https://doi.org/10.15407/socium2021.01.012
UDC 316.012: 351

Makarenko A.S. *Dr Habil (Physics and Mathematics), Professor, Head of Applied Nonlinear Analysis Department, Institute of Applied System Analysis, National Technical University of Ukraine "Igor Sykorski Kyiv Polytechnic Institute", 37-A, Peremogy Prospect, 03056, Kyiv, Ukraine, email: makalex51@gmail.com, ORCID iD: https://orcid.org/0000-0001-6728-3058*

MENTALITY ISSUES IN THE TRANSFORMATION PROCESSES OF THE POSTMODERNITY SOCIETY

The paper deals with transforming social systems and their reflection in the concepts and models of the corresponding processes. A new approach to modelling and research of large social systems was proposed. The author emphasises and describes qualitatively some aspects of the approach that are important for considering the transformation of society. The main feature of such systems is the following properties. Firstly, these systems operate in a small number of reasonably stable states. (In our approach, this is interpreted as so-called associative memory). Secondly, the evolution of such systems (actually, history for long periods) has an analogue in the learning process in models, when connections are established between the system elements. Furthermore, thirdly, the proposed approach was able to consider individuals' internal properties (mentality) – participants in large social systems. New models of socio-economic systems are described, and an interpretation of their behaviour as trajectories on certain surfaces in the space of variables is given. The ways of transforming systems are explained: revolutionary, evolutionary and with a unique trajectory of transition. The classes are considered, into which the internal (mental) variables of individuals are divided. The internal representations of the individual from some slice of reality (in psychology, for example, this is called "internal plans") are represented as a network of objects, concepts and the like, depending on the "object" and purpose of modelling. There are three networks (patterns, drawings) of descriptions: the actual state of affairs, presented in the form of a network; the state of things in the imagination of a particular individual and the desired (ideal) state of affairs in the imagination of a particular individual. The dynamics of changes in the parameters that characterise the individual depends on the state of the environment "externally" and on the "internal" mental variables and the above three ideas about the external environment. Adequate consideration of the external environment by representing and internal representations of surrounding individuals is possible. Such an approach is proposed when considering archetypes in the transformation of the social system. The problem of sustainable development of education and science systems is considered.

Keywords: *the transformation of society, scenarios, mentality, archetype, sustainable development.*

Макаренко О.С., *д-р фіз.-мат. наук, професор, завідувач кафедри прикладного нелінійного аналізу Інституту прикладного системного аналізу Національного технічного університету України "Київський політехнічний інститут імені Ігоря Сікорського", проспект Перемоги, 37-А, 03056, Київ, Україна, email: makalex51@gmail.com, ORCID iD: https://orcid.org/0000-0001-6728-3058*

ПИТАННЯ МЕНТАЛІТЕТУ В ТРАНСФОРМАЦІЙНИХ ПРОЦЕСАХ ПОСТМОДЕРНІСТСЬКОГО СУСПІЛЬСТВА

Йдеться про трансформацію соціальних систем та їх відображення в концепціях і моделях відповідних процесів. Запропоновано новий підхід до моделювання та дослідження великих соціальних систем. Якісно описано деякі аспекти підходу, важливі для розгляду трансформації

