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ACCOUNTING UNDER THE INFLUENCE OF GLOBAL TECHNOLOGICAL CHANGES

Summary

The research of historical features of the spread of technological conformations in time and geographically, allowed authors to identify and reveal the key features of each of them. The considered features of technological conformations reveal key changes in technical and economic processes, however, the same periods testify to the manifestation of significant changes in data processing and, in particular, in the accounting of business entities, their reporting. Modification of key scientific markers of accounting under the influence of changes in technological levels is presented by authors on the example of its subject, objects and methods. Particular attention is paid to the main approaches to determining the subject of accounting, which have changed under the influence of the development of technological levels. The concretization of the subject of accounting is carried out due to the emergence of new objects of accounting, the system of which has changed with the formation of new technological conformations. The study of the nature of the impact of technology on the accounting method is presented on the example of elements of the accounting method that are traditional for the Ukrainian scientific environment in the period 1990–2021. The results of research represented that Ukraine in 2021 in the field of automation of the elements of

the accounting method has the characteristics of the Vth technological level. Wider introduction of software products and online services, in particular, NFC technologies, cloud services, blockchain, will enable Ukraine to develop to the VIth technological level.

Introduction

During the twentieth century in the public life of Ukraine there were two significant events that influenced the development of its accounting system, in particular, the formation of a new economic stratum called socialism (1917–1991) and gaining the country's independence (1991), which caused its transition from socialism to capitalism, or to a market economy. These events caused the greatest transformations in the accounting of Ukraine, which was historically formed on the basis of the accounting system of the former USSR in the environment of command-administrative economy with the priority of state ownership.

Ukraine's transition to independence with the development of non-state ownership and various organizational and legal forms of management in the 1990s led to the urgent need to transform the accounting system and adapt it to new business realities. Accordingly, the path of harmonization of the national accounting system with the requirements of international accounting and reporting standards was chosen.

In Ukraine, the issue of accounting development is in the centre of attention of many scholars, and democratic views prevail among Ukrainian scholars on possible directions and concepts of further development of accounting in the XXI century.

A feature of the accounting system is its high sensitivity to the influence of various factors. Key ones are stakeholder inquiries about the structure and content of information needed to make economic and other decisions, technological innovations that determine the nature of accounting procedures, government policy in the field of accounting and its dependence on global and geopolitical changes.

The transformation of key scientific markers of accounting under the influence of changes in technological devices is observed in the example of its subject, objects and methods.

Defining the subject of accounting means determining the place and role of the science of accounting among other economic sciences and at the same time to clarify the scope of its application, as well as the importance and functions in the enterprise management system.

Another area of research on the impact of technological innovations and technological conformations on transformational changes in accounting is a set of accounting methods and its development. The growth of the technological level of data processing for each technological wave has strengthened the automation of accounting procedures and expanded the information potential of the accounting system.

This study is devoted to the key influences of technological innovations on the development of the accounting system on the example of Ukraine.

Part 1. Key influences of technological innovations on the development of the accounting system

Techno-economic paradigm includes different levels of technological development. Technological levels are a set of technically and technologically related processes and methods of production, historically defined in time, reflecting changes in development of society.

As one of the leading factors influencing the accounting system, technological levels have changed as a result of revolutionary changes introduced in the field of engineering and technology and affected the processes of data processing. Key technological changes had a significant impact not only on production processes, economy and social communications, but also on the accounting process and its procedural context (Figure 1).

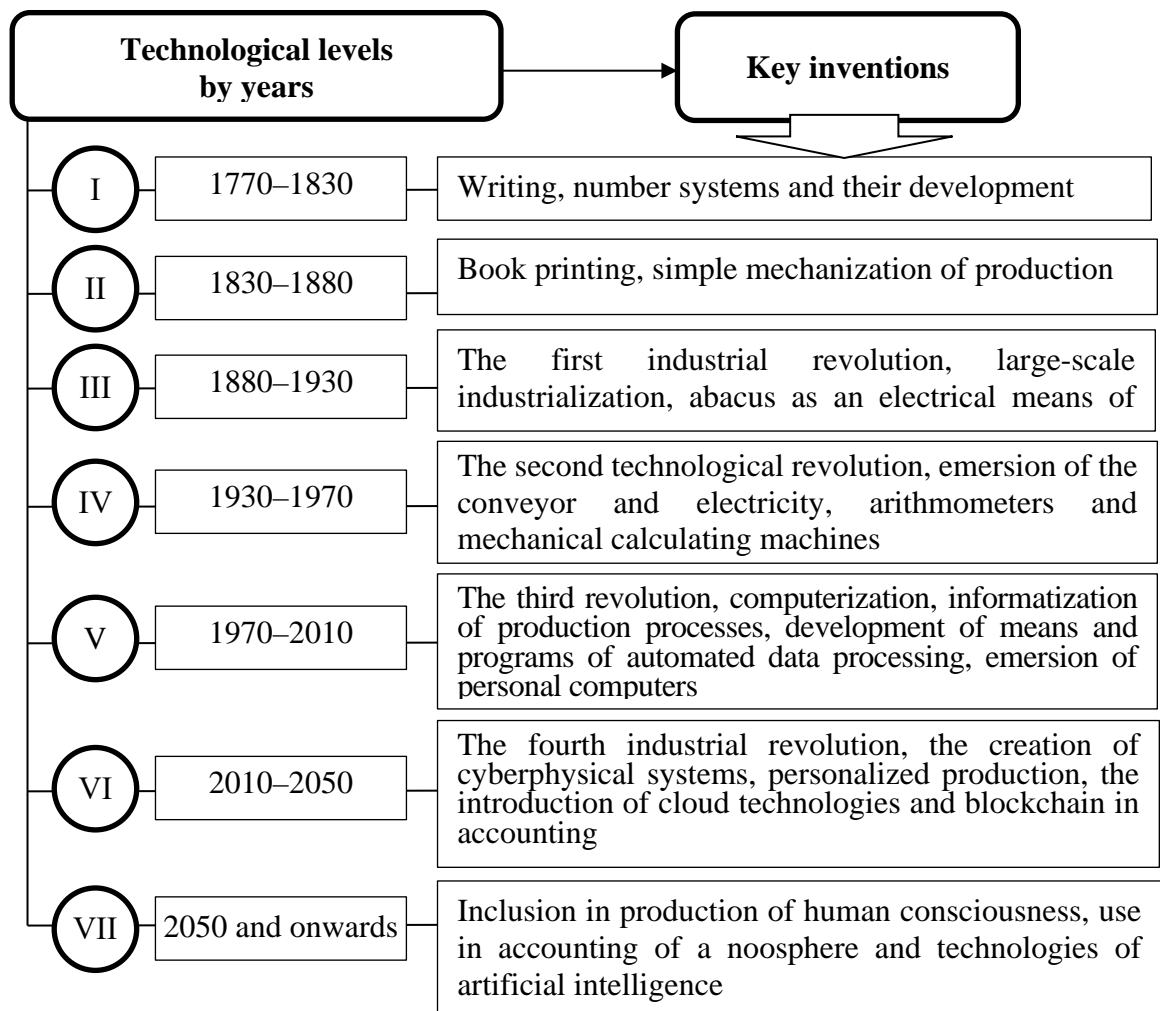


Figure 1. Influence of technological changes on the accounting system

Source: author's

The study of historical features of the spread of technological levels in time and geographically, revealed key features of each of them, including the following: the period of dominance, technological leaders, developed countries, the core of the technological conformation, key factors, the core of the new conformation that is being formed, the advantages of the technological conformation in comparison with the previous one [5, p. 173; 6; 7] (Table 1). The proposed approach to comparing the above criteria allows us to see the main transformational changes in their dynamics, taking into account the technological and economic level of development of different countries.

