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Economic assessment and forecasting of the social component of man-made damage in the national economy

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Abstract. In order to study the social component of man-made damage in the national economy, an expert model for establishing levels of technogenic morbidity of the population of Ukraine, due to the destructive influence factors (emissions, discharges, waste), have been built by means of fuzzy logic in this paper. The economic evaluation and prediction of the social component of man-made losses – cost of treating patients with tumors due to environmental pollution have been conducted. In the national economy these results should be considered in the formation of public expences on health care and the treatment of patients. This will increase the effectiveness of state regulation of the phenomenon, provide appropriate allocations for their eradication and compensation.

Key words: man-made damage, the national economy, economic evaluation, forecasting, technogenic morbidity.

INTRODUCTION

The problem of studying the social component of man-made damage to the national economy is directly related to the problems in the theoretical foundations of economic evaluation and prediction under conditions of incomplete data and uncertainty of the future. Study of the problems is also hampered by the need for assessment of anthropogenic indirect anthropogenic losses caused by factors of destructive influence of economic activity. Considering the impact of anthropogenic activity (emissions, discharges, waste) on changes in social indicators of social development (incidence, life expectancy, mortality, etc.) is challenging and, yet, important (relevant) problem in the economics and management of the national economy.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

Work on the theory of economic damage caused by the economic activity of enterprises engaged many researchers from all over the world. The research of recent publications confirms that a significant contribution in this direction was made by the following list of Ukrainian scientists [1-6]: O. Amosha, O. Balatskiy, B. Burkynskyi, Ya. Vytvytskyi, V. Geets, B. Danilishin, S. Illyashenko, O. Kuzmin, L. Melnyk, I. Nyedin, Yu. Stadnitskii, Yu. Tunytsya, Ye. Khlobystov, V.Shevchuk and many more.

The analysis of scientific sources and publications shows that scientists in Ukraine and in the whole world pay little attention to the investigation of the social component of man-made damage to the national economy and their economic evaluation and forecasting at the state level, despite the urgency of the problem. The complexity of the phenomenon is caused by the processes that take place under conditions of uncertainty and incomplete information. Thus, to describe them and get proper results in national economy we should use the methods and models of fuzzy set theory and means of neural networks. The successful use of the fuzzy sets in prediction and modeling of socio-economic and ecological-economic systems were made by such scientists as [7-9] T. Klebanova, O. Melnyk, O. Moroz and others. However, the unresolved problem of the

general study of the effects of anthropogenic impact on the recipients of environmental, economic and social subsystems is to build a mathematical model of economic evaluation and prediction of the social component of man-made damage to the national economy.

OBJECTIVES

The research of theoretical foundations and applied problems of economic evaluation and forecasting the social component of man-made damage to the national economy lead to the formulation of the following purposes: to build by means of fuzzy logic an expert model for establishing levels of technogenic morbidity of the population of Ukraine, due to the destructive influence factors (emissions, discharges, waste); to conduct the economic evaluation and prediction of the social component of man-made losses – cost of treating patients with tumors due to environmental pollution.

THE MAIN RESULTS OF THE RESEARCH

The perception indicators of destructive effects of economic activity describe the social component of man-made damage. In each of the subsystems of the national economy the corresponding indicators are changing under the influence of impact factors. Thus, in the subsystem of population the following indicators change: the level of disease, the mortality rate among the various categories of the population, birth rate, population size, its structure, etc.; in nature subsystem: the level of afforestation areas, the quality of agricultural land quality recreational areas, pollution, ecosystem threshold of perception, etc.; in the economy subsystem: the level of fixed assets, infrastructure, transport, communications, utilities and more.

Economic evaluation of relevant changes of perception depends on the state of the national economy, the level indicators that directly characterize the state of the economic subsystem itself. The structure parameters characterizing the economy mainly include: GDP per 1 person, the average size of national income produced by one worker for 1 day, the cost of maintenance of housing, urban and rural infrastructure, public transport per 1,000 people The average value in the national economy per unit of output, the average cost of maintenance of capital assets. The structure parameters describing social development include: the average costs for one day for a letter of disability for 1 employee, average medical costs for 1 day for 1 patient, etc. The set of indicators describing the state activities using and protecting the environment include: the average cost per unit of waste discarded figures on environmental taxes, the cost of environmental protection, etc.

As Database for the study of factors of anthropogenic losses were statistics impact of human activities on the environment, which the author collected from relevant sources of statistical information presented in an open statistical basis of the State Statistics Committee of Ukraine on its website (http://www.ukrstat.gov. ua). The evolution of the anthropogenic load for the period of 1990–2012 , which describe factors change the destructive impact of economic activity on the environment Ukraine, presented in Table. 1.

It is important to take into account the scale of the national economy in the economic evaluation of man-made damage, so we recommend working better with specific values of these indicators, and sometimes from their increments. Thus, the dynamics of perception factors is presented in Table. 2 in accordance with the values of specific rates of newly reported cases in the 1990–2012.

In previous studies of the authors [10, 11], there has been established the essence of the concepts of man-made damage and man-made losses, constructed a concept of economic evaluation of man-made damage to the national economy and the necessity for the application of fuzzy sets as an effective mathematical tool for economic evaluation of man-made damage to the national economy.

From existing indicator array of impact factors (tabl.1) and perception factors (tabl. 2) we can select those statistical series, which according to the experts have a direct contact with each other.

Economic losses to the national economy due to air pollution were studied under the guidance of prof. Balatskiy O.F. [12], which included core losses, expenses for environmental protection, as well as damage to human health, which led to lower productivity and more. Interesting research has been made by Kubatko O.V. [13], where a representative of the Sumy school simulates the impact of air pollution on public health. The researcher found that the excess of permissible concentrations of nitric oxide in the air can cause irreversible changes in the health of people, particularly in the increasing number of diseases. Also there has been found that pollution of water and air basins increased and can lead to the emergence of irreparable damage, when it is not possible to restore homeostasis level socio-natural systems.

Researchers at the European eco-economic school, according to de-Brian [14], considered that the problem of growth of diseases among population and the deterioration of fixed assets (metal corrosion, reducing operating time of equipment, etc.) should also include reduction of the effectiveness of natural resources due to the loss of acid rain , climate change, etc.).

Repeatedly researchers in Ukraine and the world have tried to establish the proportion of the environmental component of morbidity and mortality.

However, establishing dependence of the morbidity of the deterioration of the environment is an extremely challenging task. For example, in work [15] researchers believe that losses from deteriorating of health due to environmental pollution should be calculated at a ratio of 50-40-10, where 50 % of all human diseases are caused by the way of life, 40 % – heredity and the environment, and only 10 % – dependent on the level of medicine in the state.

More thorough studies have been conducted in work [16] where it has been determined the impact of income, providing medical staff, air pollution and ionization area of the Chernobyl accident on human health in the regions of Ukraine. In this work it has been demonstrated that disease of endocrine system (thyroid disease) increased by 30% due to increased exposure to 30 cGy.

The stated problem required from the authors to processing of large arrays of frequently conflicting data. This fact made it impossible for finding correlations between the factors of anthropogenic pollution and morbidity and mortality and, consequently, economic losses. Given these circumstances the authors propose to apply the theory of fuzzy sets and fuzzy logic.

The creator of this theory, American scientist Lofty Zadeh (L.A. Zadeh), predicting the future management theory, in [17] claimed that the theory "must provide a smaller mathematical strictness and precision and to pay more attention on the development of qualitative and approximate solutions to the pressing problems of the real world". Fuzzy logic is often perceived by many experts on mathematical modeling of economic processes as a means of taking only approximate solutions. However, experience has shown that establishing fuzzy knowledge base allows to achieve precision simulation that is not inferior to strict proportion. In the case of inaccurate and inconsistent data, but with the knowledge and experience of experts in the relevant field, this theory is the only possible tool to establish causation and prediction of possible recommendations for making effective decisions. Extraordinary benefits of this simulation it is the possibility of self-improvement like the human brain.

Table 1. Dynamics of factors of the destructive influence of the economic activity according to the indicators of technogenic impact in environment Ukraine in 1990–2012*

Year	Emissions of sulfur dioxide, t	Emissions of nitrous oxide, t	Emissions of carbon dioxide, million t	Emissions of contaminants, thous. t	Volume discharges million m^3	Volume of waste generation (I-III class), thous. t
1990	2782,3	760,8	…	15549,4	470	…
1991	2537,9	989,8	…	14315,4	701	…
1992	2376,2	830,2	…	12269,7	951	…
1993	2194	700,1	…	10015	1196	…
1994	1715	567,6	…	8347,4	1053	4955,8
1995	1639,1	530,3	…	7483,5	912	3562,9
1996	1292,6	466,6	…	6342,3	980	3150,9
1997	1132,4	455,2	…	5966,2	763	3161,4
1998	1023	444,5	…	6040,8	813	2454,1
1999	1026,1	436,6	…	5853,4	748	2820,4
2000	984,8	440,6	…	5908,6	758	2613,2
2001	992,1	452	…	6049,5	746	2543,3
2002	1032,6	435,7	…	6101,9	782	1728,8
2003	1046,3	477,9	…	6191,3	804	2436,8
2004	988,5	471,9	126,9	6325,9	758	2420,3
2005	1132,8	523,9	152	6615,6	896	2411,8
2006	1347,2	515,1	178,8	7027,6	1427	2370,9
2007	1342,6	641,9	218,1	7380	1506	2585,2
2008	1320,6	642	209,4	7210,3	616	2301,2
2009	1262,7	562,1	185,2	6442,9	270	1230,3
2010	1235,2	603,7	198,2	6678	312	1659,8
2011	1363,4	633	236	6877,3	309	1434,5
2012	1430,3	634,6	232	6821,1	292	1368,1

** Built and designed by the author according to the State Statistics Committee of Ukraine website (... – no stats)*

Table 2. The dynamics of perception factors for specific values of parameters of newly reported cases of diseases in Ukraine in 1990–2012 , inst. / thous. people*

