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## THEORETICAL AND METHODOLOGICAL FOUNDATIONS FOR MAINTAINING OF SUSTAINABLE DEVELOPMENT OF CITIES AND METROPOLITAN AGGLOMERATIONS

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## ТЕОРЕТИКО-МЕТОДОЛОГІЧНІ ОСНОВИ ЗАБЕЗПЕЧЕННЯ СТІЙКОГО РОЗВИТКУ МІСТ ТА АГЛОМЕРАЦІЙ

**Purpose.** To substantiate the criteria and prerequisites ensuring sustainable development of cities and agglomerations with consideration given to features in behavior of the basic and supporting urban subsystems. The concepts of “development”, “sustainability” and “sustainable development of the city (metropolitan agglomeration)” are in the research area.

**Methodology.** The definition of the city as a logistics system reveals basic and supporting urban subsystems, the notion of which contributes to the development of the criteria of urban sustainable development.

**Findings.** The research proves that the city is a logistics system. The given criteria work if preconditions for sustainable development of cities and agglomerations provided balanced. These preconditions are as follows: adaptation of cities to internal and external factors that helps to maintain social, ecological and economic security; the rate of change in consumption of resources and their structure (i.e. more efficient use of domestic renewable resources due to reallocation of urban flows as compared with non-renewable external ones); the balance between consumption and reproduction of socio- ecological and economic resources; the expanded reproduction of socio- ecological and economic resources.

**Scientific novelty.** Originality is observed in the definition of “sustainable development of the city (metropolitan agglomeration)” based on the researched approaches to understanding of such concepts as “development” and “sustainability”, which allowed determining the criteria and prerequisites for sustainable development of cities and metropolitan agglomeration. The author's understanding of the terms “city”, “development”, “sustainability” is given.

**Practical value.** Presented criteria and prerequisites for sustainable development of the city (metropolitan area) will contribute to the development of methodical approach in the diagnostics of efficiency in maintaining of the urban sustainable development and to the identification of priority tools appropriate to increase the efficiency in urban sustainable development maintenance.

**Keywords:** *sustainable development of a city (metropolitan agglomeration), adaptation, socio- ecological and economic resources, criterion, socio- ecological and economic security*

**Statement of the problem.** The issue of sustainable development of cities and agglomerations has become especially acute, primarily due to the socio-economic crisis, difficult environmental situation, and inefficient, irrational or uncontrolled consumption of socio-ecological and economic resources. Moreover, with the current urbanization rates, the development of cities and of agglomerations is associated directly with the positive dynamics of socio-economic indicators. Prominent scientists analyze how the cities affect the environment but only in the context of social and economic development, when all necessary resources (the building land, the raw materials for industrial production, the drinking water and the water for industrial needs, etc.) are provided, and safe environment for the life of urban population (i.e. anticipation of industrial disasters that contaminate the water, the air, the soil, or cause uncontrollable deformation of the landscape) is ensured. Uncontrolled exploitation of non-renewable and of limited renewable natural (ecological) urban resources can both not only stop the development of

the city, but completely terminates its existence. That is why today of particular importance is the task to develop theoretical foundations for sustainable development of cities and agglomerations as a constituent part of the scientific cognition of reality, as its basic standpoint.

**Analysis of recent researches.** The problem of ensuring the sustainable development of cities and agglomerations is discussed in papers of such leading scientists as Zoryana Gerasyanchuk, Olena Karlova and Oleh Kariy.

**Statement of still unsolved aspects of the problem.** Given the significant scientific achievements, still unstudied is the basis of theoretical foundations for sustainable development of cities and agglomerations with a logistics approach in mind. The reason is that existing approaches to understanding of the city, such as the city as a settlement; society (Feliks Stolberg, Viktor Ladyzhenskiy); the city as a system (Olena Karlova, Zoryana Gerasyanchuk, Oleksandra Drachenko, Alla Melnyk); the city as a spatial organization (Zoryana Gerasyanchuk, Tetyana Nischyk) should complement the approach to the city as a logistics system. It is evidenced by the position of Aleksandr Gran-

berg, who considered the region as a quasi- corporation, i.e. some integrated entity with a specific activity. However, to ensure that the activities are effective, you need to optimize them. Optimizing the processes that are in the area, city, agglomeration by means of such management approach as logistics, we can consider the region not only as a quasi- corporation, but as a logistics system.

