



# **Selected aspects of digital society development**

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# **SELECTED ASPECTS OF DIGITAL SOCIETY DEVELOPMENT**

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and Aleksander Ostenda

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## Part 3. MODERN ISSUES OF THE DIGITAL ECONOMY DEVELOPMENT

### 3.1. INFORMATION FACTORS IN ECONOMIC SYSTEMS AND BUSINESS DURING TRANSITION TO DIGITAL ECONOMY

Information and matter are the basis for developing natural and social systems. Each of them has both a material and informational beginning, mutually stimulating and mutually forming both.

Information plays a crucial role in shaping the properties of openness and stationarity of systems, which is extremely important for the functioning of systems and ensuring their efficiency. Information is also a key factor in ensuring the synergetic properties of the system, which determine the ability to coherent behavior of individual elements within the system itself, as well as in the relations of the system at the supersystem level. It is what determines the connection of this system with other systems.

In the scientific works (Brillouin<sup>425</sup>, Wiener<sup>426</sup>, Reimers<sup>427</sup>, Ursul<sup>428</sup>, Shannon et al.<sup>429</sup>, Ashby<sup>430</sup>), functional features of information are the following:

- messages;
- measure of probability and uncertainty;
- display form;
- reality that shapes matter;
- development program;
- organizational beginning;
- natural resource;
- criteria of difference;
- degree of diversity;
- degree of heterogeneity;
- choice of alternative;
- degree of choice;
- measure of ordering.

Information can be defined as a natural reality that carries the characteristic features of objects and phenomena of nature, manifested in space and time.

Information is intangible; it does not have two main features of material objects – charge, and weight. However, the carrier of information is material objects. It is formed by the energy potentials fixed by the system's memory (between the elements inside the system and between the system and the external environment). They determine the ability of the system to change in space and time.

#### *Forms, levels, and functions of information*

Table 1 shows different forms of information reality.

Based on a single essential nature, information reality has developed on the scale of our planet in a complex, diverse world, where a leading performer is a person acting within society.

Man gets the opportunity of abstract thinking (reflection). Thus, it can form information images detached from reality, that is, to create a "virtual reality". The information images she found perform social and economic functions and are very diverse.

Thus, using the terminology of material production, information products can take the form of blanks (e.g., collected and analyzed facts), semi-finished products (ideas), finished products

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<sup>425</sup> Brillouin, L. (1960): Science and information theory/trans. from English Moscow: State Publishing House of Physical and Mathematical Literature, 1960.

<sup>426</sup> Wiener, N. (1958): Cybernetics and Society/trans. with English Moscow: IIL, 1958.

<sup>427</sup> Reimers, N. F. (1990): Nature management: a dictionary. Moscow: Mysl, 1990.

<sup>428</sup> Ursul, A. D. (1971): Information. Moscow: Nauka, 1971.

<sup>429</sup> Shannon, K., Bandvagon, E. (1963): Works on information theory and cybernetics / trans. with English Moscow: IL, 1963.

<sup>430</sup> Ashby, U. R. (2009): Introduction to cybernetics / trans. from English Moscow: Librocom, 2009.

(information services, such as consulting) or “information nodes” (samples) and complex systems (technological solutions).