The general analysis of the impact of technological revolutions revealed key changes that mediated the development of accounting for different technological conformations (Table 1). In particular, if the first and second technological levels were associated with the development of writing and numeracy, printing, simple mechanization of production, then already in the third technological level (1880–1930) the first industrial revolution took place, which was associated with large-scale industrialization and led to the emergence of such electrical communications as, for example, the abacus, which facilitated the implementation of accounting operations.

IVth is the next technological level. It was formed in 1930–1970 as a result of the second industrial revolution, which brought the world electricity, production lines, highway networks and cables around the world [1, p. 109]. During this period, information has evolved from a means of communication to a general scientific category, which encompassed the processes of data exchange between humans and computers. In addition, such an important invention as the personal computer has opened up new possibilities in the use of information. For the purposes of accounting IVth technological level opened arithmometers and mechanical counting machines, electronic computers, contributed to the development of automated control systems.

The third technological revolution took place at the Vth level (1970–2010), associated with achievements in the field of microeconomics, computerization, informatization of production processes and all spheres of social and economic life [1, p. 110]. The main achievement of this period was the development of tools and programs for automated data processing, the personal electronic counting machines (personal computers) of small size with increased reliability, simple configuration changes and advanced dialog capabilities of data processing were widely implemented in the practice of enterprise management [2, p. 134]. This helped bring automation tools closer to the end user, created conditions for the abandonment of batch processing of credentials, the transition to dialog technologies.

In order to automate accounting processes in Ukraine in the 2000s, the following software products became the most widespread:

- 1) Sail, Best-Report Plus, 1C: Accounting, X-DOOR – to automate the accounting process.

Table 1

Characteristics of technological conformations

		Number of technological level						
		I	II	III	IV	V	VI	VII
Characteristics of conformation								
The period of dominance		1770-1830	1830-1880	1880-1930	1930-1970	1970-2010	2010-2050	2050-onwards
1	Key factors	2	3	4	5	6	7	8
		textile machines [5, c. 173]	steam engine, machines [5, c. 173]	electric motor, steel [5, c. 173]	internal combustion engine, petrochemistry [5, c. 173]	microelectronic components [5, c. 173]	structural materials with predefined properties, CALS-technologies, artificial intelligence	creation of technologies for which there is no unambiguous idea today and for the creation of which it is necessary to define and develop new physical principles [4, c.16]
Technological leaders		UK France Belgium [7]	UK France Belgium Germany USA [7]	Germany USA UK France Belgium Switzerland Netherlands [7]	USA Western Europe Japan [7]	USA Japan [7]	USA EU countries Japan [1]	...

Characteristics of conformation		Number of technological level						
		I	II	III	IV	V	VI	VII
The period of dominance	1	1770-1830	1830-1880	1880-1930	1930-1970	1970-2010	2010-2050	2050-onwards
Developed countries	2	German states Netherlands [7]	Italy Netherlands Switzerland Austria-Hungary [7]	Italy Denmark Austria-Hungary Canada Japan Spain Russia Sweden [7]	USSR Newly industrialized countries [7]	Newly industrialized countries Brazil Russia [7]	China, South Korea [1]	...
The core of the technological conformation		textile industry, textile engineering, pig iron smelting, iron processing, canal construction, water engine [5, c. 173]	steam engine, railway construction, transport, machine-shipbuilding, coal industry, machine tool industry, ferrous metallurgy [5, c. 173]	electrical engineering, heavy engineering, steel production and rolling, power lines, inorganic chemistry [5, c. 173]	automotive, tractor construction, non-ferrous metallurgy, production of durable goods, synthetic materials, organic chemistry, oil production and refining [5, c. 173]	electronic industry, computer technology, fiber-optic technology, software, telecommunications, robotics, gas production and processing, information services [5, c. 173]	biotechnology, nanotechnology, photonics, optoelectronics, aerospace industry, non-traditional energy sources [6]	«thermonuclear fusion» technologies, psi-technologies, bioenergy, technologies related to morality and responsibility [6]

(Continuation of Table 1)

		Number of technological level						
		I	II	III	IV	V	VI	VII
Characteristics of conformation		1770-1830	1830-1880	1880-1930	1930-1970	1970-2010	2010-2050	2050-onwards
The period of dominance		2	3	4	5	6	7	8
The core of the new conformation that is being formed		steam engines, engineering [7]	steel, electricity, heavy engineering, inorganic chemistry [7]	automotive, organic chemistry, oil production and refining, non-ferrous metallurgy, road construction [7]	radars, pipeline construction, aviation industry, gas production and processing [7]	nanotechnology, molecular biology [7]	picotechnology (10 ⁻¹²), technologies of «cold thermonuclear fusion»	the probability of combining animate and inanimate nature in relation to the need to protect humanity from the potential threats of antisocial uncontrolled use of technologies of the sixth technological level [4, c. 13–14]
The advantages of the technological conformation in comparison with the previous one		mechanization and concentration of production in factories [5, c. 173]	increasing the scale and concentration of production based on the use of a steam engine [5, c. 173]	increasing the flexibility of production based on the use of electric motors, standardization of production, urbanization [5, c. 173]	mass and serial production [5, c. 173]	individualization of production and consumption, increase of flexibility of production, overcoming of ecological restrictions on energy and material consumption on the basis of CALS-technologies [5, c. 173]	overcoming environmental constraints through the use of non-traditional energy sources	appearance of categories «hyperintelligence», «hyperinformation» and «hypercognition»

Source: author's developments on the basis of data from publications [1, p. 110; 4, p. 13, 14, 16; 5, p. 173; 6; 7]

2) Electronic office of the taxpayer – to automate the personal workplace of the taxpayer to work with the fiscal service remotely in real time.

3) Art report, M.E.DOC IS EDC (electronic document circulation), FREDO DocMen or FlyDoc, Timely – for exchange of primary documents between contractors directly from the configurations of business automation systems.

4) SAP R/3 – to automate the software system for planning corporate resources.

5) XBRL (eXtensible Business Reporting Language), XLM – to automate the creation, generation and submission of electronic financial statements.