This opinion is shared by Zoryana Gerasymchuk, Lyubov Kovalska, Nadiya Khvyshchun, Olena Moroz, who view the region as a logistics system. Besides, Zoryana Gerasymchuk, Tetyana Nischyk see the city as a spatial system with interacting subsystems and envision a logistics approach. Given that, Galyna Ivanova-Kostetska notes that a logistics approach is the basis for solving the problems that arise in cities [1].

**Setting of goals.** The purpose of the paper is to develop the theoretical and methodological framework for the sustainable development of cities and agglomerations.

**Statement of arguments.** From our point of view, the city as a logistics system is characterized by the system of input and output flows that occur through the consumption of socio-ecological and economic resources; by internal and external environment in which there are such basic stages of the logistics process as procurement-production-distribution-consumption, that actually confirms the position to consider the city as logistics facilities.

The city as any logistics system is adaptive, open to interaction with the environment, organized, structured economic system consisting of interconnected and interacting participants, united by common purposes and economic interests, and developed to optimize the resources used in economic flows.

Since we characterize the city as a logistics system, we should single out subsystems taking into account the functional direction of subsystems in the city and their role in logistics processes. We differentiate the backbone subsystem (residential, industrial and economic, medical, educational and cultural) and the supporting (power distribution, transport, allocation, information and communication) subsystem of the city. Thus, urban backbone subsystems consume and reproduce socio-ecological and economic resources, while supporting subsystems consume and relocate socio-ecological and economic resources within the urban subsystems (figure).

1. Residential urban subsystem of the city functionally provides urban public housing, ensures comprehensive improvement of housing, as well as comfort living in urban areas, including the consumption of public services. Effective organization of residential subsystem is achieved by financial affordability of housing for residents, by reduced expenses aimed at its creation, and by optimal organization of communication interfaces that help reduce costs for housing and transportation needs.

2. Industrial and economic urban supporting subsystem covers companies, offices, financial firms, banks, insurance and credit institutions, and is supposed to produce goods and services consumed by city residents.

3. Medical urban subsystem provides physical reproduction of residents, thus ensuring other urban subsystems with qualitative social resources, and contains med-

ical facilities that provide primary, secondary and tertiary health care.

4. Educational and cultural subsystem of the city (preschool, school educational institutions, higher educational institutions, cultural institutions, sports facilities) is aimed at creating the conditions for training of qualified social resources in proportions and quantities required as for the backbone and supporting urban subsystems; at raising the public awareness; development of harmonic consciousness; conservation and enhancement of cultural heritage, development of physical culture and sports.

5. Power distribution supporting subsystem (gas, electricity, water supply and drainage systems, communication networks) plays a key role in the logistics system, because it provides distribution of energy resources in the city through all subsystems and contributes to the reduction in consumption of the urban environmental and economic resources due to rational organization of this subsystem, by reducing losses during transportation, in particular.

6. Urban transportation subsystem is one of the most important supporting subsystems and includes external transport facilities and non-urban routes and commuter links, urban street and road network. Basic functions of this subsystem are as follows: organization of the public, and other intercity transport, organization of external passenger and freight transportation.

The efficiency of the transportation urban subsystem in delivery process will ensure the flows' movement in the shortest time and at the lowest cost. It is possible to perform in the framework of the transportation subsystem operation, where the whole range of services is minimized with respect to loss of time, of socio-ecological and economic resources, and all the necessary related services are provided for customers. Problems associated with insufficient transport services and uncertain transportation terms, may adversely affect the logistics maintenance of the urban sustainable development as a whole.

7. Distribution subsystem is an aggregate of interacting and integrated sets of elements (shops, and restaurants, kiosks, permanently stationed markets). Their operation allows providing optimal and rational organization of goods transfer from the supplier to the consumer through the logistics chain at minimal cost, which promotes the rational use of socio-ecological and economic urban resources. The effect of a distribution subsystem in the logistics maintenance of the urban sustainable development is determined by the fact that it is designed to meet consumer needs for goods and services with minimal investment of time and resources (transport, material) as the result of development of urban logistics distribution network.

8. Information and communication subsystem provides management of the information flows (formed on individual objects) in the processes of supply-production-distribution-consumption aimed at improving of governance in economic activity, health care, higher levels of education and cultural activities, law enforcement, elimination of emergencies. Therefore, it should be noted, that information and communication subsystem has significant influence on the logistics maintenance of the urban sustainable development.

