UDC 69.003

Mishlanova M.Yu.

An earned value method in a smart system of construction project management

Mishlanova Marina Yurievna,
Candidate of Technical Sciences, Associated Professor of the Department of economy and management in construction; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; ID RISC: 386390; mishlanova_m@mail.ru

The article presents a brief overview of methods used to estimate the implementation of investment and construction projects. The advantages of the earned value method, areas of its development and prospects for its application in smart systems of construction project management are addressed. The author has developed a rhombus tolerance technique to standardize the implementation of construction projects and automatic deviation control. The valuation dependence on the value of construction and installation work is considered as an aspect of formation of a field of acceptable project implementation indicators. A dynamic dependence and correlation between the number of project assignments, valuation and schedule are revealed. The decomposition of project indicators into component groups is presented. Basic deviations, arising during the project implementation, including the total expenditure deviation, the deviation of the valuation of a unit of work, the productivity deviation, the deviation of the number of works, the deviation of the valuation of resources and the deviation from the schedule. The signal function of deviations of an implemented investment and construction project indicators is considered. Relevant management functions of the earned value methodology are identified. The author lists the basic situations that entail the implementation of signaling functions in the system of intelligent management of construction projects based on the earned value method. Situational precedents are identified as a methodological basis for future case modeling. The comparability of the earned value methodology and relevant construction engineering techniques is identified. Fundamental iterations of the implementation of the earned value methodology are developed. A decision-making algorithm, based on the principles of smart management, is presented for investment and construction projects. The author presents the areas of further improvement of the earned value method to optimize the management of construction projects.

Keywords: *an investment and construction project, an earned value method, deviation management, decision-making*

INTRODUCTION

We present a review of current approaches to assessing the valuation of investment and construction projects at the stage of their implementation [1–15]. The traditional method used to analyze the project valuation uses the concepts of the planned valuation of work according to the schedule and the valuation of the work, which is actually done. The traditional method of assessing the project valuation is simple and easily accessible, but it has the following disadvantages: there is no estimate of the project completion degree; the work, which is actually done at the expense of the money spent is not considered; there is not information about such project indicators as value and time; it is not possible to predict the future performance of the project work.

Project managers should have a lot of information about the execution of work relative to the plan, about the compliance with the schedule, about the deviations and their nature to make effective management decisions. These tasks can be solved by the earned value management (EVM) methodology that controls the main project parameters, including its planned, actual and earned valuation. According to the Project Management Body of Knowledge [10], the earned value management method conveys the actual physical progress of the project and the integration of the most important areas of project management, such as content, time and cost.

The application and development of the EVM methodology are studied in different ways [3]:

- modification of EVM model indicators; the earned schedule concept;
- using fuzzy logic and implementing a probability approach to improve estimates of real projects;
- control metrics for the adequate evaluation of the volatility impact on the project implementation;
- analysis of the EVM model dependence on experts' judgments;
- analysis of advantages and critical success factors of the EVM model in construction projects;
- the EVM model and quantitative methods of the control theory;
- analysis of the EVM model as the methodological basis of the theory of management decision-making;
- the EVM model as a component of investment analysis.

The earned value management methodology significantly expands the evaluation, in particular, prospects for automatic deviation management[1] [16–19]. Continuous earned value management of a project ensures early warning signals of project problems and opportunities, accurately and reasonably predicts its full or partial implementation,

1 *Sultanov I.A.* Management of the mastered volume and timely solutions. URL: http://projectimo.ru/realizaciya-proekta/metod-osvoennogo-obema.html (rus.).

the risks of budget overruns and missed deadlines, penalties, and the launch of competing projects.

RESEARCH METHODOLOGY

A systematic approach, basic principles of the standard cost system, methods of economic and mathematical modeling, valuation parameters characteristic of an investment and construction project, decomposition methods of the project valuation and identification of deviations, projected prospects of an adaptive management model, methodological elements of software development and algorithm formation were applied to achieve the goal of the research.

RESULTS AND DISCUSSION

The earned value management method entails the use of a report on the earned value, the time-focused allocation of planned and actual values, planned amounts of work performed within the framework of a project, including the planned value, the actual value, and the earned value.

