MYKOLO ROMERIO UNIVERSITETAS
Uniwersytet Wrocławski

ISSN 1822-8038 (online)
INTELEKTINĖ EKONOMIKA
INTELLECTUAL ECONOMICS
2021, No. 15 (1), p. 88–103.

MODELING THE OPTIONS FOR ACCOUNTING FOR THE INNOVATION COSTS OF INDUSTRIAL ENTERPRISES IN UKRAINE

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DOI: 10.13165/IE-21-15-1-06

Abstract. *In this article, the methodology and organization of accounting for innovation costs are considered, and directions for their improvement are suggested. This is accompanied by an analysis of the modern economic literature on the reflection of the costs of innovation in accounts, which allows for the identification of several options.*

The purpose of this study is to identify the main problems of accounting for the cost of innovation and to develop recommendations for their solution for effective enterprise management. The object of the study is the process of formation of costs for innovations to be reflected in the accounting system.

The complexity of reflecting the cost of innovation in accounts necessitates the creation of appropriate approaches and methodologies. It was found that businesses account for the costs of innovation on different balance sheets, which indicates the absence of a rational method of accounting. To meet the information needs of the data management system, a tailored accounting approach is proposed, which combines the process of financing and using the costs of innovation. It was determined that, when modelling this system, it is important to take into account the factors that influence the formation of the methodological

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principles of accounting for innovation costs. It is established that the accounting method may be influenced by the following factors: forms and sources of financing the costs of innovation (factor F); the procedure for writing off the cost of capital investment (factor K); and the procedure for writing off current operating costs (factor O). It is determined that the use of the proposed approach will improve the quality of accounting and information support of the enterprise management system.

Keywords: *accounting, innovation, costs of innovation, capital investment*

JEL*: M41, O32*

1. Introduction

In order to set Ukraine on a trajectory towards sustainable development with increasing welfare and quality of life for all segments of the population, the Ministry of Economy of Ukraine – with the participation of central executive bodies and the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine – has prepared a strategy for development: "Ukraine 2020: A Strategy for National Modernization". The main problem to be solved by this strategy is the lack of preparation present in the Ukrainian economy in responding to global challenges associated with global crisis processes. One of these processes is the transition to fundamentally new resource-saving technologies, including the use of production waste, the development and implementation of new products (goods, works, services), the overhaul and modernization of fixed assets, and the introduction of advanced integrated mechanization and automation. At the same time, there is a need to form a system of accounting for the costs of innovation and the operational control of these costs, which would provide information to each company in particular and the state innovation policy in general in conditions of uncertainty and in the globalization of the economy.

Recently, developments aimed at improving the organizational and methodological aspects of accounting for innovation costs are becoming increasingly interesting. Therefore, in the process of managing innovation, one of the main tasks is to build an effective organizational method of accounting for innovation costs. Unlike other aspects of accounting, which are the subject of constant research on improvement, the methodology and organization of accounting for innovation processes are poorly developed.

The organization of accounting involves the use of a unified approach to the reflection of business transactions in accounting. However, the current state of accounting is characterized by a lack of clear recommendations for reflecting the costs of innovation processes, which leads to the scattering of costs in different accounts and complicates the determination of the cost of each stage of work and the formation of the total cost.

Analysing the current state of accounting for the costs of innovation in the enterprises of Ukraine under study allows the authors to comment on a certain episodicity, which is due to the lack of appropriate legal regulation. Some aspects of accounting for the cost

of innovation, given the current development of the economy – especially in terms of innovation – require additional research to improve them. In particular, this concerns the clarification of the conceptual apparatus, the classification of costs for innovations, and methods of organization for their accounting and internal control.

The generalization of theoretical and practical experience at the domestic enterprises under study on the accounting of expenses for innovation provides the opportunity to establish that the available technique is carried out in an unsystematic order and does not correspond to the modern requirements of these businesses. Current accounting models do not correspond to adequate types of innovation processes, and do not provide sufficiently reliable data for economic analysis and regulation in the field of innovation. The debatable nature of these issues, the need to address them, and the insufficient level of regulatory and methodological support for the cost of innovation led to the focus of this paper, and determined both its relevance and main areas of research.