The fourth industrial revolution, according to forecast estimates, covers the period 2010-2050 and determines the transition to the VIth technological level. Its main features are the creation and implementation of cyber physical systems and personalized production, which are automated (cyber) real physical systems that are programmed by users for a specific functional purpose and communicate with other cyber physical systems and users on the Internet [1, p. 111; 3, p. 25].

Key changes in data processing and exchange in the accounting system are due to the introduction of cloud services and blockchain technologies [2, p. 135]. The main technologies of this conformation should be: DaaS – Desktops as a Service; IaaS – Infrastructure as a Service; ITaaS – IT as a Service; SaaS – Software as a Service, PaaS – Platform-as-a-Service, as well as cloud services (Private Cloud, Community Cloud, Public Cloud and Hybrid Cloud).

VIIth technological level is projected after 2050 and is expected to include human consciousness in technological and production processes [4]. For the purposes of accounting and data processing, it is possible to use the realm of the mind (noosphere) or biological computers compatible with human intelligence (artificial intelligence technologies).

A study of the peculiarities of the deployment of technological levels in different countries shows that not every country today has reached the Vth and even more so the VIth level. For example, the VIth technological level is observed in the USA, Great Britain, Switzerland, Germany, the Vth level mainly covers the Netherlands, Sweden and France. In most developed countries of the world the Vth level is widespread. Developing countries are more likely to have the IVth level.

For comparison with the world, Ukraine has mainly developed IIIth and IVth technological levels and their total share is 95%. At the same time, Vth technological level corresponds to a share of 5%, and the VIth is completely absent [8]. In connection with this fact, Ukrainian scientists raise the question of the importance of identifying areas of innovative development that will allow the country to improve the level of technological conformation.

Among the possible key areas of strategic development of Ukraine's economy, which are able to qualitatively improve the nature of the technological conformation, include:

1) consistent innovative development with a comprehensive expansion of technologies of the Vth level – according to the authors, involves building a strong industrial base, which is the basis for effective use of information technology [9, p. 8; 10, p. 11];

2) the advantage of the development of services and information technology as the basis of the priority VIth level, which is an alternative way of intensive economic development instead of restoring the domestic industrial complex as a Soviet heritage [11, p. 13–14; 12, p. 12];

3) advanced transition to the technologies of the VII level, prototypes of which have not yet been created and which require the development of new physical principles [4, p. 15–16].

Features of technological conformations considered above reveal key changes in technical and economic processes, however, the same periods indicate the manifestation of significant changes in data processing and, in particular, in the accounting of business entities and their reporting.

Part 2. Transformation of conceptual components of accounting under the influence of changes in the techno-economic paradigm

The transformation of key scientific markers of accounting under the influence of changes in technological practices can be traced to the example of its subject, objects and methods. The concept of the subject and objects of accounting has always been the focus of researchers in the field of accounting. To define the subject of accounting means to determine the place and role of the science of accounting among other economic sciences and at the same time to find out the scope of its application, as well as the meaning and functions in the management system of the business entity.

Discussion questions cover both the definition of the essence of the term «subject of accounting» and its relationship with the term «object of accounting» and the composition of accounting objects.

The main approaches to determining **the subject of accounting**, which have changed under the influence of the technological level's development, are presented in Table 2.

Accounting in Ukraine has historically been formed on the basis of the continental model with state regulation, which was later strengthened in the 20th century by the command-administrative type of the economic system of the former USSR. The key transformations of the subject of accounting developed in the following areas.

The period of 1917–1991 coincided with the formation of the IV and V levels of technological conformations in the world. During that time, the subject of accounting was associated with the recording by the accountant of the facts of economic activity of the entity. In this regard, Professor Ya.V. Sokolov noted that according to Kant, one of the features of the classification of sciences is the subject identification, respectively, the subject of accounting are the facts of economic life [13, p. 6–7]. The subject of accounting was mainly considered

from the point of view of accounting as a practical activity, while economic facts were associated with the movement of material and monetary objects of accounting. According to professor Ya.V. Sokolov, this approach was shared by such scientists as:

Table 2

Approaches to determining the subject of accounting in the papers of Ukrainian scientists in terms of technological conformations

Technological level	Period	Prevailing views on the subject of accounting
1	2	3
I	1770–1830	✓ <i>Technical aspect:</i> the accountant records the economic activity, which is the subject of accounting
II	1830–1880	
III	1880–1930	
IV	1930–1970	✓ <i>Technical aspect:</i> the accountant records the facts of economic life, which are the subject of accounting ✓ <i>Expert aspect:</i> the accountant does not take into account the business processes themselves and especially not the property of the enterprise, but only the information that generates the rights and responsibilities of persons involved in these processes
V	1970–2010	
VI	2010–2050	✓ <i>Traditional approach (applied):</i> the subject of accounting is considered within the economic activity of the enterprise, consisting of individual business transactions, which change the composition of assets, equity and liabilities ✓ <i>Non-traditional approach (scientific):</i> <ul style="list-style-type: none"> • economic activity of the enterprise and its external environment; • is determined by the content, place and role of accounting in the institutional environment; • considers the patterns of development of accounting methodology

Source: author's

– J.L. Crepe – the purpose of accounting is to study the results of economic activity, which is associated with constant changes in the volume and composition of property. These changes are the subject of accounting;

– S. Spinendi considered that the subject of accounting the wealth of the enterprise, which is studied not only in terms of enterprise management, but also in terms of the reasons for its emergence, transformation, growth;

– I.F. Schär – according to which the subject of accounting can be only external and internal economic and legal facts that have already occurred;

– K. Arnold – according to his beliefs, the subject of accounting are things that are capable of multiplication or reduction, because they include in their price a certain value;

– E. Mudrov defined that the subject of accounting is all kinds of fishing, all kinds of work, which has the purpose of profit;

– R. Delaport determined as a subject of accounting the movement of values in time and space [13, p. 115–348].

Some Ukrainian researchers note that the accountant does not take into account the business processes themselves, much less the property of the enterprise, but only the information that gives rise to the rights and responsibilities of persons involved in these processes [16].

The subject of accounting in this approach is to determine by the professional accountant in practice how to apply the elements of the accounting method in their possible alternatives and variability.

The same approach to determining the subject of accounting is found in the papers:

– D. Cherboni considered that the subject of accounting are the rights and responsibilities of individuals and legal entities [13, p. 120];

– I. Akhmatov determined that the subject of accounting science is to come up with accounts for different cases, so that always know the state of the latter. The subject of accounting is not the economy itself, but its reflection on the accounts [13, p. 79–240];

A significant contribution to the development of accounting in Ukraine in the period 1917–1991 was made by such scientists as P.P. Nimchynov [30], A.N. Kuzminskyi [31], M.V. Kuzhelnyi [19], V.V. Linnik [19], F.F. Butynets [32] and others. These authors defined the subject of accounting as means of economy and economic processes.

Butynets F.F. in his textbook «History of Accounting» [31] most fully and comprehensively revealed the contribution of Ukrainian scientists to the development of accounting science, its further improvement, the formation of the accounting system.

