

## Convergence of Neuromarketing Technologies in Modern Conditions of Economic Development

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During periods of socio-economic, innovative-ecological and political transformations, the social system may not perform its functions, which will lead to a disruption of the sustainable of public life. The economy of transformation is a part of the societal system that contributes to the change of the client himself and his needs and demands. These processes are manifested in ignoring generally recognized economic and environmental values, political, ideological, cultural and moral. The development of technologies in the past was usually determined over long periods by some one discovery or progress in one area, today with the development of digitalization, the universal introduction of information technologies in various spheres of life: services, production and economic activities, education, culture, etc. etc., there is a convergence of economics, management and marketing in a short time frame. This phenomenon is caused by the rapid development of information and communication technologies, microelectronics, microbiology, simulations, nanomanipulations, "strong" artificial intelligence in most countries of the world. We believe that the convergence of information technology, biotechnology, nanotechnology and cognitive science is especially significant. And in such modern convergent conditions, neuromarketing technologies are rapidly developing at a new level. The development and application of neuromarketing technologies deserve study so that there is no further ethical "shock" and coercion to buy at an unconscious level. Such technologies were used earlier in various fields of economic activity, in psychology and in solving other issues. Neuromarketing technologies are changing ideas about the environment: nature, man, mind. It is difficult to describe the results of such transformation processes, where all aspects of human life are subject to change.

*Keywords:* neuromarketing, convergence, societal systems, information and communication technologies, biotechnology, cognition, innovation.

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**Introduction.** The rapid development of the scientific and technological revolution accelerates the processes of convergence of neuromarketing technologies, information and communication technologies, artificial intelligence, modifying and finding new methods and mechanisms that contribute to improving the efficiency of production and economic activities. Therefore, innovative marketing approaches to shaping the behavior of subjects of socio-ecological and economic activity are relevant. Complex innovations require a very special configuration of the organizational structure of the production and purchasing activity of the subjects capable of uniting specialists of different professions into well-functioning adhocratic teams. Such organizational and management structures combine different knowledge, which will allow her to remain flexible and be ready for the next change. And changes occur at different rates and in all areas of society: in social, political, moral, ethical, economic and

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ecological environments. It is in these conditions that two opposite marketing directions are being combined: socialization and personalization.

**Problem statement.** The issues of neuromarketing technologies are studied by Ukrainian and foreign scientists, in particular, Akunich M. [1], Gladun G. V. [4], Ilchenko K. [5], Kan E. Yu. [6], Kolesnikov A., Shulhat N. [7], Korol A. N. [8], Kryukova Ye. [9], Korchmaryuk Ya. I. [29], Minyaylo V. [12], Piven O. P. [14], Sadchenko O. V., Zalubinska L. M., Kirilina M. A. [15], Soroka M. [17], Pradeep A. K. [26], Fortunato VCR, Giraldi J. M. E, de Oliveira J. H. C [23], Braidot Néstor [21], Belden S. R. [20], Tryndl A. [18], Sylwia Bas [19], Lewis D. [10], and etc.

Scientists have devoted their research to studying the psychological mechanisms of consumer behavior. Neuromarketing technologies make it possible to prioritize the quality of needs with minimal impact on the unconscious actions of consumers of services and goods.

**The purpose** of the research is to study problems of activation of neuromarketing technologies in modern transformational conditions of integration and convergence of economic development, actualization of cooperation between business entities in multifaceted types of human activities, which, in turn, will affect the provision of balanced development of societal systems.

**Results of the research.** Considering innovative approaches to economic systems as part of the socio-ecological-economic system, which is also a societal or social subsystem, as the basis of a sustainable harmonious societal, the basic elements of which are political, ideological, moral, social, economic and environmental factors.

The productive forces of economic development are the material basis. These are the forces of nature and society, factors of production and resources capable of creating national wealth and ensuring the growth of labor productivity. The productive forces of the first and second order are distinguished. The first include the means of production, labor, entrepreneurial ability. The productive forces of the second order include any factors of production that can be included in the production process either at the present moment or in the next period of development (natural forces, science). They influence the result of the labor process indirectly, through intermediate links [2]. It is precisely such productive forces that neuromarketing belongs, which helps the buyer to make a decision and manage the processes of interaction between the elements of the systems, and, therefore, satisfy the manufacturer's needs for making a profit. Neuromarketing tools include tools that are used as a means of changing the economic state of the object and the economic consciousness of the subject. Such tools will be especially relevant in the context of the development of societal systems, where moral and ethical issues will be the norm.

