

**ЕКОНОМІКА ТА УПРАВЛІННЯ НАЦІОНАЛЬНИМ ГОСПОДАРСТВОМ**

UDC 330.3:008

УДК 330.3:008

**O. Yu. Chubukova**, Doctor of Economics,  
Professor,  
**N. V. Rallie**, Candidate of Economic  
Sciences, Associate Professor,  
**Yu. V. Zimbalevska**, Candidate of Economic  
Sciences

**О. Ю. Чубукова**, д. е. н.,  
професор,  
**Н. В. Ралле**, к. е. н.,  
доцент,  
**Ю. В. Зимбалевська**, к. е. н.

**TOPICAL CONCEPTIONS OF THE  
DEVELOPMENT OF INFORMATION SOCIETY  
UNDER CONDITIONS  
OF NBIC-CONVERGENCE**

**АКТУАЛЬНІ КОНЦЕПЦІЇ РОЗБУДОВИ  
ІНФОРМАЦІЙНОГО СУСПІЛЬСТВА  
В УМОВАХ NBIC-КОНВЕРГЕНЦІЇ**

**Urgency of the research.** The need for studying the problems and current trends in the field of integration of scientific achievements of the present in the context of its influence on the social paradigm is caused by the requirements and challenges of the next stage of civilization development - the information society.

**Target setting.** It is expedient to update the directions of the development of the information society and formulate its main concepts on the basis of the analysis of the achievements of world science.

**Actual scientific researches and issues analysis.** The scientific works of such scholars as I. Rodzin, S. Titarenko, M. Anissimov, J. Schummer, K. Borner, M. Rocco, V. Bainbridge and others are devoted to questions of the actual technological, social and economic aspects of the information society.

**Uninvestigated parts of general matters defining.** The scientists have not yet sufficiently developed the issues of developing and implementing the achievements of the newest world-building technologies in their synergy and interacting within the framework of the NBIC-convergence.

**The research objective.** The article aims to analyze and develop proposals for the actual concepts of building an information society in the context of NBIC-convergence.

**The statement of basic materials.** The article defines the main components of NBIC-convergence and the results of their interdependent development, which form the latest technological basis of the information society. It is substantiated the necessity of development of cognitive technologies in the socio-economic sphere in their synergy with information technologies. It is offered hypothetical directions of development of society in the post-informational era.

**Conclusions.** NBIC-convergence as the natural process of science towards the synergistic interaction and interdisciplinary scientific approaches creates the foundation for the transition to a new state of human capabilities through radical technological transformation.

**Keywords:** NBIC-convergence, information society, cognitive technologies, information technologies.

**DOI:** 10.25140/2410-9576-2018-1-2(14)-43-48

**Актуальність теми дослідження.** Потреба у вивченні проблематики та сучасних тенденцій у сфері інтеграції наукових досягнень сьогодення в контексті її впливу на суспільну парадигму спричинена вимогами та викликами наступного етапу цивілізаційного розвитку – інформаційного суспільства.

**Постановка проблеми.** Доцільним є актуалізація напрямів розвитку інформаційного суспільства та формування його основних концепцій на основі аналізу здобутків світової науки.

**Аналізостанніхдосліджень і публікацій.** Наукові праці таких вчених, як І. Родзін, С. Тітаренко, М. Аніссімов, Й. Шуммер, К. Бьорнер, М. Роко, У. Бейнбридж та інших присвячені питанням актуальних технологічних, соціальних та економічних аспектів інформаційного суспільства.

**Виділення недосліджених частин загальної проблеми.** Науковцями ще недостатньо опрацьовані питання розроблення та впровадження досягнень новітніх світобудівних технологій у їх синергії та взаємовпливі в рамках NBIC-конвергенції.

**Постановка завдання.** Метою статті є аналіз та розроблення пропозицій щодо актуальних концепцій розбудови інформаційного суспільства в умовах NBIC-конвергенції.

**Виклад основного матеріалу.** У статті визначено основні складові NBIC-конвергенції та результати їх взаємозалежного розвитку, які формують новітню технологічну основу інформаційного суспільства. Обґрунтовано необхідність розвитку когнітивних технологій в соціально-економічній сфері в їх синергії з інформаційними технологіями. Запропоновано гіпотетичні напрями розвитку суспільства в постінформаційну епоху.