2. Literature review: theoretical and methodological concepts

A significant contribution to the study of the theory and formation of the concept of accounting for innovation was made by domestic economists and practitioners such as Borodkin (1999), Kantaeva (2010), Krupka (2006), Lehenchuk et al. (2020), and Ozeran (2013). Although there are significant achievements in the works of these researchers, the issues of structuring the accounting of innovation, which is relevant in the transition to intensive and dynamic development, remain unresolved.

The issue of financing innovation in the scientific literature is considered in terms of sources of funding for enterprises (Davydenko, Buriak, and Titenko 2019; Ilchenko 2009; Kucherenko, Ratushna, and Melnyk 2019; Lehenchuk et al. 2020). However, the order of accounting for such financial income is given little attention. Problematic issues of accounting and analytical support for innovation management were cited in the works of Basova (2017); Bondar, Iershova, and Chaika (2019); Chursin and Strenalyuk (2018); Plaskova et al. (2020); Resler (2017); and Smokvina and Popovych (2020).

In solving the main tasks of accounting for the cost of innovation, scientists focus on the following vectors of research: 1) the variety of ways to reflect the cost of innovation in the accounting system (Koval 2019; Plaskova et al. 2020); 2) gaps in the development of criteria for the recognition of objects of innovative origin as part of assets, which prevents the adequate disclosure of information about them in the reporting (Ax and Greveb 2017; Druzhynina et al. 2020); 3) the lack of a single method of accounting for the costs of innovation that is able to ensure their adequate reflection in the information system of the enterprise (Bondar, Iershova, and Chaika 2019); and 4) the absence or inadequacy of accounting records in accounting for the cost of innovation (Chursin and Strenalyuk 2018).

The level of theoretical research of accounting problems lags far behind the needs of the practice of business entities, and includes a lack of methodological support for the accounting of objects related to innovation, which requires, in turn, their identification and appropriate classification. With this in mind, the existing accounting system should

disclose information about the impact of economic activity on the objects of the innovation process to meet the information needs of internal and external users. This function can be implemented through the reflection in the accounting of objects related to innovation. Therefore, we consider the identification of related objects to be an important task in accounting for the costs of innovation.

Thus, Sidorenko (2011) divides the objects to be managed in the accounting of innovations into those that provide innovative activities (the resources and property of the enterprise involved in creating innovation) and those that constitute innovative activities (the development, testing, and implementation of innovations). Yezhakova (2011) refers to the objects of innovation as innovations which, from the moment of their acceptance for distribution, receive a new quality – i.e., become innovations (innovative products). Kantaeva (2010) distinguishes two groups of objects of accounting for innovation: the assessed and legalized intangible assets of the enterprise (in the understanding of the author's intellectual capital); and the cost of research and development. According to Zhuk (2011), the main objects of accounting for innovation are: estimates for its creation; costs of investment in new technologies and research activities; innovative products; and the processes of the commercial use of products (or their use for further innovation).

Krupka (2006) takes a slightly different position, arguing that the methodology and organization of accounting depend on the type of innovative product. They can have a material content (machines, equipment, experimental samples of products), be expressed in the intangible form (new technologies, projects and design solutions for new products, software materials), or be presented in the form of intellectual property (industrial property rights, copyright and other rights).

Stolyarchuk (2018) systematized the composition of objects of accounting and the internal audit of innovation and identified several groups: classic objects of accounting, objects of internal (management) accounting, and non-systemic objects of accounting.

The economically justified classification of costs is the basis of accounting and control of the economic activity of the enterprise, and is necessary for a correct understanding of the purpose of costs and their economic role in the management process. Classification is a necessary prerequisite for the rational organization of the analytical accounting of innovation costs and their management in making managerial decisions.

A critical analysis of the existing features of the classification of costs for innovation has revealed several approaches. Kuzminsky and Voronova (2006) propose grouping the costs of the research and development of innovative products according to stages, by standard items of cost of research and development, and by costs of preparation for production in the industry. A similar point of view is held by Saenko (1991), who divides the costs of innovation into three stages: 1) costs for research (science) related to theoretical research, which is further materialized in technical solutions; 2) costs for the creation and development of new equipment, which, in turn, is divided into costs for the development of technical and technological documentation and costs associated with the implementation of production works; and 3) costs for the introduction of new equipment (costs at the stage of preparation for implementation, costs during implementation, costs during operation).

