Synchronization of construction, replenishment and leasing cycles with account of wave dynamics of innovation cycles in the construction and transport field

Tatyana Alekseeva

1 Moscow State University of Civil Engineering, Yaroslavskoe shosse, 26, Moscow, 129337, Russia

E-mail: atr-mgsu@mail.ru

Abstract. The article considers the contradictive nature of the basic cycles of the growth in construction, the core of which are construction cycles, replenishment cycles of the active part of fixed assets, innovation and investment cycles. All of the listed cycles objectively thwart the science and technology progress in construction. There are presented results of the study of finance leasing as an effective tool, that provides time reduction of the innovation replenishment cycle of the active part of fixed assets in construction. It takes into account the development and implementation terms of construction investment projects in order to timely support the innovation wave and enhance its efficiency in construction for a rapid transition of the construction investment complex and national economy to a new vector of growth.

1. Introduction
For the rapid transition of the construction investment complex as one of the most important sectors of the national economy to the sixth technology revolution, it is necessary to overcome the negative trends that have developed in Russia: shrinking the investment base of construction and backlog of its technological development. One of the main problems of innovative development of the construction investment complex is the contradiction of the basic cycles of construction development, which dwells on construction cycles, replenishment cycles of the active part of fixed assets in construction, innovation and investment cycles that objectively thwart the science and technology progress in construction. Problems of cyclical dynamics of innovative development of the national economy are reflected in the works of the following scientists [1].

In a scientific study, construction cycles stand for fluctuation periods of economic growth, that are related to massive periodic renovation of housing and industrial facilities, changes of the construction costs, investment funds availability and etc. Construction cycles influence the growth of the national economy through science and technology progress. The overwhelming technology affects the level and direction in construction.

2. Materials and Methods
Technological underdevelopment in construction and actual and moral depreciation of the major part of the construction organizations’ fixed assets reduce labor efficiency, what is consequently affects the parameters of construction cycles: execution terms expand and construction expenditures increase. According to the research results, the average duration of a construction cycle, in the context of the dynamics of housing commissioning in Russia, is about 20 years [2].
Low labor efficiency retards the development of the construction investment complex and the national economy in general. According to the Russian Federal State Statistics Service in the economy, including construction sphere, there is a slowdown in growth rates of labor efficiency, in 2012 this indicator was 103.5% in relation to the previous year, in 2013 - 101.8%, in 2014 - 100.7% and in 2015 - 97.8%. Technological modernization in the process of building product creation is required in order to increase the labor efficiency in construction field [3].

Experience has shown that the capital renewal has been conducted in an extremely slow pace for the last 20 years. According to the Russian Federal State Statistics Service, the rate of their renewal in construction was 4.3% in 2013, in 2014 – 3.8% and in 2015 – 2.9%. At same period of time the capital consumption rate in construction has been decreasing: in 2013 it was 1.2%, in 2014 – 1.1% and in 2015 – 1.1%. In addition to the above, low investment level in the capital renewal was registered, which is related to the low gross accumulation level in the economy of Russia. Thus, the national construction investment complex and economy in general are characterized by irrational and irrelevant structure of transport and equipment majorly with expired service life. According to the data of the Russian Federal State Statistics Service, as of January 1, 2017, 40-50% of the total number of construction equipment in the construction organizations are transport with expired service life, for some types of construction equipment - more than 60% [3].

The results of the research showed that the duration of cycles of innovation replenishment of the active part of fixed assets in construction significantly exceeds the normative terms of their service. These cycles are determined by the sequence of the following stages: the introduction and development of new construction equipment, modern construction equipment and other property belonging to the active part of fixed assets, their operation in the process of creating construction products and depreciation with actual and moral deterioration and the need to replace for innovative fixed assets.

Innovation replenishment cycles of the active part of fixed assets in construction stand for cyclical fluctuations in the expenditure volumes associated with the acquisition, operation in the process of construction and replacement of morally and physically obsolete construction equipment, machinery, etc. with innovative basic facilities, which meet the latest technological requirements.

Innovation replenishment cycles of the active part of fixed assets are a complex category and can be considered both at the level of the construction investment complex as a whole and at the level of a separate construction organization. They are interrelated with the life cycles of construction investment projects as well [4].

3. Results
The life cycle of the construction investment project is understood as the sum of stages and works from the investment concept to the commissioning of the constructed property. The stages of the life cycle of the construction investment project are: pre-investment stage, design and survey and construction stages, as well as the stage of commissioning the constructed facility.

The results of the research showed that the duration of the innovation replenishment cycle of construction equipment or machinery in a construction organization may coincide with or exceed the life cycle of a construction investment project. In the latter case, these fixed assets will be used by this construction organization in other projects. The duration of the innovation replenishment cycle of the fixed asset should not exceed the standard period of its service. Therefore, the maximum limit of the duration of such a cycle on average is 6-9 years for construction equipment [5]. Exceeding the standard period of their service adversely affects the quality of the construction products, a decrease in labor efficiency, prolongation of the construction terms and increase in the cost of construction, etc.