суспільства. Головною особливістю таких систем є певні властивості. По-перше, ці системи функціонують у невеликій кількості досить стабільних станів (у нашому підході – так звана асоціативна пам'ять). По-друге, еволюція таких систем (власне, історія протягом тривалих періодів часу) має аналог у процесі навчання в моделях, коли між елементами системи встановлюються зв'язки. По-третє, запропонований підхід зміг врахувати внутрішні властивості (менталітет) індивідів – учасників великих соціальних систем. Описано нові моделі соціально-економічних систем і визначено їх поведінку як траєкторію на певних поверхнях у просторі змінних. Пояснено шляхи трансформації систем: революційні, еволюційні та зі спеціальною траєкторією переходу. Розглядаються класи, на які поділяються внутрішні (психічні) змінні індивідів. Внутрішні уявлення особистості з певного зрізу реальності (наприклад, у психології це називається "внутрішніми планами") представлено у вигляді мережі об'єктів, концепцій тощо, залежно від "об'єкта" та цілей моделювання. Наявні три мережі (візерунки, креслення) описів: реальний стан справ, представлений у вигляді мережі; стан речей в уяві конкретного індивіда та бажаний (ідеальний) стан речей в уяві конкретного індивіда. Динаміка змін параметрів, що характеризують індивіда, залежить від стану навколишнього середовища (зовнішнього), від "внутрішніх" ментальних змінних і зазначених трьох ідей зовнішнього середовища. Адекватне врахування зовнішнього середовища шляхом представлення та внутрішнього уявлення оточення неможливе. Застосування такого підходу пропонується при врахуванні архетипів у проблемі трансформації соціальних систем. Розглянуто проблему сталого розвитку системи освіти та науки.

***Ключові слова**: трансформації суспільства, сценарії, ментальність, архетип, сталий розвиток.*

A well-known phenomenon in modern society functioning is the complexity of processes, the interconnectedness of different systems (including different countries), globalisation and at the same time, opposite trends and much more. There is an apparent acceleration of the evolution of systems and processes. Simultaneously, there is a growing need to manage such processes and systems under the conditions of increasing complexity. Intuitive control of such systems is becoming increasingly complex and sometimes even dangerous. Here is an example of K. Popper's statement – when making decisions in complex systems, seemingly obvious decisions are usually wrong (counterintuitive principle of behaviour). Therefore, there is a need to use modern methods for predicting system dynamics and building possible scenarios and decision-making (choosing options from many available). However, this approach requires the increasing use of mathematical models and appropriate mathematical methods. As the complexity of the systems increases, the accuracy of the models can often decrease for various reasons. Nevertheless, it can help understand general trends and provide general qualitative recommendations for complex socio-economic modelling systems.

In some cases, mathematical modelling can give good quantitative predictions. As examples, we can cite some models in economics, application of system dynamics to world dynamics; the evolution of large cities (for example, methods of cellular automata; methods of econometrics; science of networks and many others). However, there are still at least two key problems in modelling society that still need to be addressed. The first is the modelling of the properties of large social systems: global society, countries, large organisations. The

second is to consider the individual's internal intellectual and cognitive properties (let us call it mentality) and the place of these properties in society's general properties and models.

Based on the importance of these issues for philosophy, theory of social phenomena, and the solution of practical problems, such matters are receiving more and more attention. However, the generally accepted concepts are still a long way off.

The paper proposes a new way for accounting for the mental properties of individuals in society models and considers the social transformation based on such a concept.

In his research, the author proposed reflecting the properties of society, which offers conceptual principles of the approach, which can significantly advance the problems of modelling society as a whole and consider the mental properties of individuals. The results are given in many publications, including [1–4].

The author highlights the paper [1], which at a qualitative level shows the results of systematic analysis of society, the principles underlying the construction of new models of society and individuals, and provides a qualitative description of models and examples of their application. The studies presented in the proposed work are, in a sense, significant extensions and extensions of previous results. At the same time, it is proposed to consider the transformation of society and large social systems. We discuss managing such processes considering new aspects of such systems' behaviour. An example is a process of sustainable development, particularly the sustainable development of science and education.

The structure of the article is as follows. First, we examine unique new models of social systems and their geometric interpretation. Then we consider the accounting of mental characteristics in the problem of transformation. Finally, we discuss the problems of sustainable development of education and science.

Basic issues for consideration of large social systems. In [1; 2; 4], a new approach to modelling and researching large social systems was proposed. These works provide details of the proposed models. Here we emphasise and describe qualitatively some aspects of the approach that are important for considering the transformation of society. The main feature of such systems is the following properties. First, these systems operate in a small number of reasonably stable states. (Our approach interprets it as a so-called associative memory [5]). Second, the evolution of such systems (actually, history for long periods) has an analogue in the learning process in models, when connections are established between the system elements. Third, the proposed approach was able to consider individuals' internal properties (mentality) – participants of the large social systems.

