

MODERN ENGINEERING INSTRUMENTS FOR ACCOUNTING THEORY AND PRACTICE**O. Onyshchenko**

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Purpose. The article deals with the basic analysis of the concept of ‘engineering’, it explores the role of business process reengineering as one of modern concepts used in the theory and practice of management, expertises the engineering in social and economic sciences. **Methodology.** Engineering accounting proves that there is a connecting link between accounting methodology and the system of strategic management and is a concept for the development and implementation of accounting information systems based on the use of specialized engineering instruments. The article provides the analysis of the historical background of accounting engineering, highlighting some details of concept patterns of accounting engineering instruments using the approach described by M. V. Shumeiko.

Practical value. The author determines the prospects to applying the accounting engineering as an instrument for modelling the accounting performance of modern enterprises. References 38, table 1, figure 1.

Key words: engineering, accounting engineering, concept of accounting engineering instruments.

БУХГАЛТЕРСЬКИЙ ІНЖИНІРИНГ ЯК СУЧАСНИЙ ІНСТРУМЕНТАРІЙ ОБЛІКОВОЇ НАУКИ ТА ПРАКТИКИ**О. В. Онищенко**

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У статті досліджено питання сутності поняття «інжиніринг», розглянута роль реінжинірингу бізнес-процесів як однієї із сучасних концепцій використання інжинірингу в теорії і практиці менеджменту, застосування інжинірингу у соціально-економічних науках. Визначено, що з'єднуючою ланкою між обліковою методологією та системою стратегічного менеджменту є бухгалтерський інжиніринг як концепція розробки і впровадження облікових інформаційних систем на основі використання спеціалізованих інжинірингових інструментів. Проведено аналіз історичного розвитку бухгалтерського інжинірингу. Розглянуто паттерни концепції інструментів бухгалтерського інжинірингу М. В. Шумейко. Означено перспективність застосування бухгалтерського інжинірингу в якості сучасного засобу моделювання облікової діяльності підприємств.

Ключові слова: інжиніринг, бухгалтерський інжиніринг, концепція інструментів бухгалтерського інжинірингу.

PROBLEM STATEMENT. Changes in the economic conditions for the enterprise, saturation of the competitive environment, rapid changes in production, information and communication technologies, high rates of process innovation in the late XX century brought forward new requirements for company management. Due to changing conditions, greater managerial flexibility is required as well as improved strategic thinking, so as to plan and forecast the long-term company performance.

Thus, we face the new modern requirements in developing the accounting information, with the modernization and rationalization of existing accounting information technology, which in terms of increase in information capabilities and information communication and accounting control, gets changed from the traditional control methods to engineering. It evokes the research of accounting engineering phenomenon as a mechanism to ensure adjustment and adaptation to certain conditions.

The issues encountered with engineering accounting are analyzed by I.M Bohataia [1], V. M. Zhuk [2], N. A. Breslavtseva, T. O. Grafova, H. Y. Kroklicheva [3], O. V. Kuznetsova [4], V. V. Lesniak, V. I. Tkach [5], I. M. Tkach, M. V. Shumeiko [6], R. F. Brukhanski [7], N. V. Sydoryna [8] and others.

The aim of this research is to analyze the scientific approaches to the category of engineering by reviewing

the historical aspects of its origin and to establish basic rules for the accounting engineering.

EXPERIMENTAL PART AND RESULTS OBTAINED. The term engineering originates from the Latin “ingenium” (to construct, create or invent) and was initially used to describe human intellectual abilities to solve some practical problems. The most widespread modern concept of the term “engineering” is derived from the English “engineering”.

The history of engineering, in its modern form, first appeared in England and dates back to the early XX century [9]. At first engineering was associated only with civil construction, and a lot later within the industrial sphere, particularly in the USA. During that period, engineering was associated with providing engineering and consulting services.

After WWII the construction of military facilities, roads, airports, ports became critical and engineering activity became common in many countries. The active position and activities of various international organizations, mostly established at that time, also contributed to it. As a result, in the 1950s engineering became an independent area, receiving its widest development so far.

An analysis and review of the references allows us to assert that the term “engineering” is much more frequently used within areas of research.

There are the following modern interpretations of this concept and term presented in Table 1.