**Висновки.** NBIC-конвергенція як закономірний процес розвитку науки в напрямку синергетичної взаємодії та міждисциплінарних наукових підходів створює фундамент для переходу у якісно новий стан людських можливостей шляхом радикальної технологічної перебудови.

**Ключові слова:** NBIC-конвергенція; інформаційне суспільство; когнітивні технології; інформаційні технології.

**Urgency of the research.** If we rephrase the well-known mythology that the Earth stands on four pillars, then one of them, of course, is a science and in its current development, the Cybernetics plays a leading role as the fundamental science of the complex systems managing that has a global goal, a mandatory inverse and generates the need to use the technology. The laws of the Cybernetics laid the

---

**ЕКОНОМІКА ТА УПРАВЛІННЯ НАЦІОНАЛЬНИМ ГОСПОДАРСТВОМ**

---

foundation of the society that changes qualitatively under the influence of the science development, the achievements of information revolutions and the movement from simple to complex systems. As a science, the Cybernetics consists of a plurality of aspects that covers the processes of forming and development of all possible types of economic, political, social and spiritual activities. It focuses on the study and solving of complex problems, the interconnection of management and information systems in the technology, living nature and society, the creation of an artificial intelligence, the development of nano-, bio-, info- and sociotechnologies.

**Target setting.** Accelerating the pace of scientific and technological progress and the emergence of new advances in information revolutions require the revision of existing approaches to determine the fundamental principles of future society. New interdisciplinary sciences can bring more understanding to the vision of the current social and economic processes.

**Actual scientific researches and issues analysis.** Many scientists and researchers deal with the problems of forming and developing the information society, studying the issues of scientific influence on these processes. Among them: I. Rodzin, S. Titarenko, M. Anissimov, J. Schummer, K. Bjorner, M. Rocco, V. Bainbridge and others.

**Uninvestigated parts of general matters defining.** To date, such direction of society development as the development and implementation of the achievements of the newest world-building technologies - technologies of NBIC-convergence, remains practically unexplored.

**The research objective.** The purpose of this article is to analyze and elaborate proposals for actual concepts of forming an information society in the context of NBIC-convergence.