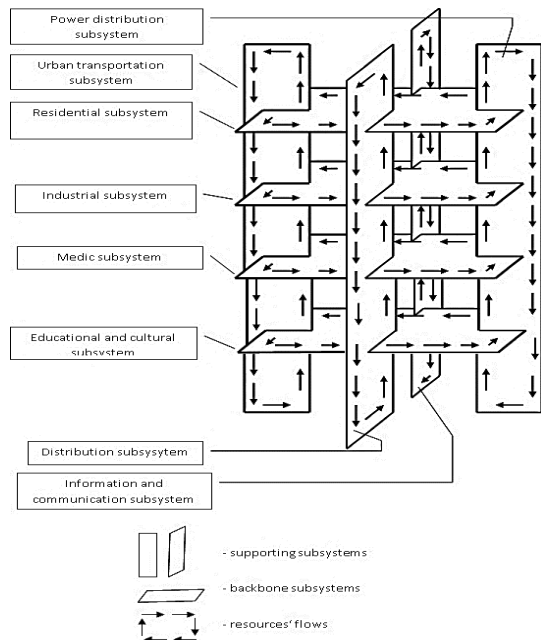


Fig. Backbone and supporting subsystems

Mentioned above subsystems are interconnected by logistics flows. Thus, the logistic flow (as a set of homogeneous elements relocated in space and time at a certain speed and intensity) does not arise directly in supporting (logistics) subsystems, but it occurs in a static backbone subsystem as a result of consumption of socio-ecological and economic resources (spatial basis, capital goods, equipment, machinery, facilities, buildings, transport, finance, population, employment potential, human and intellectual capital). In supporting subsystems, the flow just moves between the “destination points” (system-subsystem). The defined backbone and supporting subsystems and their particular operation confirm the fact that the city is also a logistics system.

From our position, the city is a complex logistics system focused on fulfilling of the needs of a specific group of subjects (of urban population) by the consumption of socio-ecological and economic resources that form the backbone and supporting subsystems.

However, the functioning subsystems of a certain city interact in space with subsystems of another city forming their agglomeration, i.e. territorial entity that can occur on the basis of one or more cities. The interaction between subsystems occurs when there is a lack of specific internal resources in the city, which leads to consumption of socio-ecological and economic resources provided by backbone and supporting subsystems of another city.

At the same time, a characteristic feature of supporting subsystems is that they cannot exist beyond the backbone ones. However, independent existence of backbone subsystems in theory is possible, but its effective functioning will steadily decrease until the termination of the urban life cycle. During its operation and interaction with the backbone subsystems, supporting subsystem undergo changes, i.e. transformation.

During the transformation of supporting subsystems considered as the basic guiding for material and immaterial

urban flows, the city must adapt under the changing conditions and have the potential for such transformations that create opportunities for development. However, remember the fact, also emphasized by Zoryana Gerasymchuk, Iryna Vahovych [2] that the transformation not always leads to the improvement of the system, while the main goal of sustainable development is to achieve better results.

The statement of the mentioned goal of sustainable development is determined by our understanding of urban (agglomeration) sustainable development as positive quantitative, qualitative, directed, irreversible changes in the process of supply-production-distribution-consumption, the ones that help to adapt to the effects of endogenous and exogenous factors, to ensure higher rates of reproduction of resources relatively to the rate of consumption and, at the same time, to eliminate the disturbance of socio-ecological and economic security regarded as a result of the balance between consumption and reproduction of resources. Formulation of such a definition is based on the research of semantic concepts of „development“ and „sustainability“.

Regarding the study of the semantic content of the notion of “development”, we have found out different approaches to its treatment, namely development as a movement, development as directed and irreversible changes, development as a progress, development as an improvement.

It is worth noting the fact that positive, qualitative, targeted, irreversible changes, improvements in the system may occur due to resource consumption and reproduction of these resources in the system, i.e. these processes are quite important conditions for development. Thus, Zoryana Gerasymchuk, Iryna Vahovych [2] note that reproduction characterizes the process of reimbursement of certain resources that have been lost, and is necessary but not a sufficient condition for development. Unfortunately, in scientific works, little attention is paid to the system’s development based on rational consumption and reproduction of resources. Therefore, defining the concept of urban development processes, we take into account consumption and reproduction of socio-ecological and economic resources.