The controlled implementation of an investment and construction project is based on analytical indicators that convey the deviation of relevant accounting indicators from the planned ones. Control operations may be conducted for all component groups; methods of model differentiation are used in this study. Component groups are formed with account taken of the basic tasks of project management: objects, construction and installation works, structural elements, costs, resources, etc. The methodological plan is differentiated by absolute and relative indicators of each component group, which is further integrated into common implementation indicators of an investment and construction project.

At the micro-level of elementary work performed within the framework of an investment and construction project, project valuation can be considered as a linear dependence between the valuation and value of construction and installation works (Fig. 1). The variability of the valuation of an investment and construction project forms a diamond tolerance for standardizing processes of project implementation and deviation management.

The advantages of the earned value method allow to identify the dynamic dependence and correlation between the basic parameters of an investment and construction project implementation, including valuation, amount of work and schedule. For a detailed description of the studied dependencies, we will decompose the basic indicators of the earned value method to project unit indicators.

For example, the concept of the unit valuation of work V_{sp}, widely used in construction, allows to analytically decompose the valuation by the deviation factor — the unit valuation or the amount of work- and decomposition of the planned and actual value of work allows, in addition to all of the above, to control production P.

$$PV = PV_{sp} \cdot PQ = PV_{sp} \cdot PP \cdot T, \quad (1)$$

$$AV = AV_{sp} \cdot AQ = AV_{sp} \cdot AP \cdot T, \quad (2)$$

$$EV = PV_{sp} \cdot AQ = PV_{sp} \cdot AP \cdot T, \quad (3)$$

where PV_{sp} is the the planned unit valuation of construction and installation works; PQ is the planned amount of construction and installation works for the planned time; PP is the planned production;

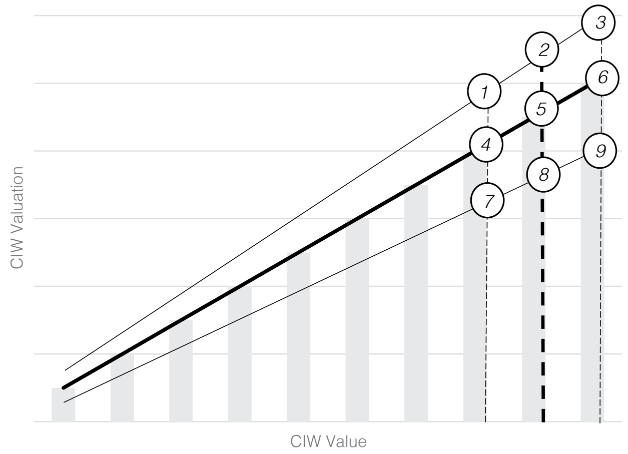

Fig. 1. Valuation variability of an investment and construction project: 1 — actual valuation of the overspending in terms of the actual backlog value; 2 — actual valuation of the overspending in terms of the planned value; 3 — actual valuation of the overspending in terms of the actual lead value; 4 — earned valuation of the backlog; 5 — planned valuation of the planned value; 6 — earned valuation of lead; 7 — actual valuation of actual backlog value savings; 8 — actual valuation of planned value savings; 9 — actual valuation of actual lead value savings

T is the control period; AV_{sp} is the actual unit valuation of construction and installation works; AQ is the actual amount of work performed during the planned time; AP is the actual production.

Single rates, presented in (1)–(3) by the type of work, allow to identify the use of resources for the implementation of these types of work in the future. A similar decomposition of the valuation of an investment and construction project can be performed in relation to objects, structural elements, costs, resources, implementers and other groups of components.

Given the basic methodological principles, the total deviation of the cost as of the date of control is the amount derived from the difference between EV, the earned valuation of the work performed, and AV, the actual valuation of the work performed:

$$\Delta C = EV - AV. \quad (4)$$

In (4), the indicator of the unit valuation of work and its deviation from the planned significance ΔV = (5), the indicator of production and its deviation from the planned significance ΔP (6) are used:

$$\Delta C = PV_{sp} \cdot AQ - AV_{sp} \cdot AQ = \left(PV_{sp} - AV_{sp}\right) AQ = \Delta V_{sp} \cdot AQ, \quad (5)$$

$$\Delta C = PV_{sp} \cdot AP \cdot T - AV_{sp} \cdot AP \cdot T = = \left(PV_{sp} - AV_{sp}\right) AP \cdot T = \Delta V_{sp} \cdot (PP + \Delta P) T. \quad (6)$$

