The process of capital accumulation in a digital ecosystem: theoretical and methodological aspects

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Abstract. The paper presents a theoretical and methodological analysis of the process of capital accumulation in the conditions of formation of a new civilization. The core of this civilization is the production mode as a set of productive forces that are in a contradictory unity with production-economic and eco-social relations, which reflect the contradictory relationship between production and consumption, namely, in their prerequisites, conditions, implementation, results and forms of manifestation.

1. Introduction
The current state of the global and national economy indicates that the dominant feature of the accumulation process is information, transformed knowledge that exhibits the characteristics of a commodity with the price determined by the law of supply and demand. This is one of the factors of capital accumulation, which is primarily based on digital and computer technology that radically changes ways and means of scientific and technological progress and affects the empirical laws of long-term development. Many companies are oriented towards formation of their own ecosystem based on digital platforms. Diversification of their activities in the digital economy acquires new content, which includes emergence of high-tech companies or groups of companies that are attractive to investors in the technology sector. From this standpoint, the study of capital accumulation becomes particularly relevant.

The basic law of the Russian Federation states that the main goal of the welfare state is to create conditions that ensure ‘... a worthy life and a free development of man.’ [1]. Achievement of the stated goal requires identification of trends and features of capital accumulation in the context of its merging with the state and a variety of forms of ownership.

In terms of science and practice, economic theory reveals the scientific and practical essence of capital accumulation and its role in the development of modern Russia. Common features of this process should be identified for all civilizations through the prism of materialistic dialectics. The study of specific forms of economic development allows economic science to provide general definitions that characterize production as such. Focus on these general historical features.

Accumulation is an internal component of the reproduction process, a prerequisite for the socio-economic development of society based on domination of private capitalist property, which implies wage labor and appropriation of the producer’s surplus time, and serves as a material prerequisite for expanded reproduction of production, organizational-economic and socio-economic relations.
This study explores the problem of transformation of the essence and the role of capital accumulation in the socio-economic development of modern Russia based on the analysis and synthesis of natural phenomena in civilization formation as a way of interaction of productive forces and economic and social relations, in which information as knowledge transformed through digitalization becomes dominant.

2. Methods
Understanding of the essence of capital accumulation should start with an abstract category that is significant within the framework of various historical eras and expresses the essence of economic relations between owners of the means of production and wage labor [2,3]. This, in turn, reveals production relations and internal structure with respect to specific socio-historical forms of production. It should be noted that the truth of scientific abstractions must always be verified in practice. This conceptual approach considers different facets of the process of understanding and serves as a general methodological basis for capital accumulation investigation.

Dialectics interconnects such categories as the general, the particular, and the singular. One of the sides of objective reality becomes absolutized if one of the categories is excluded from the analysis. Similar to the categories of economic science, these sides in reality mutually exclude each other and simultaneously form a unity. They are mutually presuppose each other.

The process of accumulation in different formations proceeds in accordance with the universal laws of dialectics, with the law of the unity and struggle of opposites as a crucial one. Any phenomenon, including the economic one, exhibits opposite characteristics mutually presupposing, conditioning, penetrating each other and simultaneously negating each other.

The study identified new trends in transformation of capital accumulation. They are based on transition to a new technological mode, where information is the dominant, and the core is computer and digital technology, which caused transition from a functional based on division of labor to a network economy. The study employs the basic laws of dialectics, neoclassical and reproductive approaches using general scientific methods such as historical and logical methods, and scientific abstraction.

2.1 Contradictions in the process of capital accumulation
The accumulation process is characterized by contradictions: internal and external ones. The former can be attributed to the relationship between the owners of capital and hired producers, since the specific historical nature of these relations related to factors of the accumulation process and the results of its appropriation form the basis of economic knowledge. In contrast to internal contradictions, external ones are determined by the relationship and interdependence of two processes: accumulation and reproduction. In reality, the contradictions, which are expressed in both qualitative and quantitative characteristics of the accumulation process, intensify the contradiction between production itself, on the one hand, and consumption, on the other one, and overproduction crisis, when material wealth grows as compared to the development of a person.