Efremov (2006) notes that the costs of innovation include 3 groups of costs: 1) marketing costs – identification of market opportunities (for new products and services), testing of new products (services), preparation of sales channels, advertising activity, training (education) of sales staff; 2) costs for technological preparation of innovations – implementation of R&D (own forces and/or with the involvement of third-party organizations), purchase of technical documentation (know-how) or licenses for the use of research and development results, costs of licensing (certification) of new products (services), purchase of new equipment, materials, components, and semi-finished products, retraining (or training) of production staff; and 3) production costs of development – use of new equipment, materials, components, and semi-finished products, release of new (modernized) products.

To organize the accounting of costs for innovation, Avilkina (2009) offers the following grouping: 1) the cost of marketing research; 2) research and development costs; 3) costs of innovative design; 4) costs of innovative production; 5) the cost of commercializing the product; and 6) other costs.

Pylypenko et al. (2011) propose to divide the costs of innovation into three groups: 1) costs associated with forecasting and planning the implementation of innovations; 2) fixing the actual costs incurred for the implementation of the innovation project and its support; and 3) costs for the accounting, analysis, and evaluation of results from the implementation of innovations. In this case, the most important and significant group of costs, in view of the authors, is the first, because the quality of implementation of the preparatory stage directly affects the correct choice of innovative development strategy and becomes the key to achieving goals.

The study of the above approaches to accounting for the cost of innovation has identified a key area that is supported by most authors: Abubakirova (2012); Borodkin (1999); Valuev and Kantaeva (2009); Hrytsay (2010); Hyk (2021); Ilchenko (2009); Kantaeva (2010); Korzhavina (2009); Ozeran (2013); and Siryk et al. (2021) all consider a reflection of the cost of innovation as a separate accounting object. An assessment of the nature and content of the considered approaches shows that the vast majority of them are reflected in the system of accounts as independent objects of accounting as part of costs and capital investments.

Despite the significant achievements of Ukrainian and international scholars, it should be noted that – given the radical change in the vector of Ukraine's economy with regards to the European Union, the country's existing military and political instability, rapid global growth and quality of investment in innovation, and the digitalization and globalization of public relations – accounting and analytical support for the management of innovation activities of enterprises of the national economy has been partially or completely ignored, and most of the existing approaches should be considered obsolete. There is a need, then, for a comprehensive study of the methodological development and the improvement of the current methodology and organization of accounting for innovation costs in the current conditions of economic development in Ukraine. This need determined the direction of our study:

RQ: To identify problematic issues of accounting for innovation costs and to develop recommendations for their solution for the effective management of the innovation activities of the enterprise.

3. Research Methodology

An important indicator of innovation activity in economic entities is the amount of costs for innovation, which can be carried out in the direction of research and development, the acquisition of new technologies, machinery and equipment, etc. Indicators of the dynamics of spending on innovation for 2010–2018 and their structure in terms of key components are summarized in Table 1.

Table 1. *Indicators of dynamics and the structure of innovation expenditures in Ukraine for 2010–2018*

Year	The cost of innovation	Including by areas					
		Research and development	Including		Acquisition of other external knowledge	Purchase of machinery equipment and software	Other expenses
			Internal GDR	External GDR			
	UAH million						
2010	8045.5	996.4	818.5	177.9	141.6	5051.7	1855.8
2011	14333.9	1079.9	833.3	246.6	324.7	10489.1	2440.2
2012	11480.6	1196.3	965.2	231.1	47.0	8051.8	2185.5
2013	9562.6	1638.5	1312.1	326.4	87.0	5546.3	2290.9
2014	7695.9	1754.6	1221.5	533.1	47.2	5115.3	778.8
2015	13813.7	2039.5	1834.1	205.4	84.9	11141.3	548.0
2016	23229.5	2457.8	2063.8	394.0	64.2	19829.0	878.4
2017	9117.5	2169.8	1941.3	228.5	21.8	5898.8	1027.1
2018	12180.1	3208.8	2706.2	502.6	46.1	8291.3	633.9

Source: *Compiled on the basis of data from the State Statistics Service of Ukraine (http://www.ukrstat.gov.ua/druk/publicat/Arhiv_u/16/Arch_nay_zb.htm)*

Analysis of the level and dynamics of the indicators listed in Table 1 shows that the total expenditure on innovation between the years 2010 and 2016 showed a galloping trend, but suffered a decline 2017 which may be due to the decline in innovation activity of enterprises and the effects of the economic crisis. Analyzing the dynamics of the main components of innovation costs, it should be noted that the reduction in the overall level of innovation costs in recent years is primarily due to lower costs for the purchase of machinery and equipment associated with the implementation of innovations.

