Mechanisms for the implementation of complex construction contracts within the framework of life cycle management of a capital construction facility

Vitaly Shcherbakov[1], *Sergei Beliakov*[1,*], *Khusen Khairulloevich* Juraev[2], Ayman Othman Abdel Alim Mohamed[3], *Yulia Alexandrovna* Laamarti[3]

[1]Moscow State University of Civil Engineering, 26, Yaroslavskoye shosse, Moscow, 129337, Russia
[2] Bukhara State University, 11 Muhammad Ikbol Street, Bukhara city, 705018, Republic of Uzbekistan
[3] Financial University under the Government of the Russian Federation, 49/2 Leningradsky Ave., Moscow, 125167, Russian Federation

Abstract. The development of industrial areas with difficult climatic conditions and high environmental burden on the population requires innovative management approaches from the construction industry, including energy construction as a factor of safety and reliability, as a basis for the development of enterprises in the region and urban development. The purpose of this study is to determine the place and role of complex construction contracts (CCC) in the life cycle (LC) of an industrial capital construction facility and to form mechanisms for improving the implementation of CCC to ensure the innovative nature of such an object at all stages of its LC within the framework of the relationship with the development of the economy of the studied region as a whole. The LC model proposed in the study allows us to determine the place and role of innovation engineering assessment at each stage of the implementation of large engineering projects during the construction of capital construction facilities within the framework of territorial development management. The combination of methods for assessing innovativeness will reveal the necessary reserves for accelerated development of territories with maximizing environmental and economic effects.

1 Introduction

The concept of economic development, as a scientific category, implies movement towards ensuring the fullest well-being of all members of society in accordance with modern achievements of scientific and technological progress. Well-being, in turn, is not determined only by material goods, but is also expressed in free comprehensive development [1], that is, in the free time of society, and in an environmentally friendly environment. The last two

* Corresponding author: serj-bel@yandex.ru

indicators can be achieved by saving labor in the productive sector, that is, in industrial production and construction. The sustainable development of individual territories in the investment and construction sector in modern conditions of a turbulent economy seems to be an urgent challenge for our country in the current conditions of sanctions pressure and restrictions. The electric power complex is one of the main conditions for the development of both the productive and consumer sectors and the provision of services.

Aging fixed assets require reconstruction, the development of production requires the commissioning of new capacities, which is provided for by the Energy Strategy of Russia, approved by Decree of the Government of the Russian Federation dated 06/09/2020 No. 1523-r "On Approval of the Energy Strategy of the Russian Federation for the period up to 2035" [2]. Since 2019, a mechanism has been in place to modernize and upgrade existing thermal power plants to In 2031. The industry problems include the imperfection of the current model of relations between energy and heat supply market participants, as well as pricing and the imbalance between the claimed characteristics of electricity consumption and actual values, which leads to overspending and excess energy resources. The solution can be, on the one hand, the transition to breakthrough technologies for energy storage and conservation for subsequent generation distribution, network technologies in the electric power industry in the form of active adaptive networks, forecasting based on "Big data" and neural networks, the introduction of cloud and fog computing, machine learning, intelligent sensors, production robotics, additive technologies, computer simulation based on digital twins. On the other hand, the improvement of existing models of relations between subjects of electric and thermal energy, as well as the improvement of planning at all levels (from government to corporate governance), including contractual relations for the implementation of the construction of electric power facilities. The transition to integrated construction engineering contracts (CCC) with an innovative component may be one of such solutions in the implementation of life cycle management (LC) programs for capital construction facilities. In order to determine the role and problems of the implementation of CCC in the management of LC of industrial facilities, it is necessary to identify the most significant aspects and stages of LC of any industrial capital construction facility. Based on the identified problem areas and contradictions, it is possible to build models and reveal mechanisms for the implementation of the most optimal allocation of resources, the use of hidden reserves and to assess the effectiveness of CCC at each stage of the LC of the capital construction facility, including at the stages of operation and liquidation within the framework of project management (PM) of both CCC and the LC of the facility as a whole, starting from the idea and ending with liquidation and new construction.

