Acceleration of the cycle of extended reproduction of the active part of fixed assets in construction

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Abstract. One of the main reasons hindering the scientific and technological development of construction and the national economy as a whole is the mismatch of the cycles of expanded reproduction of the active part of fixed assets in construction as the basic cycles of the development of construction. The renovation of the active part of the fixed assets of construction organizations in the conditions of shrinking the investment base of construction is very slow, and, as a result, there is no timely provision of construction work with the new high-performance construction equipment and vehicles. Financial leasing, as world experience shows, is an effective tool for updating the fixed assets of construction organizations, but its share is too small in the total volume of investments in the active part of fixed assets in construction. There is a need to develop new mechanisms that would ensure synchronization of the basic cycles of development in construction and contribute to the development of leasing technologies in the construction sector. As a result of scientific research, a new mechanism for accelerating the cycles of expanded reproduction of the active part of the fixed assets in construction was developed. It is titled “innovative leasing engineering,” which allows to synchronize them with construction and investment cycles, contributes to increasing the volume of financial leasing in construction, and also provides timely support and capacity of strengthening the innovation wave in construction, eventually contributing to the accelerated transition of the investment and construction complex, as well as the national economy as a whole, to a new technological order.

1 Introduction

For the scientific and technological development of our country and the accelerated transition of the national economy, including in the investment and construction complex, which is one of its most important sectors to the sixth technological order, it is required to overcome a number of negative trends. Such trends include the compression of the investment base in the construction sector and the backlog of its technical and technological development.

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Studies have shown that the renewal of fixed assets, including their active part in the construction sector, is very slow. According to the Russian Federal State Statistics Service, the coefficient of their renewal decreased from 2011 to 2015, from 5.1% to 3.4%, and in it increased to 6% by 2016. At the same time, the coefficient of retirement of fixed assets in construction is gradually decreasing from 2013 to 2016, from 1.2% to 0.9%. Also, during the last 6 years (from 2011 to 2016), there was an increase in the share of the fixed assets being fully worn out, which make up the active part of fixed assets in construction from 27.5% to 46.3%. As a result, in construction organizations as of January 1, 2017, about 50% of the total number of construction machines are those with the expired service life, and it is more than 60% for certain types of construction equipment.

Modern building production is characterized by a continuous increase in the pace of construction of buildings and structures, the creation of innovative construction technologies, the emergence of investment projects of the new generation. All this requires significant qualitative and quantitative changes in the means of construction mechanization.

The analysis showed that the actual duration of the cycles of extended reproduction of the active part of fixed assets in construction far exceeds their normative service life, resulting in a mismatch of these cycles with the construction cycles and the timely support of this sector with the latest technology and high-performance construction equipment, which could inhibit the scientific and technological development of the investment and construction complex and the entire national economy.

2 Materials and Methods

Studies of construction cycles are reflected in the writings of many scholars [4, 6-8, 10]. Some of them define the construction cycle as a period of fluctuations in economic growth (20 years), which is associated with a massive renovation of housing and industrial premises [8]. E. Hansen describes it as an investment cycle in the construction of residential and non-residential buildings; while R. Barras links construction cycles with "long waves" that affect the development of the economy through the scientific and technological progress [7]. Domestic scholars consider construction cycles as a kind of economic cycles, as periods of fluctuations in the volumes of housing introduced, associated with the influence of factors affecting construction activity, and their duration on average corresponds to 20-22 years [6-8]. In this article, construction cycles are considered as periods of fluctuations in volumes introduced into the operation of residential and non-residential buildings, associated with the cyclical development of the economy, the availability of investment funds, fluctuations in construction costs, and innovative activity of construction organizations.

Support for construction cycles in order to accelerate the transition of the national economy to a new technological order should be provided by the cycles of expanded reproduction of fixed assets on an innovative basis. The cycle of expanded reproduction of the fixed assets in construction, including their active part, is a complex category that considers the process of capital flow in physical and monetary terms, both at the level of the construction organization and at the macro level.

