ARTECO Journal. Socio-Economic Researches and Studies
Vol. 2, No. 1, July 2019, pp. 5–10
ISSN 2602-0599, ISSN-L 2602-0599

www.arteco-journal.ro

Cybernetics, Tcoding and Information Security – the basis Components of the Modern Digital Economy

Dmitro TRUSHAKOV[1], Oleksandr KOZLOVSKYI[1]

[1] Central Ukrainian National Technical University, Kropyvnytskyi, Kirovohrad region, Ukraine

Correspondence: Dmitro TRUSHAKOV, Central Ukrainian National Technical University, Kropyvnytskyi, Kirovohrad region, Ukraine, 25006, m. Kropyvnytskyi, University of Ave., 8, E-mail: *dmitro.trushakov@gmail.com*

Abstract

Digital economy is an economy associated with the accumulation, processing, transmission and storage of large amounts of information. This is an economy built on new standards and platforms associated with a wide range of Internet services for human activities. In addition, it is necessary to take into account innovative activities without which the development of the digital economy is impossible. Data is the foundation of the digital economy. A modern scientific-educated person needs to have ideas about cybernetics and information protection as integral components of the modern digital economy, namely, binary calculus as the basis for presenting data in digital form, the basis for coding information, to have an idea about the basics of transmitting information messages using digital cybernetics.

Key words digital economy, large amounts of information, innovative activities, digital cybernetics, information security, transmission of information messages

JEL Codes: D80.

Introduction

Now, the rapid development of communication capabilities has to solve a number of problems, both technical and organizational.

In the digital economy, the core of the new infrastructure is software, which is able to influence the global economy and numerous global markets.

Data is the foundation of the digital economy. Millions of lines of data in the form of information messages, combined with a powerful global idea and business model, are capable of changing entire markets.

However, data without movement, without exchange between companies, quickly lose their relevance. Therefore, in the modern world in the development of the digital economy, special attention should be paid to the protection of information flows. The basis of protecting the information infrastructure should be activities aimed at protecting the objects of information and telecommunication systems of the world market.

Our task is to show that the digital economy is not only an economic component with its existing laws and concepts of the world market, but also a cybernetic component. In our opinion, it is in the cybernetic composition that the foundation of the digital economy with the inherent rules and laws of cybernetics is laid.

1. Literature review

In our previous papers, our main idea was that the development of the digital economy and the production of modern devices is not possible without paying special attention to the reliability of modern digital devices. In paper (Trushakov & Moshna, 2012), we conducted a study of the reliability of the information system. In paper (Trushakov & Rendzinyak, 2013), we investigated the reliability of a personalized electronic measuring machine.

2. Research methodology and data

Modern digital economy is an economy associated with the accumulation, processing, transmission and storage of large amounts of information. This is an economy built on new standards and platforms associated with a wide range of Internet services for human activities. Humanity every day has to deal with a large amount of information. Information is transmitted between objects in the form of information signals that form an informational message. As is known, information signals are of two types: analog and discrete. Analog signals have a sinosuidal shape, discrete signals transmit information in the form of 0 and 1 in digital form. They try to convert all transmitted information to discrete, since it is easier to record and process in digital form. Thus, at present, special attention is paid to cybernetics, economic informatics and information security. This is all an integral part of the digital economy.

To transfer an informational message using digital devices, these messages must first be encoded, that is, recorded in the form of numbers of one of the systems of interpretation, most often in binary.

After that, the information recorded in the form of zeros and ones must be transferred to the communication line.

Under the line of communication means the physical environment through which transmit information. Such a medium can be electrical wires, optical media. For the transmission of informational messages choose the media, which is well distributed in a particular communication line.

A coded message that is transmitted to the communication line using different physical media is called an information signal.

The purpose of our research is:

- show innovative activities without which the development of digital economics is impossible;
- that along with the standard concepts of the digital economy - the accumulation, processing, transmission and storage of large amounts of information, a scientific educated person needs to have an idea about cybernetics and information protection as integral components of the modern digital economy.

3. Results and discussions

Innovative activity and cybernetics as an integral part of the digital economy

Innovative activity. Now, special attention should be paid to innovation and science, without which the development of the economy, including digital, is not possible. Let us give some examples of statistical information on the innovation activities of my region of Ukraine – Kirovograd region.

The costs of research and development by type of work in the Kirovograd region of Ukraine are presented in Table 1, retrieved.

Table 1. Costs of research and development by type of work in the Kirovohrad region, Ukraine (in thousands of hryvnias)

Year	Volume of expenses – total (thousand hryvnia)	The amount of costs including the implementation		
		Fundamental Research	Applied Research	Scientific and technical (experimental) developments
2010	27880,5	877,0	3036,6	23966,9
2011	32409,6	644,3	3255,5	28509,8
2012	30181,8	904,4	3773,1	25504,3
2013	28829,5	932,1	3731,7	24165,7
2014	31902,9	1221,0	5928,5	24753,4
2015	54940,1	3044,6	5011,3	46884,2
2016	74614,5	1762,7	4826,8	68025,0
2017	75619,7	2911,5	7280,9	65427,3

Source: http://www.kr.ukrstat.gov.ua/?r=stat/2018/06/nayka/stat_inf_rik_nauka2.