An analysis of domestic and foreign literature on PU in construction (Shapiro V.D., Mazur I.I., Lukmanova I.G., Malakhov V.A., Lapidus A.A., Silvius A.G., Schipper L., etc.) shows that the scientific environment is dominated by systemic and process approaches that define the project as a system of processes aimed at achieving a unique and definite result. Each author has made an invaluable contribution to the systematization of the processes and content of project management. But in practice, in conditions of capitalist relations, with a lack of time and resources in the competitive struggle, the project manager and the project team need a simple and understandable tool for making decisions and correcting the continuous changes that inevitably accompany the implementation of large-scale and technically complex projects. In addition, the construction object is developing and requires the use of management methods for the developing object, and not processes frozen in time and space, only with the fixation of the fact of incoming and outgoing information at the junction of business processes. Since PU is in its infancy and is associated with the development of both the construction industry and related scientific fields (economics, management, mathematical modeling, computer science, system engineering, etc.), the search for reserves to improve the mechanisms of implementation of KSK within the framework of project management becomes an urgent task in the context of the need for modernization and accelerated industrialization of the domestic economy, requiring both innovation and environmental friendliness in modern conditions of society development.

Such distinguished scientists as Lapidus A.A., Telichenko V.I., Yakubov H.G. and others have successfully studied the environmental components of the implementation of construction projects. Such prominent scientists as Yakovets Yu.V., Kiseleva S.P., Masloboev A.V., Chebotarev N.F. and others devoted their works to the research of environmental innovations, innovations in general. The analyzed studies by various authors address the need to take into account the environmental component at all stages of the LC of a capital construction facility and the need to introduce innovations and eco-innovations. Yelmeev V.Ya., Bainev V.F., Dolgov V.G. and others devoted their in-depth research to innovations from the point of view of the consumer-value paradigm aimed at saving labor in the production and consumption of an industrial product, which contributes to the development of society as a whole. However, the direct process of implementing the KSK within the framework of the ISP project management is little studied as the main factor in the material embodiment of the innovative nature of the capital construction facility at all stages of the LC, starting from the idea and ending with liquidation and new construction.

2 Materials and methods

The purpose of this study is to determine the role and place of KSK in the LC of an industrial capital construction facility, as a process of creating an innovative product within the framework of project management in the form of goal setting, followed by the development of mechanisms to improve the achievement of project goals and assess the degree of innovation of the product put into operation. To achieve this goal, it is necessary to determine the beginning of the LC of an industrial capital construction facility, the intermediate stages of the critical path, the completion of the LC of such an object and the transition to a new facility, as the relationship of all categories. In addition, it is necessary to identify problem areas and contradictions, as well as the specifics of the implementation of the CCC within the framework of the developed LC model of the capital construction facility. To fulfill the set goals and objectives of the study of a capital construction object developing in time and space, it is necessary to apply a method and a system of categories that most fully reflect the process of development of the subject under study, namely, a dialectical approach, which, like any method, has certain limitations. Such limitations lie in the fact that when abstracting (considering) a certain point (side of the contradiction), there is a need for a detailed consideration of a specific side of the subject using formal, mathematical methods, without considering the contradiction as a whole. After analyzing the specific aspects of the subject under study, there is a logical need to return to a comprehensive examination, but enriched with new knowledge of the opposite sides, one of which is the dominant trend, while the other is the negative aspect of the dominant trend. This approach allows us to identify ways to resolve existing and emerging contradictions in the process of project implementation in relation to the objectives of the construction project. The forms of conflict resolution can be scientific methods of mathematical modeling, analysis and synthesis, managerial and psychological management methods, modeling and evaluation methods, etc.