The cycle of expanded reproduction of the active part of the fixed assets of a construction organization is determined by a time interval that covers the period of formation of the active part of the fixed assets of this particular organization, their operation, and disposal. At the macrolevel, the duration of each cycle of extended reproduction of the active part of fixed assets is determined by scientists as the period of the realization of one generation of means of labor, which corresponds to 8-10 in world practice and is associated with investing in a massive renewal of the active part of fixed capital [3, 5, 9]. The duration of this cycle is determined not only by the dynamics of

renewal in the active part of fixed assets, but also by the dynamics of their retirement [5]. In the course of the study, the concept of the cycle of extended reproduction of the active part of fixed assets in construction is clarified, under which it is proposed to understand the periods of fluctuations in the volume of the active part of fixed assets in construction as being related to their mass renovation and retirement, investment dynamics, cyclical economic development, and innovative activity in construction. The duration of the cycle of extended reproduction of the active part of fixed assets in construction reflects the average useful life in the investment and construction complex.

The cycles of extended reproduction of the active part of fixed assets in construction are provided by investment cycles of development in construction, which are the periods of fluctuations in the volume of investment in the active part of fixed assets in construction, which are related to the cyclical development of the economy, changes in the structure of investment, innovative activity in construction, changes in legislation country, and others.

In the structure of investment development cycles and for the purpose of this scientific research, it is proposed to single out the cycles of financial leasing and the cycles of “non-leasing investments” into the active part of fixed assets in construction, as well as to clarify their concept. Non-leasing investments include non-leasing investments in the active part of fixed assets, including credit resources, own funds, state financing, etc.

Under leasing cycles, scientists understand the periods of fluctuations in the volume of leasing investments in fixed assets, for which the structure of leasing property has a great influence [3]. In our country, the duration of leasing cycles is on average 4 years, which is associated with the use of the mechanism of accelerated depreciation with a factor of up to 3 and the fact that equipment and vehicles predominate in the structure of leased property, which are amortized on average over 4 years [3].

We consider the cycles of financial leasing of the active part of fixed assets in construction as a kind of investment and leasing cycles. Under these cycles, it is suggested to understand the periods of fluctuations in the volume of financial leasing of the active part of fixed assets in construction, which are related to the cyclical development of the economy, the level of leasing development in Russia, changes in leasing legislation, and institutional structure of financial leasing.

The analysis conducted according to the data of the Federal State Statistics Service of the Russian Federation showed that the average growth rate of financial leasing volumes in the active part of fixed assets over the period from 2004 to 2016 was 28.06%. The average growth rate in the volumes of “non-leasing investments” for the same period of time was 13.19%, while the ratio of average growth rates of financial leasing volumes and “non-leasing investments” for the period from 2004 to 2016 was 2.13. Thus, financial leasing makes it possible to accelerate the cycles of expanded reproduction of the active part of fixed assets in construction, while its share in the total volume of investments in the active part of fixed assets is very small. According to the Russian Federal State Statistics Service in 2016, this value was 15.81%.

The mismatch of construction cycles, the cycles of expanded reproduction of the active part of fixed assets in construction and investment cycles, which are the basic cycles of the development in construction, requires the development of new mechanisms for their synchronization, with a purpose to have an accelerated transition of the investment and construction complex and the entire national economy to a new technological order.

3 Results

In the course of the scientific research, a new mechanism for accelerating the cycles of extended reproduction of the active part of fixed assets in construction was developed. It is called the “innovative leasing engineering,” which allows to synchronize these cycles with

construction and investment cycles while increasing the share of financial leasing in the total volume of investments in the active part of fixed assets in construction. Such an effect of innovative leasing engineering is achieved due to certain functions realized by it in construction at the micro-, meso-, and macrolevels.

At the micro level, these functions consist in the integrated management of the life cycles of financial leasing in the construction organization at the preparatory stage, taking into account their synchronization with the life cycles of the investment and construction projects it realizes, as well as with the cycles of expanded reproduction of the active part of the fixed assets of a particular construction organization (Figure 1). The main stages of this management process include:

- Making a list of the necessary fixed assets for providing a new investment and construction project based on the results of a technological and technical audit of a construction organization, as well as the results of monitoring the markets for construction equipment and vehicles;
- Forming the initial maximum price of the financial leasing contract, the subject of which are these fixed assets (using the methodology developed by us [1]);
- Modeling the parameters of the extended reproduction cycle of the active part of the fixed assets of a construction organization, including determining an optimal duration of this cycle (T_{OKL}) and its cost $S_{RBL}(T_{OKL})$, using computer technologies and taking into account the synchronization of this cycle and the life cycles of investment, as well as construction projects and financial leasing on the basis of innovative leasing engineering tools.

