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Tools for Managing Business Processes in the Municipal Solid Waste System

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Abstract. The economy of the Russian Federation at the present stage is characterized by an extremely high level of consumption of raw materials and waste generation. This is due to the export-raw material orientation of production, as well as the level of technological development. In this regard, the amount of waste generation and accumulation is steadily increasing. Analysis of current trends has shown that every year, on average, Russians emit about 80 million tons of municipal waste. At the same time, both in Russia and in other countries, the structure of MSW is approximately the same. These are primarily glass, paper, plastics, fabrics and organic products, as well as oversized items such as old furniture, car parts, etc. At first glance, recycling household garbage is a fairly simple and profitable business. Thus, by recycling car tires, you can get rubber coatings that are actively used in the economy, new paper is made from waste paper, and organic garbage is obtained from. The methodology used for creating data or information flow diagrams is described. The relevance of using this technology in modern practice is shown. The practical application of the DFD methodology in modeling a new financing system in the field of solid municipal waste management is presented.

1. Introduction

The accelerated growth of environmental contradictions in socio-ecological and economic systems at various levels dictates the need to form appropriate management systems that ensure not only environmental safety, but also environmental health. Modern society strives to enter a new stage of interaction with nature - what is now called the concept of sustainable development. This concept is based on the transition to rational use of resources and an environmentally friendly way of life. But we cannot talk about eco-development, development without destruction, without a serious restructuring of public consciousness. Modern man does not notice how innocuously he lives. Russia has accumulated more than 130 billion tons of waste, about 800 tons per person. The total area of landfills and landfills of solid municipal waste is 107 thousand hectares. They are located on 1,100 polygons, 150,000 authorized polygons, and 31,000 unauthorized polygons. Every year, the volume of solid household waste increases by 40 million tons. In this regard, there is a need to develop scientific and methodological foundations for the formation of a solid municipal waste management system based on the development and implementation of financing mechanisms.



An important factor in evaluating the Russian mechanism for financing solid municipal waste management is the analysis of foreign experience in this area. The management of solid municipal waste has been an acute problem for the European Union for several decades. According to European statistics [5], in 2019, about 250 million tons of solid household waste were accumulated on the territory of the EU countries, most of them in Germany and France. At the same time, on average, about 487 kg of solid household waste is generated per capita in the EU countries per year.

In the world practice of solid municipal waste management, the main principles concerning the priority of some methods of solid waste management over others are highlighted. These principles are reflected both in the legislation of the European Union (Directive 2008/98 / EC "on waste and repeal of certain directives") and in the legislation of the Russian Federation. MSW management methods are ranked in order of preference as follows (Fig. 1). This technological hierarchy of stages of solid municipal waste management is called the Lansink ladder [4].

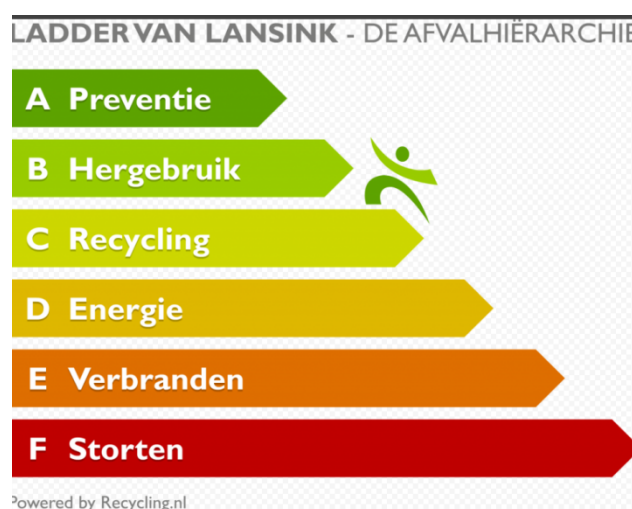


Figure 1. Lansink ladder.

This technological hierarchy was proposed in 1979 by Ad Lansink, who was part of the Dutch government. The hierarchy of priority methods for MSW management developed by him was eventually included in the EU waste Directive (Directive 2008/98/EC on waste) as the fundamental hierarchy for waste management [1].

Disposal of municipal solid waste is the lowest level of the entire hierarchy, since this method of handling MSW implies a high level of negative impact on the environment. The disposal of untreated waste leads to air, soil and groundwater pollution. Moreover, the mass burial of MSW causes the need to constantly expand the areas for landfills and landfills, which is extremely inefficient and irrational use of the country's territories.

