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### **EVALUATION OF EFFICIENCY OF INNOVATION PROJECTS IN HOUSING AND COMMUNAL SERVICES**

*The purpose of the article is improvement of the theoretical foundations and development of methodical recommendations as to evaluation of the effectiveness of innovative projects in the field of housing and communal services. The proposed complex parameter for evaluating of the innovative project allows clearly and unambiguously to evaluate to alternative innovation projects in the field of housing and communal services considering all aspects of implementation and realization and choosing the best of them. It will significantly increase the management efficiency of innovation projects in dynamic conditions of the market environment.*

Keywords: innovation projects, evaluation, discounting, efficiency, risk, uncertainty, housing and communal services.

**Statement of the problem.** Housing and communal services is the most technically backward sector of the economy with many problems that have recently become particularly acute. Taking into account the importance of the proper functioning of the housing and communal services, its impact on the social sector of Ukraine, the industry needs radical reforming.

Lack of investment in the sector, inadequate financing of its development has resulted in significant deterioration of technical condition of fixed assets, increase of critical conditions of objects in housing and communal services, increase of unit costs and nonproductive consumption of material and energy resources, that negatively affects the level and quality of communal services. Thus, the availability of an appropriate methodological instrument for estimation of innovation projects in housing and communal services is necessary.

**Analysis of recent research and publications.** In theory and practice of innovation management the most commonly are used the methods for estimation of the acceptability of innovations which can be divided into three groups. The first group includes the methods based on application of the concept of discounting of costs and revenues (dynamic methods) [1; 2]; to the second group belong methods that do not involve usage of the concept of discounting (static methods) [3], to the third group – methods that take into account the probabilistic characteristics of innovation (probability methods) [4].

O.V. Amelnytska [5], Ye.N. Vodovozov [6], V.I. Titjaiev [7] and other scientists have devoted their works to evaluation of innovation and investment projects in the sphere of housing and communal services. In their opinion for more accurate assessment of the social-economic efficiency of design decisions in housing and communal services it is appropriate to use methods of discounting, namely: to perform calculations using the criterion of net present value (NPV). Additionally, Ye.N. Vodovozov [6] proposes to consider the probabilistic

distribution of NPV at calculating of expected cost of the project. However, the mentioned above publications do not specify the branch peculiarities of estimating innovation projects in the field of housing and communal services.

**Unsolved constituents of the general problem.** The conducted analysis of the recent research and publications on evaluation of innovation projects revealed lack of relevant methodological recommendations permitting to take into consideration peculiarities of formation and determination of social-economic effect in the field of housing and communal services from introduction of innovations, possible risks and uncertainty of innovation processes.

**The purpose of the article** is improvement of the theoretical foundations and development of methodical recommendations as to evaluation of the effectiveness of innovative projects in the field of housing and communal services.

**Statement of the main material of the research.** Evaluation of innovative projects should be based on the following principles:

1. Consideration and analysis of the innovative project throughout its life cycle (accounting period) – since the moment of emergence of new ideas until the moment of commercialization and practical application.

2. Modeling flows of products, resources, money costs at all stages (phases) of the innovative project implementation.

3. Harmonizing conditions of comparing different variants comparing of the innovation project.

4. The principle of taking into account the time factor in estimating of the parameters of the innovation project and its external economic environment.

5. The effectiveness of the innovative project is evaluated by comparing of the cash flow formed during the exploitation of the project and the initial investments in it. The project is considered to be profitable if the initial return of all deposits at an acceptable rate of return for the project participants is ensured.

6. Mandatory adjustment of both initial investments and the amount of cash flow to the present value.

7. The process of discounting of all cash expenditures and receipts is carried out by the discount rates, which are selected depending on the innovation project characteristics.

8. The principle of alternatives which takes into consideration various possibilities of resources usage, ways to achieve the goal of innovation project, choosing the best options of the project decisions.

9. Evaluation of the innovation project effectiveness should be implemented by comparing of the situation “without the project” and “with the project”, rather than situations “before the project” and “after the project”.

10. Taking into account of all the most significant consequences of the innovation project: economic, scientific, technical, social, environmental.

11. The multi-stage evaluation at the stages of substantiation of the volume of innovation costs, feasibility studies, choice of funding schemes, monitoring, etc. At each stage the cost of the project is confirmed.

12. Taking into account the impact of inflation, uncertainty and risk, as well as possibility of using for its implementation of different currencies.

