

## ROLE OF SERVICE PROVISION IN LIFECYCLE MANAGEMENT OF TECHNOLOGICAL COMPLEXES OF RECTIFICATION PROCESSES

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### ABSTRACT

*The importance of effective organization of communication between the developers and the customer for the construction of the management system of the lifecycle of technological complexes is shown. A scheme for controlling the lifecycle of technological complexes reflecting the relationship between the developer and the customer is proposed. The effect of maintenance on extending the lifecycle of complexes is shown. The possibilities of increasing the optimal operating modes and capacities of rectification complexes by introducing digital technologies and the lifecycle management system, improving the efficiency of working with customers have been analyzed. Interactions of approaches to increasing the efficiency of the separation complex are described. Factors that have a negative impact on the management of the lifecycle of complexes are shown separately. By establishing a service center, the tasks that help to optimize the indicators of the lifecycle of the complexes are defined.*

**KEYWORDS:** *Lifecycle Management Of Complexes, Service, Efficiency, Optimization.*

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### INTRODUCTION

The main goal of managing the lifecycle of technological complexes of rectification of multi-component mixtures is to organize long-term efficient use of complexes of rectification devices and to achieve energy and resource savings along with the production of quality products. In recent years, special attention has been paid to the modernization of industrial enterprises, especially oil and gas processing plants. All this ensures obtaining high-quality products, satisfying consumer needs, introducing energy and resource-efficient technologies, and saving resources spent on technical and technological needs. Therefore, it is desirable to introduce innovative solutions aimed at solving the problems presented for chemical, petrochemical and food industry enterprises.

Among the technological priorities focused on the rectification of multicomponent mixtures are issues such as increasing the efficiency of technological complexes of rectification, extending their service life by managing their lifecycle and saving resources spent on them, managing the efficient operation of technological complexes of rectification processes, increasing the reliability of the complexes.

Today, special attention is being paid to the innovative development of industrial enterprises and factories on the basis of the new industrial paradigm –“Industry 4.0”, this concept includes the

wide use of digitization in the management of business processes, establishes information exchange between technological processes and business elements, and provides for optimization. With the application of modern information technologies, artificial intelligence and cloud computing to the improvement of technological process management systems, new concepts such as product lifecycle management [1], process and systems lifecycle management [2] have appeared. Digitization of technological processes and production design processes through the use of digital modeling, which is one of the elements of the new industry paradigm Industry 4.0 [3] (Engineering 4.0) [4] remains important today in industrial automation.

## **REVIEW OF LITERATURE**

Many scientific studies are being conducted on the creation of automated control systems of technological processes and complexes, including the work of Alexey Lyutov and others [5] presents an intellectual method of automated design of technological processes in mechanical processing. The method is based on the principle of an intellectual approach to the intellectual processing of information and implies the use of a knowledge system in technological design. In [6], the need and possibilities of integrating digital twin modeling into the RMS system were considered. It compares the use of two simulation models: Plant Simulation 11 for simple simulation modeling and Visual Components modeling software for building a simulation model of a digital twin. Also, J.A. Caballero's article [7] proposed a new algorithm for accurate design of rectification columns. The algorithm makes it possible to formulate the process simulator into generalized disjunctive programming. [8] the article examines the use of digital modeling in the modeling of complex technological process control systems, and the role of "Digital Twins" in industrial automation is illustrated by an example. In the work by Kaan Doga Ozgenturk et al. [9], research was conducted on the process of bringing all information flows about products into the product lifecycle management system within the manufacturing enterprise, and it was recommended that the designers should be specialists working in the IT field, who are viewed as experts and accepted by them. Special attention is paid to the effective use of decisions. Analyzing the reviewed works, it can be noted that they describe more technological processes and views on the life cycle design of complexes. However, there are no considerations in terms of the importance of service systems in the organization of technological processes and lifecycle management of complexes and prolonging the lifecycle of complexes.

## **SIGNIFICANCE OF THE STUDY**

An important trend in the development of large manufacturing companies is to implement production management based on the concept of product, production and infrastructure management, as well as to integrate devices and their complexes, auxiliary production tools into the management system, and establish process management in the enterprise, allowing the manufacturer to manage the lifecycle and product and allows to manage costs related to technical and operational parameters of production [10]. From this point of view, it is important today to extend the life cycle of devices by organizing the management of the lifecycle of technological complexes in the production of products.