Synchronization of these cycles is carried out under the condition that the term of the financial leasing contract (T_L) is at least 2 years, and the fixed assets are purchased under an investment and construction project. This restriction is due to the fact that the mechanism of accelerated depreciation with a coefficient of 3 cannot be applied to the leased items that relate to 1-3 amortization groups. The mechanism of innovative leasing engineering is applied only with respect to the active part of fixed assets (construction machinery, equipment, vehicles), the standard useful life of which is more than 5 years. We believe that in order to accelerate the cycle of expanded reproduction of the active part of fixed assets in construction, it is necessary that construction organizations, after ending a financial leasing contract and receiving the leased asset (fixed assets), continue to exploit them in construction until the moment (T_{OCL}), when these basic funds cease to meet the needs of this organization and be eventually disposed. The results of the research showed that for a construction organization as a lessee, selling a fixed asset immediately after the end of a financial leasing contract and obtaining it into ownership is not beneficial by the criterion of minimum annual costs associated with owning and operating the fixed asset.

At the same time, the duration of the cycle of extended reproduction of this fixed asset in the investment and construction complex is not reduced, but it is acquired by another organization and can exploit this, as practice shows, longer than the normative period of its service.

The optimum duration of an extended reproduction cycle of the active part of the fixed assets of the construction organization (T_{OKL}) is determined by the formula (1):

$$T_{OKL} = T_{OPL} + T_{KP}, \quad (1)$$

where T_{OPL} is the initial optimal useful life of fixed assets being purchased with the use of financial leasing and determined by the criterion of minimum annual costs of the construction organization as a lessee being associated with the ownership and operation of these fixed assets, depending on their age $Z_{RBL}(T)$.

T_{KR} is the time interval that is proposed to be determined by synchronizing the time period from the T_{OPL} point in Fig. 1 until the end of the normative useful life of these fixed assets (T_{NOR}) with the expiration dates of their use in investment and construction projects (TOC), financial leasing by the construction company into ownership, and then choosing an investment and construction project taking into account $Z_{RBL}(T) \rightarrow \min$ (Fig. 1). The cost of the extended reproduction cycle of the active part of the fixed assets of the construction organization, $S_{RBL}(T_{OKL})$, is defined as:

$$S_{RBL}(T_{OKL}) = \sum_{t=1}^{T_{OKL}} Z_{RBL_t}(T) - S_U \quad (2)$$

where $Z_{RBL}(T)$ is the annual costs of a construction organization as a lessee associated with the ownership and operation of fixed assets being purchased using financial leasing, which are determined by the formula 3:

$$Z_{RBL}(T) = Z_{UPL}(T) + Z_E(T) \quad (3)$$

where $Z_{UPL}(T)$ is conditionally constant part of the annual costs of the lessee - the construction organization, determined using the calculation methodology of the IMPFLC [1]; $Z_E(T)$ is a variable part of the annual costs of the construction organization, determined using methods and approaches that are reflected in the writings of a number of scholars [14]; S_U is the cost of disposal of fixed assets, which is determined by selling them to specialized organizations that provide comprehensive services for the utilization of construction equipment, vehicles, etc. (in rubles).

On the basis of the constructed model describing the cycle of extended reproduction of the active part of fixed assets in construction, an assessment of its parameters is conducted. According to its results, a decision is taken to prepare and conduct procedures for purchasing financial leasing services in electronic form using the methodology developed by us [2]. Based on the results of the procedures for purchasing financial leasing services, a decision is made to enter into a financial leasing agreement and other related agreements.

Realization of the above-mentioned functions of innovative leasing engineering on a microturbine can be carried out by specialized engineering companies or construction organizations themselves, taking into account the relevant training of their specialists.

At the meso-level, the implementation of the functions of innovative leasing engineering can be provided by regional engineering centers and consists in monitoring and coordinating the processes of accelerating the cycles of expanded reproduction of the active part of fixed assets in construction being carried out at the micro-level, taking into account the results of foresight research of the scientific and technological development in construction, as well as the results of the conducted monitoring of construction equipment markets, equipment, vehicles. The implementation of the functions of innovative leasing engineering at the meso-level also consists in ensuring the harmonization of the financial leasing entities' interests in the construction, as well as coordination, control, and regulation of the activities of specialized engineering companies and construction organizations that independently use the mechanism of "innovative leasing engineering."