These statistics correlate with the information of the provisions (standards) of accounting, which provide some ways to keep track of innovation costs. In addition, this study will use other accounting methods proposed by the authors.

This study uses a modelling method to develop a model of accounting for innovation costs, utilizing tabular and graphical methods to develop a conceptual framework for accounting for the targeted funding of innovation projects. Methods of comparison and grouping, tabular representation, and graphical representation were used in the analytical research. The information base of the study was formed from the scientific works and publications of domestic and international scientists on these issues, current domestic legislation on accounting for innovation, professional scientific periodicals, and statistical information.

The generalization of theoretical and practical experience in accounting for the cost of innovation in domestic enterprises made it possible to establish that their existing methodology is carried out chaotically and does not meet modern business requirements. It was found that businesses account for the cost of innovation on different balance sheets, which indicates the imperfection of the current method of accounting. In practice, the so-called impersonal (boiler) method is used to reflect the costs of innovation in accounts, the essence of which is to keep records of costs in general, and this approach therefore does not provide for constant operational control. With this in mind, we have proposed our own approach, which is based on the use of the modelling method. When creating a model, it is necessary to take into account the factors that influence the formation of the methodological principles of accounting for innovation costs.

In the opinion of the authors, the accounting method may be influenced by the following factors:

1) forms and sources of financing the costs of innovation (factor F);
2) the procedure for writing off capital investment costs (factor K);
3) the procedure for writing off the costs of current operating expenses (factor O).

Accounting for innovation costs largely depends on the financing process, which may include several areas of formation through: the company's own funds (F_1); long-term or short-term bank loans (F_2); funds allocated from local or state budgets (F_3); or other ways reserved for innovation costs (F_4). A reflection of sources of funding for innovation costs is given in Table 2.

Table 2. *Sources of funding for innovation costs in the accounting system*

Form of financing	Source of funding	Class of accounting accounts
Own funds of the enterprise (F_1)	Retained earnings, issue income, revaluation of assets	Class 4 accounts "Equity and collateral"
Raised funds (F_2)	Long- and short-term bank loans, financial leasing, long-term promissory notes	Class 5 Accounts "Long-Term Liabilities" and 6 "Current Liabilities"
Funds allocated from local or state budgets (F_3)	Budget allocations, targeted contributions, grants	Class 4 account "Equity and collateral" (account "Assigned financing and assigned revenue")
Other ways of financing (F_4)	Reserve to cover costs	Class 4 account "Equity and collateral" (account "Securing other expenses and payments")

Source: *Developed by the authors*

Each of the above areas of financing significantly affect the system of formation of the financial results of the enterprise. For example, in the case of financing with bank loans, there is a need to take into account the received credit resources and interest on the loan. Allocation of funds from budget revenues necessitates the separate accounting of targeted funding.

In the case of the acquisition (creation) of non-current assets, the costs incurred are included in the capital investment, and their amount increases the initial cost of non-current assets. The results of the study of the practice of accounting for innovation costs under this approach allowed us to identify two options – involving the cost of acquisition (creation) of new and/or significantly improved fixed assets (K_1) or intangible assets (K_2).

The reflection in the accounting of the write-off of costs for innovations associated with the creation of new products as they arise does not involve direct capitalization but is reflected in the current costs in full. To accumulate information on the costs of the preparation and development of new products, Borodkin (1999) proposed the introduction of a separate balance sheet account – "Expenses for the preparation and development of new products" (O_1) – and to account for them as part of future expenses. The debit of this account from the credit of various accounts during the period of development of products should reflect: consumed materials, accrued wages, depreciation, services of third parties, and other costs.

In enterprises with multi-item production, where the period of development is short and the costs are relatively small, in the case of individual production, costs can be planned and accounted for as part of overhead costs (O_2), as stipulated in paragraph 15.5 – "Costs to improve technology and organization production" AR(S) 16 "Costs" (1999). However, it should be remembered that the cost of improving technology does not belong to the type of preparation for the production of innovative products in the event that this technology involves the introduction of machines and mechanisms of traditional models and types or their replacement with the latest modifications of the same models. Thus, if the company does not implement significantly improved production methods, then there can be no question of preparing the production of innovative products.