To the branch features distinguishing the introduction of innovation projects in the field of housing and communal services from those in other industries one can be attribute:

1) most infrastructure projects are characterized by high capital intensity and

comparatively low current expenses. The payback period of the projects is generally longer than the projects in the sector of material production;

2) with the projects in the field of housing and communal services one can't make long-term agreements on supplying with the project product. It makes such projects highly risky and makes forecasting of the cash flow difficult;

3) implementation of the infrastructure projects is based primarily on service contracts (with construction companies), more rarely on contracts for supplying with machinery and equipment;

4) using by enterprises of the housing and communal services of different types of capital assets, namely: fixed assets, which form the engineering infrastructure of the city (water, heat, electricity and gas supply), and funds which provide the servicing of the infrastructure objects.

Evaluation of effectiveness of innovation projects in the housing and communal services is based on methods of the Ministry of Economy and European Integration of Ukraine and the Ministry of Finance of Ukraine (*Order from September 25 2001, № 218/446*) [1] by supplementing and specifying of its generalized aspects. According to this methodology, the basic indicators recognized in the international practice, which accumulate benefits from the introduction of scientific and technological development and innovation, and are used for evaluation of the economic efficiency of projects are:

- discounted net revenue (net present value);
- profitability index;
- payback period of the project;
- internal rate of return.

Determining of the net present value at a constant discount rate and consistent investment of funds for  $m$  inflationary years is implemented the next way [8]:

$$NPV = \sum_{k=1}^n \frac{P_k}{(1+i)^k} - \sum_{k=1}^m \frac{IC_k}{(1+i)^k}, \quad (1)$$

where  $P_k$  – annual cash flows for  $k$  year, UAH;  $IC$  – initial investment, UAH;  $i$  – discount rate;  $k$  – relevant year life cycle ( $k = 1, n$ );  $n$  – innovation project duration, years;  $m$  – number of years of consecutive investment of financial resources.

The main types of effects on introducing innovations in housing and communal services making up the annual cash flows include:

– economic – consists in obtaining of economic results from introducing innovations, reducing costs and resource consumption;

– science and technology – consists in increase of the scientific and technical level of housing and communal services, namely: improvement of the parameters of machinery and technologies, components of the engineering infrastructure of the city, raising moral and technical qualities of buildings and extending of their service life, introduction of new technological means of production, materials and products. Scientific and technical effect could be valued on the following directions: saving power consumption, material components, reducing losses resulted from downtime caused by malfunction of the machinery, expenditures on its repairing, etc.;

– social – reflects changes in conditions of human activity at work and in society. The social efficiency of housing and communal services must be estimated on the basis of parameters that characterize the degree of public satisfaction with the provision of appropriate

services (number of unfulfilled requests in time, increase or decrease in complaints, etc.), as well as by determining of the degree of its employees satisfaction (conditions and salary, premium systems, training and retraining, etc.);

– ecological – consists in positive environmental changes caused by the use of technological innovations to reduce environmental pollution (reducing of greenhouse gas emissions in the atmosphere, pollution of wastewater in general water removal, bringing to the requirements of environmental safety the condition of dumps for disposing solid waste, etc.) and aimed at the rational use of natural resources.

Thus, the annual cash flow for each year of the innovation project life cycle will equal to the sum of the above four types of effects.

For taking into account for the uncertainties and risks that affect the successful functioning of the innovative project, the following methods can be used:

- correction of the project parameters;
- formalized description of the risk;
- formalized description of uncertainty.

Correction of the project parameters is performed on the basis of specification of the initial technical and economic task, including the terms of the project implementation caused by the delay in funding of its stages, failure to comply with the technology at implementation of the innovations, violation of the terms and volumes of raw materials supplying and other difficulties. In all cases of such changes, the expenditures caused by them are added to the cost of the project.

Formalized mathematical description with known probabilities for different conditions of the project implementation is as follows [1]:

$$E_p = \sum_{j=1}^L E_j \cdot \alpha_j, \quad (2)$$

where  $E_p$  – comprehensive economic effect with allowance for the risk of the innovation project functioning, UAH;  $E_j$  – discounted comprehensive economic effect under the  $j$ -th condition of the innovation project implementation, UAH;  $\alpha_j$  – probability of the  $j$ -th condition of the innovation project implementation caused by external factors, the unit fraction;  $L$  – number of conditions of the project implementation.