Table 1 – The Approaches to the Interpretation of the Engineering Term [compiled by the author]

References	Definition
«Le Lettre» French Dictionary [10, p. 11]	Search for any mean to succeed due to his own genius and his own thoughts.
American Council for Professional Development [11]	The creative application of scientific methods and principles to the design and development of buildings (constructions), machinery, machines, production processes, and the methods for their use separately or combined.
General Business Dictionary [12, p.29]	Engineering and consulting services, research, design and engineering, calculation and analytical works, providing the feasibility study (FS) for projects, developing the recommendations to set up production and management, final goods marketing.
Foreign Trade Encyclopedia [13, p. 136]	Services to set up the production process and final goods marketing (works, services), to get everything ready for construction and operation of industrial, infrastructure, agricultural and other facilities, pre-design and design services
UN European Economic Commission [14]	Special activities related to the creation and operation of enterprises and infrastructure facilities or, in other words, there is a set of design and practical services related to the for engineering and technical field and required for the construction of the facility and its operation assistance.
Zagorodny A. H. [15, p. 234]	Engineering and consulting services, research, design and engineering, calculation and analytical works particularly for providing the feasibility study (FS) of the projects, business plans, and recommendations on the production management and its structure
Ukrainian Explanatory Dictionary [16]	Activities to provide engineering and consulting services as to the construction of industrial facilities as well as manufacturing and social infrastructure facilities
Bahrova I. V. [17, p.94]	Engineering and consulting services to create enterprises and other organizations
The Tax Code of Ukraine of 12/02/2010, 2755-VI (Art. 14.01.85) [18]	Providing services (works) with drawing up technical specifications, project proposals, conducting scientific research and technical and economic surveys, implementing the engineering and exploration works on construction sites, developing the technical documentation, engineering and design processing for the equipment and technology objects, providing the consultancy and architectural supervision during the assembling and commissioning works as well as consultations related to such services (works)
Bilousko V. S. [19, p.354]	These are works and services requiring to conduct the scientific research and development work, to prepare the project proposals and feasibility studies for construction of industrial and other economic facilities, to carry out the engineering and exploration works for the facilities construction, to plan and design the engineering and technological processes
Didkivski M. I. [20, p. 446]	Providing the technological expertise required to purchase, install and use the purchased or leased machines and equipment
Ivanova L. O. [21, p. 37]	This is a kind of innovative activities to provide research, design, calculation and analytical services, related to the creation of agricultural facilities, preparing the feasibility studies of projects, developing the recommendations for production and management as well as the functioning of enterprises in a wide range of purposes of their marketing activities
Shchelkunova O. V. [22, p.97]	Provision of research, design, calculation and analytical, and manufacturing services includes the developing of investment justification, recommendations for production and management, and final goods marketing
Chupryn A. V. [23, p.7]	The process of interaction within the market aims to create the additional consumer value by optimizing customer investment costs
Synytsia M. I. [24, p. 20]	This is the area of human intellectual activity, discipline, profession, which task is to apply the science and engineering achievements, use the laws and natural resources to address the specific problems, goals and objectives of mankind
Redkin O. V. [25, p.103]	Provision of research, design, calculation and analytical, manufacturing and organizational services includes the developing of feasibility study (FS) and business plans, projects and programmes, recommendations as to manufacturing, marketing and management
Lobanov A. A. [26, p.11]	This is a set of design, consulting, engineering works to create (construct) and maintain the facilities by applying their marketing research and logistic assistance
Lukin S. Y. [27, p.31]	Providing the technological expertise required to purchase, install and use the purchased or leased machines and equipment

Engineering is originated as engineering skill associated with technological knowledge. Engineering solves design problems by the implementation of standard

procedures which apply a specific sequence from an idea to a model, from a general understanding of model principles to the detailed design and special

calculations. There are several engineering principles to be stated: providing the details of engineering stages; multi-version; building a model to assess all the possible solutions to the problem. Although, engineering initially focused on solving problems associated with technical systems, it was also found that under the general systems theory all purposeful systems proved to be governed by the same laws. Therefore, the experience of improving the technical systems with engineering began to apply to the socio-economic ones. Professor Kuznetsova I. O. justifies the use of an engineering paradigm for the formalization of management process [28].