According to the classical approach of the theory of labor value, the analysis of real contradictions of the capitalist economy should be based on specific material. The essence of capitalist production can be stated as follows: “Production for the sake of production.” Social ownership of the means of production turns production itself into a means of satisfying the producers’ needs. Therefore, a person is a subject of production, and material factors are an object. Man as a personality and his needs become an objective goal of production. New goals allow production to go beyond its limits into higher horizons of human life. Two facets of the social process of reproduction, production and consumption, are inseparable parts of a whole, and during this process both material conditions and socio-economic relations with respect to producers change.

It should be remembered that at every real moment the productive forces are limited. Therefore, they are a means of satisfying both personal and social needs of a rather limited amount. The limit of production that is based on private property is capital itself. This limit manifests itself during
expansion or contraction of production, since their value depends on appropriation of unpaid labor.  
The study of the accumulation process should be based on analysis of its structure, changes during the accumulation process, where productive forces change together with the corresponding changes in production relations and aggravation of contradictions between productive forces and production relations. Accumulation in a simplified form is the quantitative growth of capital, which is not followed by changes in its structure. In this case, accumulation typically shows quantitative increase in capital, including the growth of its constant and variable parts. This is not characteristic of each specific historical process of capital accumulation, since the variable part reduces relative to the constant part of capital, which results in emergence of a reserve army of labor.   
Practice shows that accumulation of capital during continuous technological revolutions is followed by continuous quantitative changes in its structure and by increased labor productivity. The growth of the organic composition of capital in turn leads to formation of a reserve army of labor and redistribution of labor between various sectors. The growth of the technological and organic structure of capital is particularly associated with the release of labor from individual industries, its redistribution into emerging or developing industries, reduced number of people employed in material production, and redistribution of the latter into the sphere of non-material production. Qualitative transformations, namely, changes in the structure of production, turn into quantitative ones, i.e. the number of people employed in material production reduces. The material basis of socio-economic development is improvement of the quality of accumulated potential.  

2.2 From concrete to abstract  
The process of capital accumulation should be studied by method of ascent from the concrete to the abstract, and then back to the concrete at a new higher level.  
Understanding of the accumulation process is a simple empirical fact – a visible phenomenon of the economic life of society. Accumulation represents a concrete phenomenon – the whole, and its inner essence is not revealed. This can be done through the study of individual phenomena in their generality, real pattern. Consistently summarizing the facts and analyzing them, we identify the next general economic abstraction – extended reproduction. This definition is interrelated with categories of property, centralization and concentration of capital. The reverse movement in cognition from the abstract to the concrete starts from accumulation (abstraction) and goes to its real manifestations: the definition and establishment of the boundaries of accumulation, the norms of the optimal ratio of savings and investments.  
It should be considered that the quantitative value of capital accumulation is calculated based on the form of returns (e.g., interest) to capital, since its qualitative value (source) depends on the level of development of productive forces (material and human capital), the productivity of surplus labor time. As a result of the sequential understanding of the entire process, we obtain a concrete single whole. The theoretical study of the accumulation process results in economic efficiency and social effects of the process under consideration, and it leads to practical implementation.  

2.3 The law of the negation of negation  
The law of the negation of negation, which characterizes the direction, form and its result, should be finally employed to study capital accumulation. Accumulation as a production process is a spiral movement. Each previous reproduction process is the basis for the next cycle of expanded reproduction and, in turn, it becomes identical to this basis after passing the reproduction process, since both processes involve expanded reproduction. Simultaneously, quantitative and qualitative changes occur directly in the reproduction process during capital accumulation due to changes in its organic structure.  
Therefore, the study of capital accumulation in terms of materialistic dialectics allows the following assumptions.
1. Consistent transition from the analysis of capital accumulation in general to the analysis of the characteristics of its accumulation in a specific historical form excludes repetitions and provides a broad theoretical foundation for studying the socio-economic aspects of this process.

2. The need to use the laws of dialectics not as their mechanical sum, but as a total sum, which in turn reflects the progressiveness and continuity of the process development. This approach is effective for development of a unified concept of the capital accumulation process.

3. Methodological approaches are employed, since in a number of cases there is a need to free oneself from subsequent subjective interpretations of the essence of the accumulation process in order to form true ideas about this process in the developing Russian economy.

4. A number of certain theoretical propositions and conclusions should be developed, clarified and concretized to reveal through social and political practice specific discrepancies between the established ideas about the accumulation process and its real content, which is enriched with new, yet unexplored phenomena, on the one hand, and those distorted by deformations, on the other one.