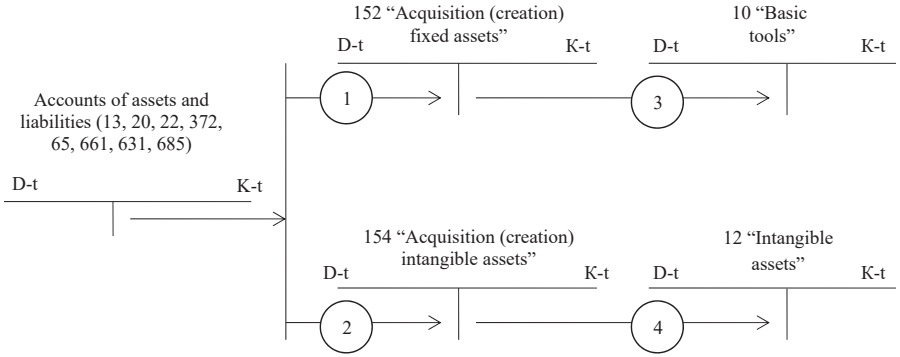
Costs of innovation collected in expenditure accounts ("Research and development costs") (O_3) refer to the cost of production or financial results in one reporting period.

4. Results and Discussion

The analysis of the current practice of domestic industrial enterprises to reflect the costs of innovation in accounts allowed for the identification of several options. As a result of the consistent combination of factors and their features, it is possible to obtain all possible options for accounting for the cost of innovation. In the field of logical possibilities, 20 models were thus identified (Fig. 2). We describe the models most commonly used in enterprises.

$M_1 = \mathbf{F_1K_1}$ and $\mathbf{M_5 = F_1K_2}$ are models of innovative measures of a capital character which are carried out at the expense of the enterprise.

In the case of acquisition (creation) of non-current assets, the costs incurred are included in the capital investment and their amount increases the initial cost of non-current assets (Fig. 1).



Content of business operations: 1) the initial cost of the acquired (created) innovative object of fixed assets is reflected; 2) the initial cost of the acquired (created) innovative object of intangible assets is reflected; 3) the acquired (created) innovative object of fixed assets is put into operation; 4) the acquired (created) innovative object of intangible assets is put into operation.

Figure 1. *The scheme of accounting for the cost of innovation for the acquisition (creation) of new types of non-current assets*

Source: *Generalized by the authors*

This technique is used in the case of an innovative direction to improve the material and technical base of the enterprise and increase economic benefits in the future by: increasing production capacity; increasing productivity; improving product quality; reducing operating costs as a result of innovative measures; and creating (or acquiring) intangible assets.

$M_2 = \mathbf{F_2K_1}$, $\mathbf{M_6 = F_2K_2}$ and $\mathbf{M_{10} = F_2O_1}$ are models of innovative measures of a capital and non-capital nature, which are carried out at the expense of borrowed funds (mainly bank loans). The fee for their use is fixed (in the form of interest) and additionally provides for the return of invested funds to the creditor.

$\mathbf{M_9 = F_1O_1}$ is a model of innovative measures which is carried out at the expense of the company's own funds concerning current costs ("Costs for the preparation and development of new products"). These include the cost of developing design, and estimate documentation for the development of new enterprises, industries, shops and units, the maintenance of personnel engaged in commissioning, and the cost of commissioning the comprehensive testing of equipment.