We will also consider the deviation of the amount of construction and installation works in natural terms as of the date of control. Similarly to the above, we assume a positive significance corresponding to favourable conditions and a negative significance corresponding to unfavourable conditions.

$$\Delta Q = PQ - AQ. \quad (7)$$

Then

$$AQ = PQ - AQ, \quad (8)$$

$$\Delta C = \Delta V_{sp}(PQ + \Delta Q). \quad (9)$$

In fact, we have proven the above (5) using other logical justifications.

In addition to the above method of decomposition of the deviation of an investment and construction project valuation, we will consider the deviation of expanded valuation ΔC_R in respect of resources.

$$\begin{aligned}\Delta C_R &= EQR \cdot PVR - AQR \cdot AVR = \\ &= AQR_{sp} \cdot AQ \cdot PVR - AQR_{sp} \cdot AQ \cdot AVR = \\ &= AQR_{sp}(PVR - AVR)AQ = AQR_{sp} \cdot \Delta VR \cdot AQ,\end{aligned} \quad (10)$$

where R is the type of resources; EQR is the earned amount of resources (the planned amount of resources by the actual value of work); PVR is the planned valuation of resources; AQR is the actual amount of resources by the actual value of work; AVR is the actual valuation of resources; AQR_{sp} is the actual unit amount of resources per unit of work during the control period; ΔVR is the deviation of the resources valuation.

Based on the above (7)–(10), factors of deviation of resources and project indicators suggest a deviation in the amount of resources, the resource valuation, the amount of work performed. The deviation of the valuation of an investment and construction project includes basic components of the deviation of direct costs, deviations of overhead expenses, the price for the contractor's work and other components in general and in each subject phase.

In turn, on the date of control, the schedule deviation is determined by the difference between the earned valuation of the work performed and the planned valuation PV of the work according to the schedule. Similarly to the work value deviation in natural indicators, we assume a positive significance corresponding to the favourable conditions and a negative significance corresponding to unfavourable conditions.

$$\Delta S = EV - PV. \quad (11)$$

In the above (11), it is possible to associate a deviation from the schedule with the unit valuation of work, which illustrates the fundamental methodological significance of this valuation discrepancy compared to the discrepancy determined by (6):

$$\Delta S = PV_{sp} \cdot AQ - PV_{sp} \cdot PQ = PV_{sp} \cdot \Delta Q. \quad (12)$$

Formula (12) has a deviation from schedule ΔQ, expressed in natural units or in units of construction and installation work value. The deviation from the schedule can be rationally used together with methods of network planning: an estimate of the event parameters, works and the network schedule, simulation of the project implementation based on the formation of a set of works, their prioritizing, determining the necessary resources and tasks that must be solved to complete the project.

In this paper, the author presents the basic part of design deviations DS, ΔQ, ΔCR, ΔV_{sp}, ΔP, ΔVR, ΔS and recommendations for establishing other significant deviations in the course of implementation of investment and construction projects. Basic deviations DS, ΔQ, ΔCR, ΔV_{sp}, ΔP, ΔVR, ΔS serve as signals of the complex system and a chain of events, which further ensures automatic adaptive project management, such as the coding and implementation of one or more smart algorithms using a specially designed and structured database. The process of smart project management is based on monitoring the signals and factor indicators, their analysis taking into account the impact on the target indicator, forecasting possible changes and conditions for the management of the object development process, evaluating alternative solutions when choosing the most effective management actions.

The EVM methodology provides project management with the necessary information that allows to:

- determine the common progress of the project;
- control deviations according to project indicators, identify trends and prevent possible deviations;
- justify the need for additional work funding, rescheduling and shifting the end of work stages, increasing the project team;
- reducing and preventing the risks of work performed on the basis of objective indicators;
- justifying the need to withdraw from the project or transfer it to other implementing structures;
- optimizing resources allocation across projects;
- developing and implementing an adequate motivation policy for the project team by linking the corporate goals and the project team;
- accumulating and summarizing quantitative and qualitative chronological information, making databases;
- identifying current problems in the project management field.