Years	Total of di-seases	Tu-mors	Diseas-es of the ner-vous system	Diseas-es of the blood circu-lation system	Raspi-ratory system deseases	Diseas-es of the skin and subcu-taneous tissue	Diseases of the musculo - skeletal system and con-nective tissue	Diseases of the genitouri-nary system	Congenital anomalies (malformat-ions), deformat-ions and chromosomal abnorma-lities	Injury, poisoning and certain other consequences of external causes
1990	620,93	5,98	50,93	22,16	328,35	34,70	26,51	23,61	0,79	55,29
1992[1]	638,04	6,40	57,73	27,12	311,70	38,40	29,37	28,03	1,00	57,98
1993	647,59	6,35	58,28	27,03	319,10	38,99	29,53	29,08	1,03	55,09
1994	603,58	6,29	58,03	26,88	278,21	40,97	27,61	28,57	0,94	51,89
1995	629,19	6,32	58,71	26,87	303,60	41,45	27,37	29,85	0,91	51,17
1996	588,12	6,53	59,79	27,53	257,73	40,74	27,90	31,64	0,97	50,74
1997	613,12	6,85	61,08	29,46	278,03	40,36	29,04	33,67	1,04	48,88
1998	634,77	7,39	66,13	33,55	275,50	42,13	31,76	37,34	1,17	48,94
1999	660,26	7,65	15,37	39,06	290,18	40,81	31,01	37,78	1,22	48,10
2000	677,14	7,73	15,13	47,30	296,16	40,38	31,78	39,23	1,25	47,32
2001	678,45	8,05	15,23	48,73	290,52	41,04	32,56	41,88	1,21	45,77
2002	665,19	7,88	15,44	48,91	275,96	40,24	32,98	42,08	1,18	46,31
2003	678,80	8,23	15,64	49,70	288,21	39,89	32,75	43,27	1,12	47,85
2004	683,98	8,53	15,85	52,45	283,71	40,25	33,79	45,21	1,15	47,14
2005	696,10	8,63	15,95	51,40	293,86	40,95	33,84	46,21	1,12	47,88
2006	686,99	8,82	16,28	51,80	283,57	40,61	34,03	46,28	1,13	48,78
2007	703,32	8,73	16,12	52,24	298,98	41,85	33,64	45,71	1,09	48,96
2008	700,13	8,76	16,24	53,44	294,81	41,21	33,79	46,06	1,10	48,80
2009	715,85	8,82	16,34	52,51	314,84	40,96	33,46	46,38	1,13	46,90
2010	719,71	9,09	16,32	52,00	317,54	41,79	33,33	46,52	1,13	48,23
2011	707,34	9,24	16,25	51,25	309,05	41,09	32,55	45,76	1,20	46,66
2012	682,87	9,49	15,87	50,80	289,70	40,58	31,67	44,86	1,18	46,90

** Built and designed by the author according to the State Statistics Committee of Ukraine website*

[1] Data for 1991 in Ukraine there are no statistical basis

The proposed model is determining the level of technologenic morbidity Ukraine sets by means of fuzzy logic relationship between indicators of destructive influence factors and indicators of the perception factors. The structure of the parameters of destructive impact factors includes n-indicators of anthropogenic activity (Table 1) and of the parameters of perception factors includes m-indicators of the level of morbidity population of Ukraine (specific value of number of newly reported cases of a particular disease (Table. 2)).

Let's conduct the formalization of the considered problem as the object with n-inputs and m-outputs (1):

$$\begin{cases} y_1 = f(x_1, x_2, ..., x_n) \\ y_2 = f(x_1, x_2, ..., x_n) \\ \quad ... \\ y_m = f(x_1, x_2, ..., x_n) \end{cases}, \qquad (1)$$

where: $x_1, \ldots, x_n$ – a set of input variables; $y_1, \ldots, y_m$ – a set of the output variables.

Detailed construction of a mathematical model of fuzzy expert system is described in previous papers of the authors [10]. Here is only the necessary notation to describe quantitative variables transferred in linguistic terms: $U_i = [\underline{u_i}, \overline{u_i}]$, $i = \overline{1,n}$, $Y_j = [\underline{y_j}, \overline{y_j}]$, $j = \overline{1,m}$, where $\underline{u_i}, \overline{u_i}$ is the smallest and the largest possible value of variables x_i; $\underline{y_j}, \overline{y_j}$ is the smallest and the largest possible value of the output variables y_j.

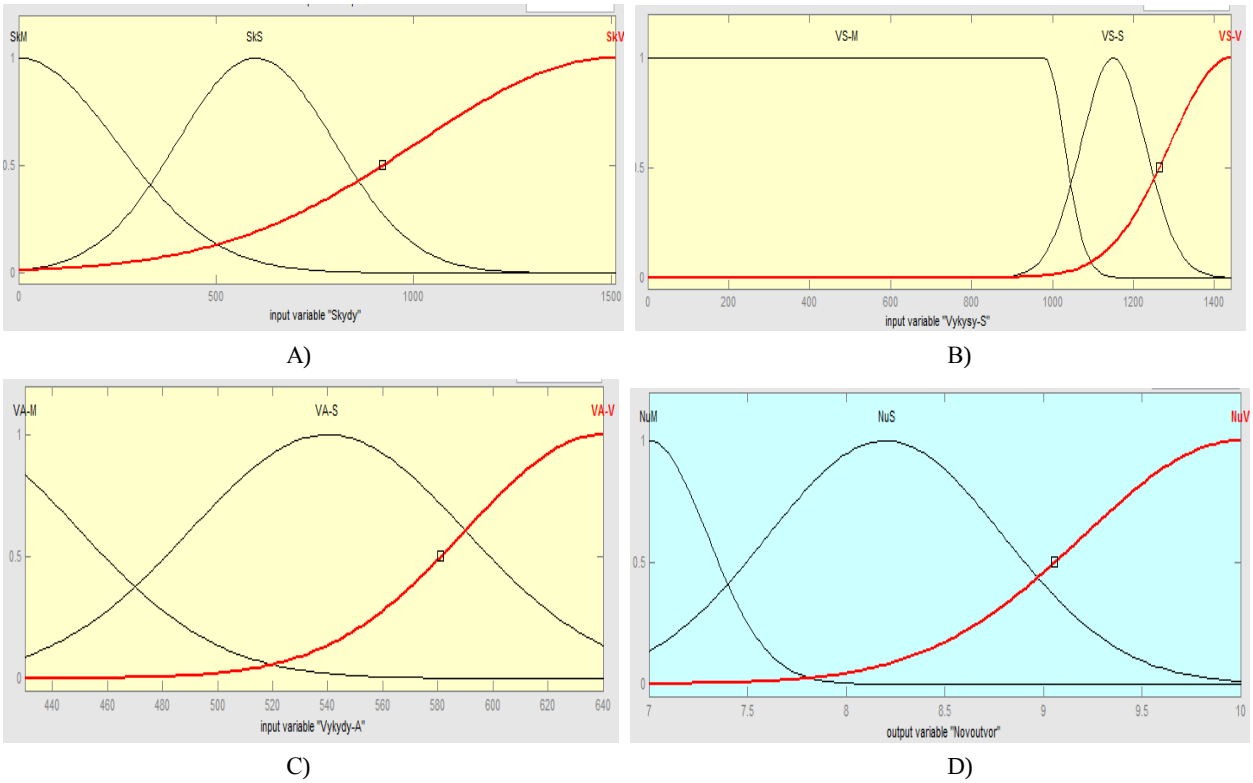
After constructing fuzzy knowledge database, which is represented in the formalized form of a grid system of fuzzy decision knowledge rules, decision-making $d_j^* jD\{d_{j1}, d_{j2}, \ldots, d_{jm}\}$, , which corresponds to a fixed vector of values of input variables $x^* = (x_1^*, x_2^*, \ldots, x_n^*)$, is carried out according to the fuzzy inference by Mamdani [18, 19]. To obtain accurate numbers y_j^* from the interval $[\underline{y_j}, \overline{y_j}]$, corresponding fuzzy output, it is offered at the center of gravity method [20].

These distinct values y_j^* determine the levels of morbidity in Ukraine due to the destructive influence of factors (emissions, discharges, waste and radiation background) for each disease. In other words, they determine the levels of technogenic morbidity. This result allows evaluating the economic social component of man-made damages – the cost of treating patients in Ukraine, a disease of which is caused by technogenic factors of destructive influence.

A validation of the proposed model to determine the level of technogenic morbidity in Ukraine in tumors has been conducted. Among the analyzed data in accordance with the recommendations of the experts the most significant impact on the number of newly reported cases of tumors is cased by the outstanding amounts of untreated polluted water, total emissions of sulfur dioxide and nitrogen oxide from stationary and mobile

sources. This greatly simplified the development of an appropriate knowledge base in fuzzy expert system for establishing interdependencies between the magnitude of discharges x_1 (removal of untreated polluted water in million m^3), sulfur dioxide emissions x_2 (total emissions from stationary and mobile sources in tonnes) and nitrogen oxide emissions x_3 (total emissions from stationary and mobile sources in tonnes) on the number of fixed tumors (per 1,000 citizens of Ukraine) $\boldsymbol{y_1}$. Using the statistical data presented in Table 1 and Table 2, we define the universal sets of input variables described for x_1, x_2, x_3 and output $\boldsymbol{y_1}$, respectively: $U_1=[0;1500]$, $U_2=[0;1450]$, $U_3=[400;640]$, $U_4=[7;10]$. For each input and output variables we built term-sets: $A_i=\{$*"small"*, *"medium"*, *"large"*$\}$, where $i=\overline{1,4}$.

The proposed model uses Gaussian membership function of two types (symmetric, asymmetric) for the terms of input and output variables, the type of which is shown in Figure 1. To solve the partial problem experts constructed a fuzzy knowledge base presented in Table 3.