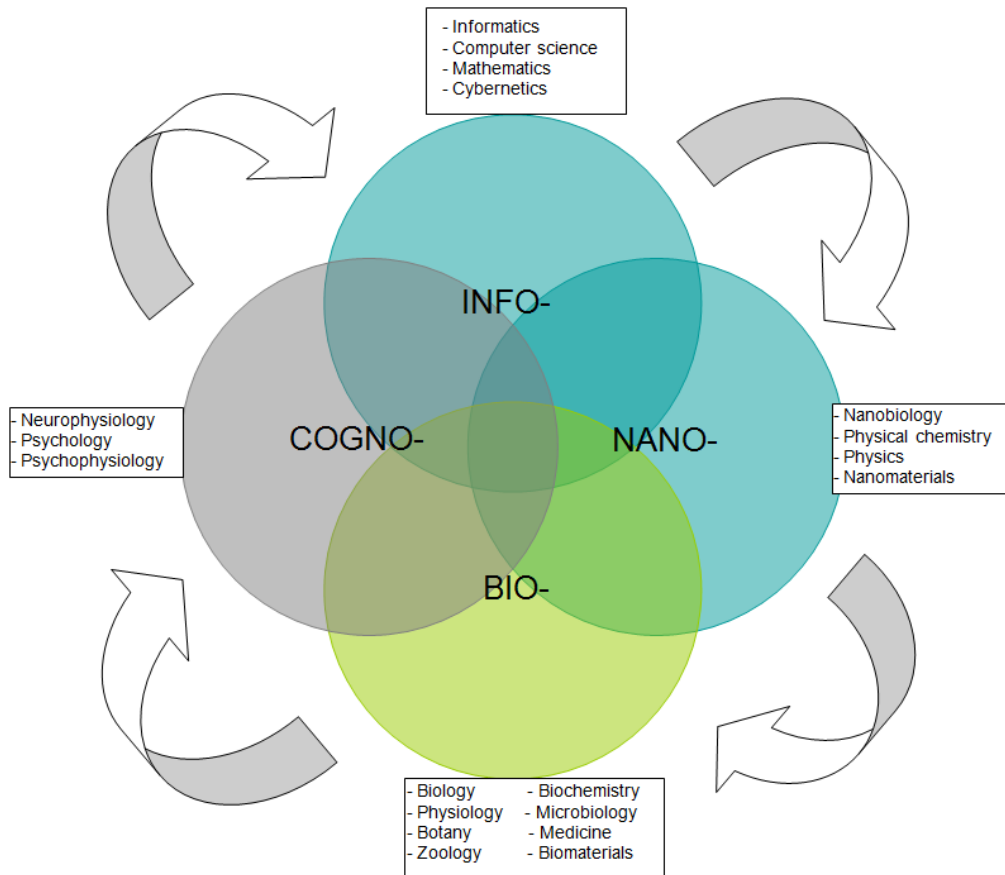
**The statement of basic materials.** Under the conditions of the turbulent environment and constant information changes and the results of the scientific and technological progress, there are whole wave of discoveries that are superimposed on each other in time. As practice shows, almost all the laws of the Universe have been already discovered. For the science development, actual knowledge is not only from a certain science. Everything takes place at the intersection of sciences, where medicine and biology occupy the dominant place. Thus, in the early 80's of the last century, one-by-one scientific and technological revolutions took place in the information and communication technologies, and in recent years there were marked changes in the field of the nanotechnology and cognitive sciences. In fact, all these events are very interconnected and affect one another. This phenomenon was widely studied in the scientific community, and in 2002, its researchers, M. Rocco and W. Bainbridge, reported about their achievements at the World Technology Assessment Center (WTEC) [1], revealing its peculiarities, focusing on the meaning for the world civilization development, and also giving the name - *NBIC-convergence*.

Taking into consideration the doctrine of the changes in Kondratiev's waves and the forming of the technological processes, NBIC-convergence can be interpreted as a hypothetical core of the sixth technological structure, which is based on the unification and synergistic enhancement of the achievements of nano-, bio-, info- and cogno-technologies, which results in merging these technologies into a single scientific technological area of knowledge [2].

NBIC-convergence is at an early stage of development. However, it is expected to create an artificial intelligence, cyborgs (a biological organism consisting of mechanical or electronic components, a machine-human hybrid), iBodi (an immortal body, non-protein, built on new principles for the transfer of human personality to it), biocomputers, any materials with predefined or predictable properties, etc.

It is known that the development of an information society takes place by moving from the post-industrial phase to innovation and knowledge-oriented. Knowledge is also a driving force in the society development, all types of economic and socio-technical activities, a human as a whole. Practice shows that under the present living conditions, the individual and social development of a person is based on the achievement of technical and technological capabilities of NBIC-convergence, which can be visualized, based on the analysis of the information borrowed from different sources of the citation and the cluster analysis in the form of a scheme that most fully reveals its essence (Fig. 1) [2].

**ЕКОНОМІКА ТА УПРАВЛІННЯ НАЦІОНАЛЬНИМ ГОСПОДАРСТВОМ**



**Fig. 1. Cognitive map of intersection of the latest technologies**

Source: Formed by the author on the basis of [3]

Today, a person is surrounded by a huge amount of knowledge and information that is neither possible nor necessary to be kept in the memory. So, it's important to be able to accumulate and use it at the right time and in the right place. Therefore, the most advanced are information and communication technologies, which are used as a tool for the accumulation, processing of the information and knowledge, as well as the development of other technologies through the possibility of computer simulation of various processes.