So, the societal system (from Latin *societas* – community) is a fairly new term, little used and few people use it in modern economic science. When considering the societal systems of society (in the system-theoretical approach), due attention is not paid to environmental aspects, and when considering sustainable development, insufficient attention is paid to the environmental policy of the state, ethics, morality, therefore, in view of its multidimensional and interdisciplinary nature, it becomes necessary to form a new concept of unifying socio-ecological-economic, political, ideological, moral directions in a single societal system.

The issues of societal development of society, taking into account the economics of environmental management, as a unified system, in the modern conditions of the market-legal field have not practically been developed and were considered only in separate publications. The problems of environmental economics in all its areas (environmental management, eco-marketing, environmental education and education, etc.) are deeply and in detail considered,

but as a societal system requires modern clarifications.

The societal system is a change in relations and processes at the level of society as a whole. The term was introduced by T. Parsons, A. G. Keller [13]. Societal systems were considered in the form of social formations that perform their functions: economic, political, social, ecological, ethical and spiritual. The function of the social system is its self-reproduction, self-organization, self-government, self-adaptation, self-sufficiency. Neuromarketing technologies in modern conditions of development of information and communication research affect the unconscious behavior of the subject of economic activity. Self-organization relies on four main components: strong dynamic nonlinearity, often, although not necessarily involving positive and negative feedback; balance of use and research; multiple interactions; the presence of energy (to overcome natural entropy).

Today, thanks to the acceleration of scientific and technological progress, we observe a number of discoveries: in the field of information and communication technologies, biotechnology, a revolution in the field of nanotechnology, as well as the progress of the development of cognitive science, which is defined by many scientists as an emerging scientific revolution [3, 27]. Each of these areas of expertise is capable of providing many important theoretical and practical innovative results. At the same time, the results obtained have an impact not only on the development of their research area, but also affect the acceleration of the development of related areas – the development of neuromarketing technologies. This phenomenon is called NBIC-convergence (according to the first letters of the areas: N-nano; B-bio; I-info; C-cogno). The term was coined in 2002 by Michael Roco and William Bainbridge, authors of *Converging Technologies for Improving Human Performance* (Roco, Bainbridge 2004), produced in 2002 by the World Technology Assessment Center (WTEC). The report is devoted to the disclosure of the features of NBIC convergence, its significance in the technological development of world civilization, as well as its evolutionary and cultural significance. Transforming the process of information processing, new information technologies have an impact on all spheres of human activity and make it possible to establish countless connections between different areas, as well as between elements and agents of this activity, between those who provide goods (services) and acquire (buy) them [22].

Each social system has its own structure. An important quality of such a system is stability (the system develops without changing its structure). To maintain the stability of the social system, internal regulation of processes is necessary – their subordination to a single order. The convergence of economics, ecology, management and marketing will facilitate the development of such technologies. The share of newly created value will increase as a result of the sale of goods (services), impressions, sensations, which will lead to an improvement in the quality of life. It is in such conditions that the use of neuromarketing technologies will be most effective.

Today, there are changes in the relationship between consumers and producers, an economy of experience (the economy of impressions) is emerging, because society needs positive emotions. To increase labor productivity, efficiency, and therefore create more value in both the material and spiritual spheres. The concept of value in neuromarketing is the expression of the content of a person's uniqueness, and it must be investigated if we want to understand a person as a "Human" and his behavior. In a market economy, the psychology of human behavior, the consumer of public goods, is very important. Values can act as motives, incentives, regulators of socio-ecological-economic behavior of people. Value systems are closely related to and overlap with the system of social norms, while performing the same

social function – the regulation of human behavior. The marketing approaches of the economy in modern conditions contribute to the introduction of innovative technologies and the introduction of neuromarketing approaches into the market space.

It is also important to note that the last decade has seen the final formation of a new scientific field: cognitive science (Luger 1994). Cognitive science ("the science of mind") combines the achievements of cognitive psychology, psychophysics, research in the field of artificial intelligence, neurobiology, neurophysiology, linguistics, mathematical logic, neuroscience, philosophy, and other sciences - it influences and forms behavior through the mechanisms of innovative marketing subjects of environmental and economic activities.