A) B)

C) D)

Fig. 1. Aspects of the functions of linguistic variables "Discharges" (A), "Emissions of sulfur dioxide" (B), "Emissions of nitrous oxide" (C), "tumors" (D)*

** own development*

Table 3. The fuzzy knowledge base of the studied task*

Number of logical rules	Input variables			weight	Output variable
	x_1	x_2	x_3	w	y_1
1	*M*	*S*	*S*	*0.9*	*S*
2	*L*	*S*	*S*	*0.6*	*M*
3	*M*	*S*	*M*	*0.9*	*M*
4	*L*	*S*	*M*	*0.7*	*M*
5	*L*	*M*	*S*	*0.7*	*M*
6	*L*	*M*	*M*	*0.4*	*M*
7	*L*	*L*	*M*	*0.6*	*L*
8	*L*	*M*	*L*	*0.7*	*M*
9	*L*	*L*	*L*	*0.9*	*L*
10	*M*	*M*	*M*	*0.6*	*M*
11	*M*	*L*	*L*	*0.6*	*L*
12	*S*	*L*	*L*	*0.9*	*L*
13	*M*	*L*	*M*	*0.6*	*L*
14	*L*	*L*	*M*	*0.4*	*M*

** own development*

In Fig. 2 it is shown a graphical representation of active rules for input and output variable and a function of target variable y for data in 2009 year. As a result of work of the fuzzy expert system (Fig. 3), there have been obtained the level of technogenic morbidity in Ukraine in 2000–2012 years caused by tumors, which are presented in Table 4. As shown in the Table 4 real incidences of tumors which were first found in 1000 people are high. In many cases the level of technogenic morbidity reaches above 90 % of the overall incidence of tumors. Obtained in our previous paper [21], the predicted values of volumes of polluted wastewaters, emissions of sulfur dioxide and nitrogen oxide during the 2013–2015 allow predicting the number of newly reported cases of tumors per 1,000 people and estimating the losses due to the costs for the treatment of the patients. In an optimistic forecast of the main factors of influence and perception factors are reduced (Table 4).

The results in Table 4 allow assessing one of the social components of man-made damages – the cost in Ukraine for the treatment of newly diagnosed cases of tumors caused by man-made environmental stress (Table 5). To do this, there have been used the results of relevant research [22] on the cost of treating one patient with a tumor, which in 2012 amounted to 3700.00 UAH., in 2013 – 4123.82 UAH., in 2014 – 4616.85 UAH., and in 2015 will amount to 5109.87 UAH.

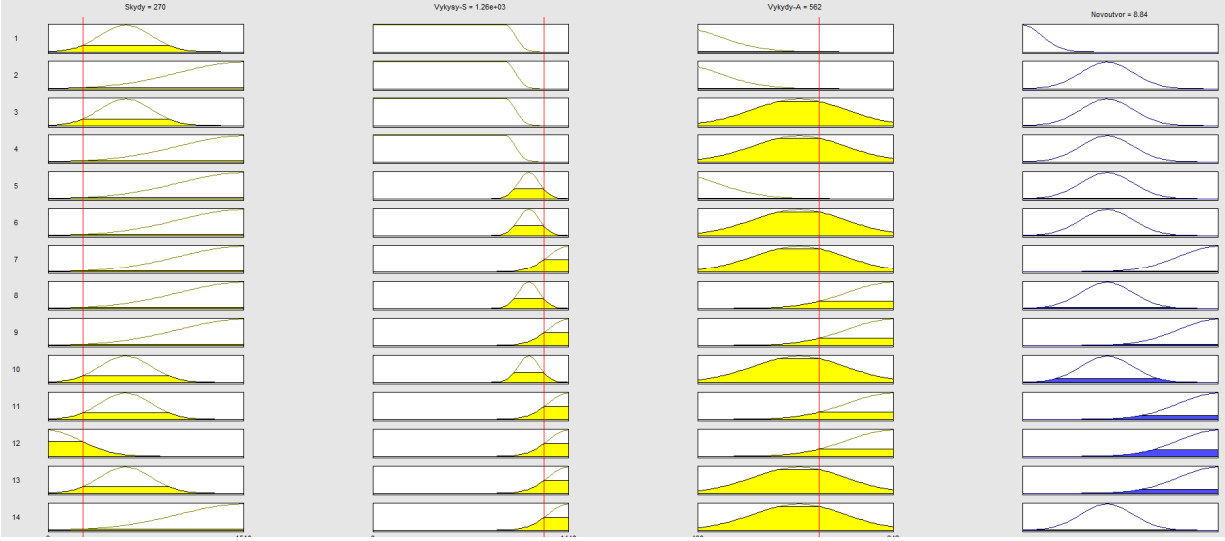


Fig. 2. The view of the membership function of the linguistic input and output variables and the active rulers for data in 2009 year*

** own development*

Table 4. Dynamics of technogenic morbidity levels in Ukraine for the period of 2000–2015*

Years	Volume discharges million m^3	Emissions of sulfur dioxide, t	Emissions of nitrous oxide, t	General morbidity level of tumors, inst. / thous. people	Technogenic morbidity level, inst. / thous. people	The proportion of technogenic morbidity, %
2000	758	984,8	440,6	7,73	7,51	97,2%
2001	746	992,1	452,0	8,05	7,48	92,9%
2002	782	1032,6	435,7	7,88	7,60	96,4%
2003	804	1046,3	477,9	8,23	7,73	93,9%
2004	758	988,5	471,9	8,53	7,51	88,1%
2005	896	1132,8	523,9	8,63	8,64	100,1%
2006	1427	1347,2	515,1	8,82	8,82	100,0%
2007	1506	1342,6	641,9	8,73	8,72	99,9%
2008	616	1320,6	642,0	8,76	7,48	85,4%
2009	270	1262,7	562,1	8,82	8,09	91,7%
2010	312	1235,2	603,7	9,09	7,78	85,6%
2011	309	1363,4	633,0	9,24	7,85	85,0%
2012	292	1430,3	634,6	9,49	8,20	86,4%
2013[1]	269[1]	1319,20[1]	610,73[1]	9,36[1]	8,17	87,30%
2014[1]	226[1]	1249,75[1]	586,06[1]	9,14[1]	8,04	88,00%
2015[1]	180[1]	1155,42[1]	558,98[1]	9,18[1]	8,00	87,10%
Average values				**8,73**	**7,98**	**91,56%**

** own development*

[1] predicted values of volumes of pollution

Table 5. Economic evaluation of the social component of technogenic damages caused by the tumor deseases in 2012–2015 years*

Years	Technogenic morbidity level, inst. / thous. people	Social technogenic damages, thous. UAH	The absolute increase in thous. UAH.	Relative growth,%
2012	8,20	1384523	0	0
2013	8,17	1534754	150230	11%
2014	8,04	1676776	142022	9%
2015	8,00	1822866	146091	9%

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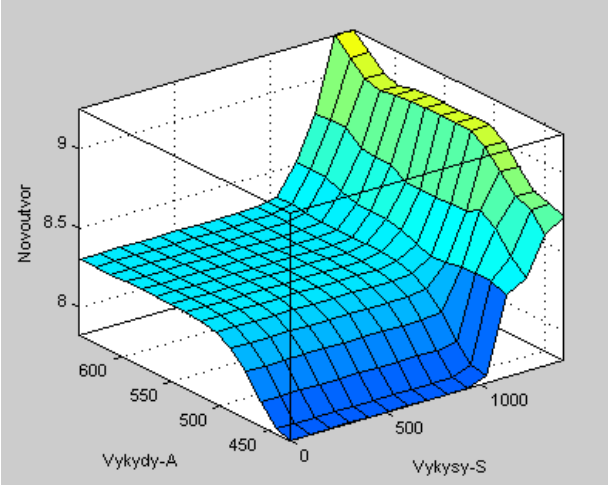

Fig. 3. Graphic representation of active rules and membership functions for the variables "nitrogen oxide emissions – sulfur dioxide emissions – tumors" *

** own development*

As it is shown in Table 4, the general expenses for treatment of only one category of people with tumor diseases in 2012 were 1,38 m in UAH. Yet, current expenses for health protection amounted to 26 859,7 m in UAH, according to the State Statistics Committee of Ukraine in 2012 amounted to 26 859 700 000 UAH., including the cost of treatment in day hospitals, funded by the government, made up 9 676 900 000 UAH.

In an optimistic forecast of the main factors of influence and perception factors are reduced (Table 4).

It should be noted that despite the trend of depopulation of Ukraine the volume growth of man-made losses for 3 years is more than 438 m in UAH., compared with that in 2012 which is more than 32% more. In the pessimistic forecast (growth factors influence) volumes of the same losses will increase in several times. The results suggest the need to increase funding for health care, as well as finding ways to reimbursement for treatment of diseases that are caused by the deterioration of the environment due to pollution of its air and water basins.

Thus, under conditions of incomplete information and uncertainty of the future, it has been studied that the influence of emissions and discharges of pollutants to the level of technogenic morbidity in Ukraine is cumulative in nature and manifests itself in the growth of the social component of man-made damage. In the national economy these results should be considered in the formation of public expenses on health care and the treatment of patients. This will increase the effectiveness of state regulation of the phenomenon; provide appropriate allocations for their eradication and compensation.

CONCLUSIONS

The theoretical foundations and applied problems of economic assessing and predicting the social component of man-made damages to the national economy allowed for the following conclusions.

1. There have been built by means of fuzzy logic an expert model for establishing levels of technogenic morbidity of the population of Ukraine, due to the destructive influence factors (emissions, discharges, waste).

2. The economic evaluation and prediction of the social component of man-made losses – cost of treating patients with tumors due to environmental pollution have been conducted. It has been tested a proposed model for the incidence of tumors.

3. On the basis of the proposed model in an optimistic forecast there was obtained increasing of social component of man-made damage by 32%, in a pessimistic forecast – several times higher. The study found that the impact of emissions and discharges of pollutants to the level of technological morbidity of Ukraine is cumulative in nature and manifests itself in the growth of the social component of man-made damage.

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Features and prospects of logistic humanitarian approach to the formation of the supply chain

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Abstract. The article investigates improvement of the supply chain according to the requirements of nowadays, particularly impact of natural disasters. The main role in this process is given to humanitarian logistics. The phases of the disaster and the actions of humanitarian supply chain during these phases are analyzed. It is very important to understand in which cases more appropriate using particular type supply chains. From this point of view authors analyzed the main differences between commercial and humanitarian supply chains. The most important role in the supply chain during the crisis situations played humanitarian organizations. For the purpose of comprehensive understanding peculiarities and involve members were identified main participants of humanitarian supply chain. The ranking of donor countries that are in the top 10, and examples of humanitarian operations and logistics companies in the aftermath of disasters are shown. Authors analyze usage of model of disaster management by logistics companies and humanitarian organizations in different disaster stages. The main advantage of proposed approach is getting clear criterion which arises during the recovery phase of the disaster and enables logistics companies, humanitarian organizations and the military to integrate their efforts and logistics performance, and adapt them to the specific needs.