Another important prerequisite, that should be considered in the process of directed, irreversible qualitative changes, improvement and progress of the city is the adaptation, since any system in the operation is influenced by endogenous and exogenous factors, which requires the system to adapt rapidly (adaptation) to changing conditions without violating the state of security. To support this statement, consider the position of Zoryana Gerasymchuk and Iryna Vahovych that determine adaptability as the principle of development, and specify it in line with the tendency of the system to equilibrium, which presupposes that system parameters adapt to changes in the parameters of the environment, in accordance with specific situations.

Overall, the adaptation of the system involves the adaptation of the system itself, its subsystems and individual elements to the changing internal and external environment in order to ensure stability and establish a dynamic equilibrium between the system and the environment.

Summarizing all mentioned above, we emphasize that a common dominant in the examined approaches to understanding the essence of development is that within a

separate system during its operation quantitative, qualitative, directed and irreversible changes occur that lead to the progress of the system and its improvement. It should be noted that these changes can be both gradual and (or) sudden system response to endogenous and exogenous disturbances to which the system must adapt without breaking is safety. However, from our position, adaptation of the system to the newly created environment and transition to a new system state is achieved either by increasing the amount of resources in the system, or by changing the quality characteristics of such resources, or by reallocating resources between the various elements of the system, as a prerequisite for its development.

We found out that among the scientific approaches to understanding of the essence of development there is unstudied basis through which qualitative changes occur, and these changes need to be persistent. We believe that the transfer of any system in a brand new condition is primarily associated with changes in the structure and rates of use of both internal (generated and regulated directly by the system) and external (generated outside the system and beyond its control) resources. The increase of the share of domestic resources in the overall balance is considered by us as the most promising way, especially on condition that external resources are beyond the control of the system (the system does not affect their number and rate of supply to the system), especially if resources are exhaustible (non-renewable), or the rate of reproduction of external resources does not ensure proper functioning, and especially the development of the system. Accordingly, system's development should provide efficient use of internal resources, their reproduction alongside with the reduced consumption of external resources. Reduction of external resources and efficient use of internal resources in the system is achieved through the redistribution of resources. Speaking specifically about the city, such conditions are provided if there is redistribution of flows in the city, because the city as a logistics system has characteristic stages of the logistics process: supply-production-distribution-consumption.

Thus, we review the development as positive, quantitative, qualitative, targeted, irreversible changes that allow the system to adapt to the effects of endogenous and exogenous factors without violating the security of the system as the result of efficient use of internal resources, their reproduction alongside with the reduced consumption of external resources in the supply-production-distribution-consumption.

Therefore, the development of cities is to be observed in positive quantitative and qualitative changes in the subsystems of the city during the transition from one qualitative state of it to another, a better one.

Having accepted the definition of "development" as the basic notion, we insist that urban development is the adaptation of the city to the effects of endogenous and exogenous factors through qualitative, directed and irreversible changes, the improvement in the structure and in the rates of consumption of ecological and socio-economic resources, and their reproduction in the process of supply-production-distribution-consumption.

However, in the present conditions we have to speak not only about the urban development, but also about urban development under the principles of sustainability, as it is evidenced by the Resolution of the Verkhovna Rada (the parliament of Ukraine) "On the concept of sustainable development of the residential areas" dated from 24.12.1999. Therefore, it is necessary to determine conditions for achieving sustainability in order to determine the key parameters and time interval maintaining urban sustainability. Given that, we define the nature and the meaning of the "sustainability" term taking into account scientific researches dealing with the interpretation of the concept "sustainability":

1. The ability of a system to attain equilibrium after being taken out of this state by external disturbances (or by internal ones as in case of systems with active elements), the state of equilibrium, which the system is able to attain, is called the stable equilibrium ("Theory of Systems And Systems Analysis In Management of Organizations") [3].

2. Sustainability as a property of the system during its development to return close to its initial state in phase space, ad libitum (sustainability by Siméon Denis Poisson).

3. Sustainability as a property of the system in its development to remain in the limited area of the phase space (stability by Joseph-Louis Lagrange).

4. Sustainability of the system as its ability to retain some of the features of the phase portrait under small perturbation (structural stability by Alexandr Andronov and Lev Pontryagin).