*Table 1. Forms of information reality*

<b>Level of information reality</b>	<b>Form of information reality</b>
1. Primary fundamental entities that determine the organizational basis of material substance	<ul style="list-style-type: none"> <li>• fundamental physical laws of nature;</li> <li>• causal relationships;</li> <li>• patterns of interaction between objects of the material world (for example, space objects in the universe);</li> <li>• spatial order of bodies and phenomena;</li> <li>• the order of events in time;</li> <li>• information codes of elementary particles, as well as atoms and molecules (carriers of properties of matter and energy);</li> <li>• self-regulation programs</li> </ul>
2. Secondary information entities that have emerged as a result of self-regulation of nature	<ul style="list-style-type: none"> <li>• genetic programs (genetic code, genome) that determine the self-organization of living organisms and biological species;</li> <li>• fixed links that determine the functioning of natural communities (biocenoses) and ecosystems</li> </ul>
3. Information entities of the highest level, which are the result of the development of living nature	<ul style="list-style-type: none"> <li>• information code of the human brain;</li> <li>• nervous sensations of living organisms;</li> <li>• intelligence (thinking and sensory essence) of man and higher animals (soul, thought, spirit, personality, socio)</li> <li>• public entities (economic and social relations)</li> </ul>
Information products of intellect and society	<ul style="list-style-type: none"> <li>• knowledge</li> <li>• emotions</li> <li>• types of communication interaction (languages, messages, images, etc.);</li> <li>• types of motivational influence (intimidation, stimulation, inspiration);</li> <li>• sensory impressions of the accurate picture of the material world;</li> <li>• skills of performing physical and mental work;</li> <li>• principles (laws, rules, traditions, values, standards, instructions, prohibitions, regulations);</li> <li>• artificially bred animal breeds and plant varieties;</li> <li>• technologies (including management);</li> <li>• results of activities in the sectors of culture, art, sports;</li> <li>• computer programs, robot programs and artificial intelligence;</li> <li>• information changes made by man in landscapes, biocenoses, ecosystems</li> </ul>
5. Secondary information products of intellect and society	<ul style="list-style-type: none"> <li>• the resulting genetic information from human-made species;</li> <li>• information products produced with the help of computer programs;</li> <li>• results of computer "viruses";</li> <li>• artificial self-organizing systems</li> </ul>
6. Products of self-organizing systems	<ul style="list-style-type: none"> <li>• new generations of self-reproducing genetically modified organisms;</li> <li>• self-playing computer programs;</li> <li>• results of self-reproduction of technical systems</li> </ul>

Both information resources and information products can be considered as independent functions of the information principle. In some sources (Bell<sup>431</sup>, Inozemtsev<sup>432</sup>) these two information entities are characterized by two different terms: the first is called information, the second – knowledge.

<sup>431</sup> Bell, D. (1999): The future post-industrial society. Experience of social forecasting / trans. with English Moscow: Academia, 1999.

<sup>432</sup> Inozemtsev, V. L. (1999): Prospects for post-industrial theory in a changing world. A new post-industrial wave in the West. Anthology / eds. V. L. Inozemtsev. Moscow: Academia, 1999.

The programs mentioned above (including development plans and computer programs) are also a type of information product. In advanced economic systems, any product becomes an object of sale. Information products are no exception.

In the XXI century, the software product has become one of the most profitable products, bringing manufacturers billions in profits. Consumers pay this money, realizing that only by mastering the most advanced types and means of production they will increase efficiency dramatically. This, in turn, is highly cost-effective.

#### *Features and content of information products*

A common feature of any product is that they are created for sale and profit. Information products are no exception. The specific characteristics of such goods are that in their production and use (consumption), the primary role is played by information.

The nature, content and forms of sales of products under the conditional name "information goods" are so diverse that it is difficult even to list all their possible manifestations. Any approaches to the identification and evaluation of such goods are very conditional. With this in mind, let's try to describe the factors that determine the content of information products and schematically classify them by possible features.

According to the form of the essential nature of their formation, information goods can be divided into two groups: tangible (materialized) and intangible.

Material products are sold in material form. Their "information" is due to the priority role of information in the production or use of products.

Intangible goods are sold in intangible form, of course, with the help of tangible media (paper, magnetic media, etc.). Examples are various rights to intellectual or artistic products (including science, culture, education, the arts), including computer programs, technology, and works of art.

According to the functions performed in the economic system, information goods are divided into two groups: means of production and consumer goods.

The means of production, in turn, may differ in the functions performed in the production cycle. In particular, information products can play the role of:

- raw materials (databases, statistical and analytical information, expert assessments, etc.);
- means of labor (computer programs, technological solutions, management technologies, etc.); in particular, information can play the role of even a "working body" in the impact on material objects (such, for example, are the means of protection: in particular, anti-virus computer programs, insect repellents, etc.);
- items of work or semi-finished products (genetic information, manuscripts, and versions of works of art);
- labor products (advice, recommendations, information services of intermediaries, etc.);
- means of communication (e.g., means of communication);
- labor factors (knowledge, skills, worldview, beliefs, ability to work in a team, etc.).