Key words: humanitarian logistics, natural disaster relief, humanitarian supply chain, donors, international humanitarian organizations, logistics companies.

INTRODUCTION

Recently, the numbers of natural disasters, such as hurricanes, earthquakes, floods, are rising around the world, causing great sacrifices and material damage. They spend limit on human destinies, coolly dividing towns, villages, buildings, life in the “before” and “after”. But if there is hope for life, then it must be fought by all possible means. Effective management during a disaster is the key to leveling effects of the disaster. Organization of an incident response and providing assistance after a disaster is an important step in disaster [7]. Supply chain must be quick to react to sudden changes and be efficiently organized as a coming disaster areas and in remote areas. That logistics is central to the activities associated with the management in the aftermath of the disaster. However, most participants in such operations underestimate the importance of logistics and its role in the aftermath of the disaster. Therefore, disclosure of the concept of humanitarian supply chain and its proper organization and coordination of all participants is an urgent problem nowadays, since the disaster accounted for almost 80 % of it is logistical effort.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

At its core, a natural disaster can be interpreted as an extraordinary natural phenomenon that operates with great destructive force, causing considerable damage to the area in which it takes place, gives livelihood, destroying wealth. During the occurrence of this nature emergency requires it is need to do a quick reactions and provide necessary assistance to the affected people. This set of actions are relating to humanitarian logistics.

Humanitarian logistics consists of processes and systems that are involved in mobilizing people, resources, skills and knowledge necessary to provide humanitarian assistance to people who are affected by natural disasters and complex emergencies [3, 6, 18].

Humanitarian logistics includes a number of measures, including the purchase of essential goods, medicines and food; transportation of humanitarian goods; system of cargo tracking; customs clearance; storage and packaging of humanitarian goods; direct delivery of all humanitarian aid to victims of natural disasters people [1].

Disaster Management is usually divided into three phases: preparation phase, response and recovery (Figure 1). The first phase is associated with prevention and preparation for natural disasters. Measures of response in a response phase of natural disasters require flexibility, planning and preparation. A recovery phase could take several years before the public "will not return to the orderly functioning".

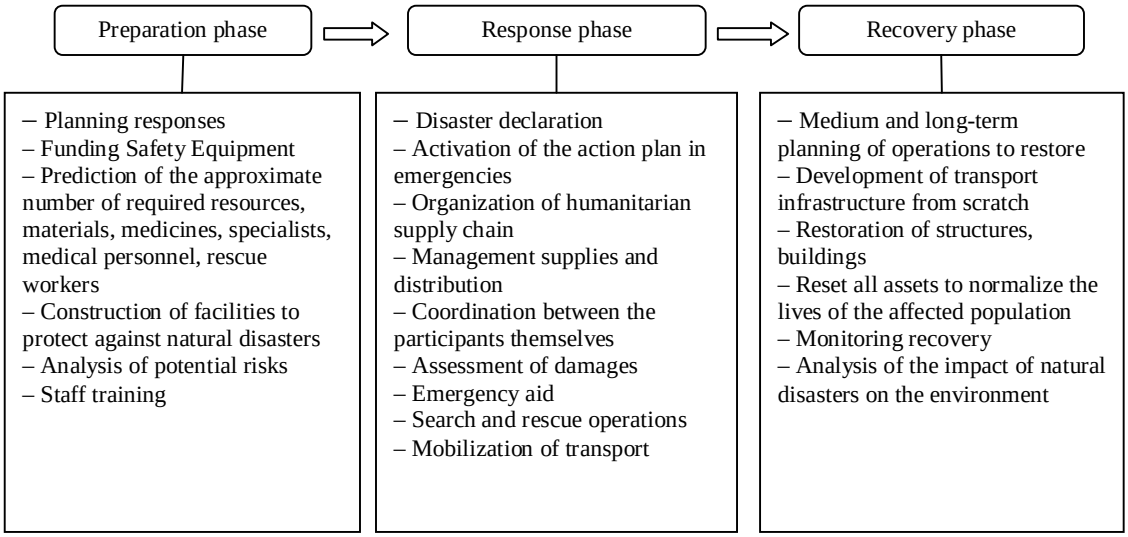

Fig. 1. The phases of disaster*

** elaborated based on [16]*.

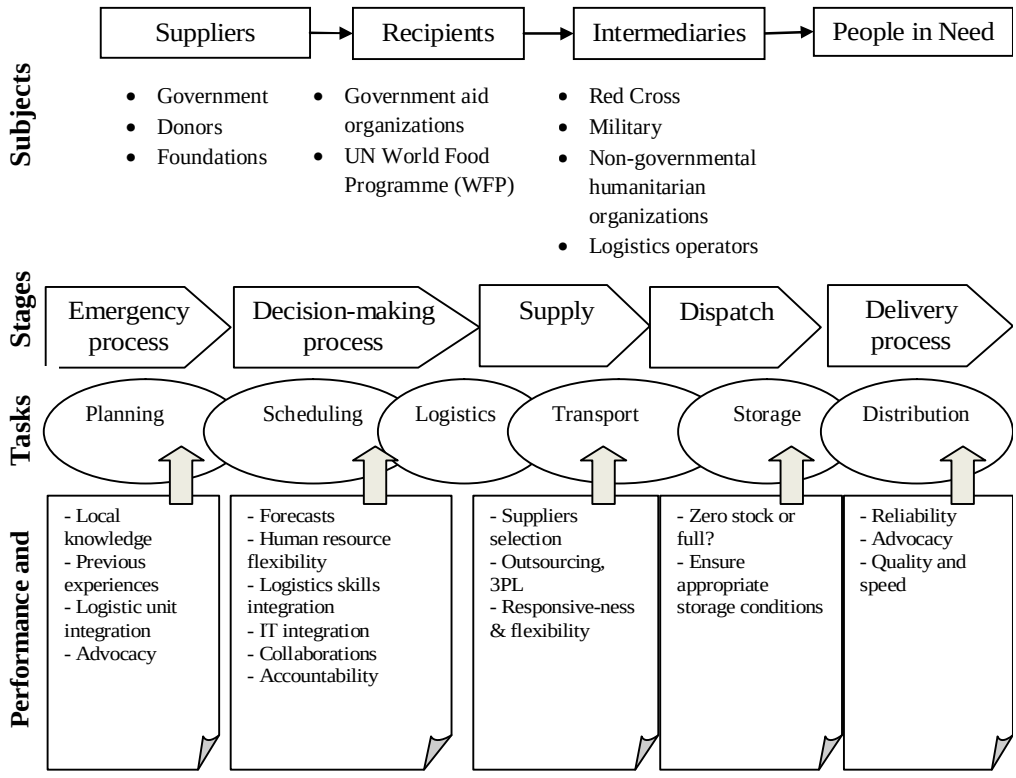

Fig. 2. Humanitarian supply chain*

** elaborated based on [16]*.

Table 1. Characteristics of commercial versus humanitarian supply chains*

Criteria	Commercial supply chain	Humanitarian supply chain
Objectives	Profiting	Minimization of life loses
Planning methods	Strategic	Operational
Time	Delay in supply leads to higher losses in monetary terms	Delay in delivery may result in the loss of thousands, or even millions of people's lives
Inventory management	Accurate methods for determining the stocks based on the terms, requirements, service levels	Management is challenging due to the high variation of time, space and place
Information systems	Accurate reliable information, use new information systems	The information can not be verified, is not reliable and not timely.

** elaborated based on [1].*

Supply chain management for the business has a long evolution, and this process is well-known by logistics companies all over the world [8]. However, the strategic objective of commercial supply chain and supply chain during a disaster are very different from each other (Table 1).

From the table we can determine significant differences humanitarian supply chain from the commercial. There are: the unpredictability of demand in terms of geographical location, type and quantity of the goods; sudden demand for a large number of products and services; limited deadlines logistics operations; lack of basic resources in terms of human resources, technology, food and finance.

OBJECTIVES

The main purpose of the article is to investigate and disclosure the features of formation of product supply chains in terms of implementation of humanitarian programs; exacerbation of issues regarding responsibility in the management of humanitarian supply chain.

THE MAIN RESULTS OF THE RESEARCH

Supply chain management is complicated because of coordination of all shareholders. A large number of organizations that are involved in helping should communicate with each other in a certain limit time and unplanned situations [9, 17].

Logistics companies play a crucial role in achieving effective integration of humanitarian ties between members of the supply chain [2, 4]. As members of the chain they must work as partners and it would be advisable to conduct strategic positioning logistics companies as members of humanitarian chain.

The categories of companies who "solve problems" are those logistics providers that organize their financial assets so as to offer customers a range of integrated solutions with high adaptability. This is usually multimodal transport operators and express couriers that are engaged in the delivery of essential humanitarian supplies.

Logistics companies that are referring as "integrators" are logistics providers that offer more complex solutions with a high degree of personalization. The company is integrator that able to organize and direct a portion or the entire logistics process on behalf of its clients. "Agents" are those who offer combined logistics services and play an important international role (e. g., forwarding and logistics brokers) in humanitarian supply chain due to their potential and strong ties. Companies that position themselves as those who "provide services" to its range of services include traditional services such as transport (by ship, by rail, by road and air transport) and storage of materials and products for emergency assistance during natural disasters [5, 10].

Donors provide the bulk of funding assistance. These are the countries that provide monetary and financial aid to victims of natural disasters [19]. In recent years, foundations, donor countries, and companies are an important source of funds for institutions that provide humanitarian assistance. Table 2 shows the top 10 countries – donors in 2011 – 2013. The largest donor is the US, European Union and United Kingdom.

The most important role in the supply chain during the crisis situations played humanitarian organizations. They are the front line assistance to people affected by disasters and emergencies. The major international humanitarian organizations that directly organize the logistics during disasters is the World Food Programme and the International Red Cross and Red Crescent Movement.

The World Food Programme (WFP) is a very important element of the humanitarian supply chain because it provides food for about 90 million people in need throughout the year. It is governed by the WFP Executive Board, which consists of 36 member states. WFP is struggling with hunger and lack of food base and thereby save the lives of people in emergency situations.