5. Sustainability as a property of the system in any way to deviate a little from some not perturbed motion (movement of the object of the research for its sustainability) under certain perturbations of the initial state of the system (depending on the specified deviation) in the phase space (sustainability by Alexandr Lyapunov).

6. Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs ("Agenda 21").

7. Sustainability as security, stability, reliability, integrity and strength of the system (by Leonid Abalkin).

8. Sustainability as relative immutability of the main parameters in the socio-economic system, the system's ability to remain unchanged over a definite period of time (Alexandr Haponenko, Nikolay Reimers, Vladimir Rohchyn).

9. Sustainability as a balance between social, economic and ecological subsystems (Evhen Khlobystov, Lyubov Zharova, Tetiana Chernova).

10. Sustainability as a balance, stability, restoration of dynamic equilibrium, security, competitiveness, harmony, balance between socio-ecological and economic subsystems (Zoryana Gerasymchuk, Iryna Vahovych, Inna Kondius, Vadym Polishchuk).

11. Sustainability as a condition for achieving an optimal balance between economic development, normalization the quality of the natural environment, growth of spiritual and material needs (Bohdan Danylyshyn, Liliya Shostak).

12. Sustainability as harmony, security (Tetiana Galushkina, Viktor Reutov, Lyudmyla Kacharovska, Mykyta Glazovskyi, Nataliya Karaeva, Ihor Nedin).

13. Sustainability as a permanent reproduction of so-called state of homeostasis (the dynamic equilibrium) with a periodic change in its level at which there were a permanent solution to the contradictions between the internal components of the system, and the change of the parameters of the biosphere does not extend beyond the catastrophic (fatal) ones for system transformation (Leonid Melnyk).

14. Sustainability as a form of social and natural development which ensures survival and continuous progress of the society and does not destroy the environment (especially the biosphere) (Arkadiy Ursul, Tetiana Ursul, Vladimir Tupalo, Aleksandr Engel).

As we can see, the concept of sustainable development is being clarified by scientists, and there are a lot of features defined in order to meet the needs of present and future generations. Specifically, Zoryana Gerasymchuk and Vadym Polishchuk noted that nowadays, sustainable development is increasingly understood as the ability to reproduce a dynamic balance of the socio-ecological-economic regional system.

For the first time, equilibrium in the “nature-human being” system was characterized by Nikolay Reimers. In his writings, he offered several definitions of equilibrium, but they all boil down to the following: the balance in the “nature-human being” system is dynamic (quasistationary), i.e. the system appears to be in such a state for a while or to change; equilibrium is limited in human history due to the pressure of economy on the habitat of people that still retains the natural conditions of life for the humans as biological species – there are limits to human impacts; he equilibrium provides the maximum socio-ecological-economic effect for relatively infinite time period [4].

We believe that the dynamic equilibrium should provide both consistency between various elements of the system in use and reproduction of resources in terms of occurrence of disturbances, i.e. external and internal threats to the socio-ecological-economic system.

We believe that stability is the ability of the system, imposed under certain external and internal influences, to provide qualitative improvements of the system with minimum deviation, to anticipate a balance in the consumption and reproduction of resources without violating safety of the system and contribute to increasing of reproduction rates over consumption ones. It should be emphasized, that in the short term, the system oscillates around the equilibrium, and the long-term condition provides a balance between consumption and reproduction of system resources. System’s return to the equilibrium state is a prerequisite for such a development that meets the needs of the present day and at the same time creates an opportunity for future generations to enjoy the present achievements and to meet their needs. A crucial role is assigned to the socio-ecological and economic security as a component of sustainable development in the safe existence of the present and future generations.

In our opinion, the criteria of sustainable development of cities (agglomeration) are:

1. Rational consumption (use) of resources that means the consumption of a certain amount of resources only for its intended purpose (for the most efficient operation of the system). Rational consumption of socio-ecological and economic resources of the city (agglomeration) is a key issue, since it provides their guaranteed saving and usage. To ensure a sustainable development, the process of consumption of urban socio-ecological and economic resources should be based on rational criteria.

2. Reproduction of socio-ecological and economic resources of the city (agglomeration). Reproduction of a separate system occurs due to the restoration of its elements (resources), caused by the fact that in the consumption of resources there is a loss of their original characteristics. Reproduction is the well-timed appearance of a certain system resources, sufficient to ensure the functioning of the system or its individual components (quantity and quality). Reproduction of any system requires constant renewal cycles that contribute to streamline functional and structural relationships between elements of the system.