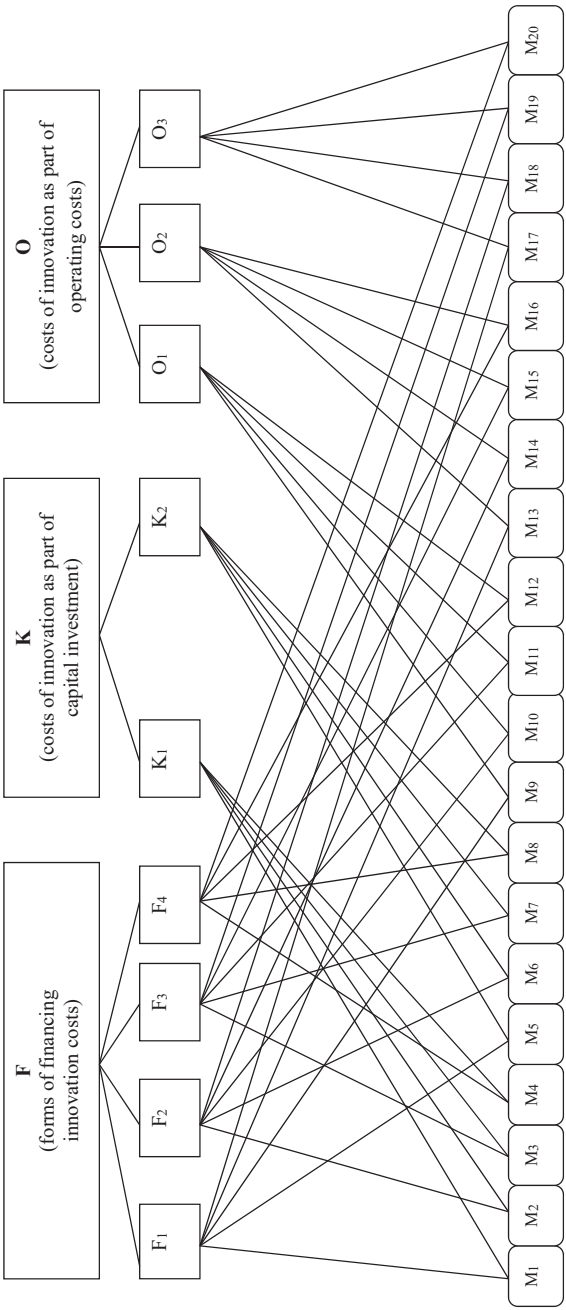
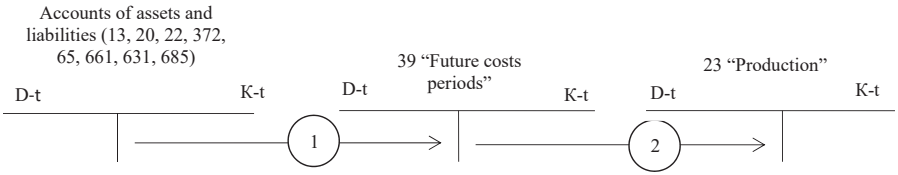


Figure 2. *The modeling of options for accounting for innovation costs*

Source: *Generalized by the authors*

Borodkin (1999), Koval (2019), Ozeran (2013), and others suggest accumulating information about the costs of the preparation and development of new products on account 39 "Deferred expenses" (Fig. 3).



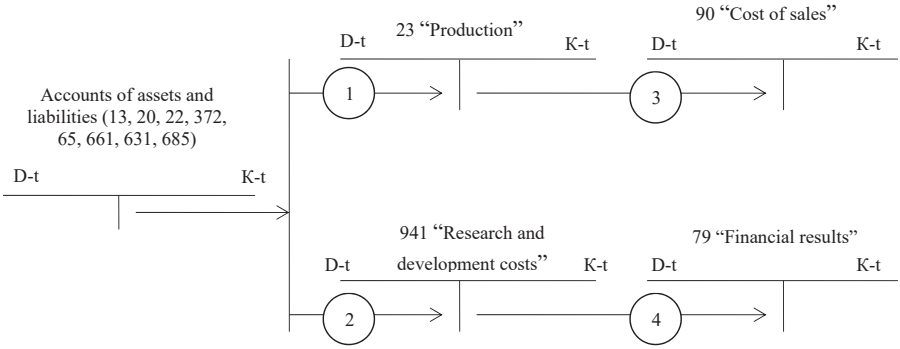
Contents of business transactions: 1) reflects the production costs for the preparation and development of new products; 2) written off the costs of future periods for production costs.

Figure 3. *A scheme of accounting for the cost of innovation using account 39 "Deferred expenses"*

Source: Generalized by the authors

$\mathbf{M_{13}} = \mathbf{F_1O_2}$ and $\mathbf{M_{17}} = \mathbf{F_1O_3}$ are models of innovative measures which are carried out at the expense of the company's own funds with reference to current costs (23 "Production" and 941 "Research and development costs").

The option of reflecting costs for innovations in the write-off as they arise does not involve direct capitalization, but is reflected in the current costs in full (Fig. 4).



Content of business operations: 1) written off for production costs associated with the preparation and development of production of new products (goods, works, services); 2) reflects the costs of research and development of innovative products as part of other operating costs; 3) included in the cost of costs associated with the preparation and development of new products (goods, works, services); 4) written off to the financial results of the costs of research and development of innovative products (goods, works, services).

