the closed storage of potash fertilizers, tent storage facilities were arranged. Since 2011, East Ural Terminal LLC has been engaged in coal transshipment, gradually increasing the annual cargo turnover of coal to 4.56 million tons in 2019. Coal is unloaded from the wagons using mobile manipulators equipped with grapples.

Tent storage facilities are now used for partial placement of coal, while with a high concentration of coal dust inside, there may be prerequisites for explosive situations, and in cases of spontaneous combustion of coal, fire elimination is extremely difficult.

JSC "Astafiev Terminal" - the primary specialization was the production of tin-and-tin products for subsequent loading on marine floating bases. But when re-profiling for the transshipment of coal products, the entire initial technological process was completely eliminated. JSC "Astafiev Terminal", as well as LLC "East Ural Terminal", started transshipment of coal since 2011 and in 2019 increased the volume of transshipment to 2.95 million tons.

The coal handling technologies used today are as follows: coal is unloaded using mobile grab manipulators to an open warehouse, and the vessel is loaded using cranes with grabs and one conveyor loader.

The terminals with mixed coal transshipment technology in the Primorsky Territory include JSC "Commercial Port of Posyet". Since 2010, the stevedoring company has increased the cargo turnover of coal products from 3.57 million tons to 5.64 million tons in 2019. The technology of coal transshipment of JSC "Commercial Port of Posyet" includes coal unloading with the use of a car dumper, a system of conveyor lines for transporting coal products to an open warehouse. Loading on the ship is carried out using portal cranes with grabs.

The closed technology of coal transshipment at a specialized coal terminal in the Primorsky Territory is implemented only at JSC Vostochny Port. In 2019, the stevedoring company's cargo turnover amounted to 25.51 million tons, which accounts for 42% of the total coal turnover in the Primorsky Territory. The company has installed a closed complex of car dumpers designed for unloading cars by means of a side turn of 160°, which provides unloading of cars using air aspiration systems and fine water mist. In winter, all gondola cars are kept in heated car defrosters before unloading to restore the flowability of coal. Then, using a system of covered conveyor lines, the coal is fed by a stacker to the warehouse. From the warehouse with the use of reclaimers, conveyor systems and ship loading machines, coal is fed directly into the ship's hold. All reloading equipment is optimized for a total capacity of up to 3.5 thousand tons per hour, the depth at the berths up to 16.5 meters allows you to take the processing of vessels with a deadweight of up to 180 thousand tons. To minimize the possible environmental impact, the water dome of the irrigation system completely covers the entire surface of the storage area. In addition, crushing and sorting complexes are used, which are designed to control the size of the fraction, sort coal and remove ferromagnetic and other inclusions. Wind(dust) filters are installed around the entire perimeter of the terminal.)protective metal perforated barriers with a height of 20 meters. And industrial and stormwater runoff is treated with a multi-level treatment system and the use of treatment facilities.

All these measures allow JSC "Vostochny Port»:

- accept and handle larger vessels than other stevedoring companies engaged in coal transshipment;
- provide a full range of services to maintain the quality of coal at the proper export level (cleaning if necessary);
- observe a continuous schedule for handling the train without damage and ensure smooth operation all year round;
- comply with the norms and requirements of the environmental legislation of the Russian Federation;
- to increase the efficiency of transport schemes for sending coal for export, and with it the competitiveness of Russian coal in the markets of the countries of the Asia-Pacific region.

*The practical significance of the study* is that the analysis showed the real picture: coal transshipment through the ports of Primorsky Krai is carried out mainly through universal berths by grab cranes, 58% of the total volume of export coal. The region has the only specialized coal complex in the port of Vostochny with an annual capacity of up to 55 million tons, through which 25.5 million tons were transshipped in 2019. The low intensity of crane grapple loading and the inability to accept large-capacity vessels with a deadweight of more than 40 thousand tons in most coastal ports reduce the competitiveness and efficiency of coal exports.

The cost of storing and accumulating ship lots is ten times higher than the marginal tariffs of a specialized coal terminal. The cost of loading and unloading operations with grapple loading on ships is twice as high as with specialized coal transshipment. At the same time, the increased deadweight of ships handled in the Eastern Port, up to 180 thousand tons, allows you to significantly reduce the cost of cargo owner for sea cargo transportation.

Gross unloading of 4 double car dumpers at the same time of 8 cars takes about three minutes, while for unloading coal with a grab it takes at least 15 minutes per car. A priori, the significant difference that is economic in terms of the costs of loading and unloading and storage, and that is operational in terms of the impact on the turnover of wagons, is more than clear and indicative.

Long-term processing of rolling stock with coal in non-specialized sea ports of the Primorsky Territory, their lack of car-defrosting devices, among other things, leads to a slowdown in the turnover of cars, according to the results of January 2020, the slowdown in the turnover of cars was 5.2 days compared to January 2019, as a result of which the capacity of the Eastern Polygon of the Russian Railways network decreased.

To date, the situation with the shortage of railway capacity of the Eastern polygon of the Russian Railways network leads to the non-removal of coal cargo from the mining enterprises of Kuzbass and is critical for the preservation of the port industry of the Primorsky Territory, which is the main taxpayer and employer of the region.

## 2. Conclusion

Based on the above, it is assumed that the increased loading of coal cargo to the specialized coal terminals of the Far East (mono-cargo) in order to reduce the turnover of gondola cars at the Eastern polygon of the Russian Railways network, reduce shunting and sorting operations of Russian Railways, together will lead to an increase in the volume of Russian coal exports to the Asia-Pacific markets and will guarantee an increase in the profitability of Russian Railways and ensure the social stability of Primorsky Krai in difficult conditions of declining economic activity.

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