Geometric illustrations to new models. In addition to the works [1; 2; 4], we present the aspects essential for considering the transformations of social systems. In these works, it is shown that various indicators that can characterise the system's behaviour are essential for understanding processes in such systems. Thus, in such models, the dynamics of the systems is reflected by an indicator called the "potential energy" of the system. The evolution of the system takes place so that over time the energy of the system decreases, reaching a minimum in one of the steady states. We illustrate the "potential energy" form, which in the models of this class in the simplest case with symmetric connections is:

$$E = \sum_{i \neq j}^{N} J_{ij} s_i s_j ,$$

The states of the elements of the system J_{ij} – the magnitude of the relationships between the elements *i* and *j*, *N* – the number of elements in the system. In simpler models J_{ij} are the connections between the established elements and the "matrix" of the systems. An obvious illustration of the energy of the system is shown in Figure 1.

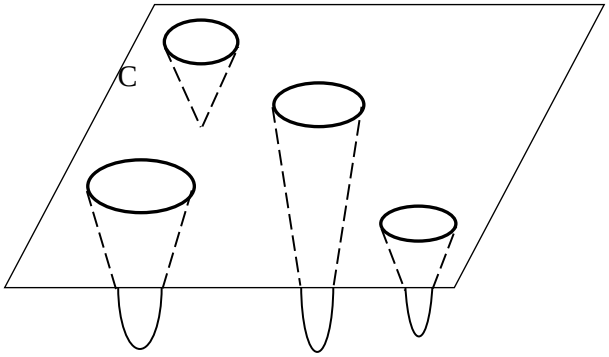

Figure 1. Illustration of a potential "landscape"

Figure 1 gives a conditional illustration of the energy E. Figure 2 gives an even more simplified ("one-dimensional") illustration of the "energy" function.

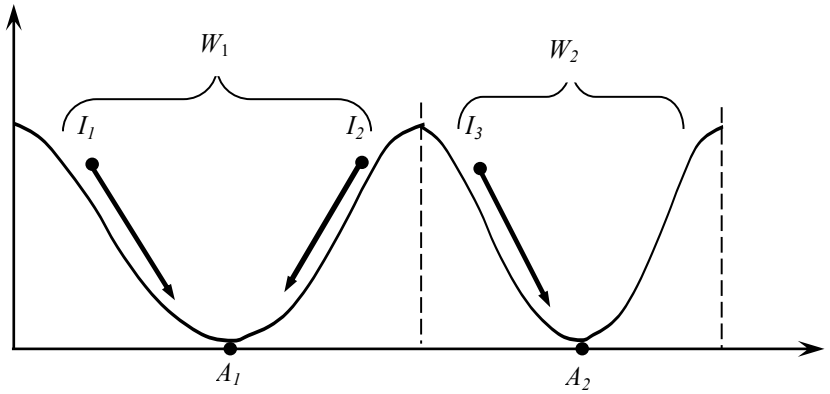

Figure 2. "One-dimensional projection" of system dynamics

Despite the simplification of Figures 1 and 2, they make a more transparent illustration of the possible evolution of large socio-economic systems.

Such analogy can illustrate the evolution given by the "landscape" of potential energy. At a given point in time, the state of the system is represented as a spot on the "energy surface". Over time, the spot moves along the potential surface step by step to the local energy minimum. An illustration-analogy is the ball rolling to the local minimum of the energy (lunules in the surface in Fig. 1, 2). The transformation of society from one state to another in a fixed state of relations corresponds to the transition on the potential surface.

Possible ways to transform socio-economic systems. The movement of the system on the surface of potential energy helps to understand the problems of transformation of such systems qualitatively. The transformation process can be associated with the transition of the socio-economic system from one relatively stable state (between the lunules in Figure 1, or, say, between the states A_1 and A_2 in Figure 2). Here we will highlight some typical situations.