Mutual influence, but also the interpenetration of technologies [29]:

- nanotechnology and cognitive science - for example, the introduction of sufficiently small sensors-"spies" that enter the membranes of the bodies of all neurons with blood flow. These "spy" sensors will be able to track changes in electrical and chemical changes in the activity of the neurocell to analyze the functioning of the neuron and build a model of its work;
- nano – and biotechnology – Biological systems have given a number of tools for the construction of nanostructures. For example, in the future, it is possible to synthesize proteins that perform specified functions for manipulating matter at the nanoscale (folding of proteins). The opposite possibilities were also demonstrated, for example, modification of the shape of a protein molecule using mechanical action (fixation with a "nano-brace"). If at the macro level the combination of living and nonliving (for example, a human and a mechanical prosthesis) leads to the emergence of a being of a mixed nature (cyborg), then at the microlevel the difference between living and nonliving is not so obvious. For example, ATP synthase (a complex of enzymes present in almost all living cells), according to the principles of its structure and functions, is a miniature electric motor. The hybrid systems currently being developed (a microrobot with a bacterial flagellum as an engine) do not fundamentally differ from natural (virus) or artificial systems;
- nanotechnology and information technology has a two-way synergistic and, what is especially interesting, recursively mutually reinforcing character. On the one hand, information technologies are used to simulate nanodevices (being, in some way, a "step" for the development of nanotechnology). On the other hand, today there is an active use of (still quite simple) nanotechnology to create more powerful computing and communication devices.

When using the tools of immersive technologies in economic activity, one should focus on the environmental marketing component [23, 29]. Today, such marketing technologies are widely used in the recreational and tourist business, the agricultural sector, and education. After all, the main task of applied ecology is the development of principles for the rational use of natural resources on the basis of the formulated general laws of the organization of life.

Recent years have seen advances in neuroimaging to such an extent that neuroscientists are able to directly study the frequency, location, and timing of neuronal activity to an unprecedented degree. However, marketing science has remained largely unaware of such advances and their huge potential. In fact, the application of neuroimaging to market research – what has come to be called "neuromarketing" – has caused considerable controversy within neuroscience circles in recent times [24]. Neuromarketing is a systematic approach to studying the internal (mental) and external (physical) actions of a person, which are aimed at meeting the needs and requirements as a result of the purchase of goods (services) using developments in the fields of marketing, cognitive psychology and neurophysiology. The main tools of

classic marketing are polling and observation, and neuromarketing analyzes physiological indicators, which allows you to track the buyer's reaction on a subconscious level – even before this choice is made. The goal of neuromarketing is to find answers to the question of why consumers prefer a particular product, as well as to develop techniques for encouraging consumers to buy, not only on a conscious but also on an unconscious level.

And you can take the definition of F. Kotler as a basis, and say that neuromarketing is a type of human activity aimed at using neuro-, that is, the impact (or related) on the nervous system (for example, neurophysiology), on an unconscious reaction leading to the acquisition goods or services, unconscious satisfaction of the needs and requirements of people in a market economy. But the unconscious has both positive and negative sides for a person (a tram (or mechanical means) is painted red – a person's defensive reaction; the use of virtual information reality at a concert is the satisfaction of needs; an enhancer of taste is harmful to health, etc.) from the consumer side; from the manufacturer: environmentally friendly goods – greater demand for such goods; color design (location) of the goods, advertising – the perception of the viewer, attract the audience, interest in specific products, etc.).

In the light of modern requirements for management restructuring, not only the relevance remains, but also the problems of improving planning based on the use of new neuromarketing methods and technologies deserve special attention. Within the framework of such research, there is a need and an opportunity for manufacturers to be competitive to rely on a new discipline that arose at the intersection of neuropsychology and market research - neuromarketing.

Neuromarketing is a relatively new direction in marketing, which consists of neuroscience, psychology of human behavior and traditional marketing. This direction is very popular with both foreign and domestic scientists, especially at the intersection of disciplines.