3. Result and discussion

A society that promotes enrichment of capital owners through exploitation of hired workers, exacerbates the main contradiction between the level of development of productive forces and the nature of socio-economic relations during capital accumulation. It should be noted that the use of methodological approaches in different areas of economic science lead to different interpretations of the essence of capital and its accumulation. Modern neoclassical theory (‘economics’) treats the microeconomic theory of capital as the theory of interest or capital as a specific commodity; the theory of profit as the theory of capital as a percentage of production, a source of uncertain income; the investment theory as the center, which is based on the neoclassical principle of partial equilibrium [4].

Political economy, the basis of economic theory, penetrates into the essence of phenomena and substantiates their subordination and interdependence, while ‘economics’ initially analyzes phenomena and processes in the form they are represented in everyday reality.

The use of various methodological approaches in one or another direction of the economic theory leads to different interpretations of the economic laws of civilizations and production methods.

Classical political economy based on the theory of labor value considers the production of surplus value based on the capitalist private ownership to be the basic law of economics. Representatives of the ‘economics’ theory regard the equivalence of production factors realized in circulation as the initial law. The main goal is to achieve market equilibrium [5,6].

The law of surplus value reveals the specificity of surplus labor in the mode of capitalist production in comparison with other formations, and the essence of capitalism through the prism of labor exploitation by capital, which is based on the system of private ownership of capital. This law provides understanding of the inner essence of the accumulation process in an abstracted form, which is free from the developed forms of profit and capital. The reality hides capital behind specific economic institutions and forms of personal income: wages, interest, profit, rent. Capital accumulation constantly reproduces the exploitation relations on an increasingly large scale and creates contradictions between the owners of the material capital and the owners of hired alienated labor.

Thus, capitalism aiming at maximization of profit as manifestation of surplus value reduces necessary labor expenses and increases surplus labor expenses.

3.1 Dominants of economic growth

Civilization technologically based on digitalization develops based on the level of knowledge of the capital accumulation law and the quality of leisure time management, which makes the basis for development of productive forces and comprehensive human development [7–9].

Information becomes a dominant feature of economic growth and acts as a transformed form of knowledge, which exhibits the features of commodity, the value of which is determined by the socially necessary labor expenditures to transform knowledge into information, and the price, as the monetary embodiment of value, is determined in market conditions by the law of supply and demand.
Information, being one of the production factors, gives impetus to the accumulation process, the core of which is digital and computer technology. This technology radically changes the ways and methods of scientific and technological progress, which, in turn, affect the empirical patterns of long-term development and determine formation of new forms of activity. A new civilization employs the laws of the network economy, and some conventional laws inherent in the industrial economy lose their significance.

For the first time, the issue of the existence of long conjuncture cycles lasting from forty to sixty years was considered by N. Kondratiev in his study *The long waves in economic life* [10]. According to J. Schumpeter [11–13], these waves are based on innovations that induce a new Kondratiev’s cycle. For several decades they have been the locomotive in the global economic development. These are basic innovations that form a network of technological and economic initiatives that meet the following requirements:

a) technological innovations determine the vector and speed of innovative development;

b) economic innovations in the phase of recovery determine general economic development, and, hence, economic growth;

c) macroeconomic innovations lead to radical reorganizations.

Information is the basis for economic growth of the modern cycle. The core of the basic innovation is digital and computer technology with a new technological mode, where information technology is of paramount importance, and microelectronics and communication technology are of secondary importance. Scientific and technological progress has brought significant innovations in the field of microtechnology. On the one hand, the number of functions integrated in one chip continuously increases and the costs associated with processing, storage and transmission of information sharply decrease. On the other hand, the corresponding capacities turn into an unlimited resource. The areas and potential of microelectronics are expanding: medical devices and equipment, household and industrial equipment, telecommunications, and others.

In economic science, the main factors of economic growth are labor, capital, and scientific and technological progress. The latter increases the efficiency of the first two factors used in the form of material and technological innovations, which affects the growth of labor productivity. The invention of the steam engine and transition to industrial production lead to the economy of production scale based on growing functional specialization which implies the division of labor. The reduction in production costs caused by specialization deepening was simultaneously partially compensated by increased coordination costs. Modern civilization uses ecosystems to significantly reduce transaction costs.

The control mechanism operates in different ways in industrial and information civilizations. Industrial civilization is based on the production scale effect with the dominance of negative feedback. The last modern civilization is based on the network effect with the dominance of positive feedback.