As can be seen in Fig. 1, all technologies are developing interdependently. So, after the introduction of procedures for the use of information and communication technologies, there is the emergence of a biotechnological revolution that gradually integrates one into another. The result of such integration is the accounting biology, which includes bioinformatics, system biology, and so on. All of this is aimed at modeling of living organisms. The integration of the information and biotechnologies gradually becomes a sphere of nanotechnological operations and further development of the cognitive science. In general, these processes are multilateral and of a fundamental nature. For example, as a result of the integration and synergy of the information, cognitive, biological and nanoscientific operations, one can now observe the rapid development of the concept and material realization of artificial intelligence, for example, the robot-hybrid Sofia, created by the Hong Kong company Hanson Robotics in 2015, which has an artificial intelligence, can display a certain list of human emotions, recognize the language and face, maintain a conversation with people and constantly improve both hardware and

---

**ЕКОНОМІКА ТА УПРАВЛІННЯ НАЦІОНАЛЬНИМ ГОСПОДАРСТВОМ**

---

software. Creating such a prototype is undoubtedly a breakthrough in the development of future opportunities for the society [4].

The expanding possibilities and prospects for the mutual integration of the nanoscience and cognitive technologies have two-ways, that is the direct and feedback influence on obtaining new knowledge, development of the latest models and obtaining innovative scientific results [5]. So, on the one hand, there is the possibility of a more detailed and in-depth study of the human brain and its capabilities and, as a consequence, the emergence of cyborgs, biocomputers and other types of an artificial intelligence, as has been discussed above [6]. On the other hand, the reciprocal influence of the information on the cognitive technology allows the programs system to develop additional qualities that extend the human mental processes. Taking into account all human intellectual potential, it is impossible to reject the existence of certain restrictions that cause uneven the social development and the presence of unresolved problems of the universal nature - wars, incurable physiological and psychological illnesses, the social inequality and injustice. Such restrictions by their nature are cognitive, which arise as a result of the uniqueness and originality of the mind of the each individual, but do not allow the human civilization to act in a coherent way as a computer system. Currently, the direct and highly effective interaction of the computer system and the person is in a constant development and is still not publicly available. Therefore, on the edge of information and cognitive technologies, tools are developed to overcome the "gaps of misunderstanding" between a person and a computer - natural language interfaces, image and speech recognition systems, cognitive graphics, etc. To solve the problem of cognitive limitations between people for their effective socio-economic activity and progressive development, cognitive control technologies, cognitive modeling methodology, cognitive analysis of socio-economic systems and objects are formed.

The proliferation of cognitive technologies creates new knowledge and capabilities of man and machines, which also promotes the society to newer technological ways. Scientific and technological revolutions give impetus to the transition of the society from the outdated technological processes to the newest, which penetrate into all spheres of the public life, radically changing socio-economic relations towards progress. However, the emergence of new ways would be impossible without the foundation of the basic technologies, which are the core of the first, second, third and fourth modes. At the present stage of social development, the advanced technological way is the fifth, which marked the transition of the industrial to information society based on the use of information and communication technologies (computer technology, software, network technologies). In the future, one can observe the formation of the core of the sixth technological way - advanced technologies for the integration of the achievements of the world knowledge in the field of the nanobiology, psychophysiology, cognitive science, medicine, biology, physical chemistry, etc. [7].

The analysis of these trends of the mutual integration of the knowledge, sciences, technological support allows us to assert that the merger of NBIC-convergence into a single scientific and technological branch of knowledge with the advent of more sophisticated systems of knowledge, scientific discoveries, a life, reason, and man [8].

The development of NBIC-technologies is the beginning of a new phase of a human evolution. As soon as a science finally reveals the possibilities of the brain, then the stage of a change of the bodily flesh, the possibilities of self-preservation and self-development of a person, the continuation of the family, qualitative changes in the economy and social development of mankind will begin. [9]. Hypothetically, the next stage in the development of a person as a species on the basis of NBIC-convergence may be the emergence of "intellectoid" (from the words "android" and "intelligence") - biologically flawless, artificially created membranes with their consciousnesses transferred to them without cognitive limitations and differences/

In the place of the information stages of the economic and social development, an epoch, based on the concept of the formation of post-informational technologies, based on the use of resources of consciousness, which is called *psychonetics* and further *nanopsychonetics*, will come. That is, in replacing the long and slow processes of an accumulation of favorable changes, the engineering process of defining tasks and their solutions will come. Already today we can observe genetically modified plants, animals and food products, artificially created biosystems in medicine, transplants of human organs,