The evolutionary path of transformation with fixed connections. There are several possible classes of evolution. If the connections between the elements do not change over time, then the connection matrix determines the possible evolution. For example, if one needs to go from state A_1 to state A_2, one needs to move on the surface of the potential energy", which determines the possible states of the system through the "hump of energy" between A_1 and A_2. This transition requires energy consumption of the system. This corresponds to the ability to dispose of resources, i.e. to allocate them for transformation. If the possible resources of "energy" are not less than the value of "energy", which corresponds to the height of the "hump", then generally, the transition from A_1 and A_2 is possible (in the presence of political will to transform) through the top of the "hump" of energy between A_1 and A_2.

Here, we can give examples of important tasks of system transformation within the framework of the proposed concept.

1. Global transformation of society in the transition to sustainable development requires a transition from the current (economic and egoistic) state of societies to the path of sustainable development (ecological and cooperative).

2. The transition from one (suboptimal) to significantly more optimal functioning of large economic entities (such as corporations).

3. Reconstruction of the country (infrastructure, ways of development).

4. Restructuring of large organisations.

5. Restructuring of education systems.

If there are not enough resources to the "barrier", or there is a limit to the desire to spend the existing, albeit large, resources and this limit is less than the "barrier", then the evolution is as follows: the system rises from a minimum of "potential energy" to a level that is less than the level of the "barrier" ("hump"), does not cross the "barrier", and returns to the state A_1. This seems to be happening in the example of post-Soviet Ukraine when there are many failed reforms. Moreover, the dynamics is significantly determined by the unchanged "Soviet matrix" of social relations.

The case of variable connections. If social connections allow change over time, then the surface of "potential energy" is deformed over time. This can significantly change the conditions for the social systems transformation and the extreme is a revolutionary path of transformation. In this case, all connections (or a significant part of them) are destroyed first, and the new ones (built for transformation administrators) are created in their place. A partial example is the October Revolution. However, the price of such a transformation is the removal of old carriers from life (an estimated loss of 10 million people).

A more moderate case is the continuous change of connections over time. In this case, models with particular equations for changing connections were investigated, and a significant number of computer experiments were performed. This helped determine the dependence of such systems on the rate of change of connections. For example, at low rates of change, the dynamics is almost indistinguishable from fixed connections. A more interesting picture emerges with relatively rapid changes. Note that among other things, the case of asymmetric connections was investigated. When the asymmetry is relatively small (less than 20 per cent), the behaviour does not change qualitatively, i.e. the system goes to stationary states that provide a minimum of "energy".

Further, at a level of asymmetry between about 20 and 60 per cent, constant periodic movements appear instead of stationary states. In this case, instead of point A_1 in Figure 2 (or minima, as in Figure 2), there is a periodic movement. However, with the asymmetry of the connections more than 60 per cent, chaotic motions occur instead of stationary steady states (for example, instead of a point A_1). Note that such features can be practically helpful for understanding the behaviour of real socio-economic systems. However, other exciting and practically important features were found in computer experiments.

Unique opportunities for the transformation of social systems. In the case of time-varying connections in society, another necessary transition was found [2; 6]. Under certain conditions and variable connections in the surface of "potential energy", it narrows open "tunnels" that appear between the part of the surface, near point A_1 and the surface near the point A_2. If one knows where the entrances to these "tunnels" are, one can spend fewer resources than the size of the "barrier" between points A_1 and A_2. Interestingly, such phenomena have been described in the evolution of biological systems (although only in the interaction of three species). Of course, to find the conditions for the possibility of such transitions (i.e., both the specific laws of evolution of connections and individual values of parameters) can be found only with the application of advanced mathematical models. Since the possibility of transformational transitions of systems requires the existence of "tunnels" between the states and the knowledge of how the states of the system at some point in time get to the beginning of the "tunnel". Such conditions can also be found only if mathematical modelling is used.

Taking into account the mentality in the transformation of social systems. In the previous sections of the article, the most straightforward approaches to social systems consideration were given, and the matter of the account of the members' mentality of social systems is just mentioned. These issues were discussed in more detail in [1; 2; 4]. Here we

present further opportunities for developing an approach to mentality and the possibility of applying such models.

