BASIC PRINCIPLES AND SPECIFIC FEATURES OF THE USE OF LOGISTICS IN THE FIELD OF CONSTRUCTION WASTE MANAGEMENT

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Abstract:
In the modern world, logistics is becoming an important scientific direction in the development of methods for managing the flow of resources and organizational forms to meet the demand for products and deliver them to the consumer on time with minimal costs. The principles of logistics are used in many areas of human activity, but the possibilities of using a logistics approach to develop and improve the construction waste management system have not yet been adequately considered.
Logistics covers a variety of activities, including the management of stocks, material and technical resources, workers, vehicle fleets, warehouses, modern information systems and financial resources. The logistics approach allows you to integrate the management system of these areas and focus on the effective management of material flows. In the context of construction waste management, logistics ensures the expansion of the raw material base of the economy, increases production volumes, reduces costs and prevents environmental pollution.

Keywords: logistics, construction waste, waste management, ecology, recycling, reuse, waste collection, transportation, information flows, raw material base, urbanization, process organization, transparency.

1. Introduction

Currently, logistics is a scientific direction, the purpose of which is to develop methods and organizational forms of managing the flow of resources in order to maximize the demand for products and deliver them to the consumer in a timely manner with minimal costs. The principles of logistics are used today in many areas of human activity. However, despite this, the possibilities of using a logistics approach to develop and improve the construction waste management system have not yet been given due attention. [1]
Logistics is a multifaceted science that encompasses a wide range of activities. The principles of logistics are widely used in the management of material and technical resources, workers,

vehicle fleets, warehouses, modern information systems, and financial resources. [2-3] The logistics approach allows you to integrate the management of the above areas into a single system and achieve end-to-end management of material flows. Waste management logistics in construction production ensures the expansion of the raw material base of the economy, an increase in production volumes while reducing its cost, and prevents environmental pollution. The emergence of construction waste began to occur from the moment when man first began to build shelters and dwellings for his own needs. If in the early stages of the development of civilization, construction waste was mainly derivatives of natural organic and mineral substances, in the modern world it is complex composite materials with the addition of polymer products of the chemical industry. In this regard, a few centuries ago, the attitude to the management of construction waste was like an uncontrolled process, which no one tried to effectively manage. However, today such an approach threatens the natural balance of the environment. The creation of an organized system of construction waste management helps to avoid such dangers. The management of construction waste directly at the construction site begins with its collection and preparation for transportation to waste processing plants or landfills for burial.

It would be wise to organize separate waste collection, when already sorted dismantling materials are loaded into containers, and each container is loaded with a specific type of material with a minimum of foreign matter.

Precise coordination of the delivery of containers for construction and demolition waste, provision of specialized construction equipment facilities, transportation of waste, the readiness of waste processing enterprises to change the volume of incoming waste due to seasonality (peak construction occurs in the warm season) and other factors, all this is the basis for

the effective functioning of the construction waste management system. The logistics of the above processes is an effective way to strengthen such a foundation.

In the field of construction waste management, there is no connection between transport, material and information flows, which leads to the above problems. To improve the waste management system, it is necessary to create a logistics information flow, including collecting information on the flow of waste, its transfer, processing and systematization, and then providing ready-made final information. Specialists involved in the process of moving construction waste at a certain stage (collection, transportation, processing, burial) often do not have immediate information about what happened to the waste at the previous stage and whether the infrastructure is ready to accept it at the next stage.

Buildings and structures consist of certain components that, after the end of their service life, fall into the category of construction waste. The technological sequence of the process of reconstruction or demolition of a building consists of the following stages. [4 - 5]

- development of design and technological documentation for the reconstruction

(demolition) of the building;

- disassembly works ;
- construction waste collection ;
- construction waste transportation ;
- construction waste again work (burial).

Waste management in the process logistics from the approach used without , management object as straight away logistics flow seeing exit this is necessary waste movement every one in the phase separately enterprises activity clear coordination provides .

The development of urbanization processes, an increase in waste generation, and increased environmental requirements create the need to locate infrastructure (factories, landfills) for the processing and disposal of construction waste at a significant distance from the sources of their formation, which leads to an increase in transportation costs.