In 2013 for humanitarian logistics 14 thousand people all over the world were participated in WFP. In 2013, the WFP for delivered to people affected food has been used 5 thousand trucks, 50 aircraft and 30 ships; delivered more than 3.1 million tons of food. WFP also works with 1352 non-governmental humanitarian organizations; performs specific operations such as local transportation infrastructure recovery after disaster [11, 15].

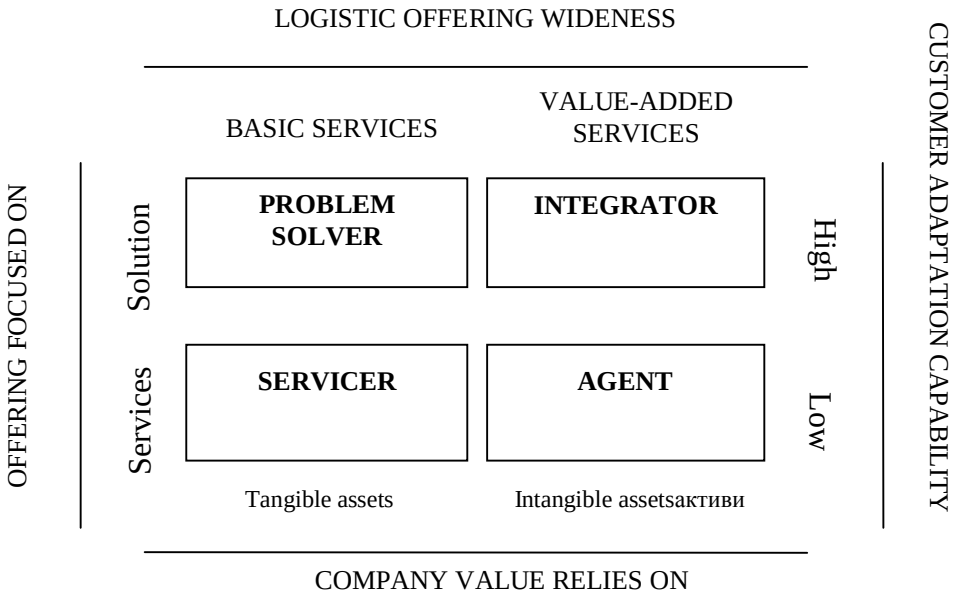

Fig. 3. Strategic positioning of logistics companies, as members of the humanitarian supply chain

Source: [5].

Table 2. Top 10 donors for 2011–2013

Year / Number	2011		2012		2013	
	Country	The extent million USD	Country	The extent million USD	Country	The extent million USD
1	USA	4,396	USA	3,963	USA	4,686
2	EU	1,744	EU	1,751	EU	1,881
3	Great Britain	1,227	Great Britain	1,166	Great Britain	1,825
4	Japan	972	Turkey	1,046	Turkey	1,638
5	Sweden	818	Germany	811	Japan	1,112
6	Germany	559	Sweden	777	Germany	949
7	Norway	510	Japan	698	Sweden	758
8	Canada	499	Canada	538	Canada	691
9	Australia	434	Norway	527	Norway	613
10	Spain	415	Australia	455	France	427

Source: [17].

International Red Cross and Red Crescent Movement – is an international humanitarian movement, which involved about 97 million volunteers worldwide. The components of this movement are:

– International Committee of the Red Cross (ICRC).

– International Federation of Red Cross and Red Crescent Societies (IFRC) (Federation is responsible for coordinating all national organizations within the movement. In close cooperation with national organizations, it conducts international humanitarian operations that require a lot of resources).

– National Red Cross and Crescent Societies, which are 186 national associations. Each of them works in their country in accordance with the principles of international humanitarian law and the statutes of motion [13].

International Federation of Red Cross and Red Crescent Societies are regarded as the world's largest humanitarian organization. The organization is controlled by seven fundamental principles: humanity, impartiality, neutrality, independence, voluntary, unity and universality.

According to data for 2012 – 48 % of the cost IFRC was necessary to respond during disasters. During the 129 operations during emergencies were assisted 12.2 million people. The organization was initiated 15 complaints regarding response to the effects of natural disasters and other humanitarian organizations and donor countries. The organization attracted 13 million volunteers around the world. It was granted 54 thousand tons of basic necessities and equipment to assist victims of natural disasters people.

Global logistics network IFRC includes headquarters in Geneva; logistics unit in Kuala Lumpur, Panama and Nairobi; office in Dubai; a logistics center in Las Palmas; and staffs directly on the ground of natural disasters around the world [20].

International Federation of Red Cross and Red Crescent Societies has offices all over the world (Figure 4).

Due to its capabilities in improving the speed and effectiveness of efforts to provide assistance, logistics companies play an increasingly prominent role, positioning itself as a partner of humanitarian organizations. One such company is – UPS. The company was in 2014 awarded the organization of "Business in the Community" (BITC). The program of humanitarian assistance in emergency situations UPS uses its expertise, logistics capabilities and financial resources for humanitarian assistance during natural disasters around the world. This means that the company provides support in all phases of disaster response: the willingness to act immediately, first aid and post-crisis recovery.

In 2013, the company UPS donated 7.5 million dollars to finance humanitarian aid, technical support and services in-kind more than 20 humanitarian organizations. With its global reach and local operational support, the company has transported 250 humanitarian goods in 46 countries. Also, for many years, the company is actively involved in assisting international after natural disasters, from floods in Pakistan, Thailand and the Philippines to the crisis caused by famine in the Horn of Africa, earthquakes in China and Haiti, and also the Indian Ocean tsunami and Japan [14].

In November 2013, the Fund UPS has provided 1 million dollars in the form of cash and in-kind assistance to victims of typhoon Haiyang – the largest in the history of Philippine. To participate in the World Food Programme UPS worked with local experts in logistics, which ran for six weeks Logistics Brigade Emergency and coordinated action of customs clearance, warehousing and transport operations in Manila, Cebu and Tacloban.

Another famous logistics company in the world that provides humanitarian aid is DHL. The company cooperates with the UN while assisting people affected by natural disasters; provides free air transportation of humanitarian goods (such as the earthquake in Haiti in 2010; organizes temporary warehouse storage of cargo at the airport, including sorting cargo area, as well as conducting an inventory of all received humanitarian goods; provides rapid loading all necessary trucks and helicopters; conducts training for local experts to improve airports in the event of natural disasters (GARD) [12].

Model disaster or "recovery model" (Figure 5) combines together and some milestones cycle management disaster. This model can be applied to any emergency.

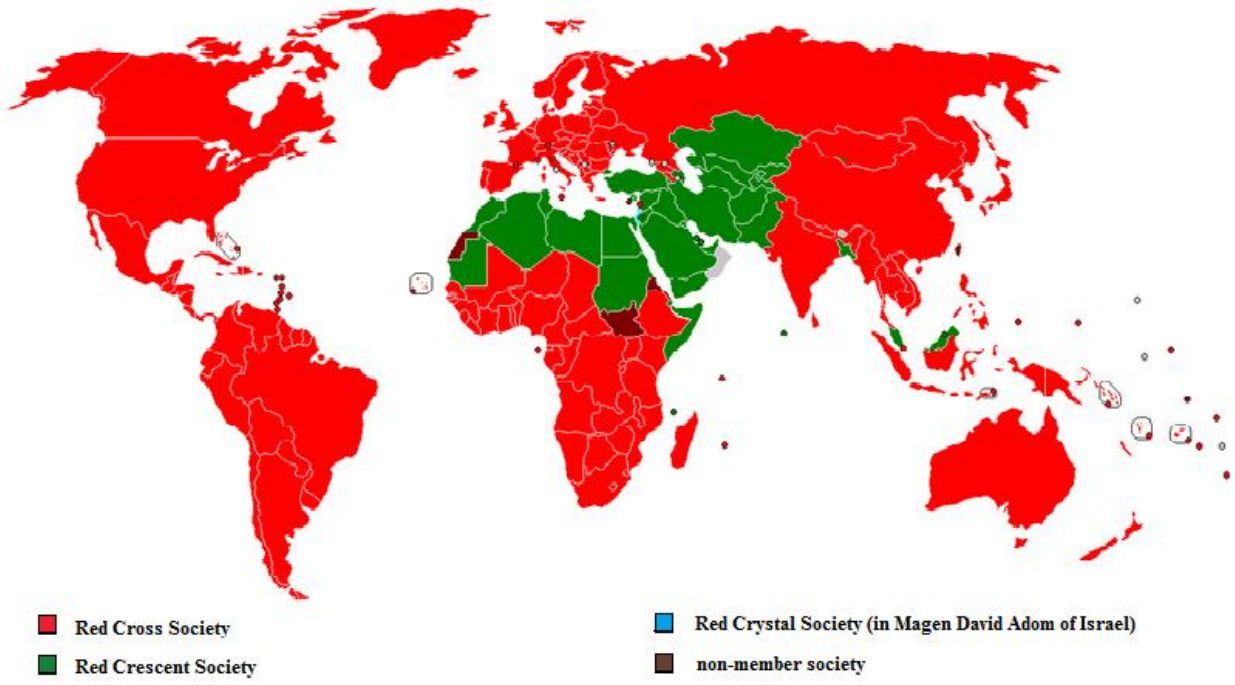

Fig. 4. Delegation of the International Federation of Red Cross and Red Crescent Societies worldwide stated on 2013

Source: [13].