The concept of neuromarketing supposedly began to be developed by psychologists at Harvard University (USA) in the 1990s. It is based on the assertion that the subconscious part of the brain is mainly responsible for the mental and emotional activity of the individual. Understanding which parts of the brain are responsible for certain decisions made it possible to manipulate the consumer in order to develop certain behavioral patterns in him. The first study, which was positioned specifically as research in the field of neuromarketing, was carried out using the method of functional magnetic resonance imaging at Harvard University in 1999 by Professor G. Zaltman. The technology was subsequently patented as the Zaltman Metaphor Elicitation Method or ZMET. The method used by Zaltman involved the use of a pre-prepared set of images in order to evoke an emotionally positive response, which contributed to the activation of the hidden images-metaphors that stimulate the purchase. The first neuromarketing conference was held in Houston in 2004 [29].

Neuromarketing technologies include the 25th frame used in intelligence and marketing (subliminal message) – as they say, this is a fictional method of influencing the subconscious of people by inserting hidden advertising in the form of additional frames into the video sequence. The author of the method, James Vicary, admitted that the results of experiments, allegedly confirming the presence of such an effect on people, were fabricated by him. As for the psychological effect, its presence back in 1958 was officially denied by the American Psychological Association. Maybe he falsified the data, but at this level of technology and technology may not affect the human subconscious, but nevertheless, the use of subliminal advertising is prohibited in many countries.

The goal of neuromarketing is to find ways to objectively determine consumer preferences without using subjective methods of obtaining information about them, as well as the

formation of advertising messages in such a way as to persuade the consumer to buy before he realized them and developed his position.

The term “neuromarketing” itself was officially coined in 2002 by a professor at Erasmus University of Rotterdam, Eil Smidts. With this word, he decided to describe the commercial application of neurobiology and neuroimaging technology, brain mapping. The goal of neuromarketing is “to better understand the consumer and his reaction to marketing stimuli by directly measuring the processes in the brain” and to increase the “effectiveness of marketing methods by studying the brain response”. However, attempts to understand consumer behavior by studying the work of the human brain were carried out much earlier than 2002. The American psychologist G. Krugman [25] can be considered a pioneer in this area.

In 1971, he conducted a study by recording an electroencephalogram in a person who was watching television, in order to determine the difference between the patterns of electrical activity in the brain and the activity of the brain that manifested itself in the process of reading. David Lewis, who worked in the Laboratory of Experimental Psychology at the University of Sussex in 1981, conducted his own neuromarketing research in the field of creating effective biofeedback sessions. For this purpose, they selected videos for the visual content of the trainings, which cause the strongest emotional reaction and activation of attention. The article “Brain wave analysis”, published by S. Weinstein, K. Weinstein and R. Drozdenko in 1984, discusses the rationale for the application of the method of recording brain activity by the fact that responses during traditional marketing research on subjects social, cultural and personal factors affect [10, 29].

Coca-Cola versus Pepsi research has become very famous in the field of emerging neuromarketing. The early 19th century took Coca-Cola to the next level, and specifically downgraded Pepsi's ratings. But blind tests in large focus groups showed that Pepsi tasted better. In opposite tests, where the names of the drinks were visible, Coca-Cola predominantly won. Soon, such tests were carried out using MRI studies of brain activity. And the results were confirmed. This showed that people prefer the taste of Pepsi, but the symbolism of Coca-Cola [12]. There are several use cases of neuromarketing that have become classics of this kind of research. Well-known Hyundai, PayPal, Cheetos can serve as a striking example – all of these companies have conducted powerful neuromarketing studies of the reaction of potential users to their ads. As a result, the most effective strategies and options were selected [5]. Neuromarketing methods are used to record emotional responses, study attention, emotional responses, memory, stress, and other functional states of the brain. Neuromarketing research allows to identify the nature of the emotional and cognitive assessment by the subjects of commercials, websites, films, goods, images of famous personalities; determine the degree of navigation comfort on sites, schemes, indoors or in an urban environment (the data will indicate “blind” zones and zones that cause an emotional response at the physiological level) [23].

Neuromarketing allows you to understand human nature and use certain qualities to make decisions when buying goods or services in a market economy. Cognition of oneself allows one to free oneself, to get away from stereotypes and a standard view of the environment, to prevent manipulation of one's consciousness. For this, it is important to define neuromarketing, as neuromarketing is the use of methods of neuroscience (psychology) to understand and analyze human behavior as a consumer of goods in market conditions.