The beginning of the period of Ukraine's independence (1991) was due to the transition from socialism to a market economy and eventually fell to the Vth level of technological conformation, which gave impetus to reconsider the purpose and role of accounting, and, accordingly, its subject. Accounting was identified as a key tool for information management system, its subject was revised in terms of creative component and professional judgment of accountants, which is a reasonable, professionally confirmed opinion on the order of reflection in the accounts of business transactions in terms of its diversity [14].

The period that falls on the VIth level of the technological conformation for Ukraine reflects the emergence of two qualitatively different approaches to the interpretation of the subject of accounting, in particular:

1) traditional – narrower, according to which the subject of accounting is considered within the economic activity of the enterprise and in the simplest form is determined by the «capital cycle in the process of expanded reproduction» [13]. Within this approach, there are certain interpretations of generally the same definition of the subject of accounting;

2) non-traditional – the subject of accounting is considered in terms of accounting as a science, in particular:

– going beyond the subject of accounting outside the economic activity of the enterprise with the inclusion of the parameters of the external environment (Holov S.F.) [15, p.453];

– the subject of accounting is determined by its place and role in the institutional environment (in terms of institutional theory) (V.M. Zhuk) [16];

– the subject of accounting considers the patterns of development of metamethodology (models of the dynamics of accounting scientific knowledge) and methodology of accounting (principles, methods and techniques) (Legenchuk S.F.) [17].

Thus, technological development and change of technological conformations are accompanied by a change in the role of accounting, its place in the management system of economic entities, the transformation of its subject with the appropriate division into components that reflect the applied and scientific aspects. The accounting boundaries and its subject matter are expanding with the complexity of technology.

The specification of the subject of accounting is carried out through the emergence of new objects of accounting. The study of the features of **the system of accounting objects**, which changed with the manifestation of new technological levels, is summarized in Table 3.

The pre-technological period was characterized by the spread of trade as the predominant type of economic relations. Accordingly, the accounting system was focused on trade operations; key accounting objects included the merchant's property, goods, money and settlements.

After the first technological revolution with the development of production, the system of accounting objects underwent radical changes and was supplemented by means of production, raw materials, work in progress, finished products, funds and reserves.

Ist, IInd, IIIrd and IVth levels of technological structure were based on invented electricity and technologies that allowed to form various types of production, build a network of railways and sea routes, develop electrical industry, oil industry and mechanical engineering [18, p. 32]. The accounting system received a deep development of the subsystem of financial accounting, and later in response to requests from the management of companies the subsystem of management accounting and reporting.

Table 3

Objects of accounting in terms of technological conformations

Technological level	Period	The predominant components of the objects of accounting	
1	2	3	
Pre-technological time	Middle Ages	<ul style="list-style-type: none"> – property; – goods; – money; – liabilities 	
I	1770–1830	– means of production;	
II	1830–1880	– raw materials;	
III	1880–1930	– unfinished production;	
IV	1930–1970	<ul style="list-style-type: none"> – final product; – money; – receivables and payables; – funds and capital 	
V	1970–2010	Enterprise resources: <ul style="list-style-type: none"> – capital; – goodwill; – biological assets (current, long-term); – cash equivalents; – emphyteusis; – reserves; – deferred expenses and income; – transaction costs 	Business processes: <ul style="list-style-type: none"> – procurement; – production; – sales
VI	2010–2050	Virtualization of units of value: <ol style="list-style-type: none"> 1) electronic money; 2) crypto-assets: <ul style="list-style-type: none"> – cryptocurrency (Bitcoin, Ether, Litecoin); – blockchain equivalents (real assets, service, transaction, hybrid) 	Business processes: <ul style="list-style-type: none"> – mining of coins or tokens (markers); – initial offers of coins or tokens (markers)

Source: author's

The Vth technological wave, which began in the mid-70's of 20th century in developed countries is associated with advances in microelectronics, computer science, biotechnology, genetic engineering, development of new types of energy, outer space, satellite communications. In the world there was a gradual consolidation of business, on the basis of separate firms began to form multinational corporations, and later networks of companies connected by

electronic means of communication that work closely together in technology, product quality control, investment planning, etc. [18, p. 32].

During the Vth wave, Ukraine was a part of the Soviet Union under the influence of the command-and-control economy, and since 1990 it has entered a transition period due to its withdrawal from the USSR and to market relations.

Ukrainian authors of the Soviet period attributed the company's resources (means of production and objects of production) to the objects of accounting, as well as sources of their formation (own (funds and reserves) and involved (loans and settlements)), economic processes (purchase, production, sale) [19].

Accounting objects in terms of the purchase process were: costs of acquisition of means and objects of labour (volume of purchased objects of labour in physical and monetary terms), costs of procurement process (to determine the actual cost of purchased means and objects of labour), settlement transactions with suppliers and other enterprises that arise in the purchase process.

The objects of accounting for the production process were mainly the production costs and full costs. Regarding the sales process, accounting objects included the volume of sold products (in physical and monetary terms), the cost of shipment and sale of products, financial results from sales (profit or loss), settlements with customers for sold products.

Thus, on the Vth technological level, economic processes mainly covered material production, which was reflected in the objects of accounting.

As a result of the introduction and development of market relations, the nature of economic activities of Ukrainian enterprises has changed significantly, new types of operations have appeared, and accordingly new accounting objects were formed. The accounting system of Ukraine received regulatory support with the adoption of a new version of the Basic Accounting Law in 1999, which marked the implementation of the National Accounting Regulations (Standards) (NA(S)R), which have been in force since 2000. NA(S)R changed the structure of the Chart of Accounts and supplemented their accounting items with new types, in particular, goodwill, biological assets, cash equivalents, etc.

The VIth technological wave, which covers the period of development in 2010–2050, gives impetus to a new level of development of medicine, nano- (10⁻⁹) and biotechnology. Data processing technologies are gaining further development, cloud services and blockchain technologies are gaining a special role in the field of accounting. On the basis of these technologies, new financial instruments such as electronic money, cryptocurrency, blockchain equivalents appear which have their own value and can be recognized as assets of the business entity, as a result of which they become objects of accounting, deepen their structure and content.

The complexity of new types of transactions and objects for accounting valuation and recognition is related to the diversity of their features. In particular, cryptocurrency has the characteristics of different groups of assets,

combines cash and cash equivalents, commodities, financial instruments, intangible assets, investments:

- Bitcoin – a digital means of saving value (investment, goods);
- Ether – a tool for raising funds (financial instruments);
- Litecoin – a decentralized, cryptographically protected inexpensive and fast means of payment (cash and cash equivalents).

Another type of accounting objects is blockchain equivalents, which can be recognized in accounting as real assets, or service, transactional or hybrid forms of such assets [20, p. 91].

With the occurrence of new types of assets, new terminology is formed related to the field of intangible production. A striking example of new activities is the mining of coins or tokens (markers); initial offers of coins or tokens (markers) [20, p. 91]. For the specified types of operations for today there is no methodical maintenance of their accounting, the procedures of recognition, estimation and documentation is not developed.