Figure 4. *A scheme of accounting for the cost of innovation to create new species of products (goods, works, services)*

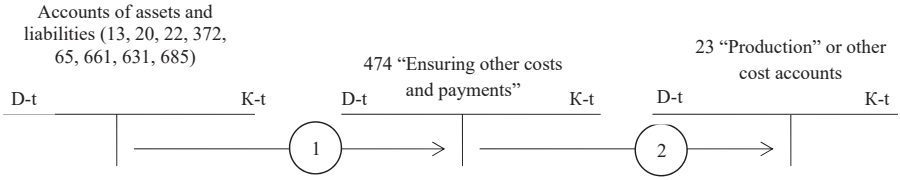
Source: Generalized by the authors

Collected in expenditure accounts (23 "Production", 941 "Research and development costs"), the cost of innovation refers to the cost of production or financial results in one reporting period.

$M_{19} = F_3O_3$ is a model of innovative measures which is carried out at the expense of budget funds for the acquisition and commissioning of assets received free of charge. This method of accounting for the cost of innovation to create new products can be used in industrial enterprises in Ukraine for which the production of innovative products is not a one-time occurence, but a permanent concern.

Enterprises participating in technology parks can also receive targeted funding for innovation costs. In this case, Minakov (2005) proposes to keep records of earmarked funds on separate sub-accounts of account 48 "Targeted financing and earmarked revenues": 481 "Targeted revenues from the technology park"; 482 "Targeted financing of a technopark participant (profit)"; and 483 "Targeted financing of a technopark participant (VAT)".

$M_4 = F_4K_1$, $M_8 = F_4K_2$, $M_{12} = F_4O_1$ and $M_{20} = F_4O_3$ are models of innovative measures of a capital and non-capital nature, which are carried out at the expense of pre-formed reserves at the enterprise. The use of account 474 "Ensuring other costs and payments" with the creation of a reserve is appropriate for enterprises in which the creation of innovative products is not one-time, but systematic (Fig. 5).



Content of business operations: 1) created a reserve for financing the costs of innovation, including social, legal, personnel; 2) the costs of innovation are written off at the expense of the previously created reserve.

Figure 5. *An accounting scheme for the creation of reserves to ensure the cost of innovation*

Source: Generalized by the authors

The use of the developed models will contribute to the more rational organization of accounting for innovation costs and their reflection in the financial statements to meet the needs of users. Whilst the cost of innovation is not a completely new object of accounting, it is an object of management, and is one of the key indicators in the decision-making process related to improving the efficiency of the financial and economic activities of enterprises.

The accounting information system can provide data on costs in different sections, including to reflect the structure of costs involved in the processes of creating new products and the technological renewal of production. Systems of modelling accounting information used by business entities allow for such a modification without significant

time and effort. At the same time, modern software creates the opportunity to generate the necessary information and obtain additional analytical indicators for the relative comparison of the costs incurred with the planned activity, and to identify reserves for their reduction.

5. Conclusions

The results of this study suggest that the current accounting practice does not allow for the full generation of the necessary information regarding the processes taking place within innovation activity. This is partly because innovation has not yet become an obvious object of business accounting, and costs incurred during the innovation process have not yet been properly reflected in the accounting system.

To a large extent, the choice of the right way to account for innovations depends on whether they are related to operating activities or are of a capital nature. The application of the proposed accounting approach will have a positive impact on the creation of a systematic, efficient, and complete reflection of the costs of innovation and their timely write-off to non-current assets or expense accounts of the reporting period, which is essential to determine financial results.

In the opinion of the authors, it is expedient to create a single methodology for accounting for the cost of innovation, which will help to provide reliable information and increase its analytical properties. It is also important to identify reserves to reduce costs. Thus, automation of the accounting of expenses for innovation will allow for their efficiency to be increased without a considerable increase in the complexity of accounting works.

The results of the study to account for the cost of innovation determine the need for the development and implementation of guidelines (standard correspondence of accounts) for accounting to reflect them in accounts and in accounting registers. The results of this study are aimed at improving the reliability, efficiency, and analytical nature of accounting, which will enhance the effectiveness of innovation cost management.

Prospects for further research in this area include the development of approaches to the generation of forms of internal reporting to manage the cost of innovation. The compilation of internal reporting will systematically allow for the formation of databases, which will facilitate both the rapid use of the necessary information to manage innovation processes and the rapid search for the necessary data.

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