Consumer goods may differ in their intended use in society. Possible areas of application can distinguish the following groups of goods:

- production purposes (for example, handbooks for subsistence farming, materials for self-preparation);
- household purposes (for example, humidity or temperature control systems);
- environmental purpose (monitoring systems);
- means of reproducing the human condition as a biological organism (recreational services and equipment);
- means of meeting human social needs (cultural and artistic works, tourist, cultural and sports services, spectacles, etc.);
- means of forming personal qualities (education, training, etc.);
- means of performing socially conditioned functions (legislation, state and territorial administration, social protection, etc.).

According to the objects of influence, i.e., objects that are affected by information products, the latter are divided into the following groups of goods that:



- impact people (educational technologies, services, works of art, etc.);
- impact the living matter outside humans (genetic engineering, agricultural and forestry technologies, etc.);
- impact the inanimate matter (science-intensive means of production);
- impact intangible reality (computer programs, data collection and processing technologies, etc.).

According to the degree of completion of the development cycle, information products can be differentiated into two groups:

- goods of the completed development cycle (computers, equipment, devices, printed products, monumental works, etc.);
- goods capable of self-development without the direct participation of people who created them (derived by humans biological species: animal breeds, plant varieties, strains of microorganisms; some types of computer programs, such as computer viruses; in the future – existing models of artificial intelligence, self-developing works).

Concerning the information reality, goods can be divided into the following groups:

- goods that materialize information (science-intensive products and services);
- products designed to influence information (computers, storage devices);
- goods that use information in production as a "working body" (genetic engineering, educational technology);
- goods that use information as a consumer (tourism, perfumery);
- goods that are information themselves (computer programs, virtual services).

The specifics of information products become more transparent with a detailed acquaintance with some types of information products.

*Types of information goods.* In 2000, humanity crossed not only the boundary between two millennia. It was also a milestone in the economy. Sales of intellectual products in world trade equaled the value of material goods. Currently, the share of information goods is even higher because information, even in the manufacture of goods that have a material form, is increasing every year. According to some data, the cost of information at the turn of the millennium was three-quarters of the value-added of manufactured products (Dyatlov et al.<sup>433</sup>, Socio-economic<sup>434</sup>). More and more people sell and buy not substances and energy in the new economy, but information focused on human knowledge and worked in products and services (Sineviciene, et al.<sup>435</sup>).

A complete list of such products would probably take hundreds of pages. It would include science-intensive industrial products (aerospace, instruments, chemical reagents, building materials, clothing samples, interior elements, pharmaceuticals, perfumes, information and communication, cultural and artistic works, educational technology, etc.).

The process of developing a new information space is not limited to the production and consumption of products. It is a highly complex phenomenon of public life, affecting and changing the whole complex of social relations, industrial relations, basic principles, behavioral principles, lifestyle. The transition to information goods and services is forcing a radical transformation of socio-economic relations, which are the basis for the formation of society.

*Evaluation of information quality.* For systems to function and develop, not only material (ie material-energy) but also information metabolism of systems must be carried out. In other words, there must be an exchange of information (called communication) between the system and the external environment, as well as between individual parts of the system itself. It means that

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<sup>433</sup> Dyatlov, S. A., Maryanenko, V. P., Selishcheva, T. A. (2008): Information and network economy: structure, dynamics, regulation. Saint-Petersburg: Asterion, 2008.

<sup>434</sup> Socio-economic problems of the information society (2010): monograph / eds. L. G. Melnyk, M. V. Bryukhanov. Issue 5. Sumy: University Book, 2010.