In the case of normal distribution of probabilities of the innovative project implementation, the expected comprehensive economic effect is determined as follows [1]:

$$E_p = \sum_{j=1}^L E_j \cdot \alpha_j - H_p \cdot D, \quad (3)$$

where  $H_p$  – standard taking into account the effect dispersion, the unit fraction;  $D$  – standard deviation of the random variable dispersion, units.

The standard making allowance for the effect dispersion is determined in dependence on the industry specifics of the enterprise in the range from 0 to 1 [1]. Determination of the standard making allowance for the effect dispersion for innovation projects in housing and communal services was performed by Delphi method. With tolerated error of the expertise results at the level of 5% the group of 32 experts, including representatives of Kharkiv utility plants and leading teachers of O.M. Beketov National University of Urban Economy in

Kharkiv and Kharkiv National University of Civil Engineering and Architecture, was formed. Each of the experts met all requirements applied to the respondents, namely: professional competence, objectivity, high level of creativity, general knowledge, low level of conformism. The average level of ratio of the expert group competence was 0,83. According to the results of the expert survey there was determined a standard making allowance for the effect dispersion for innovation projects in housing and communal services at the level of 0,65.

Formalized mathematical description of the economic effect with the allowance for uncertainty is as follows [1]:

$$E_{HB} = H_H \cdot E_{max} + (1 - H_H) \cdot E_{min}, \quad (4)$$

where  $E_{HB}$  – comprehensive economic effect with the allowance for uncertainty of the innovation project functioning, UAH;  $E_{max}$ ,  $E_{min}$  – largest and smallest values of the comprehensive economic effect under the terms of its implementation, UAH;  $H_H$  – standard of the effect uncertainty, the unit fraction.

The standard making allowance for the effect of uncertainty is determined by the industry specifics of the enterprise ranging from 0 to 0,5 [1]. Considering the peculiarities of innovation in housing and communal services on the basis of the results of the expert survey the standard making allowance for the effect dispersion at the level of 0,35 was determined.

The expected comprehensive economic effect ( $E_{CE}$ ) taking into account the probability of successful functioning in the implementation of innovative project is proposed to be defined as the minimum value of the comprehensive economic effect considering risk factors and uncertainties:

$$E_{CE} = \min\{E_P; E_{HB}\} \quad (5)$$

Thus, the calculation of the net present value of sequential investment is proposed to be determined by the following formula:

$$NPV' = E_{CE} - \sum_{k=1}^m \frac{IC_k}{(1+i)^k}. \quad (6)$$

In the case when the investments are made within one year, their value is not discounted.

The accuracy and reliability of calculations of the discounted comprehensive economic effect, net present value, profitability index, payback period of the project implementation depend on the discount rate substantiation. In the methodology of determining of the effectiveness of spending on scientific research and developments and their introducing to the manufacturing [1] there are no instructions regarding establishment of the discount rate. In the works on economy, the scientists [8; 9] distinguish the following types of discount rates: commercial, social, budgetary, project participant and suggest various methods of their determining. Commercial discount rate is used at evaluating of the commercial efficiency of the project. It is determined taking into account alternative (that is related to other projects) efficient use of capital [8; 9].

Social (public) discount rate is used in calculations of social efficiency indicators and describes the minimum requirements of the society to social efficiency of the projects [8; 9].

Budgetary discount rate is used in calculations of budget efficiency and reflects the

opportunity cost of the budget funds. It is set by national and regional authorities. It is considered to be a national parameter and should be set centrally by the state authorities taking into account forecasts of economic and social development [8; 9].

The discount rate of the project participant reflects the effectiveness of involvement in the project of organizations or other stakeholders. It is chosen by the participants. In the absence of clear advantages the commercial discount rate can be used [8; 9].

Taking into account the direction of innovation projects in the field of housing services for improvement of people welfare, it is advisable when determining the discount rate to calculate the average expected inflation during the project and its social significance.

In the first case, the discount rate can be determined by setting of the nominal risk-free rate, which represents the level of average expected return on government bonds at the term of their redemption in the last year of the innovation project life cycle. Determination of the rate on government bonds is independent of analytical and assessment methods, which increases the reliability of the calculations.

The social discount rate can be determined by the following approaches: social rate of time preference (*SRTP*), social opportunity cost of capital (*SOC*). Having made the analysis of these methods, it is proposed to determine the social rate by the method of *SRTP*. The social discount rate according to this method is considered as the rate at which the society is willing to give up the current consumption for the future consumption. In other words, the rate reflects preference by the society of the current consumption compared with the future one.