The possibilities of the smart management of investment and construction projects may be expanded through the use of a situational approach. The earned value methodology is the analytical basis for assessing the state of an investment and construction project; it assumes the following basic situations. The situation of "Ahead of schedule and budget overruns" has a dual character. On the one hand, unplanned circumstances can lead to the overspending of funds in the course of performing the scheduled work. On the other hand, the work can be performed ahead of the schedule and, accordingly, more money is spent. The situation of being "Behind the schedule and having budget overruns" occurs when the work is performed in violation of the planned schedule and in excess of the planned costs. This situation is negative.

The situation of being "Behind the schedule and having budget savings" is either neutral or positive. On the one hand, the work can be done behind the schedule and, accordingly, money can be saved. On the other hand, there may be real savings of money which is a positive fact. The situation of being "Ahead of schedule and having budget savings" is non-standard. On the one hand, given the accelerated performance of work, money can be objectively saved. On the other hand, the project work implementation may be ahead of the schedule and budget savings are possible for the reason of the subjective nature of violations in the project and estimate documentation, work planning, accounting policy.

The implementation of the earned value management methods in the smart management system, applied to investment and construction projects, involves the following iterations.

1. Definition of the value and detailing of project work.
2. Creating a hierarchical project structure.
3. Setting control tasks at the level of individual components and indicators.
4. Responsibility delegation and the management schedule development.
5. Evaluation of the actual project implementation, control of earned value indicators and cost effectiveness.
6. Optimization of project costs during its implementation, taking into account the identified trends.
7. Management of work in progress.

8. Management of identified trends in the implementation of all stages of the project.

The construction valuation engineering system allows to quickly estimate and predict the results of the project based on the earned value methodology, to make management decisions based on a case approach used within the framework of an investment technology for the smart management of construction projects (Fig. 2).

This algorithm includes integrated tools for the cost estimation of projects and prospects for the automatic adaptive management based on the deviations from the design parameters using modern economic models of development trends based on the earned value methods. The use of the methodology, addressed in this article, will make it possible to form a special structured database for the systematic implementation of a smart management system for investment and construction projects.

Methodological advantages can be listed as a result of a summarized research into the earned value methods: the ability to get an accurate idea of the project state, identify violations of the financial project model, implement corrective management measures. At the same time, it is possible to present directions for the further improvement of the earned value methodology: identification and optimization of interrelations between deviations from project indicators, development of qualitative estimates of situations, development of methods of indicative estimates, a rational combination of methods of accounting and evaluation of project parameters, improvement of methods used for the forecasting of the earned value of investment and construction works. An improved methodology for evaluating and analyzing project implementation indicators will improve adaptive management according to a special algorithm used for the optimal development of investment and construction projects.