For example, common standards and rules for regulating the transport services market for the European Union countries, uniform requirements for documents, rolling stock and operating rules have been developed [80] p. 50. By optimizing the transport flow, it is possible to achieve a significant reduction in the share of costs for it and, as a result, reduce tariffs for the transportation of construction waste for consumers.

The basis for the development of information systems, both at the level of individual waste management enterprises and at the regional level, is the emergence of data transfer standards and the introduction of computer technologies.

Automated control systems are being introduced in modern specialized transport enterprises, as a result of which the efficiency of waste transportation is increasing, the quality of information provision to enterprises is increasing, and statistical reporting is becoming more relevant and accurate. In addition, modern technical means, called transport navigation systems, based on the use of satellite navigation systems such as GLONASS and GPS, are installed on special vehicles [6-8]. A scheme for improving the transport component of construction waste management systems is shown.

Analysis of sources on logistics theory [9] leads us to the conclusion that many authors have identified the same principles of logistics. Taking into account the specificity of the field of construction waste management, the following principles can be formulated: robustness; efficiency; complexity; flexibility; constructiveness; reliability; integrity; scientificity; concreteness; alternativeness (variability); specialization; humanization; adaptability and sustainability.

The principle of coherence is based on the use of a systematic approach in any management activity. "A systematic approach is the development of a methodology for social practice of special scientific knowledge based on the study of objects as a system." [10] The general goal

of the system is to organize the process of effective use of construction waste as a secondary resource.

"Efficiency is the relative effectiveness of a process, project, operation, defined as the ratio of the result achieved to the costs" [11] . The principle of efficiency occupies one of the central places in the construction waste management system. On its basis, after analyzing all possible costs, decisions are made on the direction of waste for a particular type of processing. The principle of efficiency should be implemented throughout the entire logistics chain of movement of material, information and financial flows. Minimizing total logistics costs in the process of working with construction waste is one of the main tasks of logistics, including construction waste logistics.

Complexity is a logistics principle, without which it is impossible to organize and implement the optimal movement of material flows in the construction waste management system. The effective movement of material flows is achieved due to the formed complex of technical, regulatory, information and economic support. Within the framework of this principle, it is necessary to clearly coordinate the actions of all structural elements of the construction waste management system.

The logistic principle of flexibility allows us to avoid such situations by using mechanisms for rapid response to external or internal changes in the system through timely management decisions. The same principle includes elements of forecasting that help to correctly respond to changes in advance.

The use of modern navigation systems in vehicles transporting construction waste is an example of the principle of constructivity. This principle implies the dispatch of material, information and financial flows, that is, constant monitoring of the movement and changes in the movement of each flow object, as well as timely corrections to these processes. The implementation of the principle of constructivity can be considered complete only when dispatching systems are provided for all components of the construction waste management sector.

Reliability is the property of timely maintaining the values of all parameters within specified limits, characterizing the ability to perform the required functions under specified conditions and modes of use, maintenance, storage, and transportation .

Integrity implies the development of information cooperation between regional authorities responsible for construction waste management and local components of the management system. One of the mandatory conditions of the principle of integrity is to ensure the ability of organizations engaged in waste collection and transportation, waste processing plants and landfills to promptly coordinate and correct their actions on the disposal of construction waste.

The principle of the scientific approach implies the dominant role of mathematical calculations at all stages of construction waste management, from planning to analyzing all parameters of the trajectory of material, information and financial flows. Correct mathematical calculations

allow optimizing traffic routes at the initial stage, taking into account the need for the number and characteristics of machines, analyzing the mass of transported goods, and effectively using specialized vehicles for transporting waste. As for information and financial flows, the scientific principle is characterized by determining the frequency of data exchange, the content of the transmitted data, calculating the amount of financing required for measures to manage the development of construction production, etc.

The principle of specialization is the use of technological equipment and vehicles in accordance with the optimal conditions of their application. For example, if the task is to deliver cargo divided into separate fractions to a construction waste processing plant, it is advisable to use transport capable of transporting several containers at the same time.