3 Results

In relation to the production facility, LC, as a scientific category, is interpreted in various sciences and standards and divided into stages depending on the subject of research. In paragraph 3.1 of GOST R 58785-2019 [3], LC is defined as "sequential and interrelated stages of the LC product system from acquisition or production from natural resources or raw materials to final placement in the environment", missing in the definition of that moment of production as pre-production, and it is engineering intellectual and practical activities. Although in clause 5.1.1.2 of the specified GOST, the constituent elements of the cost of the life cycle are expressed as components of the cost of acquiring a land plot, connecting to engineering and technical networks, developing design and technological documentation, general construction work, equipment cost, installation and commissioning, repair, maintenance, environmental protection and decommissioning. That is, contrary to the definition, the beginning of LC for its evaluation is laid even before the direct purchase of finished products (object) or the beginning of direct production of products (object). In SP 333.1325800.2020 on information modeling in construction in clause 3.1.1 "LC buildings or structures: The period during which engineering surveys, design, construction (including conservation), operation (including ongoing repairs), reconstruction, major repairs, demolition of a building or structure" are carried out [4]. That is, in relation to information modeling in construction, the pre-investment stage, according to the authors of the set of rules, is not included in the LC. This will be true if the information modeling of the object does not include engineering activities at the pre-investment stage when developing a conceptual/sketch model, according to clause 3.1.7 (Note) SP 331.1325800 [5]. So GOST R 58917-2021 [6] on the feasibility study of an industrial facility investment project defines in clause 6.3 that the LC of the facility includes both investment and post-investment periods. Although within the framework of an integrated approach to information management of LC of anthropogenic objects, according to GOST R 57296-2016, "12 stages are identified: Idea, Concept, Planning, Requirements, Project, Verification of compliance with requirements, Implementation, Validation and Verification, Operation, Accumulation of knowledge, Modernization, Decommissioning" [7]. That is, if there is information about an object in the form of an idea of an object, then there is an object, although in the form of an idea that should be embodied in a material object. LC Contract legislation (LCC) identifies placement and engineering surveys as the beginning and liquidation of the facility as the end (or earlier stages of completion, depending on LCC obligations) [8]. Since engineering surveys are not directly the object itself, as well as the stage of placing the object before the start of its design, but only preparation for implementation in the project, the beginning should be laid even earlier at the pre-investment stage, as well as the fixed decision to build or reconstruct an industrial facility. Recently, the concept of LC has appeared in the legal literature, including as LC of legal entities. Some lawyers believe that the LC of a product (object) is a set of industrial, property and other relations (ties) from the moment the need for a specific product arises until these needs are met and the products are disposed of" [9].

Each science conceptualizes LC theoretically in its own way, and in this sense, the LC category as a socio-legal phenomenon has a general scientific character. In relation to our research, it is necessary to determine where the implementation of a comprehensive engineering contract begins, where the fulfillment of obligations under the contract begins and where the implementation of the contract and the fulfillment of obligations ends. As well as the interconnection of all stages of the LC of an industrial facility in relation to engineering and the implementation of the contract for the construction and commissioning of an industrial facility.

LC contracts can be viewed from the point of view of process and situational approaches. So, the activity in a specific organization implementing ICP can be described in the form of business processes of the system. In this regard, the process approach is a form of a systematic approach. In an organization as a system, there are elements described as business processes, that is, repetitive operations or non-repetitive (situations within the situational approach) described, as a rule, in local regulatory documents of the organization, with incoming and outgoing data (products – ideal or material) for each such operation. An employee responsible for the process and the necessary resources (machine and/or labor) are assigned to each operation, performers who supply input data and persons who accept output data are identified, and normative indicators of such data are established. With a process approach, the life cycle of an engineering complex contract will serve as the basis for the business processes of its implementation and look like this (Fig.1).

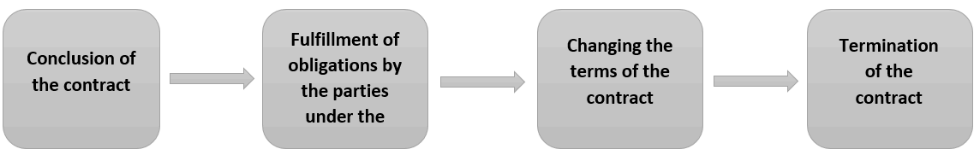

Fig. 1. The life cycle of the contract.

The conclusion of the contract also includes the process of preparing all the terms of the contract before it is signed by all parties and the beginning of execution. Legal experts note that when concluding a contract, an individual approach is used and the main conditions are stipulated [10]. From the point of view of the development of the contract itself and its implementation and execution, when describing the processes and stages, it is necessary to use a dialectical approach, namely, to recognize that the contract, as an undeveloped result, in the form of a decision on the application of the contract model in its main and essential features, in the form of a draft contract, although still undeveloped, already exists. From this moment, the formation of the contract as a legal document begins and the first stage of its implementation begins. Next, the process of agreeing on all the conditions between the customer and the contractor, the other parties to the contract, and the beginning of the execution of the contract, after signing by all parties. The contract ends after full or partial fulfillment by all parties of their obligations under the contract. In our case, the comprehensive construction contract ends after the end of the warranty obligations under the contract and the payment of all amounts due.