Despite the high level of attention paid by scientists and government officials to the recognition of cryptocurrencies as assets and, consequently, as objects of accounting, its solution is still uncertain due to the lack of normative and legal regulation. Thus, there is a situation of spreading cryptocurrencies and blockchain technologies in practice, where they are gradually becoming common tools for increasing the value of capital, but the current legal system and accounting methodology in Ukraine remain unprepared for adequate information support for the management of such assets and transactions.

Another area of research on the impact of technological innovations and technological conformations on the transformational changes in accounting is a set of **accounting methods and its development**.

The method of accounting is a set of techniques and approaches to chronological and systematic recording, which reveal the procedures for detection, measurement, registration, accumulation, generalization, storage and transmission of information about the activities of the entity. The growth of the technological level of data processing for each technological wave strengthened the automation of accounting procedures and expanded the information potential of accounting system.

Technological innovations have appeared relatively recently in the field of accounting. The path of technical accounting devices passed from primitive abacus and calculators, which until the end of the 19th century were the only technical means for performing evaluations. Significant technological impetus to the accounting system received after the second industrial revolution, which marked the emergence of various computing devices such as calculator machine and later punch card machine (1880–1890). The period of wars posed to scientists the technical tasks of developing weapons and defence systems, so the next key transformation leap occurred in 1954 with the invention of the universal automatic computer, which worked on magnetic tape. The 1960s brought the world large computers capable of generating periodic reports.

Further development of computer technology has strengthened the role of accounting in management processes. Based on the improvement of its hardware in the late 60's of the twentieth century, decision support systems (DSS) were created, which became the most advanced type of software that holds the leadership to this day.

The study of the nature of the impact of technology on the method of accounting is most pronounced in our time and presented by us on the example of elements of the method of accounting, which are traditional for the Ukrainian scientific community in the period 1990–2020 (Table 4). For Ukraine, this period corresponds to the Vth technological level. In the presented analysis we used typical accounting software products developed by Ukrainian companies or by world leaders that are promoted and used in the Ukrainian technology market.

Table 4

**Automation of the accounting methods
on the V-th technological conformation for Ukraine**

Accounting processes	Accounting methods	Possibilities of process automation	Software	Possible benefits
1	2	3	4	5
Observation of accounting objects	Documentation	automation of internal document management (electronic document management)	1C: Accounting; Sail; Best-Report Plus; X-DOOR	<ul style="list-style-type: none"> ✓ improving the efficiency of work, the implementation of effective control over the enterprise through timely management decisions; ✓ reducing the process of processing and transmission of information
		automation of tax payments (electronic tax administration)	Electronic office of the taxpayer; Art-report; M/E/Doc IS	<ul style="list-style-type: none"> ✓ reduction of time spent on tax accounting and tax reporting by taxpayers; ✓ saving time resources by tax authorities in carrying out arithmetic checks, cross-checks, checks in the form of tax returns received from businesses and citizens in the prescribed electronic form

Accounting processes	Accounting methods	Possibilities of process automation	Software	Possible benefits
1	2	3	4	5
		automation of document exchange with contractors (electronic document exchange)	Electronic office of the taxpayer; Art-Report Pro; M.E.Doc EDO; FREDO DocMen or FlyDoc; In time	<ul style="list-style-type: none"> ✓ reduction of temporary costs for processing, certification and transportation of documents between companies and contractors (from several days to several seconds); ✓ increasing the efficiency and accuracy of accounting at the enterprise
	Inventory	automation of the process of checking the availability and condition of assets	contactless information identification technologies (bar coding, QR-codes and devices for their reading, video recording using drones)	<ul style="list-style-type: none"> ✓ speed up and simplify the process of checking the availability of assets by encrypting data about objects in QR-codes ✓ accelerating data aggregation, which affects the efficiency of decision-making; ✓ objective assessment of the availability and condition of assets, as well as their changes between periods of inventory, which will prevent the loss and damage of assets, their timely renewal and reduce the cost of their restoration; ✓ saving time on inventory, which has a positive effect on the organization of the accounting process at the enterprise, increase the efficiency of accounting staff

Accounting processes	Accounting methods	Possibilities of process automation	Software	Possible benefits
1	2	3	4	5
Measurement of accounting objects in monetary terms	Evaluation	automation of determining the assessment of assets (land resources, agricultural yields, forest plantations)	Software and technological complex GIS (spatial-indicative database)	✓ spatial analysis and creation of fundamentally new models of the environment based on the results of the analysis
	Calculation	automation of cost calculation of products, works, services	Configuration of lines «1C: Enterprise» and «BAS»	✓ reduction of the cost of finished products as a result of prompt management decisions; ✓ prompt receipt of information on the cost of finished products
Systematization and reflection of business transactions	Accounts	automation of the working plan of accounts of the enterprise	Master-Accounting; ISpro; 1C: Accounting; Sail; Best-Report Plus; SAP ERP SAP BusinessOne	✓ accelerating the process of accounting reflection and systematization of business transactions in accounts; ✓ reduction of time spent for prompt receipt of information on balances on accounts
	Double entry	automation of business operations on the principle of double entry	Master-Accounting; ISpro; 1C: Accounting; Sail; Best-Report Plus; SAP ERP	✓ accelerating the compilation of data to ensure the reliability of accounting for business transactions on the principle of double entry; ✓ control of the correctness of the reflection in the accounting of business transactions; ✓ convenience of analysis of economic indicators and results of activity of the enterprise

Accounting processes	Accounting methods	Possibilities of process automation	Software	Possible benefits
1	2	3	4	5
Generalization of information on business transactions	Balance	automation of the process of compiling the balance sheet by economic grouping and generalized reflection of the state of the enterprise's assets by composition and location and by sources of their formation and purpose in monetary valuation on a certain date	Master-Accounting; ISpro; 1C: Accounting; Sail; Best-Report Plus; SAP ERP SAP BusinessOne	<ul style="list-style-type: none"> ✓ the possibility of operational control over business transactions in the process of reporting at the enterprise; ✓ high efficiency of the accounting system ✓ reduction of time for systematization and generalization of data at the analytical and synthetic levels on the economic activity of the enterprise to ensure management decisions
	Reporting	automation of the operational reporting system	SAP ERP – (Systeme, Anwendungen und Produkte in der Datenverarbeitung) – systems, application modules and products in the field of data processing) (module «Management Accounting and Reporting»)	<ul style="list-style-type: none"> ✓ coverage of all activities of the company integrated in real time, which allows to replace most of the single systems used and simplify the further technological development of the company, as periodic updates are comprehensive for all modules of the system;
		automation of financial reporting (digital financial reporting)	digital financial reporting based on the XBRL standard (eXtensible Business Reporting Markup Language)	<ul style="list-style-type: none"> ✓ fast and autonomous formation of financial statements; ✓ simplification of searching for financial reporting data on the Internet, as well as processing and analysis of information provided in it; ✓ reduction of labor costs for the creation of financial statements,