Information on the number of employees involved in the implementation of research and development, by category of personnel in the Kirovograd region is presented in Table 2.

Table 2. Number of employees involved in the implementation of research and development, by category of personnel in the Kirovohrad region, Ukraine

Year	Number of employees - total	Including				
		Of them have a degree		Researchers	Technology	Auxiliary staff
		Doctor of science	Doctor of Philosophy (Ph. D.)			
2010	505	2	24	318	91	96
2011	449	3	25	291	86	72
2012	474	3	25	309	94	71
2013	435	3	28	294	71	70
2014	433	3	31	296	74	63
2015	414	1	23	287	60	67
2016	480	10	48	348	48	84
2017	503	11	89	382	41	80

Source: http://www.kr.ukrstat.gov.ua/?r=stat/2018/06/nayka/stat_inf_rik_nauka1.

Analyzing the information presented in tables 1, 2 we can draw the following conclusions:

- the volume of costs in the Kirovograd region to perform basic scientific research, applied scientific research, and scientific and technical (experimental) development, although it is growing every year, in our opinion is still negligible;

- to advance technical progress and improve the economy, it is necessary to significantly increase the number of employees involved in the implementation of scientific research and development, namely, first of all having a scientific degree of doctor of science and doctor of philosophy (candidate of science).

Cybernetics, as an integral part of the digital economy. As it was said earlier, the digital economy has to deal with large amounts of information.

In the modern digital economy from a technical point of view, the technical implementation of information processing takes place digitally using coding and binary arithmetic in binary calculus, as shown in book (Tokheim, 2013).

Certain binary codes are often used to process digital information and perform some mathematical operations. The most common binary codes that are derived from the conversion of the natural two-sided code are: direct, inverse, and additional codes. Besides, information coding is very often used for information security, as shown in books (Böhme, 2013), (Schneier, 2015).

Direct code is used to write positive and negative numbers. To find the direct code, up to the natural two-way code, add one more decimal number just one row, which is called symbolic. If a number is given before, then a sign of a redeemer will be 0, as expected – 1. At one hour, writing a direct code to the sign box will be located in the interval.

Any non-numeric information in the form of an alphabet can be encoded with the help of two numbers – 0 and 1.

Let us show how in the simplest case the Latin alphabet can be encoded, so that we could transmit informational messages in the form of a “telegram”.

The Latin alphabet is known to use 26 characters. In addition, at least 3 more characters are needed – spaces between words (spaces), comma and period. Thus, we need at least 29 characters to transmit a simple (telegraph) message, that is, up to 25 code words in total. In this case, each letter symbol is denoted by a five-digit binary number. In this case, one of the possible options for binary code combinations for sending a text message is presented in Table 3.

Table 3. A possible variant of binary code combinations

for sending a text message

Letter	Code combination	Letter	Code combination	Symbol	Code combination
A	00001	N	01110	Space	11011
B	00010	O	01111	Comma	11100
C	00011	P	10000	Dot	11101
D	00100	Q	10001		
E	00101	R	10010		
F	00110	S	10011		
G	00111	T	10100		
H	01000	U	10101		
I	01001	V	10110		
J	01010	W	10111		
K	01011	X	11000		
L	01100	Y	11001		
M	01101	Z	11010		

For example, the expression “digital economy” using our binary code from table 1 can be written as: 00100010010011101001101000000101100110110010100011011110111001111011011100 1.

Using the numbers 0 and 1, you can encode the information shown in any picture. An image, such as a black-and-white shape, can be encoded as follows, as shown in Figure 1.

To do this, the picture is conventionally divided into small squares. If black prevails in such a square (more than half the square of the square), then it is represented as a unit, and if not, then it is zero. Then, passing all the squares in the rows from left to right, and rows from top to bottom, write down a sequence of zeros and ones.
The structure of the transmission of information messages using digital cybernetics is shown in Figure 2.