On the next step of the Lansink ladder is the incineration of waste (including the production of useful energy). Using this method can significantly reduce the amount of waste accumulated in landfills and landfills, but the process of incineration of MSW can be accompanied by the release of a large amount of harmful substances into the atmosphere of the planet. These substances can negatively affect human health and the environment, especially if the incinerated waste contains dangerous chemical compounds.

At the level above, Lansink identified the process of composting MSW, in which the biochemical process of decomposition of the organic part of the waste into various microorganisms occurs. This process of interaction of organic substances, bacteria and oxygen leads to the formation of carbon dioxide, water and heat. Eventually, either organic fertilizer – compost-is formed, or biofuels are formed. Currently, the latest technologies are being actively developed to speed up the composting

process, and specialized landfills are being designed. Composting makes it possible to convert the generated waste into useful substances for agriculture and industry.

The MSW processing process is the next step on the Lansink ladder after the composting process. A significant part of all municipal solid waste can be recycled. This method of handling MSW involves the introduction of a comprehensive system for sorting waste, which will later be processed into new raw materials. The process of waste recycling saves a significant amount of energy for creating new products, and also helps to reduce the volume of MSW exported to landfills and landfills.

The penultimate position in the technological hierarchy of Lansink in terms of priorities for handling MSW is occupied by the reuse of products. Reuse involves reducing the amount of waste generated by transferring things "from hand to hand". This concept assumes that things that some people don't need can benefit others. That is, used clothing, shoes, books, appliances or furniture can still serve someone for several years. When reused, there is no need for continuous energy generation and infrastructure maintenance, as opposed to the previously mentioned methods. Used things simply pass into other hands at the expense of human interaction.

Finally, at the top of the Lansink ladder is the most effective and priority method for handling solid municipal waste-preventing its formation. This philosophy is aimed at minimizing waste generation through rational human behavior. The implication is that there is no need to throw away old things if they can still be useful, nor to buy new ones if there is no urgent need. In other words, waste prevention assumes that the less new products are created and purchased, the less waste that needs to be recycled or disposed of will be generated.

The new reform of the solid municipal waste management system in Russia, based on domestic and global practice, provides for the allocation of the following stages of MSW management: the accumulation and collection, transport, processing, recycling, neutralization and burial.

The scheme for financing the MSW management system, which was supposed to start operating in all regions of the Russian Federation from 2019, is shown in figure 2. let's Consider the main participants in the system [2].

The main stakeholders in the financing of the MSW management system are the state, regional operators, producers of various types of products, owners of MSW and various financial entities that redistribute funding and operate the entire system.

The main flow of financing in the system of handling MSW is formed at the expense of the owners of MSW-individuals and legal entities. The owners of TKO to pay for services provided by the regional operators of municipal solid wastes. The amount of these payments is regulated by uniform tariffs set according to territorial schemes. Other sources of funding are environmental and recycling fees, which must be paid by manufacturers and importers of products and vehicles.

DFD technology is one of the important methodologies that is often used by specialists and is intended for describing data flows. Data flow diagrams show the sequence of work performed, as well as the information flows between these jobs. The DFD methodology also allows you to describe document flows (document flow) and the movement of material resources. Using DFD charts, analysts create data structure models and form requirements for the organization's information systems [2].

Just like in IDEF0, the system model in DFD notation includes hierarchically ordered and interconnected diagrams, each of which acts as a unit of system description and is placed on a separate sheet. The system model also includes a context diagram and decomposition diagrams.

DFD technology uses four main elements:

a) the data Stream shows information that is transmitted through some connection from the source to the receiver. A real data stream can be information transmitted over a cable between two devices, mailed messages, magnetic tapes or floppy disks, transferred from one computer to another, and so on.

And since there are only input and output streams in DFD, it doesn't matter from which side to start arcs in process blocks.

b) the Process (in IDEF0 – function, work) converts the input data streams into some resulting information, using a specific algorithm.

C) a data storage Device is an abstract device used for storing information that can be added to the storage device at any time and extracted after a while.

d) an External entity (terminator) is a material object or individual that is considered as a source or receiver of information (for example, customers, personnel, program, warehouse, instruction). External entities on DFD correspond in meaning to the controls and mechanisms displayed on the IDEF0 context diagram [2].

When modeling financing in a solid municipal waste management system using the DFD methodology, a progressive description of each element, as well as the information flows between them, is required.