The basic principles for considering the mentality can be found in the following works [1; 2; 4]. The internal representations of the individual from some part of reality (in psychology, for example, this is called "internal plans") are represented as a network of objects, concepts and the like, depending on the "object" and purpose of modelling. There are three networks (patterns, drawings) of descriptions: the actual state of affairs, presented in the form of a network; the state of things in the imagination of a particular individual and the desired (ideal) state of affairs in the imagination of a particular individual. The dynamics of the parameters' changes that characterise the individual depends on the state of the "external" environment, the "internal" mental variables, and the above mentioned three ideas about the external environment. Further clarification needed of these representations by considering the reflection of different depth levels (the individual's imaginations about his representation in other individuals' eyes). For internal variables of individuals, other model equations can be used then for externally visible variables. For example, for economic agents, external variables may be the intentions to buy/sell some goods, and internal variables may be ideas about the intentions of others to buy goods.

Also, equations can depend on many other parameters that characterise the mental qualities of individuals. For example, the characteristics (indices) of individuals, essential for the dynamics of mental variables, can be the results of colour tests in psychology (see [7]).

Fast and slow variables. When modelling specific socio-economic problems, the laws (equations) for modelling can be found in analysing big data employing artificial intelligence and machine learning. However, when building modelling systems and interpreting modelling results, the velocity of internal variables' is essential. The corresponding equations are given in [2; 4], and in this section, we will only illustrate these aspects and some of their consequences, which are essential for transformation issues. Figure 3 gives some illustration of the issues of mental variables.

The figure on the left and the right shows "visible from the outside" mental variables (on the left) and "internal" invisible from the outside (on the right). Such division of variables is already essential for understanding socio-economic systems and their transformation. However, Figure 3 shows another aspect – the division of the first and the second categories of variables into two classes: fast and slow (upper and lower halves in Figure 3). In [2; 4], the equations for modelling are given. For example, those mentioned above "external" economic variables (intentions to buy or sell goods "now") can change quickly, and perceptions of the ideal state of the buying and selling system can change much more slowly – for example, fashion for some goods, which can change relatively slowly. If look more broadly, the country's state of affairs may change depending on the country's population view of the state's acceptable state of affairs. In turn, changes in perceptions of the correct state of affairs can change very slowly, even in generations change. It should also be emphasised that such changes significantly depending on the growth of knowledge about the "optimal" state of affairs and their dissemination in the population through the education

system in the country. An example is the promotion of the idea of sustainable development in the world.

These, even qualitative, ideas about fast and slow variables can help plan the transformation of social systems. First, with the use of systems analysis, it is necessary to distinguish the structure of fast and slow variables. It is also necessary to model, if possible, the influence of different parameters and controls on systems' behaviour and the possibilities of different scenarios. One can then try to find appropriate controls for the different scenarios.