<sup>435</sup> Sineviciene, L., Hens, L., Kubatko, O., Melnyk, L., Dehtyarova, I. and Fedyna, S. (2021) 'Socioeconomic and cultural effects of disruptive industrial technologies for sustainable development', Int. J. Global Energy Issues, Vol. 43, Nos. 2/3, pp.284-305.

information must be transmitted by something (or someone) and received by something (someone). It determines the presence of at least three areas:

- sources (transmitter) of information (object or subject);
- information receiver (object or subject);
- information transmission channel from the transmitter to the receiver (communication channel).

Another critical point is that the information should not be transmitted from transmitter to receiver but perceived by the latter adequately. It creates specific requirements for the quality of the processes of transmission and perception of information. It is determined by the characteristics of these three interrelated groups of factors (transmitter, receiver, communication channel) and the information itself.

Under the quality of information is understood a set of properties of information that ensure its suitability for the functions of existence and development of the system.

Indicators that characterize the quality of information are presented in Table 2.

*Table 2. Indicators that characterize the quality of information*

<b>Indicator</b>	<b>Content</b>
Certainty	Properties of information that determine the degree of objective, accurate reflection of phenomena, events, facts that have occurred, are occurring or may occur The objectivity of the tool for collecting, transmitting or receiving information, which does not allow significant deviations from the actual values and guarantees the possibility of obtaining the same or similar evaluation results when re-collecting information
Adequacy	The level of conformity of the image of a real object, process, phenomenon created with the help of information
Truth	The degree of conformity of the subject's perception of the object of observation as a result of the interpretation of primary information, the actual (true) state or behavior of the system
Completeness	A characteristic that determines the amount of information needed to make a decision
Relevance	The degree of conformity of the quantity and quality of information (notification) to the needs due to the need to solve a specific problem (In technical systems): substantive correspondence between the query entered into the documentary information retrieval system and the information issued by it
Orderliness (system)	The degree of systematization of information on any grounds, which facilitates its search, storage, and processing
Timeliness	The ability of information to show its properties, in particular, relevance, value, adequacy, reliability, usefulness in a specific time
Utility	The degree of suitability of information to be used for specific purposes
Value	A measure of the ability of information to approximate the achievement of the purpose for which the information is used
Accessibility	The degree of dependence of information on technical, economic, legal, social, etc. conditions that limit the possibility of obtaining it
Complexity	The degree of diversity of the phenomenon or object that characterizes this information, the composition of its parts, their differences and the interrelationships between them The level of complexity of the tool base for evaluation, coding, transmission, reception, decoding, and perception of information
Adaptability	The degree of adaptability of information to perform certain functions, including the ability to transmit it through communication channels, encoding and decoding, acceptance and interpretation by the consumer, etc.

*Properties of information assets.* The media have distinctive properties compared to their material counterparts.

- Any computer program, design idea or technological know-how can be used by all mesh ends of the Earth at the same time.

- The appearance of each of the replicated programs does not mean the disappearance of "something somewhere" (in the sense of material and energy substance); copies of programs appear as if with nothing at the touch of a button.

- No matter how much you sell software or video products, the seller will not reduce it.

- The buyer, having purchased the information product, at the same time gets the technical ability to replicate it himself, and therefore sell it.

- Information products (unlike tangible goods) are not consumed but used because they cannot be "consumed" (in the sense of using without balance); no matter how much you use them, it does not become less.

- Information products do not wear out physically (unlike their material carriers; they can only wear out morally, especially obsolete).

The development of any open stationary system occurs in the process of interconnection and resolution of contradictions between two processes occurring in the system, which is to reduce the level of its ordering (entropy production) and increase its order (entropy removal). The leading role in this continuous race of creation and destruction belongs to information. Systems are able to accumulate better and consolidate data. Progress is an increase in the degree of systems information.

These examples convincingly confirm that information factors become the basis of social production in today's world, occupying leading positions in all critical components of the economic system and business.

Information becomes the basis of production, determining the course of production processes, controlling its main stages and components, ensuring the life and work of man himself in production and everyday life. Information is increasingly taking the place of objects of labor because, in the leading countries, the share of costs associated with information factors is more than half of the total production costs. Finally, these products are increasingly taking the form of goods that are sold and bought.

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