For a visual representation of the new solid municipal waste management system, in particular, for displaying information flows between the main participants of this system and their roles, we will construct a special diagram in the DFD notation. This diagram is shown in figure 2. let's Look at its main elements.

1) garbage Collection in 2019 is now a separate utility service provided by the regional operator for solid municipal waste management for a separate fee. All management companies (CC) are required both to charge residents-consumers a fee for municipal services for garbage removal, and to pay for the services of a regional operator of solid municipal waste. If there is no contract for the provision of solid municipal waste management services between the regional operator and the management company, such services are provided by the regional operator in accordance with the contract for the provision of solid municipal waste management services concluded with the owners of premises in apartment buildings. It should be noted that it is planned to create a subsidiary company that will perform the functions of a regional operator for handling solid municipal waste in remote and sparsely populated areas. The same structure will perform the functions of a regoperator in the regions where the contract with the regoperator that previously operated in the subject was terminated.

2) state supervision of the activities of management organizations and regoperators by the state housing Inspectorate and regional OATI will be carried out by the Ministry of construction. The same Agency will be responsible for state policy in the field of solid municipal waste management, approve territorial schemes, regional investment programs, tariffs, and implement measures to encourage separate waste collection. Equipping storage sites with new containers will also fall under the responsibility of the Ministry of construction, as well as the requirements of SanPiN, as well as the reporting requirements of reg operators.

3) the Environmental fee must be paid by firms and sole proprietors who are manufacturers or importers of products that are subject to recycling after loss of consumer qualities. The fee is also charged for the packaging in which the product is delivered. The administrator of the environmental fee is Rosprirodnadzor. This Agency is the recipient of the corresponding payments, as well as the subject of control of reporting on it. Also, this Agency is engaged in conducting state environmental expertise (see), and also receives a fee for NVOS, which are made by legal entities and entrepreneurs engaged in activities that have a negative impact on the environment.

4) it is planned to transfer the state policy In the sphere of production of equipment for operations with solid municipal waste to the Ministry of industry and trade. The Agency will also be responsible for licensing activities for disposal (disposal) on the basis of equipment and set environmental fee rates.

In addition, the Ministry of industry and trade acts as an investor and provides budget subsidies to the subjects of the Russian Federation to improve the activities of regional operators. These subsidies are also sent to banks, which, in turn, must provide preferential loans to companies that develop equipment for recycling and processing garbage.

5) the Ministry of emergency situations of Russia is proposed to assign the function of state supervision over municipal solid waste landfills.

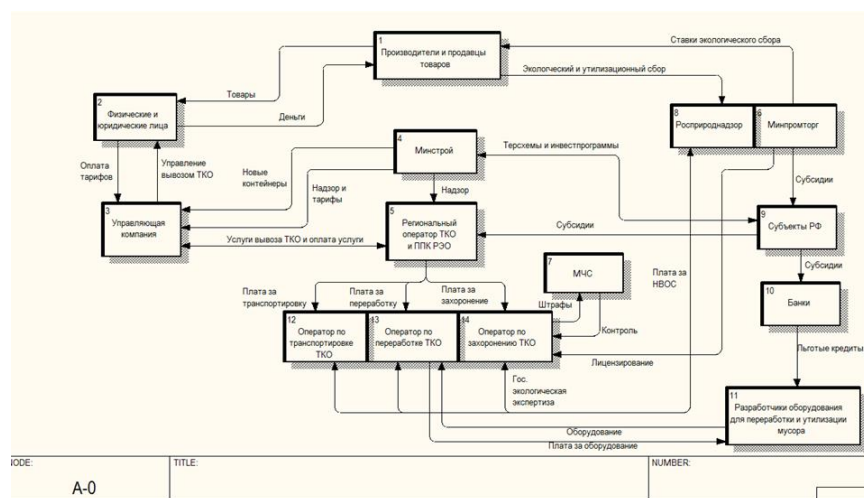


Figure 2. DFD diagram " solid municipal waste management System».

Using the DFD diagram, you can see the main information flows between system elements, but we can't tell anything about the hierarchy and subordination of these elements. Therefore, for a complete description of the solid municipal waste financing system, a single DFD diagram will not be sufficient. And since the solid municipal waste management strategy is a complex multi-stage system, it is necessary to construct a series of diagrams in IDEF0 notation, which will allow you to cascade the main elements of the solid municipal waste management system, as well as conduct its functional and cost analysis.

2. References

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