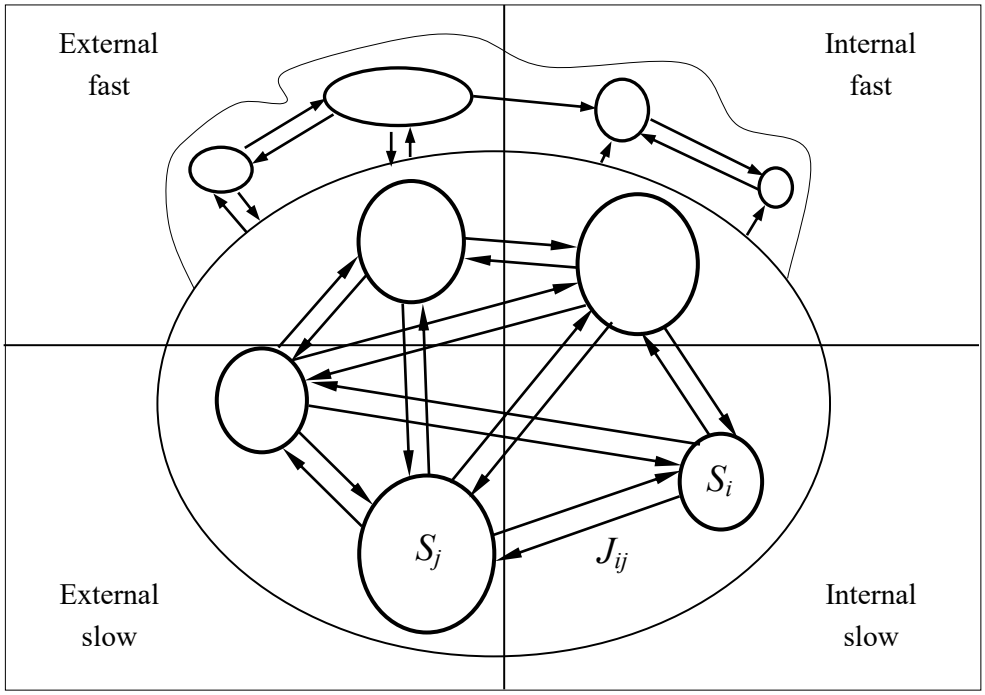

Figure 3. Distribution of internal variables on internal/ externally visible and fast/slow

Archetypes and transformation. However, the division into fast and slow variables allows us to approach other vital issues in transformation. Thus, in many works [8–10], an important problem of the influence of the archetypes on the properties and dynamics of social systems is described. Practically, this translates into an essential question of the very possibility of social transformation. First, the approach described above makes it possible to formalise archetype as a description in the form of network structures. Secondly, we can ask about the dynamics of archetypes. For example, some archetypes seem to be almost unchanged and inherent in the whole human community (myths, some primary concepts, such as "mother", "atom", and others). Although here the question of whether archetypes are

changing very slowly. However, there are also assumptions about the ethnic archetypes of nations. Perhaps these archetypes may change. It seems that with the change of generations, the national identity of emigrants may decrease (and even disappear).

Moreover, the time for change can be quite long. That variables of this type can be significant compared to the time of change of economic, mental variables, but fast compared to universal archetypes. The proposed approach considers these issues, introducing a hierarchy of time scales for different mental variables. Third, the proposed approach can also consider how archetypes are passed down from one generation to another. For example, the mechanisms of archetype transmission are involved in the upbringing of children by parents and society, or it depends on the prenatal period (the last weeks before birth). It should be noted that such issues can be explored through "artificial life" [3]. Also, the "artificial life" approach can help understand the problems of ethnic archetypes in the problem of social systems management.

Problems of sustainable development and transformation of social systems. As already mentioned, the proposed approach can be employed with many problems, including applied ones. Here, we present some considerations in sustainable development [2; 11], which are based on considerations related to the concept above. Generally speaking, the transition from one state to another is interpreted in terms of the transition to a minimum of "energy surface". We discussed the simplest case when participants' internal (mental) properties in social systems were not considered. The way to consider the mental properties described above will allow them to be included when considering sustainable development issues. In this case, the consideration becomes much more complex, and the function of "energy" takes a much more complex form. In any case, this makes it possible to raise the issue of transformation of social systems at a qualitative level. Considering the mental properties of individuals means a significant increase in the number of variables. Now the appearance of the surface of "potential energy" depends not only on the "visible" external characteristics of the individual but also on other mental variables. Deformations of "energy" can now be considered the barrier to transition due to decrease mental variables. It is also possible to create "tunnels" for transitions by changing only the mental variables.

Now it is possible and completely new tasks to ensure the transformation of social systems. It is implied that there are tasks of managing the mental properties of individuals and society as a whole. Such influences are possible through the media, public organisations, social interaction, and the evolution of society.

In addition to these opportunities, it is also necessary to emphasise another important means of influencing the mental characteristics of education systems – primary, school, higher and postgraduate, and science systems. Given the importance of such matters, we will, therefore, briefly describe the problems of sustainable development of education and science systems.