The labor efficiency drop due to prolonged replenishment cycles in construction leads to an increase in construction terms and delay of facility commissioning, what results in an increase in the duration of construction cycles and investment costs at the macro level. Therefore, it is necessary not only to timely update, in accordance with the standard service life, the main production assets for innovative high-efficiency construction equipment, modern powerful construction transport, etc., but also optimally accelerate this process. It is significant to shorten the duration of innovation replenishment cycles of the
active part of fixed assets in construction to the optimum level, taking into account the following factors: the intensity of operation of fixed assets of construction products; scientific and technical progress; duration of development and implementation of construction investment projects; investment tools, that are used to ensure the process of innovative replenishment of fixed assets (leasing, credit, etc.); operational owning costs of fixed assets; the value of selling a fixed asset on the secondary market, when planning its retirement through sale, and other factors.

When determining the optimal duration of innovation replenishment cycles of the active part of fixed assets, it should be kept in mind that too rapid replacement of construction equipment and machinery leads to wasteful investment of resources, which is particularly felt in the event of a deficit. Whereas, an excessive prolongation of these cycles undermines the competitiveness of industries and leads to the aging of the national economy [6].

Innovation replenishment cycles of the active part of fixed assets in construction are associated with innovation cycles and may not coincide in duration. In this article, innovation cycles are considered from the point of view of manufacturers of innovative construction equipment, construction machines and vehicles used in the process of creating construction products. In a scientific study, innovation cycles stand for periodic fluctuations in innovation activity connected with the creation, spread and viability of new models and generations of construction equipment, machinery and vehicles used in construction.

The change of models of the fixed assets under consideration is carried out on the basis of improving innovations for a fairly short period of time. So, for example, the technological upgrade of industrial equipment, the high competition in the manufacturers' market force the companies, producing mobile concrete plants that are currently used in construction, "... to update the production conveyor every 4-5 years: the automatic maintenance system of the plant, the weighing system of inert materials, a system of automatic monitoring and software. " The manufacturer tries to focus its attention on improving the mobility of the produced concrete plants, in order to increase the speed of installation, and improve certain technological aspects.

The change in the generations of the active part of fixed assets occurs through a longer period of time.

The phases of the considered innovation cycles are: the emergence of basic innovations, on the ground of which new generations of construction equipment, machinery and other assets belonging to the active part of fixed assets in construction are created; their distribution with the help of improving innovations, on the basis of which new models of construction equipment and technology are created; maturity, when the improving innovations prevail and the market becomes saturated with new products; crisis that is characterized by the development of pseudo-innovations, which are aimed at improving outdated generations of construction equipment and machinery and the demand for them is falling; depression, by the end of which there is again a demand for basic innovations that ensure the foundation of the next more effective generation of construction equipment and machinery - this phase introduces the next innovation cycle [6].

Innovation cycles, that are characterized by the change in the generations of the active part of fixed assets in all sectors of the national economy, including construction, underlie medium-term economic cycles.

When the duration of the replenishment cycles is shortened, it is possible to timely support and increase the capacity of the innovation wave, which will shorten the duration of the construction cycle in turn, improving the quality and other characteristics of construction products and, as a result, accelerate the transition of the national economy to a new technological revolution.

One of the factors affecting the duration of the replenishment cycles of the active part of fixed assets in construction is the implementation of various investment tools (leasing, credit, purchase of property, etc.). The results of scientific research have shown that finance leasing is the most effective tool to optimally reduce the duration of the innovation replenishment cycle of the active part of fixed assets in construction, since it implements the possibility of using the accelerated depreciation mechanism with a factor of up to 3, which provides tax savings to construction organizations. For example, the average duration of the replenishment cycle is 9-15 years for certain types of construction equipment and it
corresponds to the duration of the standard lifetime of this equipment. Let us consider it the option to reduce the replenishment cycle of this equipment, for example, 3 times, from the point of view of the construction organization i.e. with a standard life service of construction equipment for 15 years, the replenishment cycle will be reduced to 5 years. At the end of this period, the disposal of the construction equipment is expected to be carried out by selling it. At the same time, it is necessary to synchronize the considered replenishment cycles with respect to the duration of the development and implementation of construction investment projects. The cycle of replenishment of the fixed asset can both coincide with the duration of one life cycle of a construction investment project, and exceed it. In the latter case, there is a question of using the fixed asset in a number of projects. In this example, we synchronize the duration of the accelerated replenishment cycle of the fixed asset with the life cycle of the construction investment project, the duration of which is 5 years as well [7].