Neuromarketing can be viewed, on the one hand, as an unconscious effect on a person to buy a product or receive a service, and here we focus on the market (purchase), on the other hand, knowing how a person will react to a product (service), we can focus on the production

of necessary or necessary goods for a person (production-goods), on the third hand, manipulation of the consumer's consciousness (these are legally prohibited methods), on the fourth hand, neuromarketing is a practical use of neuropsychology in the field of marketing. But after all, not only can such technologies be used in market conditions, but also in other types of economy, for example, a mixed economy, which implies the presence of various forms of ownership of the means of production - private, state, public.

Public and private enterprises coexist. Certain economic activities are carried out by individuals or firms making independent economic decisions coordinated by markets; others are carried out by state-owned and state-controlled organizations, with some degree of centralized decision-making. The real economies of most countries are mixed in the sense that they combine the existing elements of both types of organization. And no matter what type of economy, neuromarketing technology will be used everywhere, although, on the one hand, it is not entirely correct to call these technologies marketing under state ownership (since marketing indicates the market), and on the other hand, sales and advertising exist for all types economy. In such a situation, neuromarketing should be used, which is the interconnection of management technologies, marketing, information communication technologies and artificial intelligence.

The use of neuromarketing technologies will allow enterprises to be competitive and effectively promote goods (services) on the market. Neuromarketing is the manipulation of the consumer's mind, which leads to certain behavior that allows one to purchase goods and bring additional profit to the manufacturer.

The purpose of neuromarketing research, as one of the tools to improve the efficiency of the economy in a sustainable development, is to obtain objective information about personal consumer preferences without resorting to subjective data that are obtained by traditional marketing means.

Neuromarketing is a set of activities that study the relationship of the human brain to marketing and advertising in particular. Research results make it possible to better predict the logic of the consumer, his reaction to stimuli by measuring processes in the brain. Various marketing messages act as irritants - banners, teasers, audio and video clips, promotions, etc. Thus, science is moving forward and improving the quality of customer service, as well as the effectiveness of marketing. In simple terms, neuromarketing is essentially an experiment involving consumers of goods and services, as well as marketers and neuroscientists / neurologists. The former react naturally to advertising (as in ordinary life), the latter and the latter measure these signals and try to predict future customer reactions in the future.

Most of the thought processes, and hence the overwhelming majority of them, occur in the subconscious of a person. Therefore, almost all information regarding decision-making reactions can be obtained by studying the activity of the brain. Thus, it is possible to predict the conscious behavior of the consumer.

Neuromarketing methods are mainly implemented through the channels of human perception.

Let us consider in more detail:

1. Visual channel.
2. The auditory canal.
3. Taste channel and sense of smell.
4. Feeling.

We suggest that you can also include "communication" as an element of human perception to obtain the necessary information. It can also be a "polemic". The purpose of controversy is

to “stir up” disagreements among the audience. Write a sensible refutation of someone's argument or a common point of view, or even launch a heated discussion, and then just watch the result.

Neuromarketing methods [29]: positron emission tomography, psycho-linguistic studies, registration of the parameters of the cardiovascular system, registration of galvanic skin response or changes in the electrical resistance of the skin, registration of facial muscle contractions using electroneuromyography (EMG), electroencephalography (EEG), evoked potentials, magnetoencephalography (MEG), functional magnetic resonance imaging (fMRI), magnetic resonance spectrography (MR spectrography), single-photon emission computed tomography (SPECT), transcranial magnetic stimulation (TMS), registration of eye movements.

The economy of experience is inextricably linked with neuromarketing, since their actions are based on the emotional potential of consumers of goods (services). Emotional arousal is a measure of our level of emotional involvement, which is an indicator of our brain and nervous system. Emotions affect our behavior in many different ways that the consumer is not even aware of.

Today more and more marketers are using immersive technologies. In the new economic relations, information marketing of the behavior of subjects of economic, environmental and economic activity in the conditions of the societal system is given the main place, because the speed of its dissemination and bringing information to consumers is high and is increasing all the time.

Neuromarketing research has the potential to significantly enhance the ability to manipulate consumer opinion. Neuromarketing is successfully used not only in offline stores, but also in online commerce. Therefore, almost all IT giants either resort to the services of companies specializing exclusively in neuromarketing research, or have their own divisions in this area. Specifically, Microsoft is known to use EEG data to better understand how users interact with computers, and Google is working with neuromarketing agencies to determine how audiences react to YouTube ads and find out which format is more popular with viewers; Apple and Facebook also have neuromarketers on staff. Conducting neuromarketing research is relevant at any stage of business development – from choosing a logo and product design to creating advertising and launching active promotions [5].