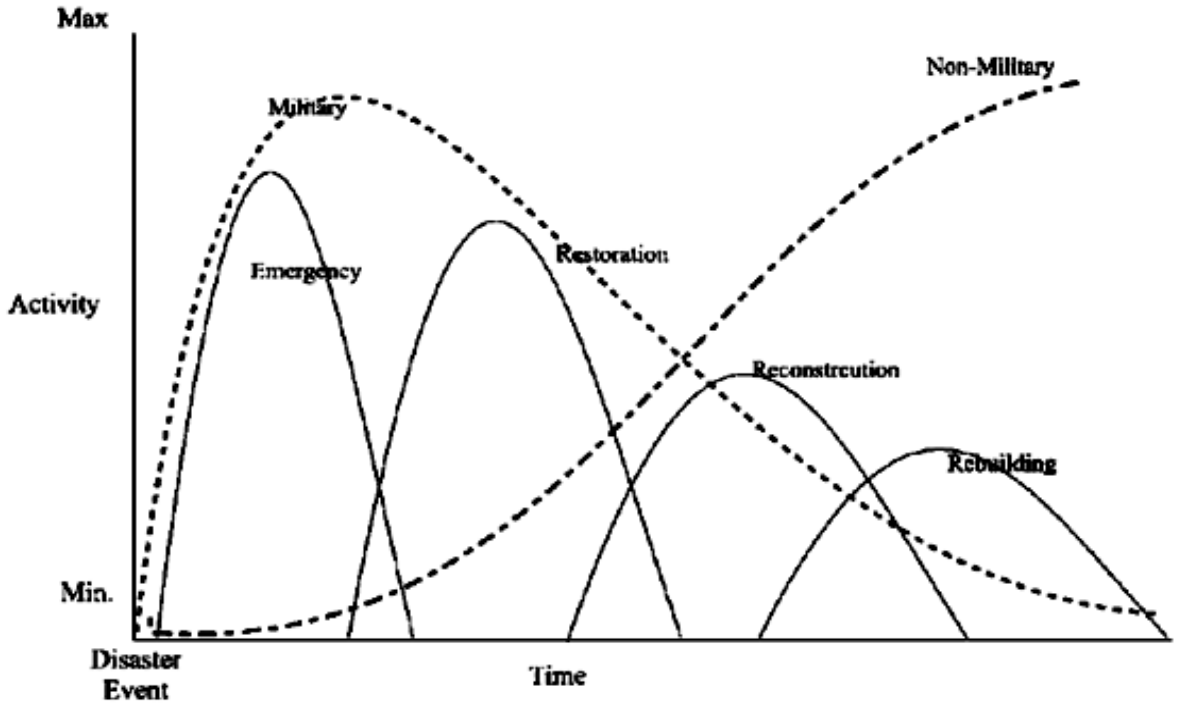

Fig. 5. Model of disaster management

Source: [16].

These logistics companies like UPS and DHL, as well as humanitarian organizations can use this model in the last stage disaster – recovery phase. "Recovery Model" consists of four stages. The emergency phase includes steps to be performed in the first few days or weeks after the disaster. Specific activities may include: search and rescue, evacuation of the population; mobilize all necessary resources. Phase recovery usually takes several months and includes direct introduction of the utility infrastructure (water and electricity); identification and repair of damaged homes and businesses. Phase reconstruction focused on the repair. In most cases, this process is focused on the reconstruction of an artificial environment to the point, which was a disaster. The last phase – the phase of reconstruction and rehabilitation phase II, which includes the actions that are associated with the reconstruction of the built environment in exactly those objects that are historically and economically important. Each of these phases begins far before the finish last. This is the feature of this model – it highlights the interdependence and duplication during recovery. It gives a clear and common criterion to be met during the recovery phase of the disaster and enables logistics companies, humanitarian organizations and the military to integrate their efforts and logistics performance, and adapt them to the specific situation.

CONCLUSIONS

Unfortunately, in our day is not possible to avoid the disaster, but that the effect of the emergency can be mitigated through integrated supply chain management. Supply chain management should be as fast and in a short time to respond to the many changes. Supply chain should be global, dynamic, flexible and fast, because it is minimizing the loss of life of the population worldwide. It is necessary to organize the effective work of all participants in the supply chain, since, according to the study, international humanitarian organizations, donors and logistics operators are an integral part of this chain and the need to cooperate with each other. Working together, participants must use their own experience and that of my colleagues, constantly exchanging information, to attract the largest possible amounts of financial and human resources required to coordinate with the government of the disaster-affected countries. This will help demonstrate the value of humanitarian logistics organizational strategies and the relationship of each member of humanitarian supply chain and enable them to use one of the "recovery model", which has been described in investigated. Future directions of research can be deeper analysis criteria exhibitor's humanitarian supply chain cooperation mechanisms, methods of organization of the supply chain as well as research into new models of disaster.

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Modelling and spatial analysis of greenhouse gas emissions from fuel combustion in the industry sector in Poland

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Abstract. This paper describes the development of geoinformation technology for the spatial analysis of greenhouse gas emissions caused by fossil fuel combustion in the industry sector in Poland. Mathematical models and software have been elaborated, which make it possible to calculate the emissions and construct an appropriate geospatial database. The models are based on algorithms of proxy data disaggregation to the level of point- and area-type emission sources. These tools take into account the non-uniformity of anthropogenic activity and spatial distribution of emission sources. Numerical experiments were conducted and the results of spatial analysis are presented in the form of digital maps.

Key words: mathematical modeling, geoinformation technology, GHG inventory, spatial analysis, industry sector, fossil fuel combustion.

INTRODUCTION

Global warming is a problem widely discussed by scientific communities and policymakers worldwide. Most scientists assert that the increase in concentration of anthropogenic greenhouse gases (GHGs) in the atmosphere is the main reason for global warming. The international community has signed a number of agreements to reduce anthropogenic emissions, among them the Kyoto protocol. The main goal of this protocol is to limit GHG emissions and to introduce a mechanism for quota trading. Scientists are actively investigating ways to overcome or at least weaken global climate change. The most significant step in this direction is the reduction of emissions of greenhouse gases. In this regard, there is a need to use GHG inventory guidelines [1] for preparation of national inventory reports [2] and assessment of inventory uncertainties [3], as well as to create spatial inventories of GHG emissions by using GIS technologies [4], which would give an opportunity to evaluate emissions for separate sources [5].

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

Many categories associated with production, transportation, storage and distribution of energy belong to the energy sector and related activities. As a result of these complicated processes emissions arise from fossil fuel combustion or from fugitive processes (fugitive emissions). The IPCC Guidelines [1] offer a methodology for conducting an inventory of GHG emissions in this sector separately for each subcategory. According to the IPCC Guidelines the "1.a. Energy" sector is divided into several major subsectors, among which is the subsector "1.A.2. Industry and Construction", which in turn is divided into separate source categories as presented in Fig. 1.

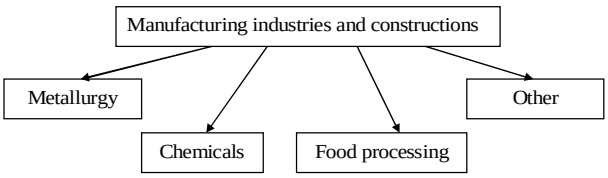

Fig. 1. Structure of GHG emissions from fossil fuel combustion in the industry sector

In 2010, CO_2 emissions (without land use, land-use change and forestry – LULUCF) were estimated as 310.40 million tonnes [2]. The main CO_2 emission source is the fuel combustion subcategory (1.A according to the IPCC Guidelines). This sector accounted for 93.6 % of the total CO_2 emission (without LULUCF) in 2010. The percentages accounted for by the main subcategories in 1.A were as follows: energy industries 53.7 %, manufacturing and construction industries 9.7 %, transport 14.1 %, and other sectors 16.0 %.

OBJECTIVES

There are many categories and sectors of anthropogenic activity with essential GHG emissions (e.g. [6, 7] and many others). In this context mathematical and software tools have been created for a GHG spatial inventory, especially for the energy sector [8], transport [9], chemical transformation in industry [10-12], forestry [13, 14], etc. Nevertheless, a spatial inventory of GHG emissions from fossil fuel combustion in Polish industry at the level of separate emission sources or small territories is not yet available. Therefore the aim of this study was to develop mathematical models that describe emission processes in this sector and to create GIS technology for the spatial analysis of such processes.

THE MAIN RESULTS OF THE RESEARCH

GHG spatial inventory. In this investigation, we used statistical data on fossil fuel combustion at the country level, data on gross value added (GVA) at the subregion level, GHG emission factors for each category under investigation (chemicals, metallurgy, food processing, and other categories), administrative digital maps, and Corine land cover map [15] as input data for modeling GHG emission processes.

Since the data on fossil fuel combustion are available at the national level only, we created mathematical models and algorithms for disaggregation of these data to the level of cities and industrial objects using other statistical data as proxy data (especially gross value added, area of industrial objects/territories, number of inhabitants in cities, etc.).

Let us assume $w = \overline{1,W}$ is the number of voivodeships (*W* is the total number of voivodeships); $r_w = \overline{1,R_w}$ is the number of subregions in the *w*-th voivodeship and R_w is the number of such subregions; $\eta_{ind}\left(j_{w,r_w}\right)$ is the j_{w,r_w}-th elementary object (industrial zone) on the land cover map of Poland and $j_{w,r_w} = \overline{1,J_{w,r_w}}$; J_{w,r_w} is the total number of such industrial objects in the r_w-th subregion of the w-th voivodeship. The emission of the *g*-th greenhouse gas at the *i*-th elementary object can be calculated by using the formula

$$E_{g,i} = \sum_{Ind \in I} \sum_{f \in F} D_{Ind,f} \cdot K_{f,g,en} \cdot K_{f,g,em} \cdot K_{Ind,d}, \qquad (1)$$

where: greenhouse gas $g \in \{CO_2, CH_4, N_2O\}$, i.e. the enumerative variable with carbon dioxide, methane and nitrous oxide; *i* is the number of the elements in the set $\overline{M} = \{m_1, ..., m_i, ...m_n\}$, which is the set of area-type emission sources (industrial zones or urban territories); $D_{Ind,f}$ is the amount of the *f*-th type fossil fuel used in the emission category under investigation; *F* = {solid fuels, liquid fuels, gaseous fuels, biomass}; $K_{f,g,en}$ and $K_{f,g,em}$ are the calorific value of the *f*-th type fuel, and emission factor of the *g*-th GHG, correspondingly, in the industry and construction sector; $K_{Ind,d}$ is the disaggregation coefficient; $Ind \in$ {metallurgy, chemicals, food processing, other}.

The disaggregation coefficients depend on the category of anthropogenic activity, because for each category there are other available statistical data.

In some categories of the industrial sector we used point-type emission sources for modeling emission processes from big plants (metallurgy, chemicals, etc.), but in many other cases we used the area-type emission sources for modeling emission processes because we could not identify the location of each small enterprise at the country level. Also, the land cover digital map of Poland was used for identifying industrial zones (territories with industrial activity).