Determining of the social discount rate ( $i_s$ ) by the method *SRTP* is based on Ramsey formula [10]:

$$i_s = \delta + L + \mu \cdot g, \quad (7)$$

where  $\delta$  – “pure” rate of time preferences, %;  $L$  – level of risk for life, %;  $\mu$  – flexibility of marginal utility of consumption, the unit fraction;  $g$  – growth rate of consumption per capital, %.

Thus, the discount rate used for evaluation of innovation projects in the housing and community sector is determined by adding of the nominal risk-free rate and the social discount rate.

**Conclusions.** The proposed complex parameter for evaluating the innovative project that brings together scientific and technical, economic, social and environmental effects taking into account the time factor, risk and uncertainty of the project implementation. This complex parameter allows clearly and unambiguously evaluating alternative innovation projects in the field of housing and communal services considering all aspects of implementation and realization and choosing the best of them. It will significantly increase the management efficiency of innovation projects in dynamic conditions of the market environment.

**Prospects for further research** in this direction are to analyze the relationship between the components of annual receipts and justification of rates and corresponding volumes of state compensation at determining the economic effect from innovation implementation in the field of housing and communal services.

1. Методика визначення ефективності витрат на наукові дослідження і розробки та їх впровадження у виробництво. Наказ Міністерства економіки та з питань європейської інтеграції України, Міністерства фінансів України. № 218/446 від 25 вересня 2001 року [Електронний ресурс]. – Режим доступу: [http://budstandart.com/read/document\\_body/id/3091320](http://budstandart.com/read/document_body/id/3091320).

### Розділ 3 Інноваційний менеджмент

2. Краснокутська Н.В. Інноваційний менеджмент : навч.-метод. посіб. для самост. вивч. дисципліни / Н.В. Краснокутська, С.В. Гарбуз. – К. : КНЕУ, 2003. – 504 с.
3. Майорова Т.В. Інвестиційна діяльність : навчальний посібник / Т.В. Майорова. – К. : ЦУЛ, 2003. – 376 с.
4. Афанасьев Н.В. Управление развитием предприятия : монография / Н.В. Афанасьев, В.Д. Рогожин, В.И. Рудыка. – Х. : Издательский дом “ИНЖЭК”, 2003. – 235 с.
5. Амелинская О.В. Методи оцінки соціально-економічної ефективності проектів в енергетиці / О.В. Амелинская // Наукові праці Донецького національного технічного університету. Сер.: Економічна. – 2011. – №10(180). – С. 7-11.
6. Водовозов Є.Н. Реструктуризація підприємств сфери ЖКГ на основі проектного підходу / Є.Н. Водовозов // Вісник ЖДТУ. Сер.: Економічні науки. – 2012. – Випуск 3(61). – С. 215-218.
7. Тітяєв В.І. Механізм активізації інвестиційної привабливості енергозбереження у житлово-комунальній сфері / В.І. Тітяєв // Комунальне господарство міст. Сер.: Економічні науки. – Випуск 106. – К. : Техніка, 2012. – С. 111-123.
8. Колтынюк Б.А. Инвестиции : учебник. – СПб. : Изд-во Михайлова В.А., 2003. – 848 с.
9. Непомнящий Е.Г. Экономическая оценка инвестиций : учебное пособие / Е.Г. Непомнящий. – Таганрог : Изд-во ТРТУ, 2005. – 292 с.
10. Емельянов А.М. Использование подхода ставки межвременных предпочтений для оценки социальной ставки дисконтирования / А.М. Емельянов, М.А. Шелунцова // Корпоративные финансы. – №1. – 2007. – С. 9-21.

1. Metodyka vyznachennia efektyvnosti vytrat na naukovi doslidzhennia i rozrobky ta yikh vprovadzhenia u vyrobnytstvo [Methodology of determining the effectiveness of spending on scientific research and developments and their introducing to the manufacturing]. *Nakaz Ministerstva ekonomiky ta z pytan yevropeiskoi intehratsii Ukrainy, Ministerstva finansiv Ukrainy vid 25 veresnia 2001 roku №218/446* [Order of the Ministry of Economy and European Integration of Ukraine, the Ministry of Finance of Ukraine from September 25 2001, №218/446]. Retrieved from [ftp://budstandart.com/read/document\\_body/id/3091320](ftp://budstandart.com/read/document_body/id/3091320) [in Ukrainian].

