Transportation and logistics system for preparing areas to unload material resources in the absence of port infrastructure

Yu D Kravets, D V Shuvalov and N A Yermoshin

Military Academy of Logistical Support "General of the Army A. V. Khrulev", Saint Petersburg, Russia

E-mail: yurakravets1977@mail.ru

Abstract. The transport system of any state is a determining link in the development of the economy, the implementation of internal and external political and military goals. At the same time, in most countries, water transport is one of the key modes of transport pursuing state interests. Despite the fact that recently the development of remote territories has reached a fairly high rate, the full development of the port infrastructure does not always meet the needs of logistics enterprises and organizations. At the same time, the need to unload material resources to the unequipped coast has sharply increased. The issue of improving technologies and developing technology in organizing the unloading of material resources on an unequipped coast has been discussed for a long time, however, a solution that satisfies the need for organizing the unloading of material assets, taking into account all the features, has not yet been found. The article proposes the author's conceptual approach to improving the process of unloading material resources on an unequipped coast, which consists in using a completely new transport and technological system for preparing unloading areas, affecting all the constituent elements of the process: vehicles, transmission links and coast.

1. General problem statement

In the modern world, success in the development of the economic potential of the state directly depends on the development of the regions, including remote ones. A number of developed countries as part of the state territory have its remote components, the development of which, due to the considerable distances, climatic features and, at the same time, the weak development of the transport system, is significantly difficult. Perhaps the development of such territories would have to be left to the mercy of time and considered prospective. However, progressive development of the economy and the raw material needs of states on the one hand, as well as the discovered raw material potentials of remote territories, on the other hand, are pushing the leadership of a number of states to actively develop remote territories.

The transport and logistics system is a system that includes elements, functioning of which makes it possible to smoothly carry out freight and passenger transportation with a high degree of reliability. A special role in this system is given to modes of transport.

Sea transport has a special place in the transport system of the Russian Federation. The fact is that the Russian Federation possesses a territory located in different climatic zones and, in addition, has an impressive network of waterways. In addition, Russia includes a sufficient number of islands or remote
areas, transport links with which are possible only by air or water. At the same time, sea transport plays a major role in freight and passenger traffic within the country in the Far North, the Far East, as well as in the seas.

Remote regions, having only waterways in the form of transport links with the main economic region, often have port infrastructure sufficient only to ensure the region’s cargo turnover. The most urgent state issue is the need for prompt delivery and unloading of goods on the coast, which is, as a rule, unequipped. Such problematic situations more and more often arise when solving state problems in defense matters, preventing emergencies, organizing search and rescue measures, eliminating the consequences of disasters and natural disasters.

2. Subproblem statement
The coast, which is not equipped for unloading material assets, as well as people, will have quite serious preparation. In most cases, work on the coast requires the involvement of equipment, human resources, and long time. Practice shows that in order to prepare for unloading on the coast of a number of islands belonging to the Russian Federation, it was necessary to deliver bulldozers, excavators and other large construction equipment. At the same time, the last parameters were preventing the organization of the delivery of this equipment by air. The above facts show that:

- coastal equipment is of national interest;
- preparing the coast for unloading requires a rather serious investment of time and resources;
- the delivery of forces, as well as materiel for equipping the coast, is also a problem, which directly affects the promptness of preparing the coast for unloading;
- as a rule, the preparation of the coast for unloading will proceed in a harsh climatic environment, but in cramped conditions that affect the efficiency of work.

The growing importance of the issue of unloading material assets in the absence of port infrastructure is the reason of searching for solutions for the prompt unloading of goods, the results of which made it possible to significantly advance in this issue [1-4]. As a rule, the search for a solution led to the development of only one side of the problem: piers, berths, etc. However, this is the first time a complex issue is being resolved in the “ship-berth-coast” system.

3. Author's approach to solving the problem
The authors of the article came to the conclusion that the most effective way to improve the issue of unloading material resources on an unequipped coast would be an integrated approach, which consists in using a completely new transport and technological system for preparing unloading areas, affecting all the constituent elements of the process: vehicles, transmission links and coast. It is by preparing three interrelated components involved in the implementation of the process of delivery and unloading of goods that it is possible to comprehensively approach the solution of the problematic issue (figure 1).

![Figure 1. Conceptual approach to solving the problem of delivery and unloading of material assets to the unequipped coast.](image-url)

The vehicles currently used for the delivery of material assets by waterways have significant drawbacks: bad adaptability to compact optimal placement on board of unloading facilities and (or) demountable berths [5, 6]. This is associated with shortcomings in the design features of the unloading facilities and berths, as well as with the approaches to coastal preparation. Thus, the first step in solving
the problem of delivery and unloading of materiel to the unequipped coast was the bilateral adaptation of the structure of vessels for unloading facilities and (or) demountable berths, as well as the latter should be adapted for the structure of ships. The adaptation consisted in the fulfillment of the following basic conditions.