Thus, the implementation of the contract begins from the moment a decision is made on the application of the contract model in its essential characteristics and the beginning of the formation of the main parameters and clauses of the contract, which must be signed by all parties. Already in the formation of the contract, in addition to the subject making the decision on the application of any model, there are other subjects, including potential contractors, society and the state, whose interests must be taken into account. In particular, all parties directly participate in the formation of the contract before signing, who give their comments on the points of the contract and defend their interests. From the moment of signing by all parties, the execution of the contract by the subjects of law begins. Thus, the implementation of a contract is a broader concept than the contract itself, as an agreement between two or more persons on the establishment, modification or termination of civil rights and obligations.

Therefore, it can be argued that the beginning of the implementation of a comprehensive engineering contract in industrial construction, as a necessity, may lie at the pre-investment stage, where, from the point of view of information and subject relations (production, property and others), the need and idea of the object are born, its main parameters begin to form, and after making a decision on the contract model, the implementation stage begins from the point of view of the legal relationship between the parties to such a contract.

The implementation of the contract is the implementation of an investment and construction project as its special stage, more specific. Therefore, it is impossible to separate the investment and construction project from the implementation of the contract for this project, since the beginning of each subsequent stage is laid in the previous stage. This is the dialectical relationship between all stages of the project and the LC object as a whole.

Since we study engineering complex contracts in industrial construction, and engineering is essentially the engineering of innovation, then for a more complete implementation of innovation and management, as a conscious impact on the object in the direction of object development, it is advisable to introduce improvements (innovation) at each stage of LC implementation of the contract and the object as a whole, including the environmental component and the future labor savings. Also, conduct an assessment and necessary adjustments in the process of implementing a set of innovations. Innovations do not exist by themselves, they are not only a continuation of the development of scientific and technological progress, but also a continuation of planning, starting from the state and ending with corporations and individual enterprises. In the LC facility, therefore, it is also rational to allocate material needs to a separate stage, to link all engineering services and direct work that is required to meet such a need, including strategic planning followed by the deployment of specific plans and tasks, as well as their physical embodiment. It also traces the historical relationship between the LC stages of an object requiring reconstruction or new construction and the LC of a new object. Using mathematical modeling, it is possible to link all services and works into a single program, into a single plan with the necessary assumptions, including planning of material needs. In this regard, the LC of the object looks schematically as follows (Fig.2).

For expanded reproduction, including capital and meeting the rising needs of society, it is necessary to plan the degree of innovation with subsequent assessment in industrial construction, which should be carried out with reference to the node-by-node construction method described in detail in [11], with the allocation of separate blocks in technological nodes, if necessary. This approach allows for an assessment of innovation, including at the testing stage (at the factory, before installation and during operation) by individual nodes, followed by an integrated assessment of the entire industrial facility or complex being built (reconstructed). This method also allows a comprehensive approach to the application of innovative solutions in the organization of construction work.

For each node, an integrated assessment of the development, implementation and evaluation of innovations, innovation evaluation criteria for corrective measures, including technical and technological innovations of both the enterprise under construction itself and innovations in design, logistics, construction organization, cost determination and control and use value at all stages of the LC facility is provided. It is also advisable to record the accumulated experience in the development, evaluation and implementation of innovations in the information model of the facility.