## **OBJECTIVES AND HYPOTHESES**

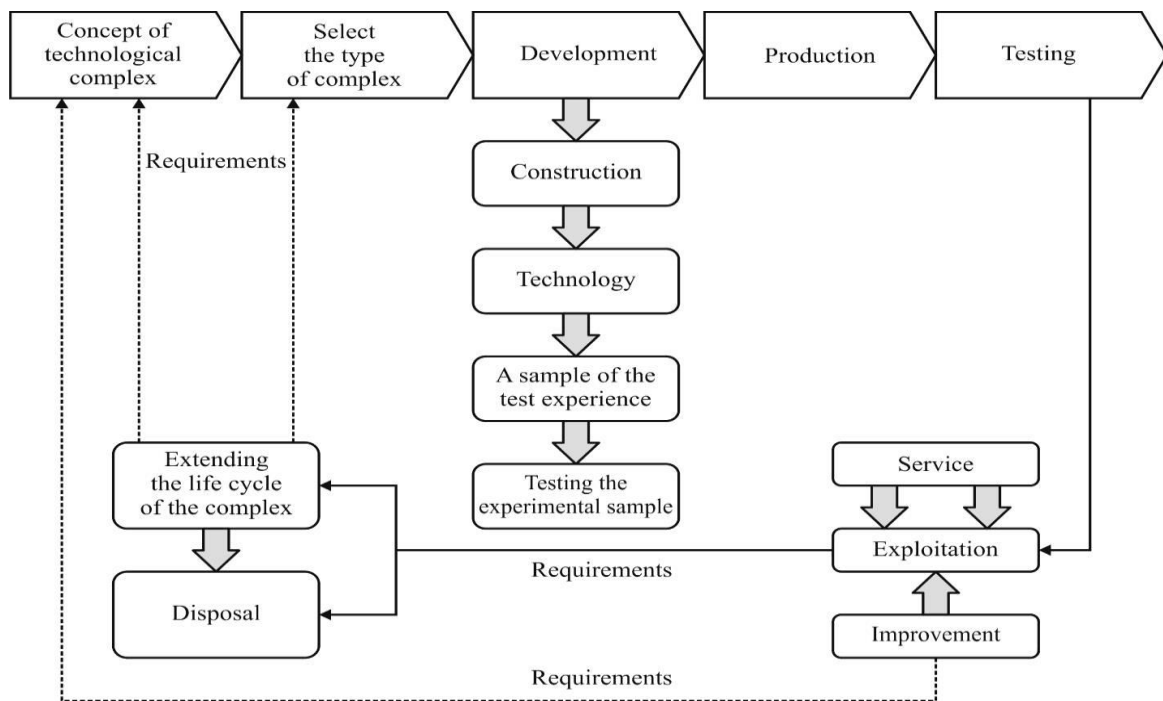
The goal of managing the life cycle of technological complexes is to organize production based on the concepts of "Digital economy", "Digital production" and to use the achievements of information and communication technologies to optimize the production process or service

provision and to establish supply chains that serve to develop communication with suppliers at various levels consists of putting.

Use of lifecycle management systems of products and complexes, maintenance and repair of technological complexes of rectification existing in oil and gas processing, food industry plants, in particular, ensuring reliable and efficient operation of rectification devices, creation of a lifecycle management system of complexes, lifecycle of devices in the complex allows to extend and reduce its cost and is the basis for creating stable cooperation between developers and operators of control systems. The purpose of the introduction and development of the lifecycle management system of the complex in relation to the relations between the manufacturers of the technological complexes for the rectification of multicomponent mixtures is to optimize the design of the complex, production technology, methods of operation and scheduled maintenance and repair systems, maintenance and current repair, all aspects of the lifecycle of the complex. development of resource expansion technologies and methods by creating a system of requirements for the equipment of rectification workshops based on customer requirements for stages.

**RESULTS**

The cost of operating the equipment of separation complexes directly affects the efficiency of rectification of multi-component mixtures and is one of the important factors of rectification costs. Reducing the cost of rectification of multi-component mixtures, including the reduction of operating costs, includes the introduction of a management system to extend the lifecycle of complexes and reduce their cost, the development of mutually beneficial relations between manufacturers of complexes and customers, and management of the effective operation of complexes (Fig. 1).



**Figure 1.** A scheme for managing the lifecycle of rectification complexes through communication between the manufacturers of rectification complexes and the customer

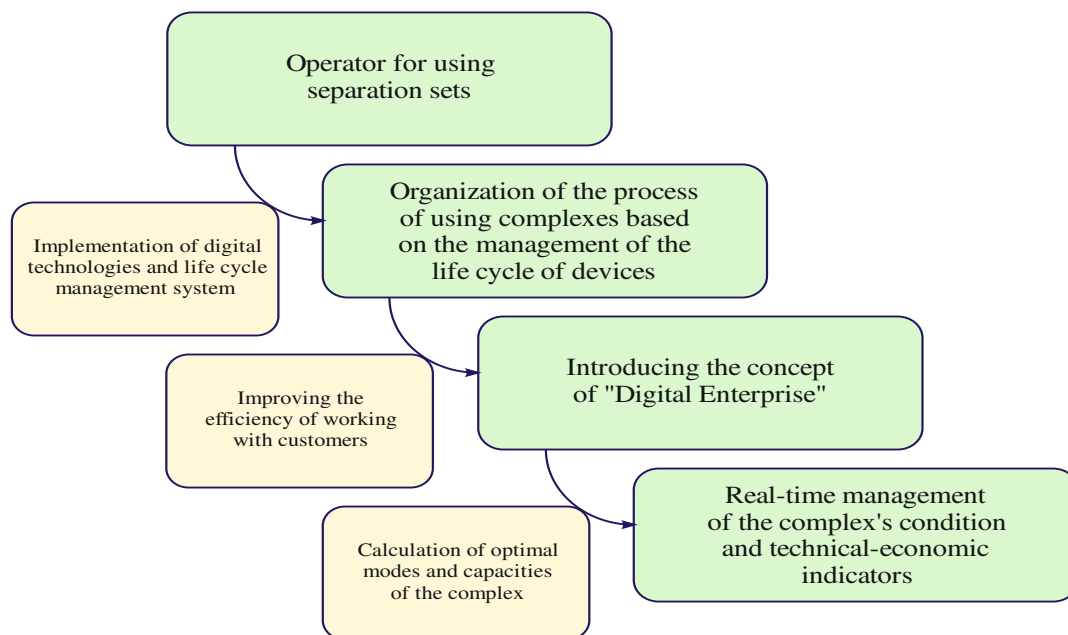
Cost management of the lifecycle of rectification complexes includes reducing the mutual costs of the participants in the use of the device, which includes changes in the design of the complex, production technology and maintenance, modes of operation and ways of destroying or extending the resource [11].