Re-engineering of business processes, being a modern concept for engineering in the theory and practice of management, assumes that the activities of the company can be redesigned by using special models of business processes [29, 30].

The task of the business process reengineering as an effective approach to the improvement and development of management is to find an entirely new way for the reconstruction of an existing business, or its most important processes by using the newest technological advances to serve the customers.

Re-engineering is aimed at solving such problems as eliminating the units of low productivity, increased efficiency of economic activity by improving production processes, strengthening the control over the use of resources, reducing bureaucratic paperwork, creating a strategically effective organizational structure and management methods allowing for the implementation of competitive strategies; therefore using innovative methods to form a new understanding of ways to solve the problems of competitiveness [31, p. 69]. Due to the drastic changes reengineering results in a significant improvement in economic performance.

Subsequently engineering has been used in almost all socio-economic sciences extending to all activities as an efficient management over diverse processes both manufacturing and economic ones.

The following terms, financial engineering, analytical engineering, accounting engineering are appearing in the economics references.

Financial engineering, having become widespread since the 1980s, is developing in the following areas: over 250 derivative type instruments; a balanced financing; asset sales with getting them back on lease; credited to the cost of trademarks price and others [32].

The end of the XX century was characterized by change in economic conditions of enterprises functioning due to the saturation of the competitive environment, rapid changes in production, information and communication technologies, and rapid rates of innovation. This crucial stage in the development of enterprise management systems requires greater management flexibility within the changing conditions and the strategic thinking, the long-term planning and forecasting of the company performance. To ensure such function implementation the enterprises introduced and developed the strategic management system as a managerial system focused on ensuring the long-term enterprise survival by establishing a dynamic equilibrium with its environment.

Strategic account system is commonly used as the methodological instruments to strategic management. Its aim is to accumulate the accounting information, which can be used by management to make the strategic management decisions. As noted by R. F. Brukhanskyi [7], to ensure full compliance with strategic management requirements the financial accounting system needs improving based on the principles acting as a connecting link between the accounting methodology and strategic management system. These systems must be integrated to each other through using the accounting engineering instruments.

V. M. Zhuk [2] defines the accounting engineering as “a process to apply specific instruments generally borrowed from other sciences in the modeling and accounting system, it is provided by some departments of an enterprises and outside organizations to enhance the importance of accounting and the results of its accountability for the resource management and the company, industry and state economy.”

Accounting Engineering Development is contributed with the following circumstances:

- improving the methodology of the relevant expertise field that provides the transition to a new development level – accounting and management for reserve system, risks intellectual capital, areas of financial risk both at the micro and macro levels;
- using the modern instrumental methods based on the computer technologies.

Accounting approach of monetary funds / net liabilities is basic among engineering instruments, it points that due the hypothetical processes available monetary resources remain in the assets, and liabilities has got the net liabilities while forming one out of three following economic situations:

- 1st – monetary funds / disaggregated net sources of funds in the case of efficient operation;
- 2nd – losses / negative equity in the case of ineffective activity;
- 3rd – lack of available monetary resources / zero equity in the case of total loss of property.

T. Limberg being a founder of the hypothetical processes suggests the concept of value in determining the hypothetical withdrawal when the asset value can be determined by deducting losses of the company in the case of its losing assets. The general rule of evaluation prescribed by T. Limberg proves value as the lowest magnitude of current expenses and the lowest rate of current value or net value of the final goods sale [33, pp. 443–444].

There is the following peculiarity of the accounting engineering instruments [6, p.76]:

- using the index of net liabilities;
- focusing on the use of a structured plan accounts;
- compiling the aggregated transactions for enlarged units: balance sections, plan accounts sections, forecast balance, as a result the number of transactions is reduced from 15000-16000 to 8-14 allowing to automate engineering processes.

The approach of the French and Germans became the methodical basis for development of accounting engineering, they have been using the technology of compiling actuarial and zero balances since the late

nineteenth century. Their appearance is related to the fact that the carrying company value is not the only possible and universal summary index, representing all the characteristics of the available company property and reflecting all the factors of value forming, and the enterprise value, in general. The development of new types of balances provides additional information sections and formats enabling to apply different processing methods and analysis tools and the functioning of management information systems of various kinds including tactical, strategic, innovative, intellectual, etc. at the enterprise, region, and state levels.