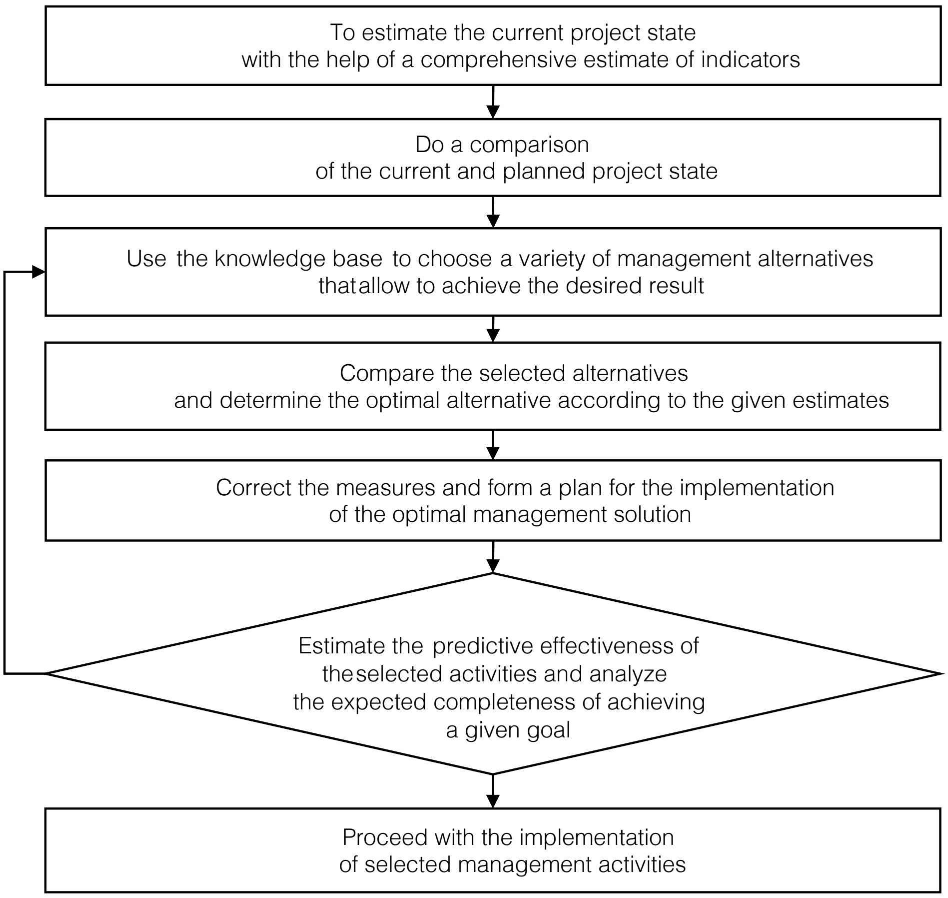

Fig. 2. A decision-making algorithm for the implementation of an investment and construction project

CONCLUSION

In this paper, indicators of deviations in the implementation phase of investment and construction projects are established, basic principles and specific features of the project management system are described using valuation engineering methods. A model of analytical indicators is developed; recommendations and formulas for the application of the earned value methods are presented to rise the efficiency of control of the valuation of an investment and construction project.

REFERENCES

1. Alekseeva K.I. Dissemination of best practices in the field of control of projects based on the method of earned value. Information and Economic Aspects of Standardization and Technical Regulation: Scientific Online Magazine. 2014; 18:1-9. (rus.).

2. Veretennikova O.V., Genova A.A., Lyakhova A.S. The need for informatization of cost engineering in the context of management of investment and construction projects. Economics of Civil Engineering and Municipal Economy. 2019; 15(1):23-29. URL: https://elibrary.ru/item.asp?id=38512902 (rus.).

3. Zubok S. Budgeting of the bank's project activities: component methods of monitoring, executing control and forecasting. Banking Bulletin. 2020; 7(684):10-19. URL: https://elibrary.ru/item.asp?id=43787279 (rus.).
4. Zuev M.B., Zuev B.P., Bulgakova I.N. The formation and development of the performance assessment method in the conception of operational management. Business Informatics. 2020; 14(1):75-84. DOI: 10.17323/2587-814X.2020.1.75.84 (rus.).
5. Malakhov V.I. Cost modeling of investment and construction projects (basic course). Moscow, 2018; 80.
6. Mishlanova M.Yu. Valuation management of investment and construction projects : monograph. Moscow, MGSU, 2020; 237. (rus.).
7. Mishlanova M.Yu., Nerushaeva S.A. Two-level assessment of investment and construction project value creation. Actual Problems of the Economy. 2020; 1(25):99-104. URL: https://elibrary.ru/item.asp?id=42813424 (rus.).
8. Tarkhanova N.A., Norkina T.P. Theoretical aspects of management cost and efficiency of investment-build projects. Economics of Construction and Urban Economy. 2019; 15(4):249-257. URL: https://elibrary.ru/item.asp?id=42727099 (rus.).
9. Shpyrko O.V. The formation of the cost of construction on various stages of investment construction process. Scientific Notes of TOGU. 2019; 10(2):385-388. URL: https://elibrary.ru/item.asp?id=41484607 (rus.).
10. A guide to the Project Management Body of Knowledge (PMBOK Guide). 6th Edition. Series: PMBOK Manual. Newtown Square, PA, Project Management Institute, 2017; 762.
11. Adam A., Josephson P.-E.B., Lindahl G. Aggregation of factors causing cost overruns and time delays in large public construction projects: Trends and implications. Engineering, Construction and Architectural Management. 2017; 24(3):393-406. DOI: 10.1108/ECAM-09-2015-0135
12. Chen H.L., Chen W.T., Lin Y.L. Earned value project management: Improving the predictive power of planned value. International Journal of Project Management. 2016; 4(1):22-29. DOI: 10.1016/j.ijproman.2015.09.008
13. Colin J., Vanhoucke M. A comparison of the performance of various project control methods using earned value management systems. Expert Systems with Applications. 2015; 42(6):3159-3175. DOI: 10.1016/j.eswa.2014.12.007
14. Construction project management: An integrated approach / ed. by Peter Fewings. New York : Routledge, 2013; 624.
15. Fleming Q.W., Koppelman J.M. Earned value project management. Project Management Institute, 2016; 232.
16. Jayaraman R. Project cost control: a new method to plan and control costs in large projects. Business process management journal. 2016; 22(6):1247-1268. DOI: 10.1108/BPMJ-10-2014-0102
17. Zelentsov L.B., Mailyan L.D., Shogenov M.S., Triputa I.G. Smart control systems in construction : monograph. Rostov-on-Don, 2017; 89. (rus.).
18. Melekhin V.B., Aigumov T.G., Melekhin A.V. Mathematical models and adaptive management methods of construction production. Moscow, 2019; 146. (rus.).
19. Telyatnikova N.A. Improving the method of project management for the construction of transport infrastructure facilities. Russian Journal of Transport Engineering. 2021; 8(1):6. DOI: 10.15862/09SATS121 (rus.).
20. Sultanov I.A. Management of the mastered volume and timely solutions. URL: http://projectimo.ru/realizaciya-proekta/metod-osvoennogo-obema.html (rus.).