In order to attract young, promising workers to the construction waste management sector, it is necessary to create modern working conditions for them. The principles of flexibility and stability of the logistics system are manifested in the conditions of variability of the external environment. The uncertainty and non-existence of situations in which the construction waste management system may arise, as well as the uncertainty of the final results of management decisions, lead to sharp changes in the quantitative and qualitative characteristics of material flows consumed by the system.

Thus, the principles of logistics ensure the effective functioning of the construction waste management system from the moment of its formation to the receipt of the final secondary resource. The logistics apparatus begins to work from the moment the decision is made to demolish or build a building.

The direct logistics flow when demolishing buildings or structures begins with the creation of construction organization projects and work production projects.

Logistics is also closely related to planning. This is because the dismantling process depends on the timely organization of preparatory work, the delivery of equipment and components of a certain quality and quantity.

Current construction practice suggests the feasibility of introducing logistics principles into the theory and practice of construction waste management, as well as the need to use the concept of "just in time" logistics to achieve the greatest technological, economic and environmental impact.

2. MATERIALS AND METHODS

Logistic methods for recycling construction waste as secondary resources .

Many aspects of making rational decisions on the use of construction waste as secondary resources are insufficiently substantiated and require improvement, taking into account the achievements of modern science and technology.

According to SBSborshikov, Construction waste is generated mainly in practice during the construction of new buildings and structures, as well as during reconstruction, repair and

demolition of dilapidated houses, since dilapidated houses pose a threat to human life. According to statistics, the service life of buildings and structures can be extended to an average of 70 years, and the service life of residential buildings can be extended to 80 to 100 years. Today, approximately 1.5 percent of the existing construction volume of objects is dismantled and demolished annually.[12]

It is known that every construction and demolition process generates a large amount of waste, which is characterized by high raw material quality.

The sources of construction waste generation include:

Construction of new facilities;

Reconstruction and repair;

Dismantling and demolition of existing buildings;

The activities of enterprises producing reinforced concrete products, bricks, fiberboard, chipboard, ceramic products. Also, during emergencies, natural and man-made situations, and when eliminating the destruction of entire cities, a large amount of construction waste is generated.

Every year, residents generate a certain amount of construction waste during the current renovation of apartments and small-scale local construction. Small-scale construction waste is not always disposed of, but is usually dumped in nearby forests, fields, and water bodies, which has a serious impact on the environment.

Table 1 Reasons for the development and demolition of buildings and structures (S. Sborshikov)