The concept of the reproductive process in the city covers interdependent unity of production, distribution, exchange and consumption of goods. Existence of the reproductive cycle’s phases, their relative completeness in space and time allows us to consider the city as the reproductive system.

Developments of the organization principles of recovering processes, as well as organization principles of the city, occur by stages. They are born, formed, reach maturity and transform. Initially, the degree of internal balance as far as functioning and organization of all elements concerned gradually increases. Having reached the stage of maturity, reproductive processes gradually modify, that one must take into account while planning their future development. It is observed in the appearance of new forms in nature management, in volatile economic specializations and cooperation for production, in changes as far as population settlement patterns and forms of communication among people are concerned. Thus, a new stage in the reproduction of the city begins; namely, in territorial organization of the economy and in people’s lives.

Each hierarchical level of local development corresponds with certain social, environmental and economic interests. Needs of the city and its development goals are coordinated with each of the aforementioned types of interests. With the lack of consistency between the interests and potentials of reproductive processes, contradictions will appear, overlap, interact, and cause complex social, environmental, economic, and other urban problems.

Therefore, reproduction processes in backbone subsystems provide improvement of urban systems, affect the self-organization of the supporting subsystems and show a certain level of urban development based on sustainability.

3. Socio-ecological and economic security. It should be noted, that a high level of economic growth in the process of sustainable development can be dangerous due to unreasonable consumption of natural resources and even their destruction; intensive production processes and significant volumes of potentially hazardous enterprises negatively impact on the atmosphere, water and land resources

by means of emissions and discharges of hazardous substances, and hazardous waste. The dominance of consumerist ideology promotes accelerated, uncontrolled reduction of the non-renewable natural resources, determines the risks and hazards in all urban structures. Careful compliance with all the requirements of environmental safety hinders economic development and creation of conditions for economic growth. Illegal human behavior causes financial and environmental risks [5]. The mentioned trends contribute to the manifestation of the risks that are barriers to achieving a sustainable development.

We believe that the security of the system provides a set of features that ensure its structural integrity and independent functioning through an adequate response to negative external and internal factors. Security of each individual system is entirely dependent on the state of safeness. The state of security is a combination of properties that ensure the structural integrity and independent functioning through an adequate response to negative external and internal factors. The need for protection is one of the primary needs of the population of the city and is a component of sustainable development.

4. Logistization criterion. Differentiation of this criterion is stipulated by the fact that the movement/allocation of resources within the urban subsystems in the form of flows during the process of supply-production-distribution-consumption affects urban sustainable development. Speaking of logistization in general, it is observed in reduction of the consumption and losses of socio-ecological and economic resources during flow's maintenance as well as in reduced impact on the environment. Therefore, from a functional point of view, urban sustainable development is also associated with redistribution of flows in the urban subsystems, and influences on the logistization level. Flows' redistribution is the process by which the direction of flow may vary in certain zones. Redistribution allows to avoid unproductive loss of resources, to diminish losses during processing, to decrease the degree of processing of raw materials in the presence of such an opportunity, and to ensure the reproduction of the city. Flows' redistribution suggests their involvement in the fields of a certain area, as they can bring the greatest benefit and ensure the reproduction process through the city.

Sustainable development of cities (metropolitan area) is ensured if the following conditions are provided:

1. The city (agglomeration) adapts to the internal and external factors under which socio-ecological and economic security is maintained. This will meet the needs of society, in other words, better conditions of life and reproduction will be provided, as well as gene pool will improve, financial security and quality of life will be higher due to reduced pollution, optimization, rational management of environmental resources in the process of social production and effective management of the urban subsystems.

2. Adaptation is observed in the change of consumption rates as for resources and in the structure of consumption, i.e. the city (agglomeration) should strive for more efficient use of domestic renewable resources and

use less amount of external non-renewable resources as a result of redistribution.