Метод освоенного объема в интеллектуальной системе управления строительными проектами

Представлен краткий обзор методов оценки степени реализации инвестиционно-строительных проектов. Выделены достоинства метода освоенного объема, направления его развития и перспективы использования в интеллектуальной системе управления проектами. Автором разработан ромб-допуск для нормирования процессов реализации строительного проекта и автоматического управления по отклонениям. Рассмотрена зависимость стоимости от объема строительно-монтажных работ, как один из аспектов формирования поля допустимых показателей реализации проектов. Выявлена динамическая зависимость и взаимосвязь количества проектных работ, стоимости и расписания. Представлено разложение проектных показателей по компонентным группам. Определены базовые отклонения, возникающие при реализации проектов: общее отклонение по затратам, отклонение удельной стоимости работ, отклонение выработки, отклонение количества работ, отклонение стоимости затраченных ресурсов, отклонение расписания. Рассмотрена сигнальная функция полученных отклонений показателей реализации инвестиционно-строительного проекта. Выявлены актуальные управленческие функции методологии освоенного объема. В статье выявлены базовые ситуации для реализации сигнальных функций в системе интеллектуального управления строительными проектами на основе методологии освоенного объема. Идентифицированы ситуационные прецеденты состояния инвестиционно-строительных проектов, как методическая основа будущего прецедентного моделирования. Определена сопоставимость методологии освоенного объема и актуального строительного инжиниринга. Разработаны основные итерации внедрения методологии освоенного объема в систему интеллектуального управления проектами. Представлен алгоритм принятия решений в отношении реализации инвестиционно-строительных проектов, построенный на принципах интеллектуального управления. В статье представлены направления дальнейшего совершенствования методологии освоенного объема для оптимизации управления строительными проектами.

Ключевые слова: *инвестиционно-строительный проект, метод освоенного объема, управление отклонениями, принятие решений*