Accounting processes	Accounting methods	Possibilities of process automation	Software	Possible benefits
1	2	3	4	5
				<p>elimination of human errors, improving the quality and reducing the risk of non-compliance, reducing the time for the preparation of financial statements;</p> <ul style="list-style-type: none"> ✓ elimination of duplication when submitting information to different users on identical or similar forms of reporting, depending on the requirements of regulators (regulatory authorities), provided that a «single window» for electronic reporting, which will be accessible to all competent authorities
			XLM format (export of regulated reports submitted to the tax authorities in the format approved by the STA)	<ul style="list-style-type: none"> ✓ rapid export of reports to tax authorities in an officially approved format; ✓ reduction of labor costs for reformatting reporting to another format
		taxonomy of financial statements (systematization and electronic submission of indicators to be disclosed in accordance with International Financial Reporting Standards	XBRL standards for presenting financial statements in electronic form (XBRL – extensible Business Reporting Language is an open standard for exchanging business information)	<ul style="list-style-type: none"> ✓ reception, processing, verification and disclosure of financial statements of the enterprise in a single electronic format; ✓ creating reports within one organization or business process; ✓ application in any country of the world, regardless of the national language, in order to make economic decisions

Source: author's

The research results presented in table 4 confirm the conclusion that Ukraine in 2020 in the field of automation of the elements of the accounting method has the features of Vth technological level. Accordingly, information technology is increasingly becoming an integral part of accounting and allows to automate most of the accounting functions and processes. A feature of the development of accounting software in Ukraine is the lack of a unified approach to data processing simulation. Each developer of accounting software takes into account those features that, in his opinion, will simplify the process of accounting data processing.

Further development of accounting directly depends on the level of complexity of information technology and their use in each country. Wider introduction of software products and online services, in particular, **NFC technologies, cloud technologies, blockchain technologies** will allow Ukraine to develop to the VIth technological level. These innovative technologies are widely used in the field of accounting and improve the quality of the automated workplace of the accountant, reduce time and costs of certain types of operations and processes.

One of such methods is the introduction of short-range technology in the accounting process – **NFC technology**. One possible scenario for the use of such a mechanism for the transfer of accounting information is the NFC as a replacement or addition to existing methods of transmission of primary documents, financial and other types of reports of the enterprise. NFC technology initiates the transmission of electronic documents and data within the «close action» through touch on specialized equipment in one second. This method of data transmission is especially relevant for internal users of accounting information at the enterprise [21, p. 353].

The use of NFC-technologies has a significant impact on the modification of the documentation process as an element of the method of accounting. With the help of NFC-technology the data transfer process is reduced, in particular, the document generated in electronic form is transmitted to the place of shipment of goods in one touch in 0.1 seconds using specialized NFC-equipment and software. An important accounting procedure is the verification of the data received by the authorized person immediately. To do this, you can use a tablet computer from a supplier, which when transferring stocks (raw materials, products, goods) via NFC-communication transmits input data to the tablet computer of the buyer, which does not complicate the procedure of supplying paper media, does not require time for processing paper documents, their verification, analysis, confirmation by «live» signatures and seals, their introduction into the accounting system, printing requests, etc. [21, p. 354]. It is also possible to affix an electronic digital signature of the authorized person to the enterprise-buyer immediately during stock delivery.

The potential for using NFC data transfer at the enterprise or between enterprises is enormous. This technology can be used to sign contracts, confirm statutory data, transfer details, financial and tax reporting, exchange data

between specialized units within the production of current and future orders, shipments, relocations, storage and more.

It is important to use NFC technology as a complement to existing printed forms of accounting documents that can coexist. An example of such a combination can be the use of both forms of information transfer, in particular, upon receipt of goods from the supplier is issued a profit invoice, which is submitted in hard copy, as well as in the form of contact transmission of the electronic version of the document to the buyer for its automatic download to the accounting software and further processing.

A more expensive option for using NFC technology in the context of increasing the cost of manufacturing special data carriers is to use paper with a built-in NFC chip, which is the basis for printing paper documents and simultaneous transmission of electronic business data to the counterparty.

As noted by M.S. Popovych, the key advantages in the application of NFC-technologies in accounting are the improvement and simplification of methods of documenting business transactions, gradual reduction of unnecessary documents and stages of their processing, reducing time and money spent on the documentation process, maximizing profits and investments in one's own business in terms of released funds, increasing financial independence, as well as a positive social effect [21, p. 354].

One of the latest interesting studies in this area is the use of information and communication technologies in eco-accounting, the essence of which is to measure the environmental impact of goods, or so-called eco-points, throughout the life cycle of goods. In eco-accounting, large amounts of dynamic data should be taken into account to calculate the eco-point.

To obtain data, Information and Communication Technologies (ICTs) must collect dynamic data to calculate the eco-point and then make it available to all stakeholders along the value chain, from one operating model to another, for example, from material extraction to production and from supplier to the customer to measure the eco-point of the product. On the basis of eco-points receive eco-debit and eco-credit, which are used in various areas that have major concerns about sustainability, such as the assessment of sustainable production, environmental purchases, processing and environmental consumer account [33].

Significant technological changes to the processing of accounting data brought the development of «clouds» – networks of interactive computing platforms that provide shared access to the system of computing resources, including communication networks, storage media and servers, applications and programs, and more. The key advantage of using «clouds» is the rapid access to various resources and services without the need for communication with their providers and, consequently, with minimal management costs.

The types of models and cloud technologies available today and the possibilities of their use by enterprises of different types are shown in Figure 2. According to H.I. Liakhovych, it was the appearance of various mobile devices

that created the preconditions for the widespread introduction of cloud technologies in the field of accounting [22, p. 35].

The most common today are the main types of customer service in cloud technologies such as: DaaS – Desktops as a Service; IaaS – Infrastructure as a Service; ItaaS – information technology as a Service; SaaS – Software as a Service. There are also four organizational models of «clouds»: Private Cloud; Community cloud; Public Cloud; Hybrid Cloud [24].