Lifecycle cost management includes cost management, taking into account all factors of costs for the life cycle of the complex, their participants, operators and manufacturers of complexes, providers of service and support services for the complex.

Reducing the cost of the lifecycle of rectification complexes should include the implementation of the following measures:

- through the implementation of monitoring systems, analysis of the operation modes, technical condition of the complex, optimization of its maintenance and repair systems, use of the complex in the course of organizational and technical measures within the operator's authority, and maintaining the highest efficiency indicator;
- introduction of new optimal methods and means of maintenance and repair with all participants of the process of using the complex, increasing its reliability through changes in the organizational, technical and design of the complex, establishing relationships that allow the complex to work more efficiently and reliably;
- based on the customer's requirements for the lifecycle cost, taking into account the cost of the life cycle of the complex by developing its design and production technology, in agreement with the project participants, the cost of the complex, devices, equipment, their design, production technology and operating modes optimization.

Another potential requirement is to implement complex lifecycle management by using a rectification complex operation and maintenance system to extend the life of the complex (Figure 2).



**Figure 2.** The sequence of application of approaches to increase the efficiency of the complex in the management of the lifecycle of rectification complexes

Lifecycle management of multi-component rectification complexes includes:

- managing the operation of complexes (ensuring the highest level of efficiency of the complex);
- technically (availability of the complex, determination of pre-emergency work modes) and organizationally (reduction of repair and maintenance time, increased transparency of value chains, improvement of repair and maintenance quality);
- cost management at the stages of the lifecycle of the complex;
- management and coordination of interactions with parties that supply the necessary equipment and devices to the process at the stages of the lifecycle through operators.

Currently, the existing management systems in industrial enterprises are working effectively, but at the same time, it should be noted that there are also the following negative factors that complicate the management process and lead to an increase in the cost of the complex during its life:

- lack of transparency at some stages of the lifecycle due to the imperfection of the supplier management system and the lack of a system for determining the status of the complex in real time;
- lack of interest of suppliers of equipment and services in timely and quality work;
- imperfection of the emergency detection system for timely removal of equipment for repair/maintenance;
- decrease in efficiency of the complex due to the use of complexes whose maximum operating time is approaching.
- It is important to solve the following issues in order to improve the efficiency of multi-component separation complexes:
  - establishing mutually beneficial cooperation of the parties participating in the use of separation complexes by implementing the concept of “digital enterprise”;
  - development of modern information-diagnostic systems that determine the operational status and technical-economic indicators of the rectification complex in real time;
  - using computer simulators, analytical tools and simulation models of the complex to increase the skills of the employees involved in the management process, to choose the operating modes and parameters during the failure conditions and operation of the complex, to plan maintenance and repair, to make management decisions on extending the service life.

The main purpose of the service center is to help optimize the lifecycle performance of the complex based on statistical information about the characteristics and operating modes of rectification complexes, operating costs and, most importantly, the development needs of the customer.

The main tasks of the service center include:

- making decisions about complex lifecycle management methods, technical and operational features and increasing the efficiency of complexes;

- development of proposals for correction of design and production technologies, maintenance and repair of complex devices;
- optimization of joint network plans for the use of complexes;
- optimization of business processes of complex equipment repair and maintenance;
- introducing project management tools and integrated management systems into the processes of managing relations between participants in the use of rectification complex devices;
- determination of current and strategic tasks in the field of development of rectification complexes;
- development of innovative projects for service to complexes.

## CONCLUSION

The development of a general structure that takes into account the communication between developers and customers in the management of the lifecycle of technological complexes of rectification serves to increase the efficiency of the management process. Taking into account their indicators in the maintenance of complexes and their development allows to extend the lifecycle of the complex. The use of digital technologies and methods of calculating optimal operating modes allows for effective management of the lifecycle of the complex. As a result of these, the performance and technical-economic indicators of multi-component mixture rectification complexes are improved. It will be possible to control the complex in real time.

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