Nowadays professor J. Rishar is one of the ideologists popularizing the concept of actuarial accounting based on developing an actuarial balance as a tool to improve the relevance of accounting information by bringing the carrying value to the market one. He suggests using the assessment concept for discounted cash flows which is determined at different times as a basis to improve the accounting assessment.

There is the other way to develop zero balances as a systemic accounting and audit control mechanism providing the real or hypothetical sale of assets and meeting obligations in liquidating prices with obtaining an aggregate index of property (net liabilities) [34, p. 5]. Such practice is widely spread in Western countries, so in Germany any enterprise inspection starts with a zero balance compiling on the basis of a conditional asset sale and meeting the commitments by comparing net liabilities at the beginning and end of the period. England uses a system of special balance sheets for this purpose whereas there are zero balances in Switzerland and financial balances in France [8, p. 2].

While cooperating with J. Loran French researcher, V. I. Tkachev, professor, was the first soviet scholar to develop in 1997 the derivative or hedged balance sheet based on the allocation of net liabilities categories. It proved the sources of funds remaining after the conditional or actual assets sales and meeting commitments characterizing the results of capital use, and the net liabilities structure by comparing the net liabilities and assets with their analysis as disintegrated and aggregated property index [35, p. 28]. The proposed methodology envisages the developing of the aggregated balance sheet items which are further adjusted by means of consolidated accounting postings of two basic types (engineering and hypothetical) and ensures the development of a hypothetical derivative balance sheet.

In 2001 professor I. M. Bohataia [1, p. 98] offered the first variant for developing the system of strategic property accounting based on the accounting engineering. The virtuality concept or virtual accounting is taken as a core principle, which implies the determining a possible enterprise condition or its possible conditions under the given conditions specified by compilers of virtual balance sheets within the framework of its strategic account information.

In 2004 H. Y. Kroklicheva, professor, further developed in details the above-mentioned items [3, pp. 59–62]. She made and suggested the concept of a network corporate accounting and reporting by using

the engineering tools (network and fractal derivative balance sheets).

The comprehensive proposals as to the general methodology for engineering accounting comprising the quintessence for compiling the derivative balance sheets of various kinds appeared in the late 2000 (L. R. Lilieieva, M. Y. Simonovych, Y. A. IIshtein, L. N. Kuznetsova, Y. V. Denysevych, L. A. Zimakova, V. V. Lesniak and others)

Having based on algorithms and instruments for accounting engineering, O. V. Kuznetsova, professor, in 2010 [4] developed the concept of accounting management for economic processes, focused on making up your computer accounting forecasting (up to 100 types of economic processes). The implementation of the concept involves the use of accounting engineering at the following stages:

- 1) the initial operator (enlarged economic aggregates);
- 2) mapping the economic transactions;
- 3) mapping the hypothetical transactions;
- 4) obtaining the specific and hypothetical derivative balance sheets.

The developed methodology is based on the accounting engineering methods and envisages the implementation of the hedged accounting postings with using the market (fair) value.

Thus, the first decade of the XXI century revealed the development and improvement of the accounting engineering instruments being the element of the accounting system, targeted to meet the management requirements. The national conceptual and categorical apparatus and common approach to developing and complying different types of derivative balance sheets for enterprise are still under the way.

The use of engineering mechanisms in economic sectors is the result of pending for fundamental changes in management being the so-called singular turn, expected in the middle of the XXI century [36, p.83]. Engineering accounting and management systems are based not on improving the outdated methods, but aimed at the innovative methodologies, models and methods, allowing to find the right solution in terms of accelerating technical processes and strategic management requirements. Having systematized the existing achievements of Russian scholars in accounting engineering in order to develop a single complete theory, professor M. V. Shumeiko [6] pointed out the patterns for the concept of accounting engineering instruments (Fig. 1), aimed at the implementing and effective functioning of integrated systems of management and strategic accounting.

The concept of accounting engineering instruments, developed by M. V. Shumeiko (Fig. 1), is aimed at the implementing and effective functioning of the integrated management and strategic accounting systems [6, p. 77]. The use of concept of engineering accounting in the strategic accounting system enables to carry out auditing forecasting as to conditions and further company performance by developing the derivative strategic balance sheets, that provides an opportunity to obtain information in the five dimensions including

time, evaluation of accounting objects, economic events, activities, and time horizons.