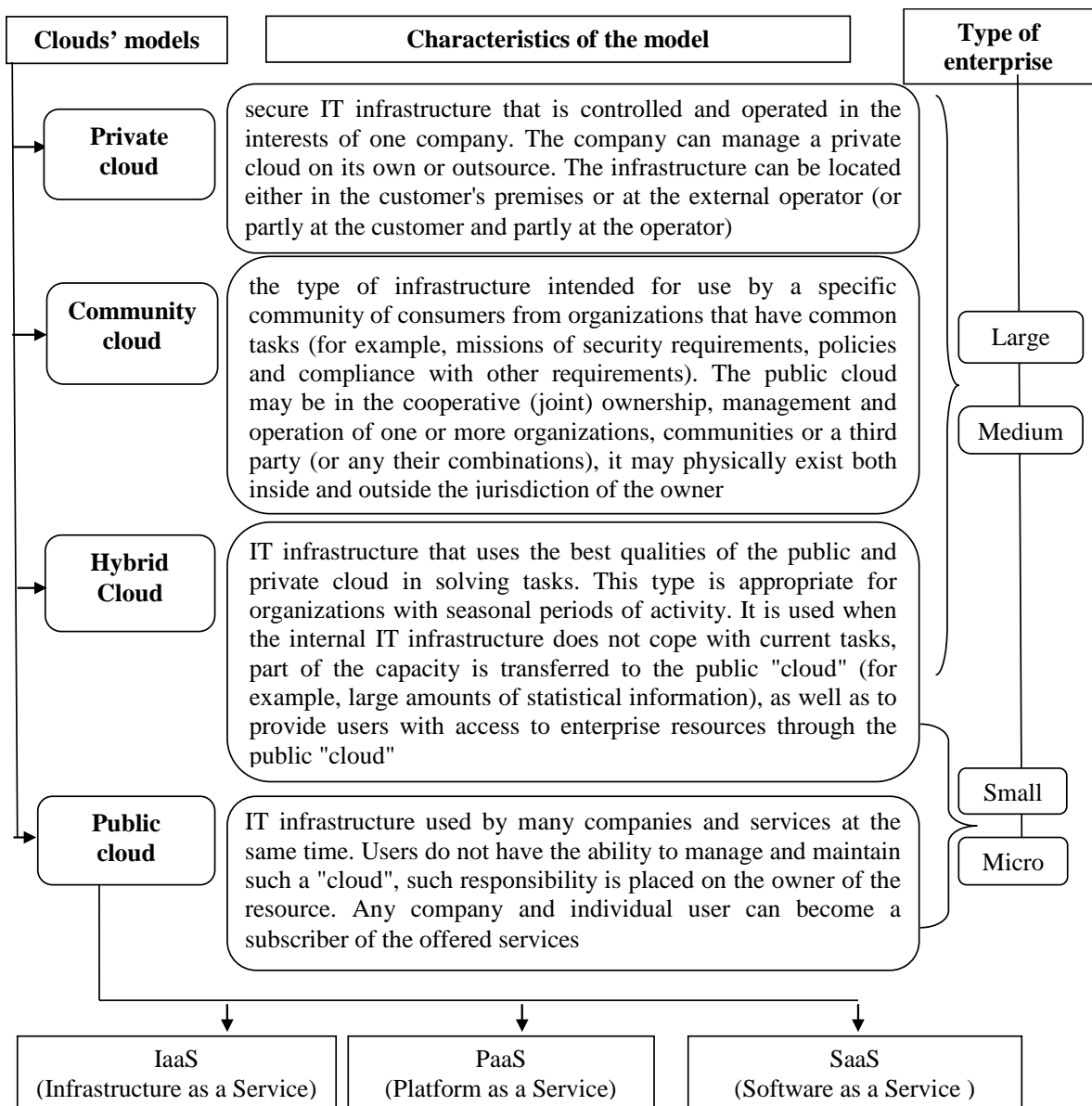


Figure 2. Models and types of cloud technologies and their use in the field of accounting

Source: author's developments on the basis of data from publications [22, p. 35; 23, p. 27; 24]

Large and medium-sized enterprises prefer private clouds when choosing the type of cloud, because this model is the most secure for preservation accounting, analytical data and confidential information. In essence, the private cloud is the property of the enterprise, is located on its server, is serviced by the information and computer department, but employees of the enterprise work with software and databases using remote access. This type of cloud is the most flexible for large and medium-sized enterprises, as the latter need to adapt the basic versions of software for their own needs and convenience, and their own information and computer department is working on it. Of course, under this model, the company continues to incur costs for the acquisition of software licenses, remuneration of employees who serve it, the purchase of computer equipment for data processing and storage [23, p. 27].

If an enterprise has limited financial resources, it can agree to share the cloud service with other enterprises in its industry (for example, with a similar organizational structure and reorganize the information and computer departments of several enterprises into one unit). Thus, the data of several enterprises will be on one server (Community cloud), while the work of employees of enterprises united by the community cloud does not change, and the budget of enterprises will be significantly reduced in terms of maintenance costs [23, p. 27].

In the event that community cloud provision requires significant investment in the acquisition of servers, administration of operating systems and databases, a decision may be made to move to a mixed cloud (Hybrid cloud), as a result of which the above functions and data will be partially or fully transferred to the public cloud (Public cloud). Having decided to use the public cloud, the company's management must choose the type of cloud computing, namely: IaaS (Infrastructure as a Service), PaaS (Platform as a Service) or SaaS (Software as a Service).

In accounting, the most widely used today is the model SaaS (Software as a Service) [23, p. 28]. The use of cloud technologies for accounting purposes provides primarily the processing of credentials over the Internet and their storage on powerful remote servers. The spread of cloud technologies for accounting purposes is exacerbated by the following factors:

- easy access to the accounting information base;
- acceleration of data exchange;
- optimization of the cooperation of accountants with other employees and contractors;
- reduction of overhead costs for management;
- prerequisite for the introduction of new products (services);
- available service (constant software updates, database backup, data protection from unauthorized access).

In Ukraine, the most common accounting software products based on cloud technologies are «BuchSoft», «jPARUS», «iFin», specialized software products «1C», «Smart Accounting» [25]. The use of cloud technologies has

the greatest impact on documentation as an element of the method of accounting, and methods of access to data, their processing and storage.

The use of cloud technologies for data processing purposes should take into account a number of features and risks that arise, in particular [23, p. 25–26]:

- high cost of cloud software maintenance;
- obstacles to access to databases via the Internet due to failures in the Internet, which slows down the work of departments of the enterprise;
- available access of Internet and hosting providers to enterprise data, which may be a probable cause of information leakage;
- most cloud technology servers in license agreements disclaim responsibility for data retention.

Thus, the use of cloud technologies for the formation, processing and storage of data should be carried out taking into account the need to address the following issues of information security: limited access to data in the cloud; compliance of software for transfer of information base; the company's ability to return the information base from the cloud to the company's information system in case of unsatisfactory conditions; flexibility of the platform in the cloud; the possibility of developing software solutions for individual enterprises depending on the nature of their activities; training of staff to work in the clouds, etc.

Research on the use of cloud technologies in today's accounting is given considerable attention, as evidenced by the large number of scientific publications in which scientists present the results of their research [34; 35; 36].

Another innovative technological way of working with data that changes the accounting system is **blockchain technology**.

Blockchain technology is a reliable way of transmitting information, protected by maintaining a unified registry, with the creation of a distributed and interconnected system of veracious accounting data. Blockchain is now seen as a prerequisite for a revolution in accounting and data processing methods.

In essence, a blockchain is a database that uses a large number of different servers to store information. The information is stored in specially structured blocks. Each block «refers» to the previous one, thus providing access not only to its own information, but also to that stored in the previous block. When changing data in one block, the system immediately detects that it is different from the data in other blocks, and notifies you. A feature of the system is the constant checking of data in blocks, notifications when they change and at the same time recording new information in a new block.