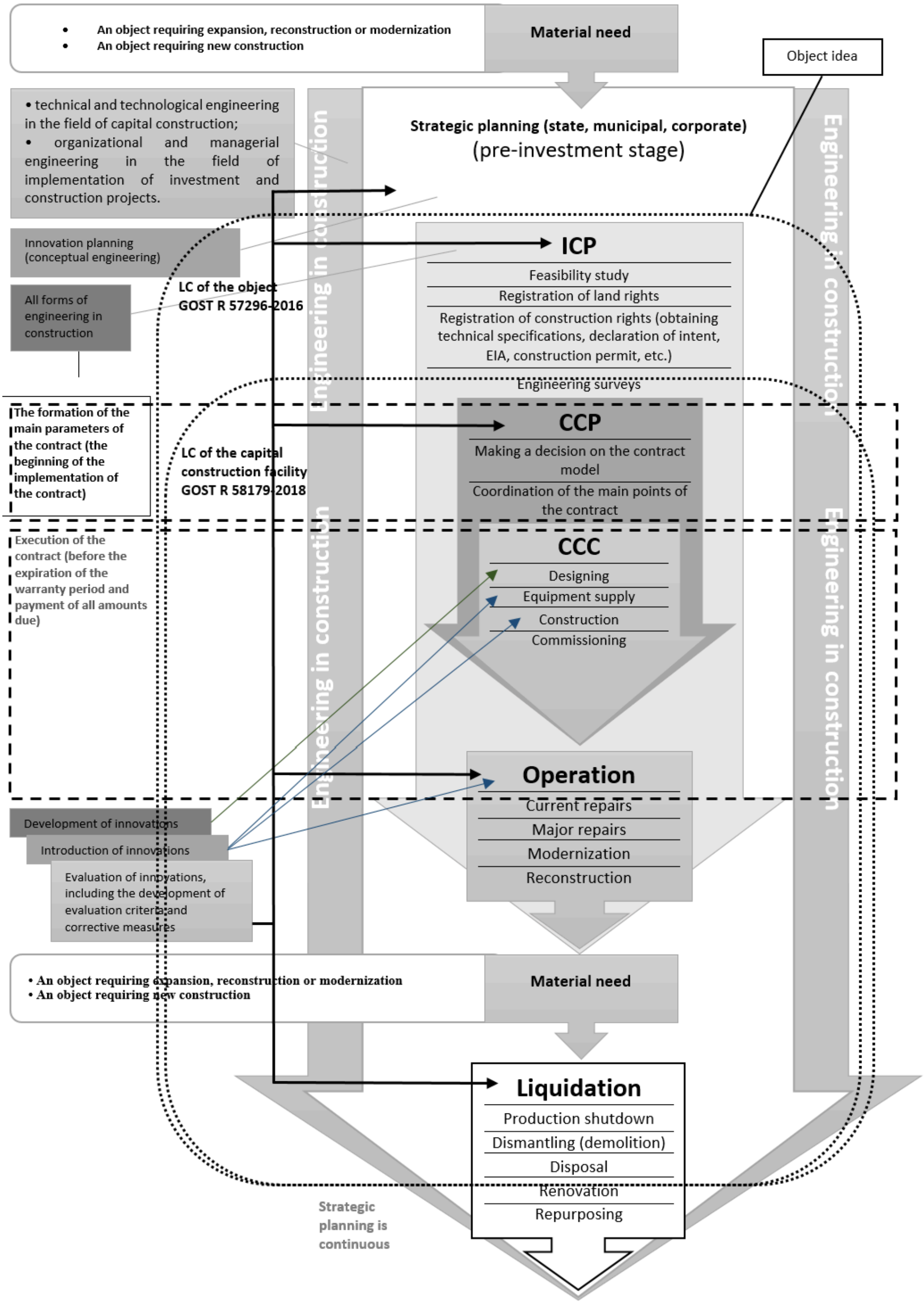

Fig. 2. LC decomposition of an industrial facility (compiled by the authors)

Thus, at the pre-investment stage of the LC facility, innovation planning takes place in the most general form on the part of the state within the framework of legislation [12-14] and strategic programs [15]. It lays down the direction and boundaries in which corporations, state and non-state, are already operating. At the corporate level, a technical and technological audit of the condition of fixed assets is carried out and requirements for their modernization, expansion or new construction are formed. The further development of the industrial facility (the industrial complex as a whole) and the territory depends on what strategic tasks will be set for the period of 7-30 years, since the normal replacement period with more advanced means of labor is 7-10 years in mechanical engineering [ ], 30-50 years in the electric power industry and nuclear industry [16] in order to withstand competition in the domestic and at the international level. Among other things, the Russian Academy of Sciences should actively participate in this process using not only the "from achieved" method, but also morphological analysis, the method of predictive scenario, complex forecasting methods, etc [17]. In this context, the level of planned innovation should be built not only according to the cost paradigm, where cost reduction and the share of value added play a key role, but also according to the consumer value paradigm, where labor savings play a key role both at the production stage and at the stage of product consumption, which corresponds to the direction of development not only scientific and technological progress but also the development of society as a whole in the form of freeing up the free time of society for the free comprehensive development of everyone. An innovative strategy for improving not only the means of labor and objects of labor (raw materials), but also the qualification of personnel, scientific organization of labor and consumer potential of the regions is directly related to labor saving. To date, the evaluation criteria in the legislation have adopted a cost paradigm, although in the same 127-FZ "On Science and State Scientific and Technical Policy" the use of public funds for innovative activities is recognized as effective in the case of a return on investment, taking into account additional socio-economic, scientific and technical results from the implementation of innovative projects, which can be used for setting goals for the consumer value paradigm.