At the level of the investment and construction complex, control, coordination and regulation of the activities of regional engineering centers in construction are carried out, taking into account the results of foresight research of the scientific and technological development of construction, as well as with the use of enforcement. The implementation of these functions of the innovative leasing engineering is proposed to be entrusted to a single engineering center in construction.

4 Discussion

The effectiveness of the implementation of innovative leasing engineering in construction is to accelerate the cycles of expanded reproduction of the active part of fixed assets in construction 1.5-2.5 times on average, while ensuring savings of their value (S_E) in the amount of 5-10%, which in its turn reduces the cost of construction and ensures the development of financial leasing in construction. The value of the cost savings of the extended reproduction cycle of the active part of the fixed assets of the construction organization (S_E) is determined by the formula 4:

$$S_E = \left(\frac{2 \cdot S_{RBL}(T_{OKL})}{S_{RB}(T_{RB})} - 1 \right) \cdot 100 \quad (4)$$

where $S_{RB}(T_{RB})$ is the cost of the cycle is expanded reproduction of the active part of fixed assets with a duration of 8-12 years and using investment mechanisms without taking into account leasing, which is determined by the formula 5:

$$S_{RB}(T_{RB}) = \sum_{t=1}^{T_{RB}} Z_{RBt}(T) - S_U \quad (5)$$

where $Z_{RB}(T)$ is the total annual costs of a construction organization being associated with owning and operating the active part of fixed assets using non-leasing investments, determined by the formula 6:

$$Z_{RB}(T) = Z_{UP}(T) + Z_E(T) \quad (6)$$

where $Z_{UP}(T)$ is a conditionally constant part of the annual costs of a construction organization being associated with owning an active part of fixed assets using non-leasing investments.

Reduction in the cost of the cycle of extended reproduction of the active part of fixed assets of construction organizations is due to its acceleration in the use of financial leasing and optimization of the duration of this cycle by the criterion of minimum annual costs of the construction organization as a lessee being associated with the ownership and operation in dependence and taking into account the synchronization of this cycle with life cycles of investment and construction projects and financial leasing, as well as by reducing the conditionally constant part of the cost of the extended reproduction cycle of the active part of the fixed assets of the construction organization using the tools of innovative leasing engineering.

5 Conclusion

As a result of scientific research, we have developed a new mechanism, the “innovative leasing engineering,” which ensures the acceleration of the cycles of extended reproduction of the active part of fixed assets of construction organizations, which are the subject to the coordination of the parameters of these cycles with the life cycles of investment and construction projects and financial leasing. Systematic monitoring of the markets of construction equipment and vehicles in the implementation of innovative leasing engineering at the micro- and meso-level allows timely “catching the innovation wave” to

ensure the process of creating construction products with the new high-quality construction equipment, high-performance equipment, and modern vehicles. At the same time, the cost of the cycle of extended reproduction of the active part of fixed assets, in construction, is reduced, which ensures a reduction in the cost of construction. So, for example, for 8-12 years, during which the cycle of expanded reproduction of the active part of fixed assets in construction continues being supported with the use of innovative leasing engineering, it is possible to replace two such cycles being supported by financial leasing cycles, saving their cost in the amount of 5-10%.

The use of innovative leasing engineering makes it possible to reduce the transaction costs of the lessees, i.e. construction organizations, including reducing the time and resources spent on preparing, organizing, and conducting leasing services, as well as reducing the risk and costs of opportunistic behavior of participants in leasing relationships.

Ensuring the timely renewal of the active part of the fixed assets of construction organizations while saving their resources using innovative leasing engineering will help increase the activity of construction organizations with regard to the use of financial leasing in the process of building construction products and the development of financial leasing in construction.

The practical use of innovative leasing engineering in the investment and construction complex ensures synchronization of the cycles of expanded reproduction of the active part of fixed assets in construction, investment and construction cycles, support and enhancement of the innovative power in construction, which accelerates the transition of the investment and construction complex and the entire national economy to the sixth technological order.

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