Therefore, the main approach to the disaggregation of activity data (statistical data on fossil fuel combustion) in the industry sector consisted of the following steps (we applied these steps using created software modules for the geoinformation system illustrated in Fig. 2):

1) the national data on fossil fuel combustion were split to voivodeship level and we took into account the coefficients of industrial activity and other available statistical data as proxy data [16-18];

2) at the district level the disaggregation of data on fossil fuel combustion was applied by using data on gross value added as proxy;

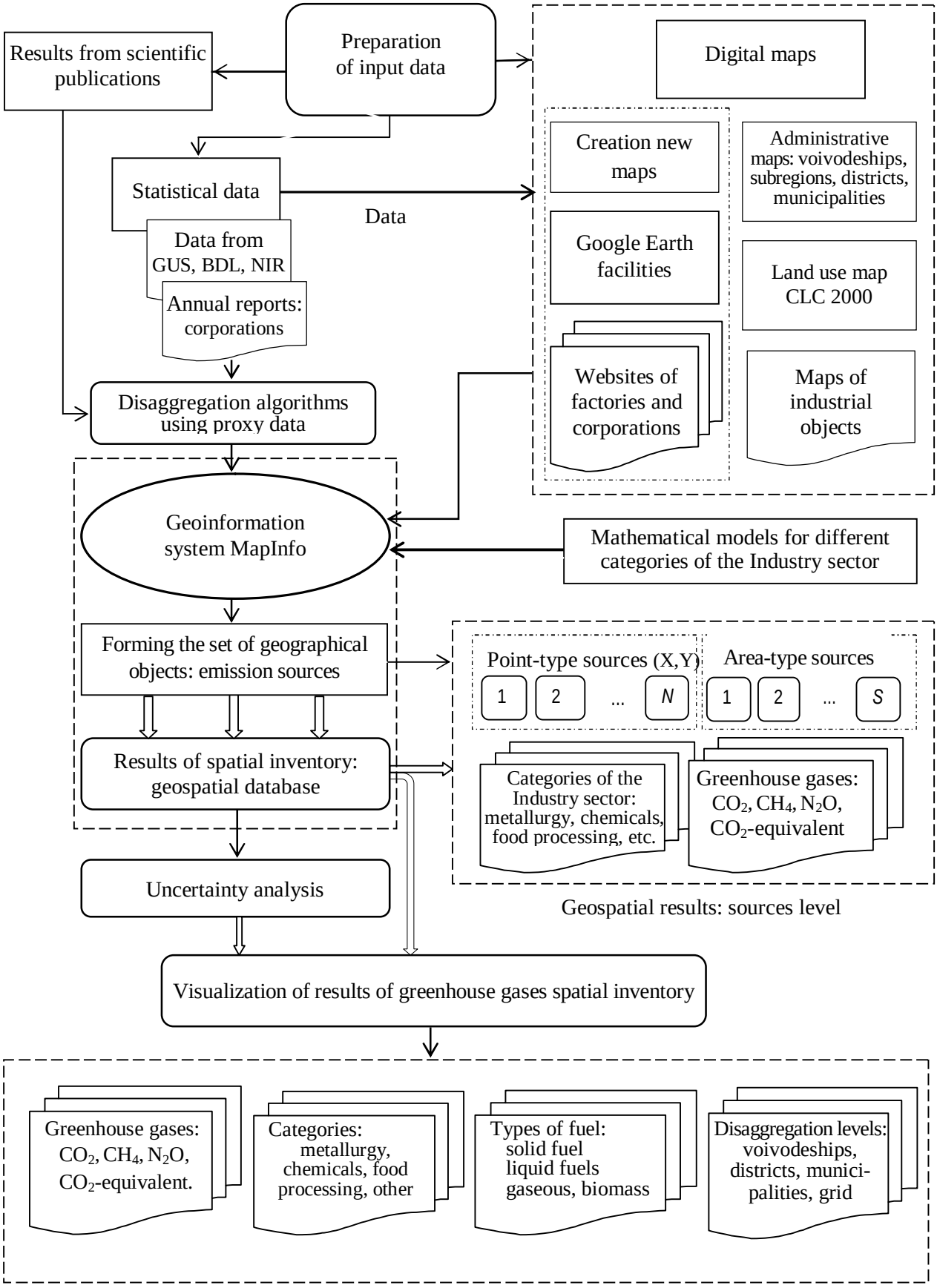

Fig. 2. Structure of the geoinformation technology for a GHG spatial inventory in the industry sector

3) calculated data on fossil fuel combustion at the district level were disaggregated to the level of industrial zones or settlements of the land cover map by using available statistical data as proxy [19] (for example, the number of inhabitants, cost of sales, etc. [20]); the available data on location of big plants as point-type emission sources were also used.

Geoinformation technology. The geoinformation technology for a GHG spatial inventory in the industry sector (see Fig. 2) consists of tools for input data preparation, mathematical models for a GHG emissions inventory, a geoinformation system for handling with geographical objects and spatial analysis, and facilities for visualization of inventory results. As input data the statistical data from GUS [16, 20], BDL [19], NIR [2], and scientific publications were used. For disaggregation of activity data we applied the corresponding proxy data, disaggregation algorithms, and digital maps. We used existing digital maps like administrative maps of voivodeships, districts and municipalities, and Corine land cover map, and also created some new digital maps using Google Earth facilities, especially maps of industrial objects (zones).

Mathematical models for different categories of the industry sector were used in the geoinformation system for forming a set of geographical objects (emission sources) and calculation of emissions in the form of a geospatial database. We took into account point- and area-type emission sources in metallurgy, chemicals, food processing, and other industrial categories. Geospatial results at the sources level included emissions of carbon dioxide, methane, nitrous oxide, and total emissions of these gases in CO_2-equivalent calculated applying their global warming potentials. Results of the GHG spatial inventory can be visualized at the level of greenhouse gases (CO_2, CH_4, N_2O, and CO_2-equivalent), categories of the industry sector (metallurgy, chemicals, food processing, and others), types of fuel (solid fuels, liquid fuels, gaseous fuels, and biomass), and levels of disaggregation (voivodeships, districts, municipalities, and grid).

Emissions from the food processing industry. For this category of anthropogenic activity we assumed that consumed fossil fuel is spatially distributed in proportion to the number of inhabitants in settlements. Only settlements with more than 1,000 inhabitants were taken into account because this industry mainly is developed not far from large number of consumers. In small villages with agriculture possibilities there are less needs for industrial food processing.

Disaggregation of activity data to the level of voivodeships was carried out on the basis some coefficients (indicators of food industry development of regions) as proxy data. Then the disaggregation of activity data to the level of subregions was carried out by using gross value added as proxy data. Finally the disaggregation of activity data to the level of settlements was carried out on the basis of numbers of inhabitants in settlements. In this case the disaggregation coefficient for activity data in the food processing industry K_{food} can be calculated by using the formula:

$$K_{food} = I_w \cdot \frac{G_{r_w}}{\sum_{r_w} G_{r_w}} \cdot \frac{P_i}{\sum_i P_i}, \qquad (2)$$

where: I_w is the indicator of food industry development in the voivodeship, G_{r_w} is the gross value added in the region, P_i is the number of inhabitants in settlement.

Emissions from the metallurgy industry. Assessment of greenhouse gas emissions in the metallurgy industry is very important, because this kind of anthropogenic activity includes technological processes with energy-intensive and raw material-intensive production. Economically it is not profitable to produce this type of product where there is no raw material base. In Poland there are only 22 steel mills, including 10 large ones, producing about 80 % of all steel products. The biggest corporation ArselorMittal includes four major metallurgy plants - Huta Celder (included among the 70 largest steel mills in the world), Huta Florian, Huta im. Sendzimira, and Huta Katowice.

For assessment of GHG emissions in this sector the locations of the 10 largest steel mills as point-type emission sources were identified by using Google Earth facilities. On the basis of these locations the corresponding industrial zones as area-type emission sources were marked in the land cover digital map, and GHG emissions were calculated according to the amount of production (sales) at each metallurgical plant.

The disaggregation coefficient: $K_{metal}\left[\eta_{ind}(j_{w,r_w})\right]$ for geographical object $\eta_{ind}\left(j_{w,r_w}\right)$ of the r_w-th subregion of the *w*-th voivodeship, as area-type emission source, depends on available data on production of various types of metals, and it can be calculated by using the formula:

1) for the industrial zone where one of the 10 largest steel mills that produce 80 % of all steel products in Poland is located:

$$K_{metal}\left[\eta_{ind}(j_{w,r_w})\right]\Big|_{\eta_{ind}(j_w,r_w)\,\mathbf{I}\,\xi_{n_m}\neq 0;\, n_m=\overline{1,N_m}} = 0{,}8 \cdot \frac{V_{metal}\left(\xi_{n_m}\right)}{\sum_{l=1}^{N_m} V_{metal}\left(\xi_l\right)},$$

$$j_{w,r_w} = \overline{1, J_{w,r_w}}, \quad r_w = \overline{1, R_w}, \quad w = \overline{1, W}, \qquad (3)$$

where: $V_{metal}(\xi_{n_m})$ is the production capacity of the n_m-th steel mill ξ_{metal,n_m}; **I** it the operation that defines a common area of two geographical objects $\eta_{ind}\left(j_{w,r_w}\right)$

and ξ_{metal,n_m}, r_w, is the number of subregion; w is the number of voivodeships;

2) for industrial objects with unknown production capacities we can use the formula:

$$K_{metal}\left[\eta_{ind}(j_w,r_w)\right]\Big|_{[\eta_{ind}(j_w,r_w)]\mathbf{I}\xi_{n_m}=0;\forall n_m=\overline{1,N_m}} =$$

$$= 0,2\cdot K_{\%,metal,w}\cdot\frac{GVA_{r_w}}{\sum_{q=1}^{R_w}GVA_q}\cdot\frac{S(j_{w,r_w})}{\sum_{i=1}^{J_{w,r_w}}S(j_{w,i})},$$

$$j_{w,r_w}=\overline{1,J_{w,r_w}},\quad r_w=\overline{1,R_w},\quad w=\overline{1,W}, \qquad (4)$$

where: $K_{\%,metal,w}$ is the amount of steel production of the w-th voivodeship in this production for the whole of Poland; GVA_{r_w} is the gross value added in the metallurgy sector of the r_w-th subregion of the w-th voivodeship in Poland; $S\left(j_{w,r_w}\right)$ is the area of industrial zones (territories) $\eta_{ind}\left(j_{w,r_w}\right)$ on the land cover map.