At the ICP stage, planning can use the methodology of the expected cost of designing technical and technological innovations to make decisions when moving to the design stage [18].

In our opinion, it is advisable to divide innovations into technological and non-technological (organizational, managerial, legal, social, environmental, etc.). Technological are directly related to scientific and technological progress, non-technological, are serving production [19]. At the same time, it is necessary to take into account pseudo-innovations (such as the improvement of outdated means of production and technologies, which, giving a momentary effect, eventually slow down scientific and technological progress and lead to technological lag behind more developed countries). The introduction of pseudo-innovations must be combated or used with caution as an alternative means. Various risks of innovation should be modeled and taken into account when developing criteria for evaluating innovations and in the process of developing innovations themselves.

To determine the level of innovation in relation to the implementation of a comprehensive construction contract in industrial construction, based on the concepts indicated in this study, we propose the following formulation – *this is a measure expressed in quantitative and qualitative indicators that improve the process of construction (reconstruction) of an industrial facility, including design, supply and construction, at all stages of the contract implementation, and its operational characteristics for the entire period of operation up to liquidation or reconstruction, modernization or expansion in comparison with forecast indicators and/or indicators such as if such improvements were not introduced.*

In our opinion, it is advisable to evaluate innovations at the stage of implementation and execution of the contract at pre-defined control points for technological nodes, and then determine the integrated indicator for the object. In the contract, it is also necessary to set a lower threshold for cost and consumer value criteria, when the effect is calculated not from costs, but from how much labor is saved when introducing a particular innovation, since the replacement, release, and facilitation of living human labor is the main function of technology as a factor of production, this is its use value, and technology, in turn, acts as the productive force of society. When consuming machinery (in our case, for example, a future thermal power plant), there is a movement of social labor, which leads to a change in its structure and proportions: both in production as a whole and in a specific product, the share of living labor decreases, and the share of materialized labor increases with an overall absolute reduction in social labor in production [20]. This is the essence of scientific and technological progress and the development of the productive forces of society.

Labor costs are understood as all the costs of living labor associated with the operation of an industrial facility (operation, maintenance, etc.). The amount of replaced labor is determined by the formula (Formula 1):

$$Z_r = \left(Z_1 - Z_2\right) * \ Q, \qquad (1)$$

where $Z_r - \ amount\ of\ live\ labor\ released\ (person\ -\ hour)$;

Z_1- labor intensity of a unit of production (work) produced by basic equipment (person-hour);

Z_2- labor intensity of a unit of production (work) produced using innovative equipment (person-hour);

Q- number of units of production (work performed) per unit of time for the entire service life of new equipment.

This formula can also be applied to new organizational production methods in construction or any other field.

The monetary value of the released labor will look like this (Formula 2):

$$Z_r = К_c\left(Z_1 - Z_2\right) * \ Q, \qquad (2)$$

where Z_r – amount of released live labor (rubles);

$К_c$- coefficient of conversion of saved labor into monetary measurement.

When converting labor intensity into monetary terms, it is necessary to take into account not only the amount of the tariff rate of an hour of work on equipment / machinery, depending on the qualifications of workers, the amount of bonuses, district allowances, overhead costs, but also the amount of surplus labor.

The determination of the released live labor takes place by recalculating the annual physical volume of output (generated) products (energy) into the required labor costs (main and maintenance personnel) and by comparing the innovative model with the outgoing production or analogues.

However, in order to calculate the total labor savings, it is necessary to calculate the past labor contained in such equipment, spent on its development and production, but for this it is necessary to take the entire production chain, which is possible only within the framework of a production monopoly or consortia, a planned economy, etc. Although today the dominance of monopolies (backbone enterprises) in the economy is already evident. Only in this case can you see the actual labor savings, since the labor costs for the production of new products may exceed the labor savings when consuming such equipment. In this calculation, the formula takes the form (Formula 3):

$$Z_r = К_c\left(Z_1 - Z_2\right) * Q - S_t, \quad (3)$$

where S_t –total cost of labor for the creation and operation of equipment/machinery (includes direct costs of production, research and design work, testing of prototypes, technological preparation of production, capital investments).