СПИСОК ИСТОЧНИКОВ

1. Алексеева К.И. Распространение лучших практик в области контроля проектов на базе метода освоенного объема // Информационно-экономические аспекты стандартизации и технического регулирования: Научный интернет-журнал. 2014. № 18. С. 1–9.
2. Веретенникова О.В., Генова А.А., Ляхова А.С. Необходимость информатизации стоимостного инжиниринга в контексте управления инвестиционно-строительными проектами // Экономика строительства и городского хозяйства. 2019. Т. 15. № 1. С. 23–29. URL: https://elibrary.ru/item.asp?id=38512902
3. Зубок С. Бюджетирование проектной деятельности банка: компонентные методики мониторинга, контроля и прогнозирования // Банковский вестник. 2020. № 7 (684). С. 10–19. URL: https://elibrary.ru/item.asp?id=43787279
4. Зуев М.Б., Зуев Б.П., Булгакова И.Н. Формирование и развитие метода оценки практической эффективности менеджмента в концепции оперативного управления // Бизнес-информатика. 2020. Т. 14. № 1. С. 75–84. DOI: 10.17323/2587-814X.2020.1.75.84
5. Малахов В.И. Стоимостное моделирование инвестиционно-строительных проектов (базовый курс). М., 2018. 80 с.
6. Мишланова М.Ю. Управление стоимостью инвестиционно-строительных проектов : монография. М. : МГСУ, 2020. 237 с.
7. Мишланова М.Ю., Нерушаева С.А. Двухуровневая оценка создания стоимости инвестиционно-строительного проекта // Актуальные проблемы экономики. 2020. № 1 (25). С. 99–104. URL: https://elibrary.ru/item.asp?id=42813424
8. Тарханова Н.А., Норкина Т.П. Теоретические аспекты управления стоимостью и эффективностью инвестиционно-строительных проектов // Экономика строительства и городского хозяйства. 2019. Т. 15. № 4. С. 249–257. URL: https://elibrary.ru/item.asp?id=42727099
9. Шпырко О.В. Формирование стоимости строительства на различных стадиях инвестиционно-строительного

процесса // Ученые заметки ТОГУ. 2019. Т. 10. № 2. С. 385–388. URL: https://elibrary.ru/item.asp?id=41484607
10. A guide to the project management body of knowledge (PMBOK guide). 6th ed. Series: PMBOK Manual. Newtown Square, PA : Project Management Institute, 2017. 762 p.
11. Adam A., Josephson P.-E.B., Lindahl G. Aggregation of factors causing cost overruns and time delays in large public construction projects: Trends and implications // Engineering, Construction and Architectural Management. 2017. Vol. 24. Issue 3. Pp. 393–406. DOI: 10.1108/ECAM-09-2015-0135
12. Chen H.L., Chen W.T., Lin Y.L. Earned value project management: Improving the predictive power of planned value // International Journal of Project Management. 2016. Vol. 4. Issue 1. Pp. 22–29. DOI: 10.1016/j.ijproman.2015.09.008
13. Colin J., Vanhoucke M. A comparison of the performance of various project control methods using earned value management systems // Expert Systems with Applications. 2015. Vol. 42. Issue 6. Pp. 3159–3175. DOI: 10.1016/j.eswa.2014.12.007
14. Construction project management: An integrated approach / Fewings P. (ed.). New York : Routledge, 2013. 624 p.
15. Fleming Q.W., Koppelman J.M. Earned value project management. Project Management Institute, 2016. 232 p.
16. Jayaraman R. Project cost control: a new method to plan and control costs in large projects // Business Process Management Journal. 2016. Vol. 22. Issue 6. Pp. 1247–1268. DOI: 10.1108/BPMJ-10-2014-0102
17. Зеленцов Л.Б., Маилян Л.Д., Шогенов М.С., Трипута И.Г. Интеллектуальные системы управления в строительстве : монография. Ростов н/Д : ДГТУ, 2017. 89 с.
18. Мелехин В.Б., Айгумов Т.Г., Мелехин А.В. Математические модели и методы адаптивного управления строительным производством. М., 2019. 146 с.
19. Телятникова Н.А. Совершенствование метода управления проектами строительства объектов транспортной инфраструктуры // Транспортные сооружения. 2021. Т. 8. № 1. Ст. 6. DOI: 10.15862/09SATS121
20. Султанов И.А. Управление освоенным объемом и своевременные решения. URL: http://projectimo.ru/realizaciya-proekta/metod-osvoennogo-obema.html

Об авторе: **Мишланова Марина Юрьевна** — кандидат технических наук, доцент кафедры экономики и управления в строительстве; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; РИНЦ ID: 386390; mishlanova_m@mail.ru.

For citation: Mishlanova M.Yu. An earned value method in a smart system of construction project management. *Real estate: economics, management*. 2022; 3:30-35.

Для цитирования: *Мишланова М.Ю.* An earned value method in a smart system of construction project management // Недвижимость: экономика, управление. 2022. № 3. С. 30–35.

Л.И. Павлова. Москва. Кремль. Соборная площадь. Рисунок, тушь, перо.