Quantum computing is a new technology that opens up new possibilities, radically changing the way humanity processes information. These are technologies of the future, which are already in dire need of the modern world. They affect many areas of our lives, from medicine to agriculture, from economics, social problems to environmental ones. Quantum computing will help you cope with a huge amount of data – the amount of information generated by big data and the Internet of Things will contribute to the development of artificial intelligence and machine learning.

The use of quantum computing in marketing technologies:

- displays based on quantum dot technology,
- quantum technologies for information security,
- quantum cryptography (military secrets, credit card numbers, medical records),
- ultra-precise watches,
- ultra-precise sensors,
- new perspectives in materials science, in the creation of new materials,
- quantum computers,



- the emergence of quantum repeaters on the market will contribute to the massive use of quantum cryptography,
- quantum teleportation (this means the transmission of information, not matter),
- increasing the relevance of advertising (quantum annealing can help advertising reach a wider range of people at a better price).

Immersive technologies are used by marketers, in particular, augmented reality (AR). The Physical Web is an attempt to build a bridge between the digital and the physical world, which allows us to extend the superpower of the web – URL – for everyday use. Immersive technologies (technologies that immerse a person in a virtual space and include VR, AR and 360 video) are slowly but surely being introduced into all business processes, eco-business processes and are already becoming an important component of the HR sphere.

**Conclusions and prospects of further research.** Thus, the use of neuromarketing technologies should be considered in modern conditions as one of the directions for improving the planning and management of the economic and social development of the national economy. An ethical component in the field of neuromarketing is imperative, because companies often act not in the interests of consumers, but in their own: maximizing profits.

Thus, neuromarketing is now almost everywhere – it is already known which packaging designs are the most pleasant for the consumer, which associations / smells / emotions “sell” better. This knowledge is actively used by those brands that are able to afford such research or use the results obtained by others.

With the development of convergence, we are witnessing for the first time a parallel accelerated development of a number of scientific and technological areas that directly affect society. Of particular interest are the likely qualitative changes in the economic system under the influence of the technologies described above.

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**Конвергенція нейромаркетингових технологій в сучасних умовах розвитку економіки**

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У періоди соціально-економічних, інноваційно-екологічних і політичних трансформацій громадська система може не виконувати свої функції, що призведе до порушення стійкості суспільного життя. Економіка трансформацій, як невід’ємна частина розвитку соціальної системи, в кінцевому підсумку, призводить до зміни самого клієнта і його потреб і запитів. Ці процеси, в свою чергу, проявляються в ігноруванні загально визначених економіко-екологічних цінностей, політичних, ідеологічних, культурних і моральних. Розвиток технологій в минулому зазвичай визначався протягом тривалих періодів будь-яким одним відкриттям або прогресом в одній області. На сьогоднішній день з розвитком цифровізації, загальним впровадженням інформаційних технологій в різні сфери життя: обслуговуванні, виробничо-господарської діяльності, освіти, культурі, і так далі, відбувається конвергенція економіки, менеджменту і маркетингу за короткі часові терміни. Це явище викликане стрімким розвитком інформаційно-комунікаційних технологій, мікроелектроніки, мікробіології, симуляцій, наноманіпуляцій, «сильного» штучного інтелекту в більшості країн світу. Особливо значущим нам представляється конвергенція інформаційних технологій, біотехнологій, нанотехнологій і когнітивної науки. І в таких сучасних конвергентних умовах різко розвиваються нейромаркетингові технології на новому рівні. Питання розвитку і застосування нейромаркетингових технологій заслуговують вивчення, щоб не було надалі етичного «шоку» і примусу до придбання на несвідомому рівні. Такі технології використовували і раніше в різних сферах економічної діяльності, в психології і в рішенні інших питань. Нейромаркетингові технології змінюють уявлення про навколишнє середовище: природу, людину, розум. Складно описати результати таких процесів трансформацій, де змінам піддаються всі аспекти життя людини.

*Ключові слова:* нейромаркетинг, конвергенція, соціетальні системи, інформаційно-комунікаційні технології, біотехнології, когнітивність, інновації.

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