To assess the innovativeness of the organization of the construction process, the cost-based paradigm is more relevant, whereas for industrial production technology it is consumer-based. This is due to the fact that the process of erecting buildings and structures consists of two points in relation to the invested labor: material resources (past labor) and labor resources (live labor). Material resources such as mechanization tools and building materials in this regard do not relate directly to construction, but relate to the technology of their production, where future labor savings are laid down when they are consumed. The task of direct construction is to use those mechanisms and materials that save as much as possible the costs of the construction organization for the purchase and use of these mechanisms and materials. Labor resources during construction should be saved in the process of performing construction operations and preparing construction in the form of saving working time, which depends on the organization of construction production at the planning stage, designing organizational and technological documentation and construction control and the use of modern mechanisms and materials. That is, according to a costly scheme. On the other hand, the engineering contract assumes engineering activities, which must take into account all indicators, including operational, including products, and therefore consumer-value characteristics, including future savings in working time when consuming the product, when carrying out design and construction. Related to this are such consumer-value characteristics as the quality of objects of labor and means of labor, the qualifications of workers and the quality of the organization of production, which contain saved labor.

Thus, in the course of the study, the most significant factors determining the effectiveness of the application of complex contracts in the implementation of investment projects in the field of electric power industrial construction were identified and a draft mathematical model for evaluating innovative efficiency in the implementation of CCC in relation to the Norilsk region was prepared.

$$K_l + \sum_e^t \Delta C_e * K_e + \sum_p^t \Delta C_p * K_p + \sum_r^t \Delta C_r * K_r + \sum_s^t \Delta C_s * K_s + \sum_v^t \Delta C_v * K_v\Big) - C_0\Big) * К_{eff} * К_{risk} \to max, \quad (4)$$

where:

E_{int} − an integral indicator of the innovative effectiveness of the contract model;

ΔC_r − saving resources as a result of innovation;

K_i − weighting factor, taking into account the importance of certain aspects of the jth innovation;

ΔC_w − saving live labor when introducing innovations;

K_j − weighting factor, taking into account the importance of saving labor;

ΔC_l − reduction of losses in the system as a result of innovation (increase in efficiency);

$K_l -$ weighting factor, taking into account the importance of reducing losses in the system;

$\Delta C_e -$ improving the socio-ecological image and attractiveness of the enterprise;

$K_e -$ weighting factor, taking into account the importance of socio-environmental reputation;

$\Delta C_p -$ environmental effect in natural terms;

$K_p -$ weighting factor, taking into account the importance of the environmental effect in

natural terms;

$\Delta C_r -$ reduction of environmental risks from boilers and storage of emergency backup fuel of thermal power plants;

$K_r -$ weighting factor, taking into account the importance of environmental risks from boilers and storage of emergency backup fuel of CHP;

$\Delta C_s -$ improving the circularity index of the CHP economy;

$K_s -$ weighting factor, taking into account the importance of matching the circularity of the CHP economy;

$\Delta C_v -$ increase in net discounted income from innovation;

$K_v -$ weighting factor, taking into account the importance of increasing the net discounted income from the introduction of innovations;

$C_0 -$ costs of implementing innovations and organizational and technological solutions;

$K_{eff} -$ coefficient of organizational effectiveness;

$K_{risk} -$ integral risk reduction coefficient.

4 Discussion

The obtained results of a theoretical study based on practical experience in the implementation of specific projects in the Norilsk region have the character of novelty, but require careful verification and further justification and clarification. In our opinion, for the first time an attempt has been made to apply the dialectical method with the inclusion of formal research methods to the study of the implementation and evaluation of CCC within the ICP for the construction of industrial capital construction facilities. Further critical analysis of the results obtained and discussion by experts in these fields can help determine the prospects of our research.