General problems of sustainable development in education and science. A separate but essential task in modelling is the migration processes of highly educated professionals: primarily scientists, students, graduate students and others. Scientific migration has two aspects – domestic and international aspects, i.e. migration abroad. Here we will point out one crucial aspect of migration in education and science both for an individual country

(especially, for example, for Ukraine) and for the world community (global aspect). The main problem is the sustainable development of the creation and reproduction of the necessary knowledge [2]. At the same time, there are many tasks in this matter. First, it is a problem of new knowledge. Second, it is a sustainable development of educational and scientific infrastructure. The problem of migration belongs to this range of problems.

General description of the migration problem. From the point of view of artificial life, it is possible to allocate such elements. Foreign sources provide resources, and the contingent of migrants is divided into communities from different countries, which implicitly compete for resources. Resources can be money, highly qualified positions and much more. It should also be noted that the same indicators should be taken into account for the internal situation in Ukraine. However, we still need to consider the "homeliness" of agents, the attractiveness of the country as a whole, the prediction of the future situation in the country and other countries. In this case, the problem can be considered locally in time, i.e. at short intervals with stable conditions. If it is desirable to study this to optimise the educational and scientific infrastructure, it is necessary to predict changes in the world. Simultaneously, there are exciting and new artificial life issues of resource management over time. In many cases, this directly leads to a new issue of sustainable development of education and science.

Here we describe informally part of the problem. Let R_z – resources for migrants abroad at the measurement scale [0, 1], R_v – domestic resources in Ukraine. When $R_v \to 0$, $R_z \to 1$ everyone will emigrate from Ukraine, and when $R_v \to 1$, $R_z \to 0$ everyone will stay in Ukraine. There should be an intermediate value $0 < R_v * < 1$ that should be optimal for the sustainable development of education and science in Ukraine. Another thing is that these productions are part of the problem of sustainable development. The primary resource of the process of sustainable development is knowledge [2]. Concerning Ukraine, this leads to the following issues (which still needs to be addressed): what knowledge is needed now and in the future; their division into fundamental and applied; how this knowledge is generated depending on the infrastructure. Moreover, all this very much depends on the number of scientists and students $0 < N_v < 1$ who remain in Ukraine.

Conclusions. In the proposed article, we set out part of the research approach and manage social transformation processes. New models for understanding processes in large social systems are described. A way was proposed to include the mental properties of individuals in society. As a result, some new models of society are taken into account, which considers the properties of the individual's mentality. The possibility of including the problems of archetypes in mathematical models is also described. Possibilities of application of the suggested concepts to problems of sustainable development are described.

References

1. Makarenko, A.S. (2020, January). Mentality issues in the transformation processes of the postmodernity society. *Public Managament*, 1 (21), 154-168.

2. Makarenko, A. (2020). Sustainable development and principles of social systems modelling. Generis Publisher.

3. Zavertanyi, V.V., Makarenko, O.S. (2021). Elements of modelling problems of artificial life. Kyiv: ESC "IASA" National Technical University of Ukraine "Igor Sykorski Kyiv Polytechnic Institute" [in Ukrainian]

4. Makarenko, A. (2020). Toward the Mentality Accounting in Social Systems Modelling. Proceedings Int. Conf. SAIC-2020. October 08-10, Kyiv. https://doi.org/10.1109/SAIC51296.2020.9239135

5. Haykin, S. (1994). Neural Networks: Comprehensive Foundations. New York: MacMillan.

6. Makarenko, A. (2021). Toward the methodology for considering mentality properties in e-government problems. In Yu. Gunchenko (Ed.), *Intellectual systems and Informational technologies* (pp. 155-168). Vienna: Premier Publishing s.r.o.

7. Afonin, E. (2006). Color and Psyche. *Airport*, 1, 54-55.

8. Afonin, E.A. Martynov, A.Yu. (2016). Archetypal principles of modelling social processes. *Problemy Upravleniya – Control Sciences*, 2 (3), 34-47 [in Russian]

9. Durand, G. (1960). Les Structures anthropologiques de l'imaginaire. Paris: Dunod [in French]

10. Maffesoli, M. (1985). La Connaissance ordinaire – Précis de sociologie compréhensive. Paris: Librairie des Méridiens.

11. Maffesoli, M. (2020). Ecosofia.

Received on 01.02.21