2. Krasnokutska, N.V., & Harbuz, S.V (2003). Innovatsiinyi menedzhment [*Innovative management*]. Kyiv: KNEU [in Ukrainian].
3. Maiorova, T.V. (2003). Investytsiina diialnist [*Investing activities*]. Kyiv: TsUL [in Ukrainian].
4. Afanasev, N.V., Rogozhin, V.D., & Rudyka, V.I. (2003). Upravleniie razvitiem predpriiatiia [*Management of enterprise development*]. Kharkiv: Izdatelskiy dom “INZhEK” [in Ukrainian].
5. Amelnytska, O.V. (2011). Metody otsinky sotsialno-ekonomichnoi efektyvnosti proektiv v enerhetytsi [Methods for assessing the efficiency socio-economic projects in energy]. *Naukovi pratsi Donetskoho natsionalnoho tekhnichnoho universytetu. Ser.: Ekonomichna – Scientific papers of Donetsk National Technical University. Series: Economic, 10(180), 7-11* [in Ukrainian].
6. Vodovozov, Ye.N. (2012). Restrukuryzatsiia pidpriemstv sfery ZhKH na osnovi proektnoho pidkhodu [Restructuring sphere of housing on the basis of project approach]. *Visnyk ZhDTU. Ser.: Ekonomichni nauky – Bulletin ZSTU. Series: Economic sciences, 3(61), 215-218* [in Ukrainian].
7. Titiaiev, V.I. (2012). Mekhanizm aktyvizatsii investytsiinoi pryvablyvosti enerhozberezhennia u zhytlovo-komunalnii sferi [The mechanism of activation of investment attractiveness of energy saving in housing and communal services]. *Komunalne hospodarstvo mist. Ser.: Ekonomichni nauky – Municipal economy of cities. Series: Economic sciences, 106, 111-123* [in Ukrainian].
8. Koltyniuk, B.A. (2003). Investitsii [*Investment*]. Saint-Petersburg: Izdatelstvo Mihailova V.A. [in Russian].
9. Nepomniaschii, E.G. (2005). *Ekonomicheskaiia otsenka investitsii* [*Economic evaluation of investment*]. Taganrog: Izdatelstvo TRTU [in Russian].
10. Emelianov, A.M., & Sheluntsova, M.A. (2007). Ispolzovaniie podhoda stavki mezhvremennykh predpochtenii dlia otsenki sotsialnoi stavki diskontirovaniia [Using time preference rates approach for assessing the social discount rate]. *Korporativnyie finansy – Corporate finances, 1, 9-21* [in Russian].

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**Оцінка ефективності інноваційних проектів у житлово-комунальному господарстві**

*Визначені галузеві особливості, що вирізняють упровадження інноваційних проектів у житлово-комунальному господарстві. Досліджені основні види ефектів від упровадження нововведень у житлово-комунальному господарстві, що входять до складу річних грошових надходжень. Запропонований комплексний показник оцінки ефективності інноваційного проекту з урахуванням ризику та невизначеності, на основі якого визначається чиста зведена вартість. Здійснено обґрунтування ставки дисконту для оцінки ефективності інноваційних проектів у сфері житлово-комунальних послуг, що визначається шляхом додавання номінальної безризикової ставки та соціальної ставки.*

Ключові слова: інноваційні проекти, оцінка, дисконтування, ефективність, ризик, невизначеність, житлово-комунальне господарство.

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**Оценка эффективности инновационных проектов в жилищно-коммунальном хозяйстве**

*Определены отраслевые особенности, отличающие внедрение инновационных проектов в жилищно-коммунальном хозяйстве. Исследованы основные виды эффектов от внедрения нововведений в жилищно-коммунальном хозяйстве, составляющие годовые денежные поступления. Предложен комплексный показатель оценки эффективности инновационного проекта с учетом риска и неопределенности, на основе которого определяется чистая приведенная стоимость. Осуществлено обоснование ставки дисконта для оценки эффективности инновационных проектов в сфере жилищно-коммунальных услуг, определяемой путем суммирования номинальной безрисковой ставки и социальной ставки.*

Ключевые слова: инновационные проекты, оценка, дисконтирование, эффективность, риск, неопределенность, жилищно-коммунальное хозяйство.

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