5 Conclussions

The obtained research results will consist in the author's theoretical justification of the need to search for reserves in new forms of dialectical reflection of developing objects obtained by using this method of interrelated moments (stages) LC of industrial capital construction facilities dialectically related to other LC of such objects and the development of the region as a whole. This concept makes it possible to simplify the perception by project participants of both the goals of the project being implemented within the framework of PM and their role in achieving the goals set for the implementation of CCC within the framework of ICP. The combination of various methods of implementation and evaluation, with the dominance of the dialectical reflection of the CCC implementation itself within the ICP, suggests that the developed approach will create conditions for the project teams to perceive the holistic picture of PM and CCC implementation, identify hidden reserves for innovative development at all stages of LC industrial capital construction facility within the framework of the concept of systematic and interrelated economic development of the studied the region as a whole.

References

1. A.V. Zolotov. Shortening the working day as the basis of modern economic development (Publishing House of Polytechnic un., St. Petersburg, 2016)
2. Decree of the Government of the Russian Federation dated 06/09/2020 No. 1523-r "On Approval of the Energy Strategy of the Russian Federation for the period up to 2035".
3. GOST R 58785-2019. The national standard of the Russian Federation. Water quality. Life cycle cost assessment for the effective operation of water supply and sanitation systems and structures" (approved and put into effect by Order of Rosstandart dated 12/27/2019 No. 1489-st) (ed. dated 07/08/2022).
4. SP 333.1325800.2020. A set of rules. Information modeling in construction. Rules for the formation of an information model of objects at various stages of the life cycle" (approved by the Order of the Ministry of Construction of the Russian Federation dated 12/31/2020 No. 928/pr).
5. SP 471.1325800.2019 "Information modeling in construction. Quality control of construction works" (approved by the order of the Ministry of Construction and Housing and Communal Services of the Russian Federation dated December 24, 2019 No. 854/pr).
6. GOST R 58917-2021. The national standard of the Russian Federation. Technological engineering and design. Feasibility study of the investment project of an industrial facility. General requirements" (approved and put into effect by the Order of Rosstandart dated 09/29/2021 No. 1025-st).
7. GOST R 57296-2016. The national standard of the Russian Federation. An integrated approach to information management of the life cycle of anthropogenic objects and environments. Description of data for mathematical modeling of life cycle processes. Basic provisions" (approved and put into effect by Order of Rosstandart dated 11/28/2016 No. 1822-st).
8. Federal Law of the Russian Federation dated 11/21/1995 N 170-FZ (as amended on 06/28/2022) "On the use of atomic Energy".
9. V.S. Belykh, O.A. Gerasimov, The category "product life cycle" in the conceptual apparatus of the science of entrepreneurial (economic) law. Business law. **1** (2020).
10. S.A. Kalaida, A.A. Faizova, Practical application of modern digital technologies at the stages of the life cycle of an insurance contract. Issues of innovative economics. **10-4** (2020).
11. Guidelines for the application of the nodal method of design, preparation, organization and management of construction of complex facilities and large industrial complexes (Stroyizdat, Moscow, 1982)
12. Federal Law No. 172-FZ dated 06/28/2014 (as amended on 07/31/2020) "On Strategic Planning in the Russian Federation".

13. Federal Law No. 127-FZ of 08/23/1996 "On Science and State Scientific and Technical Policy" // SZ RF. 1996. N 35. St. 4137.
14. Federal Law No. 488-FZ of 12/31/2014 "On Industrial Policy in the Russian Federation".
15. Decree of the Government of the Russian Federation of 04/15/2014 No. 316 (ed. dated 02.12.2022) "On approval of the State program of the Russian Federation "Economic development and innovative Economy".
16. The concept of forming the state program for the development of mechanical engineering in Russia. URL: http://www.robogeek.ru/analitika/evropa-vkladyvaet-dengi-v-robototehniku (date of reference: 05/20/2018).
17. I.A. Kirichenko, A.V. Smirnov, S.N. Naumov, Problems of strategic planning of innovative development of the industrial complex of the Russian Federation. Bulletin of the Institute of Economics of the Russian Academy of Sciences. **4** (2014).
18. T.N. Saurenko, E.G. Anisimov, E.S. Rodionova, Methodology for estimating the expected cost of designing technical and technological innovations. Management consulting. **11** (2019).
19. L.A. Sosunova, E.A. Serper, Methodological approaches to the classification of innovations. The vector of science of TSU. Series: Economics and Management. **2(2)** (2010).
20. V.G. Dolgov, Consumer value fundamentals of scientific and technological progress management. Dissertation for the degree of Doctor of Economics (Leningrad, 1989).