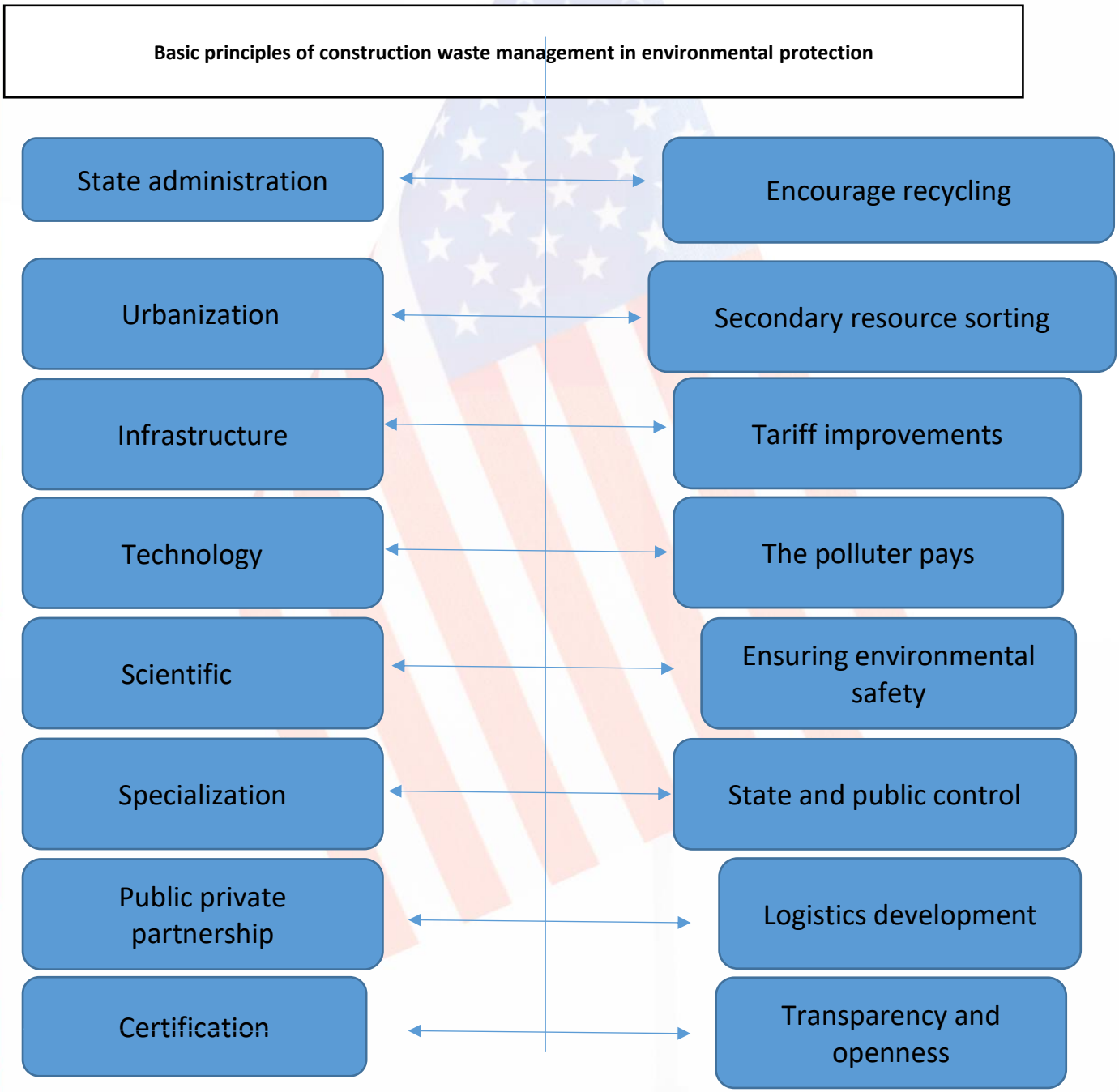
1	Reasons for dismantling and demolition	%
2	Construction of new residential buildings	40
3	Construction of new non-residential buildings	20
4	Construction of public and road areas	20
5	Change of purpose of use of buildings	7
6	Force majeure circumstances	5
7	Other reasons	8

It is stipulated that organizations performing construction and installation work, as well as factories producing building materials, must separate valuable components from the total volume of their waste at the initial stages of sorting and collection. Serves to organize scientific developments and the production of building materials, by mobilizing additional reserves. The proposed logistics methodology opens up broad opportunities for the development and improvement of the circulation of recycled building materials. Their use will allow for the rational organization of the secondary raw materials market, thereby increasing the economic

potential of the country's regions and preserving natural resources, which are gradually decreasing over time.

The following diagram shows a diagram of the formation and movement directions of the logistics flow of construction and demolition waste in the construction production system.

Table 2



There is increasing attention to construction waste in the country, but no principles for its targeted management have been developed. Therefore, in order to fully cover the topic of the dissertation, a draft of the main principles of construction waste management is being prepared.

S. Sborshikov noted that today the lack of an effective mechanism for managing construction waste leads to unjustified economic losses and environmental pollution[80].