4. Discussion
Let us compare the options for acquiring equipment using financial leasing and credit, in the context of the leasing and credit contracts are equal and correspond to the duration of the shortened replenishment cycle of 5 years. It is also assumed that the selling price of construction equipment in the secondary market is the same after replenishment cycle ends, lasting 5 years [8].

If the equipment under consideration is acquired in leasing, the use of the accelerated depreciation mechanism with a coefficient of 3 will allow to ensure the tax savings of the construction organization and this equipment will be completely self-depreciated for a period of 5 years and the leasing costs will be fully written off to the cost of the construction products, produced with this equipment.

When using a loan to purchase construction equipment for a 5-year period of time, expenditures for the production cost are not written off in full, since only a part of the principal loan can be repaid at the expense of depreciation for 5 years, due to the impossibility of applying the accelerated depreciation mechanism for lending unlike finance leasing.

Thus the costs of acquisition of the property in leasing for 5-years period of time for construction company are less than with loan. At the end of the term of the financial leasing agreement after the transfer of proprietary rights for the leasing property to the lessee, this property can be sold on the pre-owned market or probably its further usage by the construction company in other investment and construction projects upon the certain period of time. This period of time is limited with the standard operation time of this property and depends on a number of factors, including of the appearance of new more productive models of construction equipment on the market, duration of the investment and construction projects, etc. Results of the research showed that the costs of the construction company for the affected period of time at usage of leasing is lower than at lending. This is due to the fact that property in leasing is fully depreciated for 5 years and at lending depreciation is accrued for 15 years and accordingly it's necessary to pay net worth tax during this time.

Thus, the aggregate expenditures of a construction company will be less when the replenishment cycle is reduced by finance leasing, that proves the effectiveness of leasing technologies to optimally shorten the innovation replenishment cycle of the active part of fixed assets in construction.

Scheme of synchronization of cycles of reproduction of the active part of the fixed assets of the construction company, life cycles of investment and construction projects with consideration of wave dynamics of innovative cycles in construction with the usage of leasing as the most effective investment vehicle in comparison with a loan for construction companies is presented on the figure 1.
Figure 1. Scheme of synchronization of cycles of innovative reproduction.

Scheme of synchronization of cycles of innovative reproduction of the active part of fixed assets in construction, life cycles of investment and construction projects with consideration of the wave dynamics of innovation cycles in construction with usage of the leasing technologies.

In conditions of limited own funds of construction organizations, limited budget financing, high credit interests, the optimal shortening of the innovation replenishment cycle of the active part of fixed assets in construction through finance leasing is more profitable for construction organizations than using other investment tools. Rent is not considered in this case, because the scientific study takes into account the condition of the acquisition of property with the transfer of ownership to the construction organization, as well as rent cannot acquire new property, since the landlord leases it repeatedly.

5. Conclusions
Optimal reduction of the innovation replenishment cycle of the active part of fixed assets in construction using finance leasing tools will allow construction organizations to renewal their capital for modern construction equipment, highly-productive machinery and so on more efficiently. That will result in the increase of labor efficiency, reduction of the production cost as well as improve quality and other parameters.

Finance leasing implementation as an effective tool for optimal acceleration of the innovation replenishment cycle of the active part of fixed assets in construction with account of duration of the development and implantation process of a construction investment project, aiming to support and enhance the power of the innovative wave in construction field, will encourage the science and technology progress of Russia. Moreover, it will stimulate to the transition of the construction investment complex and the national economy as a whole to the innovative vector of development.
References

[1] Alekseyeva T and Yas'kova N and Rodionov P 2016 Razvitiye instrumentov modernizatsii stroitel'nogo kompleksa (Moscow, NIU MGSU)

[2] Zabortsev T and Rogov P Izvestiya Irkutskogo gosudarstvennogo universiteta (2016) 18 25-38

[3] Knežević M, Ćetković J and Žarković M 2015 Economics of transaction costs and its implications on modern interorganizational design, Wulfenia, 22(4) pp 514-524

[4] Isaev S A, Baranov P A, Vatin N I, Zhukova Y V and Sudakov A G 2014 Technical Physics Letters 40 (8) 653-6

[5] Ćetković J, Lakić S, Knežević S, Žarković M and Sazonova T 2016 The use of Transaction Costs Theory in Interorganizational Design MATEC Web of Conferences 53.

[6] Romanovich, R., Vilinskaya, A. 2016 MATEC Web of Conferences, 53, 01052, https://doi.org/10.1051/matecconf/20165301052

[7] Borboni A, Aggogerì F, Merlo A, Pellegrini N, Amici C 2015 International Journal of Advanced Robotic Systems, 12, art. no. 42. DOI: 10.5772/60052

[8] Strelets K and Vatin N 2015 Rocznik Ochrona Środowiska 17 (1) 104-12