3. Socio-ecological and economic security is the evidence of a balance between consumption and reproduction of socio-ecological and economic resources. Thus, fundamental conditions for consumption of socio-ecological and economic resources are as follows: to develop human resources and economic incentives, to create jobs, to provide residents with high-quality products, to reduce unemployment rate in the city; to reduce to maximum the losses both in consumption of resources and in their storage; to reduce consumption of non-renewable resources (i.e. fossil fuels); to decrease emissions and discharges of pollutants; to provide legal protection of the environment from adverse human impacts, to stimulate a full spectrum of production in the city and its intensification, to introduce advanced methods in organization and in technology (innovative technologies) of production that increase the volume of production per unit of a consumed resource. Reproduction process of socio-ecological and economic resources is ensured on the assumption of free physical and financial availability of housing, health care, educational, cultural, distributional, transport urban subsystems; increased income and improved financial conditions of the inhabitants in the city; regained capacity for work; compliance with the standard of living; a higher level of health care and prevention of socially dangerous diseases; the use of recycled materials, alternative energy sources, energy-efficient, resource-saving, environmentally friendly technologies and the implementation of environmental protection measures through the urban entities; increase of the efficiency and usage of high quality resources for the production of goods and services that enhance the economic growth and develop entrepreneurship in the city.

4. Expanded reproduction of socio-ecological and economic resources obtained as the result of excess of reproduction rates over consumption rates.

**Conclusions and prospects of streamlined development.** The survey results confirm that in our time it is necessary to form a brand new approach to the urban sustainable development, which should provide a consistent dynamism to achieve a balance between the rational use of socio-ecological and economic resources, their reproduction, which ultimately provides an acceptable standard of socio-ecological and economic security in the city. To ensure the fulfilment of these processes, it is necessary to work out the postulates and principles of the theory of urban sustainable development, the one, which proves to be a result of the study aimed at the genesis of theories of urbanism. Therefore, the future researches will focus on the formation of the theory of sustainable urban development based on the fundamental theories of urbanism.

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**Мета.** Обґрунтувати критерії та передумови забезпечення стійкого розвитку міст та агломерацій з урахуванням особливостей функціонування системоутворюючих та системопідтримуючих підсистем міста. Дослідити змістове наповнення понять „розвиток“, „стійкість“ і „стійкий розвиток міста (агломерації)“.

**Методика.** На основі визначення міста як логістичної системи виокремлено системоутворюючі та системопідтримуючі підсистеми міста, що дозволило сформулювати критерії забезпечення стійкого розвитку міста.

**Результати.** У роботі доведено, що місто є логістичною системою. На основі сформованих критеріїв обґрунтовані передумови забезпечення стійкого розвитку міст та агломерацій, що повинні виконуватися збалансовано. До таких передумов віднесені: адаптація міста до внутрішніх та зовнішніх чинників, за якої зберігається соціо-еколого-економічна безпека; зміна темпів споживання ресурсів та їх структура (раціональне споживання – більше внутрішніх відновлювальних ресурсів, та менше зовнішніх невідновлювальних ресурсів у результаті перерозподілу потоків у місті); баланс між споживанням та відтворенням соціо-еколого-економічних ресурсів; розширене відтворення соціо-еколого-економічних ресурсів.

**Наукова новизна.** Полягає у визначенні поняття „стійкий розвиток міста (агломерації) на основі дослідження підходів до розуміння понять „розвиток“ і „стійкість“, що дозволило визначити критерії та передумови забезпечення стійкого розвитку міст та агломерацій. Також визначено авторське розуміння понять „місто“, „розвиток“, „стійкість“.

**Практична значимість.** Сформовані критерії та визначені передумови забезпечення стійкого розвитку міста (агломерації), що сприятиме розробленню методичного підходу до діагностики ефективності забезпечення стійкого розвитку міста та визначенню пріоритетних інструментів, що доцільно буде використовувати в руслі підвищення ефективності забезпечення стійкого розвитку міста.

**Ключові слова:** *стійкий розвиток міста (агломерації), адаптація, соціо-еколого-економічні ресурси, критерій, соціо-еколого-економічна безпека*

**Цель.** Обосновать критерии и предпосылки обеспечения устойчивого развития городов и агломераций с учетом особенностей функционирования системообразующих и системоподдерживающих подсистем города. Исследовать содержательное наполнение понятий „развитие“, „устойчивость“ и „устойчивое развитие города (агломерации)“.

**Методика.** На основе определения города как логистической системы выделены системообразующие и системоподдерживающие подсистемы города, что позволило сформировать критерии обеспечения устойчивого развития города.