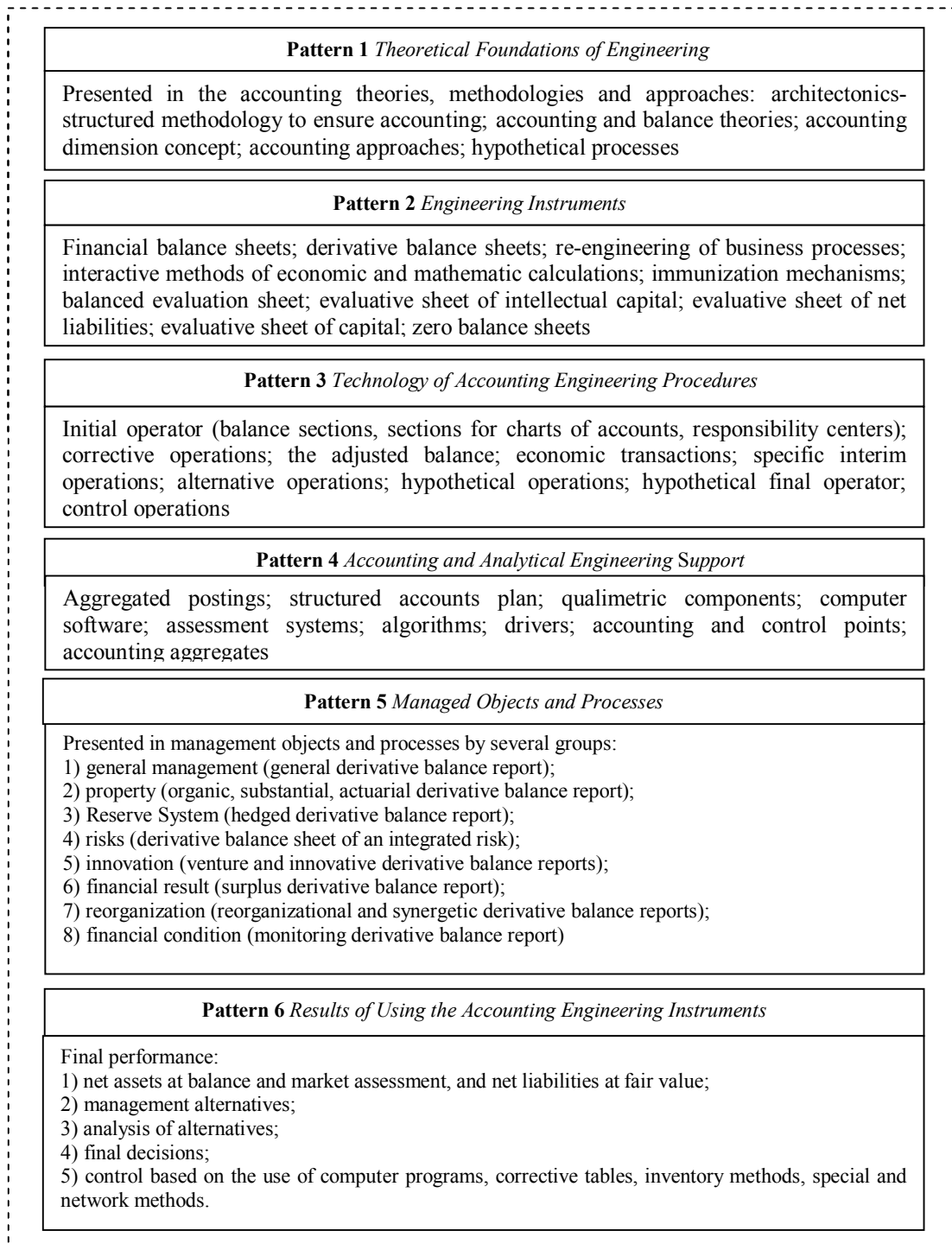


Figure 1 – Concept Patterns of Accounting Engineering Instruments according to M. V. Shumeiko (generalized referring to Shumeiko M. V. [6])

It reflects the current development of theoretical and methodological research in this area, determines the number of the areas, objects and processes involved into the accounting engineering

Having summarized the research results and existing engineering approaches V. I. Tkach and M. V. Shumeiko [5] developed the engineering accounting theory, with highlighting the following elements:

- 1) the object (property, cost elements, sources and articles for calculating);
- 2) system of the objects (net assets and net liabilities);
- 3) engineering accounting method (system of the derivative balance sheets in different assessments).