These characteristics of blockchain technology indicate its high importance for the control function of accounting, because this way of working with data does not allow errors or intentional manipulation of indicators by tracking all financial transactions and notifying all changes in real time.

As key areas of use of blockchain technology in accounting, which will reduce the cost of its maintenance and increase the value of accounting information, there are the following [27]:

1) settlements with counterparties – with the introduction of blockchain eliminates the need for mutual reconciliation of settlements. The formation and write-off of receivables or payables for the parties to the agreement will occur simultaneously in the same assessment at the time of the transaction. You do not have to confirm the fact of the transaction and its evaluation. The accountant will have to correctly classify the acquired / transferred asset and the corresponding income / expenses;

2) the movement of assets within the enterprise – any fact of economic life can be shown in real time, information about the movement of any assets is displayed at each time with a message about the change in their status. The work of the accountant is reduced to the correct classification of assets in their receipt / disposal and the formation of the value of such accounting objects. A local blockchain can be organized within one enterprise or group of companies; and the release of assets from their places of storage is accepted by the recipient, after which the asset is automatically debited to the appropriate accounts;

3) real-time operational accounting – blockchain radically changes the processing primary documents by accountants. Primary documents will become unnecessary either in paper or electronic form. Instead, the transaction is fixed in the blockchain.

The importance of the use of blockchain technology is evidenced by the existing trends in its implementation in various activities, in particular, in the practice of US regulators to control financial transactions [26].

The gradual spread of blockchain in accounting practice creates a trend of reporting companies through a blockchain system, which increases the requirements for accountants and creates a demand for professionals who can work with this technology, and not just with traditional accounting software. Thus, one of the latest studies on this issue is the development of methods for secure multivariate computing used to aggregate shared data, network analysis and the use of public key cryptography to establish identity and store data on the blockchain. Using these methods together can enhance the representative reliability of financial statements [37].

The latest key technological advancement that develops data processing systems in general and accounting in particular, is the **technology of artificial intelligence**.

According to scientists [4], the fundamental difference between the VIIth technological level from all previous ones will be the inclusion of human consciousness in the manufacturing process. It is predicted that human consciousness will become the key productive force that science once became. This new type of technology is called cognitive, respectively, the VIIth conformation is a cognitive way, where the main production factor is creative intelligence, which changes the production function, and accordingly many provisions in economic theory and management.

In particular, in the composition and structure of production means and factors of production in the first place will be human capital and knowledge-

intensive products as opposed to material and capital intensity. Cognitive technologies in the long run can lead to the creation of a new mega-industry comparable to the level of development of the computer industry.

In the early stages, computers were used only for direct computing, and the main attention was paid to electronics, architectures, speed of action. Once the key issues were resolved, the focus shifted to systems programming, application packages and their extensions. In this round, a giant software industry was formed. The same potential lies in the technology of artificial intelligence, which can affect and develop all spheres of human life.

In general, cognitive technologies are focused on helping people in setting tasks, solving poorly formalized creative tasks (political, economic, military, etc.), identifying and effectively using cognitive potential and the ability to learn and create. Today, the development of five cognitive technologies that will change the world is predicted: neuroimaging, cognotropic drugs, cognitive assistants, brain-machine interfaces, artificial sense organs [4, p. 11].

Given that the key feature of artificial intelligence technologies is the ability to process huge amounts of information in a short time; its application has significant prospects in accounting for real-time data processing with elements of planning, forecasting, risk and uncertainty.

For accounting purposes, artificial intelligence will allow you to fully automate accounting processes of different levels of complexity. Software products will independently process accounting data according to pre-built algorithms with their further automatic improvement during the operation of the program [29, p. 140]. In the event of unforeseen situations, the automated accounting system will be able to identify all business transactions.

On the basis of the accumulated experience the automated recognition, estimation and reflection of the new facts of an economic life will be carried out on accounts for the enterprise. The development of algorithms for automated accounting data processing requires modelling of business and information processes, which will radically change the economic performance and decision-making at the micro and macro levels.

Conclusions

The conducted research of the impact of global technological changes on the accounting system and its development is presented in view of the key transformations of scientific markers of accounting (subject, objects and methods) under the influence of changes in technological conformations. The key influences of technological innovations on the development of the accounting system are presented on the example of Ukraine.

A key feature of the accounting system is its high sensitivity to various factors, including stakeholder inquiries about the structure and content of information needed for decision-making, technological innovations that determine the nature of accounting procedures, government policy in the field of accounting and its dependence on global and geopolitical changes.

Technological conformations as a set of technically and technologically related processes and methods of production, historically defined in time, are one of the leading factors influencing the accounting system. Technological conformations have changed as a result of revolutionary transformations introduced in the field of engineering and technology and affected data processing. The presented influence of technological levels on the accounting system reflects the gradual technical improvement of the accounting process and the change of its procedural context.

The research of historical features of the spread of technological conformations in time and geographically, allowed to identify and reveal the key features of each of them, including: period of dominance, technological leaders, developed countries, the core of the technological conformation, key factor, the core of the new conformation that is being formed, the advantages of the technological conformation in comparison with the previous one. The formed system of comparison of the given criteria allows to see the basic transformations in their dynamics taking into account technological and economic level of development of the countries.

The considered features of technological conformations reveal key changes in technical and economic processes, however, the same periods testify to the manifestation of significant changes in data processing and, in particular, in the accounting of business entities, their reporting. Modification of key scientific markers of accounting under the influence of changes in technological levels is presented on the example of its subject, objects and methods.

Particular attention is paid to the main approaches to determining the subject of accounting, which have changed under the influence of the development of technological levels. The concretization of the subject of accounting is carried out due to the emergence of new objects of accounting, the system of which has changed with the formation of new technological conformations.

The study of the nature of the impact of technology on the accounting method is most evident in our time and is presented on the example of elements of the accounting method that are traditional for the Ukrainian scientific environment in the period 1990–2021. For Ukraine this period corresponds to the Vth technological level. In the process of the presented analysis, typical accounting software developed by Ukrainian companies or by world leaders advancing in the Ukrainian technology market are used.

The results of research allow us to conclude that Ukraine in 2020 in the field of automation of the elements of the accounting method has the characteristics of the Vth technological level. Accordingly, information technology, which automates most of the accounting functions and processes, is becoming an integral part of accounting today. A feature of the development of accounting software in Ukraine is the lack of a unified approach to simulating the data processing. Each developer of accounting software considers those features that, in his opinion, will simplify the process of accounting data processing.

Further development of accounting directly depends on the complexity of information technology and their use. Wider introduction of software products and online services, in particular, NFC technologies, cloud services, blockchain, will enable Ukraine to develop to the VIth technological level. These innovative technologies are widely used in the field of accounting and improve the quality of the automated workplace of the accountant, reduce time and cheapen the cost of certain types of operations and processes for processing and presentation of accounting and reporting data.

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