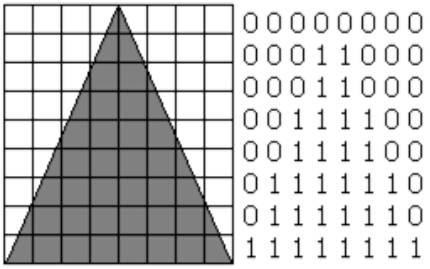

Figure no. 1. Coding of the image of a triangle for information transfer

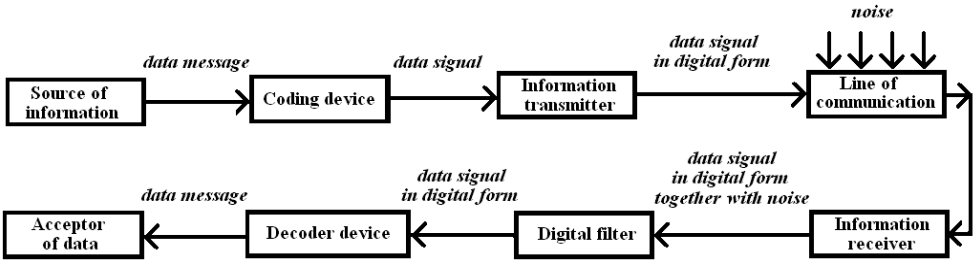

Figure no. 2. Structure of the transmission of information messages using digital cybernetics

During the transmission of informational electrical signals via communication lines, they are interfered with – extraneous electromagnetic disturbances, which are superimposed on the useful signal and distort it.

The signal may be so distorted that the recipient of the information will not understand it. In order not to fix a code combination distorted during transmission, special codes are used that make it possible to find the error. There are many such codes in digital technology. Consider some of them.

A very common code for pairing. It is formed in such a way. Choose the number of code combinations necessary for a particular case and compile a special table.

The number of digits in each combination will depend on the number of combinations, and it is determined by the formula 2^n p. Where p is the number of code combinations, n is the number of digits. Consider, as an example, table 4 for the case when the number of code combinations is $p = 7$ and the number of digits is $n = 3$.

Table 4. Binary code, additional symbol and transmitted combination code for pairing

№	Binary code	Additional symbol	Transmitted combination code for pairing
1	001	1	0011
2	010	1	0101
3	011	0	0110
4	100	1	1001
5	101	0	1010
6	110	0	1100
7	111	1	1111

As can be seen from this Table 4, 7 code combinations of a three-digit binary code were taken to transmit information. For each of these combinations, the right one adds one additional character 0 or 1 so that the total number of units in each code combination is paired. Then any distortion of a single character breaks the pairing, and the error will be found using the simplest logical devices. Such code finds errors of unpaired multiplicity, that is, single, triple, etc.

Errors of pair multiplicity, that is, double, in four characters, etc. will not be detected, because the pair of numbers in general will not be violated.

Other codes are used to find a number of distorted characters. Consider one of these stakes, which is called correlation. It is formed on the basis of the usual binary code according to this rule. Each 0 binary code is converted to 01, and each one is converted to 10.

For example, if the initial binary code combination is 01101, then the combination of the correlation code will be 0110100110. In this code, errors of any multiplicity can be found.

To do this, all the characters of the code combination are divided into pairs of digits. An error is found if there are identical symbols in any pair of digits - two zeros or two ones. It is impossible to find errors in such a code if at the same time in any pair of digits 1 and 0 are replaced by 0 and 1, respectively, or by a turn. Errors of this nature are called bias. There are other error detection codes.

In addition to the mentioned codes, there are also codes with the help of which they not only find errors, but also determine the location of the wrong character, and then correct it. These codes include Hamming code, cyclic and others.

Conclusions

In this paper, we showed that the digital economy is an economy built on new standards and platforms with new thinking. This is an economy of data related to the accumulation, processing, transmission and storage of large amounts of information. Without an innovative component, the development of digital economics is impossible. Data is the foundation of the digital economy. Modern science-educated people need to have an idea about cybernetics and information protection as integral components of the modern digital economy. The basis for presenting data in digital form for processing and transmitting it is the binary system of calculus as the basis for encoding information. A technically competent person needs to have an idea about the basics of transmitting information messages using digital cybernetics.

References

Trushakov, D., & Moshna, D. (2012). Investigation of the Reliability of Computing Systems. *Journal of applied computer science, 20*(2), 131-140.

Trushakov, D., & Moshna, D. (2011). Investigation of the Reliability of Computing Systems. *Proceedings of the XII International Workshop "Computational problems of electrical engineering*". Kostryna, Trans-Carpathian region, Ukraine, p. 62.

Trushakov, D., & Rendzinyak, S. (2013). Research of the reliability of personal computer "IBM PC" type. *Przeglad elektrotechniczny*, *89*(4), 275-277.

Trushakov, D., & Rendzinyak, S. (2012). Research the reliability of personal computer "IBM PC" type. *Proceedings of the XIII International Workshop "Computational problems of electrical engineering"*. Grybow, Poland, 50.

Tokheim, R. (2013). *Digital Electronics: Principles and Applications:* (8-th ed.). New York: McGraw-Hill.

Böhme, R. (2013). *The economics of information security and privacy.* New York: Springer.

Schneier, B. (2015) *Secrets and Lies: Digital Security in a Networked World*. New York: John Wiley & Sons.