In industrial civilization, the cost–output ratio with other conditions being unchanged is represented by the S-shaped curve, which can be concretized in some theories (for example, production, costs, wages, budget, profit). They can be summarized in the law of diminishing marginal returns, which states that income in contrast to costs initially grows in an increasing proportion, and then begins to grow in a smaller proportion.
The maximum profitable equilibrium of the company is ensured by the quantity of offered goods and services, when the equality of marginal returns to marginal income (MR=MC) is achieved. It should be noted that this negative feedback appears as a factor of balance and stabilization in material and energy-intensive industries, namely, in agriculture, mining, manufacturing.

3.2 Network effect
Information economy that employs a network organization of economic activity is characterized by the predominance of direct network effects, i.e. positive feedback, which is represented as the law of increasing marginal profitability.

Consider the essence of the direct network effect: the effect itself is the main source of income based on the growth of production scales with inherent exponential increase in utility. The network effect itself is induced by a significant increase in the productivity of workers in microelectronics. This in turn changes the structure of costs and increases the share of constant items and induces the economic law of increasing marginal profitability [14]. Structural changes in costs (fixed to variable costs ratio) are inherent in industries that employ advanced technologies. This trend is evident in the sector of telecommunications due to the need for significant production investments to create a network infrastructure. The dominance of fixed costs forces business entities to form strategic alliances using modulated costing approaches to minimize fixed costs by creating new revenue systems, for example, in the form of fixed income. However, only reduction in fixed costs alone leads to constantly increasing profits.

The above changes in the development of social production are caused by scientific and technological level of reproduction. This can be primarily observed in the high-tech sector, which includes industries that produce computers and telecommunications equipment, software, cars, airplanes, missiles, medicines, and products manufactured by means of microelectronics and telecommunications.

Thus, the method of network management should be put into practice in the reproductive system of information economy, where digital-based network relationships prevail. In reality, particularly this approach is practiced by companies to create their own ecosystems.

The potential of communication technologies expands network relationships both between and within technological systems and with participants in the social system. An important requirement for formation of such networks is compatibility of the elements combined in a network; as a result, a direct and/or indirect effect of network benefit is achieved. A direct network effect can result from a direct increase in benefits due to the use of a similar product by other consumers, that is, the cost of the network is determined with regard to the number of potentially possible communication links between all its users. An indirect network effect can arise in case of a decreased cost of components, for example, software products, spare parts, and service.

4. Conclusion
The study found out that historically the accumulation process is vector-oriented, and it employs advanced methods of organizing the economic activity in economic entities that aim to increase labor productivity and leisure time as the basis for comprehensive development of the individual.

The study revealed that according to the historical processes and economic laws of the system, the core of which is the production mode, the accumulation of capital is a limiting factor for the main goal of the community caused by the contradiction between labor and capital, including the contradiction between the social nature of labor and the private capitalist method of appropriation.

The goal of the capitalist production mode is profit maximization as a form of manifestation of surplus value in industrial civilization, and the latter results from the reduced necessary labor expenses and increased surplus labor expenses. During the transition to digitalization based information economy, further development of civilization becomes dependent on the mechanism of the universal law of accumulation and the quality of leisure time management as the basis for development of productive forces and the individual in new conditions.
The transition to a network economy causes fundamental structural changes and increases competence requirements determined by the need for appropriate qualification levels of economic and technological development of human capital.

The solution to this problem is an increase in investments in human capital and in leisure time in order to train qualified workforce.

To sum up, the conclusions and proposals are as follows:
- further development of modern civilization, in which digitalization is the technological basis, depends on the level of knowledge of the essence and mechanism of operation of the economic law of accumulation and the quality of leisure time management as the basis for development of productive forces and comprehensive development of the individual;
- information is the category that indicates the fundamental relationship between the economic growth and the basic innovation, i.e. digital and computer technology, in formation of information economy;
- digitized information is one of the strategic socio-production and economic factors promoting development of the economy and its socialization, emergence and spread of a new technological mode, and improving the quality of managerial decisions;
- digital economy is the foundation of the information society, in which information is the determining factor in the reproduction process;
- as a result of unification of the reproduction phases, the method of network management was put into practice. Its main functions include network planning, network organization of the reproduction process, network motivation, and network accounting and control, which is most effectively implemented in companies that formed their own ecosystem.

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