First. The vessel is equipped with appropriate cargo spaces, volumes and shape that allows to place a multiple number of floating berth elements.

Second. The main elements of the floating berth that receive the load are the same and are unified in size to fit the dimensions of the main standardized reusable container, an ISO container.

Third. The vessel is provided with a lifting device capable of unloading into the water, as well as lifting on board the main elements of the floating berth.

As for the main elements of the floating berth, each of them is a prefabricated pontoon, folded on board the vessel, and capable of automatically turning when unloading from the vessel to the surface of the water (figure 2) [7].

The design of prefabricated pontoons has an optimal weight and carrying capacity and allows:

- to keep the assembled state during transportation on ships;
- to automatically disassemble into the floating berth section when lowering to the water surface;
- together with other sections, ensure stable passage of vehicles;
- to automatically assemble when boarding the vessel.

The essence of preparing the coast for unloading is as follows. Vessels are not economically efficient and it is practically not always possible to equip ships with a complete set of elements, devices, parts for equipping berths. It cannot be denied that the volume of such elements directly depends on the volume of payload placed on a particular ship. Undoubtedly, some of the main elements that are high cost and are not manufactured on an industrial scale, for example, prefabricated pontoons, should be placed on ships. However, auxiliary elements, such as piles, supports, construction and restoration materials and structures that cannot be found or procured on the coast, and, which have a large mass and dimensions, should be placed on the coast, focusing them on special objects, intended for the operational support (supply) of the process of unloading material resources on the unequipped coast [8].

It is advisable to locate operational supply facilities on the coast, at a safe distance from the coastline, at points in accordance with the need to unload foods. The proposed objects can be created on the basis of several points with a high probability of unloading of material resources.

At the same time, the following requirements are imposed on operational supply facilities:
• operational supply facilities should be spacious, that is, capable of accommodating the required amount of construction and restoration materials and structures;
• approaches to the organization of storage of construction and restoration materials and structures should ensure the duration of storage, that is, preserve the properties of construction and restoration materials and structures for a long period of time;
• an important property that an object of operational supply should have is non-removability, that is, the ability of a place (object) to ensure the safety of construction and restoration materials and structures.

In existing dictionaries of the Russian language, the essence of the above requirements can be reflected in the concepts of emphasis, individuality, or isolation. However, the concept of isolation is the most fully reflecting all the requirements for the organization of storage of construction and restoration materials and structures (figure 3).

Figure 3. A variant of the placement of construction and restoration materials and structures in a specially prepared waterproofed pit.

When preparing the “ship-berth-coast” system, the key condition must be ensured: the number of forces and means in each link of the system must ensure that the measures for unloading cargo on the unequipped coast are carried out in a timely manner.

4. Conclusion
The problem of unloading material resources on the unequipped coast remains unresolved. At the same time, the need for the delivery of goods by water and their unloading at various points on the coast is constantly growing.

A conceptual approach to organizing the unloading of material resources on an unequipped coast, based on providing ships with the ability to transport elements of a floating berth together with cargo, introducing innovative elements of a floating berth, prefabricated pontoons, allows to offer a completely new comprehensive solution to the problem.

The development and equipping of state territory in terms of transport provision is currently a priority task of the federal executive authorities in the field of transport. The preparation of the coast as an element of the water transport system, together with the development of the capabilities of ships for the transportation of floating berths, as well as the development of innovative floating berths, comprehensively achieves a solution to the problem of unloading material resources on an unequipped coast.
The authors of this article, having revealed the conceptual foundations of a completely new transport and logistics system, fully and reasonably claim the originality of the idea, but leave the possibility of its further development.

References
[1] Mogilevsky V I 2005 Development of a methodology for optimization of the marine complex of vehicles for the delivery of goods to points with unequipped shore (SPb.)
[2] Mostovoy I F 1992 Improvement of the system of delivery of goods to the regions of the Far North (N. Novgorod)
[3] Popov A S 2005 Improving the organization of delivery of goods to the territory of the Republic of Sakha (Yakutia) through water transport hubs (Novosibirsk)
[4] Izotov O A, Kirichenko A V, Latukhov S V and Nikitin V A 2013 Technology and safety of transport operations. Processing of ships in unequipped points of the Russian Arctic (SPb.: Ostrovityanin)
[5] Military Pallets, Boxes and Containers 3 Containers and Flat Racks http://www.thinkdefence.co.uk/2014/11/military-pallets-boxes-containers-part-3-containers/
[6] Rough terrain container lifters http://topwar.ru/27117-konteyneropodemniki-dlya-perechennoy-mestnosti.html/
[7] Kravets Yu D, Shuvalov D V, Kravets D Yu, Kirichenko A V and Kuznetsov A L 2020 Method of forming a floating berth on an unequipped coast using self-dismountable pontoons 2716381 (Russian Federation, IPC)
[8] Shuvalov D V 2019 Method of autonomous long-term storage of wooden piles 2706375 (Russian Federation)