## ЕКОНОМІКА ТА УПРАВЛІННЯ НАЦІОНАЛЬНИМ ГОСПОДАРСТВОМ

artificial mechanisms, biocomputers, etc. [10]. And, obviously, the traditional terms, categories and images that have been formed by the human culture in the conditions of limited material and intellectual resources will deviate from the background of the future biosystems that will more closely meet the needs of a mankind. The human civilization must now assess all the risks of such a powerful scientific knowledge - the result of the NBIC-convergence, deprived of the inherent qualities and principles of ethics, humanity, conservation of nature and resources for future generations.

**Conclusions.** Nano-, bio-, info-, cognotechologies do not develop independently, they are strongly influenced by each other, interconnected, which is manifested, for example, at the level of high-tech convergence processes and the synergy of these scientific knowledge. The convergence creates the basis for the transition to a qualitatively new state of human opportunities through the radical technological adjustment. With the development of NBIC-technologies, the boundaries between living and non-living, thinking and programmed systems, concepts about life itself and death disappear. It is also a programmed system, concepts about life itself and death. It can also lead to the implementation of the "digital immortality" scenario, the restoration of living beings with the help of information about them, which will be stored on personal carriers of knowledge. By the way, this is the basis of the cybernetics and those events in human life and the society development that are taking place today.

### References

1. Roco, M., Bainbridge, W. (Eds.). (2004). *Converging Technologies for Improving Human Performance: Nanotechnology, Biotechnology, Information Technology and Cognitive Science*. Dordrecht: KluwerAcademicPublishers (Springer) [in English].
2. Rodzin, S., Titarenko, I. (2013) *Iskusstvennyy intellekt i nechetkie sistemy [Artificial intelligence and fuzzy systems]*. *Informatika, vychislitel'naya tekhnika i inzhenernoe obrazovanie – Informatika, vychislitel'naya tekhnika i inzhenernoe obrazovanie*, 2 (13), 34-48 [in Russian]
3. Borner, K. (2006). Mapping the Structure and Evolution of Science. Knowledge in Service to Health: Leveraging Knowledge for Modern Science Management. *grants.nih.gov*. Retrieved from [http://grants.nih.gov/grants/km/oermm/oer\\_km\\_events/borner.pdf](http://grants.nih.gov/grants/km/oermm/oer_km_events/borner.pdf) [in English].
4. Dick, P. K. (2005). An Android-Portrait of Philip K Dick. Retrieved from [http://web.archive.org/web/20070111040532/http://www.hansonrobotics.com/project\\_pkd.php](http://web.archive.org/web/20070111040532/http://www.hansonrobotics.com/project_pkd.php) [in English].
5. Schummer, J. (2009) From Nano-Convergence to NBIC-Convergence: "The best way to predict the future is to create it". *Governing Future Technologies*. (pp. 57-71). Heidelberg: Springer [in English].
6. Rassel, S., Norvig, P. (2007). *Iskusstvennyy intellekt. Sovremennyy podkhod [Artificial intelligence. A Modern approach]*. (2nd ed.). Moscow: Williams [in English].
7. Olson, S. (2005). Interview with Michael Anissimov. Retrieved from <http://crnano.org/interview.anissimov.htm> [in English].
8. Markram, H. (2006). The Blue Brain Project. *Nature Neuroscience Review*, 7 (2), 153-160 [in English].
9. Bakhtiyarov, O. G. (1997). *Postinformatsionnye tekhnologii: vvedenie v psikhonetiku [Postinformation technologies: introduction to psychonetics]*. Kyiv [in Russian].
10. Kurzweil, R. (2005). *The Singularity Is Near. When Humans Transcend Biology*. New York: Viking [in English].