Russia A number of organizational works have been carried out in the Federation on the management of construction waste, the development of the regulatory legal base, in 1998 the Law of the Russian Federation "On Production and Consumption Waste" was adopted, in 2000 the procedure for maintaining a state cadastre of waste and passporting hazardous waste was adopted, in 2006 the licensing of waste collection, transportation, use, neutralization, and burial activities was adopted, in 1992 the resolutions on waste disposal, limits on the use of natural resources, the approval of norms for the release of harmful substances into the natural environment and the discharge of wastewater were adopted, in 2003 the resolutions on the introduction of regulatory fees for the release of harmful substances into the atmospheric air and the discharge of wastewater into the ground and underground were adopted. Relevant documents such as the approval of the norms for waste generation and limits for their disposal by the Ministry of Ecology and Natural Resources of the Russian Federation were adopted. [12-13]

Nevertheless, in recent years, real threats have been posed to the health of the population and the environment in the regions. Construction waste logistics is a scientific direction, the purpose of which is to develop methods for managing resource flows, to deliver products to consumers as much as possible within the specified time frame at low cost. Currently, the principle of logistics is widely used in industries in the field of human activity. However, the development and improvement of the use of logistics capabilities in the waste management system in construction and demolition has been neglected.

The Moscow City Law "On Production and Consumption Waste of the City of Moscow," adopted in 2005, is noteworthy. This law sets out strict requirements for the management and disposal of construction waste, including:

The collection of construction waste is carried out at facilities where it is generated separately according to the types of waste that have a single use in accordance with the technological regulations for the process of its generation along with construction and demolition waste;

Mixing of construction and demolition waste is not allowed, except for their subsequent processing;

The burial and use of construction and demolition waste at construction sites is prohibited;

The transportation of construction and demolition waste is carried out on the basis of a permit for its movement;

Construction and demolition waste, waste and products of their processing must be sent for processing and further use under mandatory radiation and sanitary-epidemiological control, as well as taking into account the availability of appropriate processing facilities in the city, etc.

It is also established that the duration of temporary storage of construction waste at the site of

construction work should not exceed seven working days. This indicator is set at thirty days in Uzbekistan.

In addition, the Moscow City Government Resolution No. 469 of June 25, 2022 "On the Procedure for Managing Construction and Demolition of Buildings in the City of Moscow" approved three lists of construction waste sent for recycling. The first list includes the use of organic secondary resource waste generated during construction and demolition (wood waste, paper and cardboard waste), the second list includes the use of secondary resource waste with a mineral content (natural-based waste, concrete-based waste and construction mixtures, waste with a mineral binder base, asbestos-cement waste, glass-based waste and equivalent, ceramic-based waste), and the third list (tar concrete and asphalt waste, packaging, roofing and waterproofing materials, polymer and plastic waste) with priority use and recycling.

Analysis of construction management in major Russian cities shows that construction work is concentrated in Moscow and St. Petersburg. Construction waste is generated mainly within the city limits, and its collection and disposal are carried out outside the immediate vicinity.

There are two main ways to dispose of construction waste from its source. The first way is to obtain secondary resources at recycling facilities. This is an economically viable way. and more environmentally beneficial. However, the number of construction waste processing plants in Russia is small and they are mainly located around cities in the central part of the country.

The problem is that there is not enough capacity for recycling construction waste, which prevents the owners of construction waste from using it effectively. Instead of recycling, waste owners, saving time and avoiding paperwork, dump the waste in landfills. The second option is to transport construction waste to authorized landfills. However, by choosing this option, the waste owner is missing out on the opportunity to make a profit from recycling and polluting the environment. For this, it is necessary to create an economic and organizational management model to encourage the waste owner.

According to world experience, when analyzing the composition of waste materials generated during the demolition of several hundred buildings in Germany (Weimar and Bauhaus), the result was from 5 to 92 percent reinforced concrete, depending on the structure of the building and structure. As is known, in recent years, in developed countries around the world, there has been a process of construction and demolition of old buildings and the construction of new ones. In this regard, construction logistics is developing widely and changes are taking place in the industry.

Conclusion

The use of a logistics approach to construction waste management is an important step towards improving the environmental situation and increasing the efficiency of construction production. Effective logistics allows you to optimize the processes of waste collection, transportation and

recycling, which in turn helps to reduce costs and minimize the negative impact on the environment.

Creating an organized system of construction waste management based on logistics principles is a prerequisite for ensuring sustainable development of the construction industry and protecting the environment. The most important aspects are the integration of all participants, the creation of information flows, and the use of modern technologies for the management and control of construction waste.

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