**Результаты.** В работе доказано, что город является логистической системой. На основе сформированных критериев обоснованы предпосылки обеспечения устойчивого развития городов и агломераций, которые должны выполняться сбалансировано. К таким предпосылкам отнесены: адаптация города к внутренним и внешним факторам, при которой сохраняется соціо-еколого-економическая безопасность; изменение темпов потребления ресурсов и их структуры (рациональное потребление – больше внутренних возобновляемых ресурсов и меньше внешних невозобновляемых ресурсов в результате перераспределения потоков в городе); баланс между потреблением и воспроизведением соціо-еколого-економических ресурсов; расширенное воспроизводство соціо-еколого-економических ресурсов.

**Научная новизна.** Заключается в определении понятия „устойчивое развитие города (агломерации)“ на основе исследования подходов к пониманию понятий „развитие“ и „устойчивость“, что позволило определить критерии и предпосылки обеспечения устойчивого развития городов и агломераций. Также определено авторское понимание понятий „город“, „развитие“, „устойчивость“.

**Практическая значимость.** Сформированы критерии и определены предпосылки обеспечения устойчивого развития города (агломерации), что будет способствовать разработке методического подхода к диагностике эффективности обеспечения устой-

чивого развития города и определению приоритетных инструментов, которые целесообразно будет использовать в русле повышения эффективности обеспечения устойчивого развития города.

**Ключевые слова:** устойчивое развитие города (агломерации), адаптация, социо-эколого-экономические

ресурсы, критерии, социо-эколого-экономическая безопасность

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## CAPITAL STRUCTURE RATIONALIZATION TAKING INTO ACCOUNT THE INTELLECTUAL COMPONENT

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## РАЦІОНАЛІЗАЦІЯ СТРУКТУРИ КАПІТАЛУ З УРАХУВАННЯМ ІНТЕЛЕКТУАЛЬНОЇ СКЛАДОВОЇ

In modern conditions, due to the intellectual component in the structure of capital, the capital formation processes are being activated; the role of the intellectual capital that acts as an independent factor of manufacturing is increasing; the share of the value generated by this capital is rising; the virtual enterprises which do not have a material embodiment are emerging. Therefore the newest forms of the capital deserve special attention, among which a significant role is played by the intellectual one. All this requires the methodological tools of capital structure management in the knowledge economy which determines the relevance of this study.

**Purpose.** To develop the methodological provision for the capital structure management of enterprises with account of the intellectual component.

**Methodology.** In the process of the capital structure research, the following scientific methods were used: systematic, monographic, analysis and synthesis, induction and deduction and the hierarchy analysis method.

**Findings.** The authors propose a management model of the enterprises' capital structure formation on the basis of a structural approach; determine the optimal ratio between the components of the capital structure and the main directions of its optimization on the basis of the hierarchy analysis method.

It is recommended to conduct the process of determining the optimal capital structure by means of the hierarchy analysis method, which enables to define the rational relationship between material, financial and intellectual capital in accordance with the selected criterion. When determining the optimal structure of the intellectual capital, the hierarchy analysis method was applied for calculating the ratio of competence, structural and consumer capital. Search for a rational structure of the aggregate and intellectual capital was realized in accordance with the reasonable goals: the enterprise value maximization, increase of profitability, risk reduction and capital cost minimization. Expert assessment questionnaires were used to construct the output data. The expert assessments, received and grouped by the method of "pairwise comparison", formed the basis of calculations.

**Originality.** The methodological approach to the determination of the enterprise's optimal capital structure distinguishes between others as the hierarchy analysis method was used for the first time for determining the optimum ratio of intellectual, financial and real capital in the structure of the enterprise's aggregate capital as well as the ratio of the competence, structural and consumer capital in the structure of the intellectual capital in accordance with the selected criteria and justification of the ways of its formation and development.

**Practical value.** The use of the obtained results will allow the enterprises to form a reasonable structure of both aggregate and intellectual capital, to increase the efficiency of using the material, financial and intellectual components. Methodical recommendations contained in the study, provide a comprehensive approach to the management of capital structure formation and identification of potential directions of its optimization.

**Keywords:** capital structure, structure capital theory, intellectual capital, hierarchy analysis method, optimization criteria

**Statement of the problem.** In the conditions of unstable economy, characterized by the prolonged financial and economic crisis, important tasks are: activation of the

capital formation process and perfection of the enterprises' capital structure; ensuring the continuity of the process of introducing innovations; reorientation of investment flows; increasing the role of the intellectual capital, which is displayed in people's habits and skills, set forth in the form