### Література

1. *Converging Technologies for Improving Human Performance: Nanotechnology, Biotechnology, Information Technology and Cognitive Science* / edited by M. Roco, W. Bainbridge. – Dordrecht: Kluwer Academic Publishers (Springer). – 2003. – 482 p.
2. Родзин, С. И., Титаренко И. Н. Искусственный интеллект и нечеткие системы / Информатика, вычислительная техника и инженерное образование. – 2013. – № 2 (13). – С. 34-48
3. Borner, K. Mapping the Structure and Evolution of Science. Knowledge in Service to Health: Leveraging Knowledge for Modern Science Management. – 2006. – Retrieved from: [http://grants.nih.gov/grants/km/oermm/oer\\_km\\_events/borner.pdf](http://grants.nih.gov/grants/km/oermm/oer_km_events/borner.pdf).
4. Dick, P. K. An Android-Portrait of Philip K Dick. Hanson Robotics. – 2005. – Retrieved from: [http://web.archive.org/web/20070111040532/http://www.hansonrobotics.com/project\\_pkd.php](http://web.archive.org/web/20070111040532/http://www.hansonrobotics.com/project_pkd.php).
5. Schummer, J. From Nano-Convergence to NBIC-Convergence: "The best way to predict the future is to create it" // *Governing Future Technologies*. — Heidelberg: Springer, 2009. – P. 57-71.
6. Рассел, С., Норвиг, П. Искусственный интеллект. Современный подход / С. Рассел, П. Норвиг. – 2-е изд. – М. : Вильямс, 2007. – 1410 с.
7. Olson, S. (2005) Interview with Michael Anissimov Retrieved from: <http://crnano.org/interview.anissimov.htm>.
8. Markram, H. The Blue Brain Project / H. Markram // *Nature Neuroscience Review*. – 2006. – 7 (2) – P. 153 - 160.
9. Бахтияров, О. Г. Постинформационные технологии: введение в психонетику: монография / О. Г. Бахтияров. – К. : 1997. – 87 с.
10. Kurzweil, R. The Singularity Is Near. When Humans Transcend Biology / R. Kurzweil. – New York: Viking, 2005. – 652 p.

Received for publication 01.03.2018

### Бібліографічний опис для цитування :

Chubukova, O. Yu. Topical conceptions of the development of information society under conditions of NBIC-convergence/ O. Yu. Chubukova, N. V. Rallie, Yu. V. Zimbalevska // Науковий вісник Полісся. – 2018. – № 2 (14). Ч. 1. – С. 43-48.

---

**ЕКОНОМІКА ТА УПРАВЛІННЯ НАЦІОНАЛЬНИМ ГОСПОДАРСТВОМ**

---

- Чубукова  
Ольга Юріївна** доктор економічних наук, професор завідувач кафедри економічної кібернетики та маркетингу, Київський національний університет технологій та дизайну;  
<https://orcid.org/0000-0002-7125-0635>;  
E-mail: [chubukova.oy@knuud.edu.ua](mailto:chubukova.oy@knuud.edu.ua);
- Chubukova  
Olga Yuriivna** Doctor of Economics, Professor, Head of the Department of Economic Cybernetics and Marketing, Kyiv National University of Technologies and Design;
- Ралле  
Наталія Вікторівна** кандидат економічних наук, доцент, доцент кафедри економічної кібернетики та маркетингу, Київський національний університет технологій та дизайну;  
<https://orcid.org/0000-0001-9602-352X>;  
Researcher ID: N-1509-2017;  
E-mail: [nataly.ralle@gmail.com](mailto:nataly.ralle@gmail.com);
- Rallie  
Nataliia Viktorivna** Candidate of Economic Sciences, Associate Professor, Assistant(Associate) Professor at the Department of Economic Cybernetics and Marketing, Kyiv National University of Technologies and Design;
- Зимбалеvська  
Юлія Вікторівна** кандидат економічних наук, доцент кафедри економічної кібернетики та маркетингу; Київський національний університет технологій та дизайну;  
<https://orcid.org/0000-0003-2984-9553>;  
E-mail: [Yulia.Zimbalevska@gmail.com](mailto:Yulia.Zimbalevska@gmail.com);
- Zimbalevska  
Yuliia Viktorivna** Candidate of Economic Sciences, Associate Professor at the Department of Economic Cybernetics and Marketing, Kyiv National University of Technologies and Design