According to V. I. Tkach and M. V. Shumeiko, the use of engineering theory allows the company to implement about 10 kinds of strategic accounting,

which launch the strategic engineering mechanisms to forecast the varied items of the enterprise performance including strategic management accounting, strategic functional accounting, strategic property accounting, strategic innovation accounting, strategic accounting of the enterprise reserve system, strategic accounting for company development, strategic accounting of target programs; strategic accounting of funds, etc. [5, p. 11].

Increasing number of followers and supporters of accounting engineering resulted in the formation of a separate scientific trend in the Accounting Science with the research center in the Russian city of Rostov-on-Don. Representatives of the Rostov Scientific Accounting School made RESOURSUM information resource [36], functioning as an online service that allows to use its engineering instruments for managing the economic processes and resource potential at the enterprises.

In particular, there are some engineering instruments available for business accounting modeling as:

- a strategic derivative balance sheet;
- an immunization derivative balance sheet;
- a hedged derivative balance sheet;
- a methodology for a situational analysis;
- an outsourced derivative balance sheet;
- a strategic accounting and analysis of money

flows at a network company;

- a methodology for situational control;
- strategic analysis of the business property;
- a situational derivative balance sheet;
- a monitoring derivative balance sheet.

CONCLUSIONS. Under the current conditions of the enterprise, economic and commercial activities the management systems are to get a particular information support to ensure the effective running of strategic projects and initiatives. Although, the use of different systems and models may not always be an effective way for planning and forecasting its strategic actions,

because only some of them can be quickly and easily integrated into the enterprise information system, into accounting and analytical subsystem, in particular.

The accounting engineering should be considered as a universal instrument for account modeling based on use of conventional accounting data and assumes their transformation and supplement to meet the users requirements for information from the new engineering accounting system or a connecting link between the accounting methodology and strategic management system.

The experts [37, p. 258] consider it one of the most effective instruments for further development of the strategic reporting system at the enterprises. It enables with referring to the balance sheet to model the new types of strategic reports depending on the users requirements and methodological capabilities of a strategic accounting system implemented at the enterprise.

The analysis of the accounting engineering historical background and research of its methods, instruments, and theories for the past 20 years proves the great attention of scholars and practitioners to the item. The Russian Federation Rospatent has registered more than 60 instruments of accounting engineering [5].

Unfortunately, today Ukraine has almost unimplemented this type of engineering, although the use of engineering theory allows an enterprise to implement about 10 kinds of strategic accounting with the strategic engineering mechanisms for forecasting the enterprise performance under the varied conditions. The national scholar V. M. Zhuk argues that accounting engineering can transform and turn the accounting services into more effective financial and accounting departments, and insists on implementing the accounting engineering while addressing the auditors, accountants and financiers of Agroindustrial Complex Federation in Ukraine [38, p. 382].

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БУХГАЛТЕРСЬКИЙ ІНЖИНИРИНГ ЯК СОВРЕМЕННЫЙ ИНСТРУМЕНТАРИЙ УЧЕТНОЙ НАУКИ И ПРАКТИКИ

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В статье подняты вопросы сути понятия «инжиниринг», рассмотрена роль реинжиниринга бизнес-процесов, как одной из современных концепций использования инжиниринга в теории и практике менеджмента, использование инжиниринга в социально-экономических науках. Определено, что соединяющим звеном между учетной методологией и системой стратегического менеджмента является бухгалтерский инжиниринг, как концепция разработки и внедрения учетных информационных систем на основе использования специализированных инжиниринговых инструментов. Проведен анализ исторического развития бухгалтерского инжиниринга. Рассмотрены паттерны концепции инструментов бухгалтерского инжиниринга М. В. Шумейко. Определена перспективность использования бухгалтерского инжиниринга в качестве современного средства моделирования учетной деятельности предприятий.

Ключевые слова: инжиниринг, бухгалтерский инжиниринг, концепция инструментов бухгалтерского инжиниринга.

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