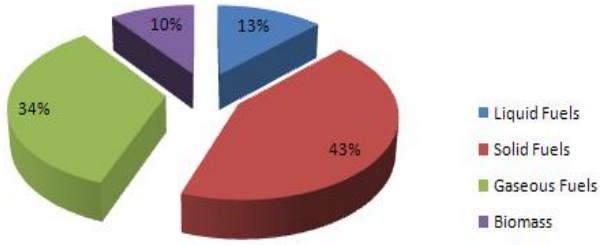

Fig. 3. Structure of fuels used in Polish industry (2010)

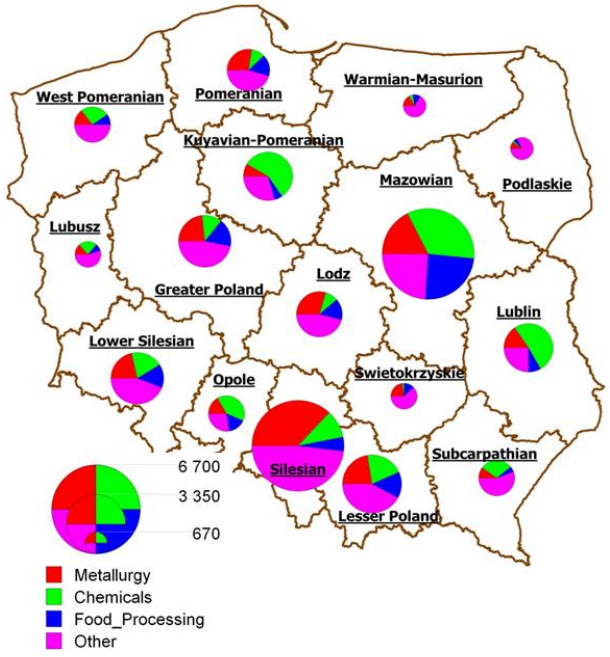

Fig. 4. Total GHG emissions in the industry sector by subsectors (Poland, CO_2-equivalent, Gg, 2010)

Emissions from the chemical industry. The chemical industry in Poland is one of the most innovative but at the same time the most environmentally dangerous sector of the economy. For the chemical industry we took into account the following categories: organic and inorganic fertilizers, plastics, and chemical reagents [21, 22]. The largest sources of GHG emissions in the chemical industry of Poland are: Puławy nitrate fertilizer plant in Lublin voivodeship (Zaklady azotowe Puławy), Anwil SA in Kuyavian-Pomeranian voivodeship and ZAK SA in Opole voivodeship. Anwil SA produces ethylene-based products (EDC and PVC) as a raw material for production of polyamide threads and plastic construction elements (caprolactam), ammonium sulfate as well as non-organic products (sulfuric acid, chlorine, sodium hydroxide). Puławy nitrate fertilizer plant and ZAK SA produce nitrogen fertilizers, plasticizers, oxo alcohols and other chemicals. For example, the annual production capacity of the Puławy plant is about 156,000 t of ammonium sulfate.

The chemical industry is growing in Poland, and it represents all major industries. The inorganic chemical industry is based on rich deposits of rock salt and sulfur. Rock salt is mined near Inowroław and Kłodawa, sulfur in Świętokrzyskie and Subcarpathian voivodeships. The centers of production of nitrogen fertilizers are Puławy, Włocławek, Kędzierzyn-Koźle and Tarnów. The largest centers of production of phosphate fertilizers are Police, Gdansk and Tarnobrzeg. The center of the country (Warsaw, Lodz, Bydgoszcz, Inowrocław) offers various products of organic and inorganic chemistry.

We analyzed the 14 largest chemical plants, taking into account their GHG emissions. In contrast to the steel industry, the number of chemical plants is much greater. There are 14 largest plants, for which the production capacities are known, and many other plants with unknown capacities. The disaggregation of data on fossil fuel combustion was carried out as follows. The disaggregation of fuel to the level of the voivodeship was fulfilled by using coefficients of economic development. The disaggregation of fuel to the level of subregions was realized according to the gross value added. It was assumed that 60 % of fuel was combusted in industrial areas (since pollution from the chemical industry is quite unhealthy, because most plants are located outside cities), and 40 % of all fuel was combusted by the 14 largest factories. Finally, for the industrial areas (other than those where the largest plants are located) the disaggregation of data on fuel used was accomplished in proportion to the area of zones, and in settlements in proportion to the population.

Emissions from other categories. This category takes into account the greenhouse gas emissions from fuel combustion for industrial purposes by other

technological processes than those discussed above. It is unrealistic to analyze each plant separately in this category of industrial activity. Therefore the disaggregation of data on fuel used in this category to the level of voivodeships and subregions was performed in accordance with the gross value added. It was assumed that 60 % of fuel is used in industrial zones. This fuel was disaggregated in proportion to the areas of industrial zones. The remaining fuel was distributed between cities with more than 5,000 inhabitants, in proportion to the population. Accordingly, the disaggregation coefficient for industrial zones can be calculated by using the formula

$$K_{other}\left[\eta_{ind}(i_w, r_w)\right] = I_w \cdot \frac{G_{r_w}}{\sum_{r_w} G_{r_w}} \cdot \frac{S_i}{\sum_i S_i}, \qquad (5)$$

where: I_w is the indicator of other industries development in the voivodeship; G_{r_w} is the gross value added in the region; P_i is the number of inhabitants in the settlement.

CONCLUSIONS

Using the mathematical models described above, and input data from GUS, BDL and NIR, as well as some proxy data and digital maps (a structure of fuels used in Polish industry is presented in Fig. 3), we calculated emissions from fossil fuel combustion in metallurgy, chemical industry, food processing and other categories at the level of area-type sources. Then results were aggregated to the level of voivodeships. The structure of the total GHG emissions in the industry sector by subsectors is presented in CO_2-equivalent in Fig. 4. This figure demonstrates the non-uniform distribution of emissions, the Mazowian and Silesian voivodeships leading the field. Relatively small emissions can be seen in Lubusz, Podlaskie, Świętokszyskie, and Warmian-Masurian voivodeships.

Considering greenhouse gases (see Fig. 5), carbon dioxide causes the most emissions in the industry sector. Amounts of emissions of methane and nitrous oxide are

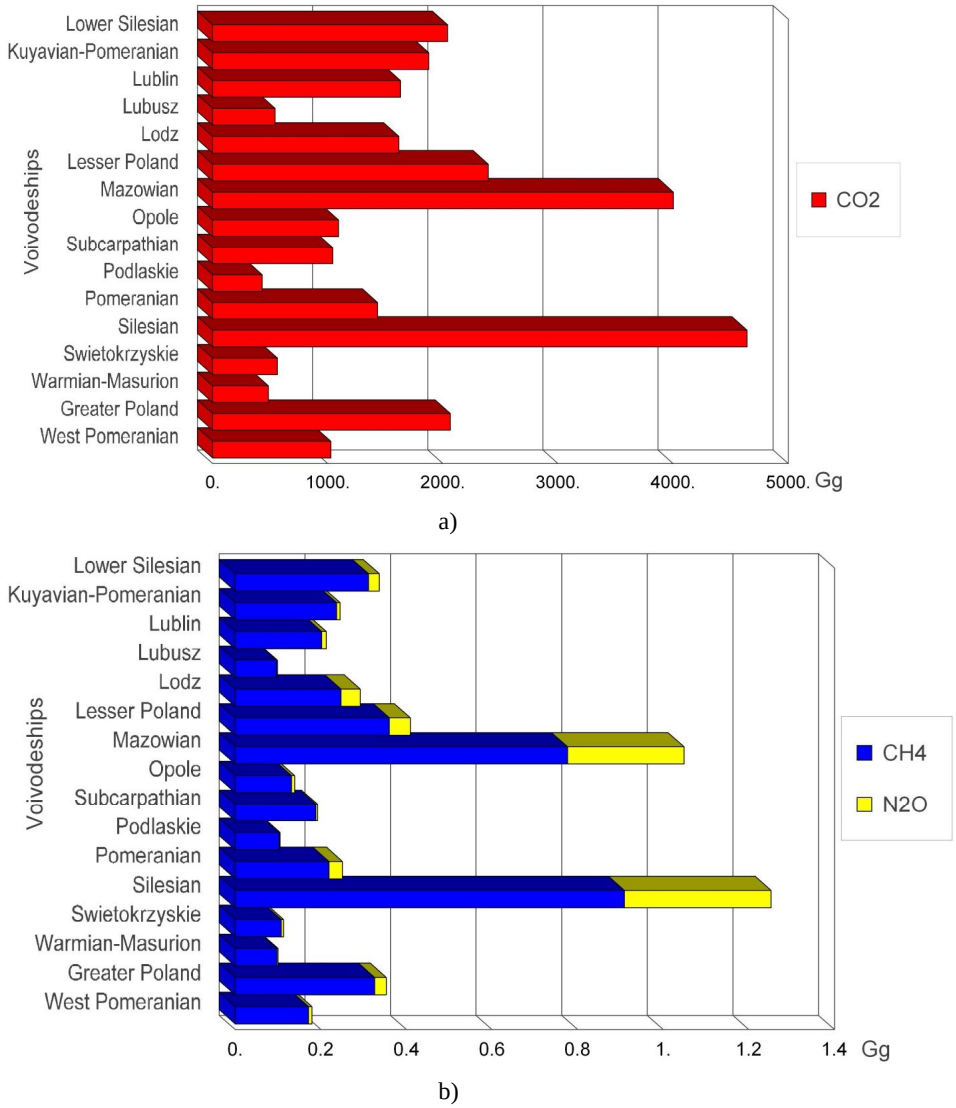

Fig. 5. Emissions of CO_2 (a) and CH_4, N_2O (b) at the level of voivodeships (Poland, CO_2-equivalent, Gg, 2010)

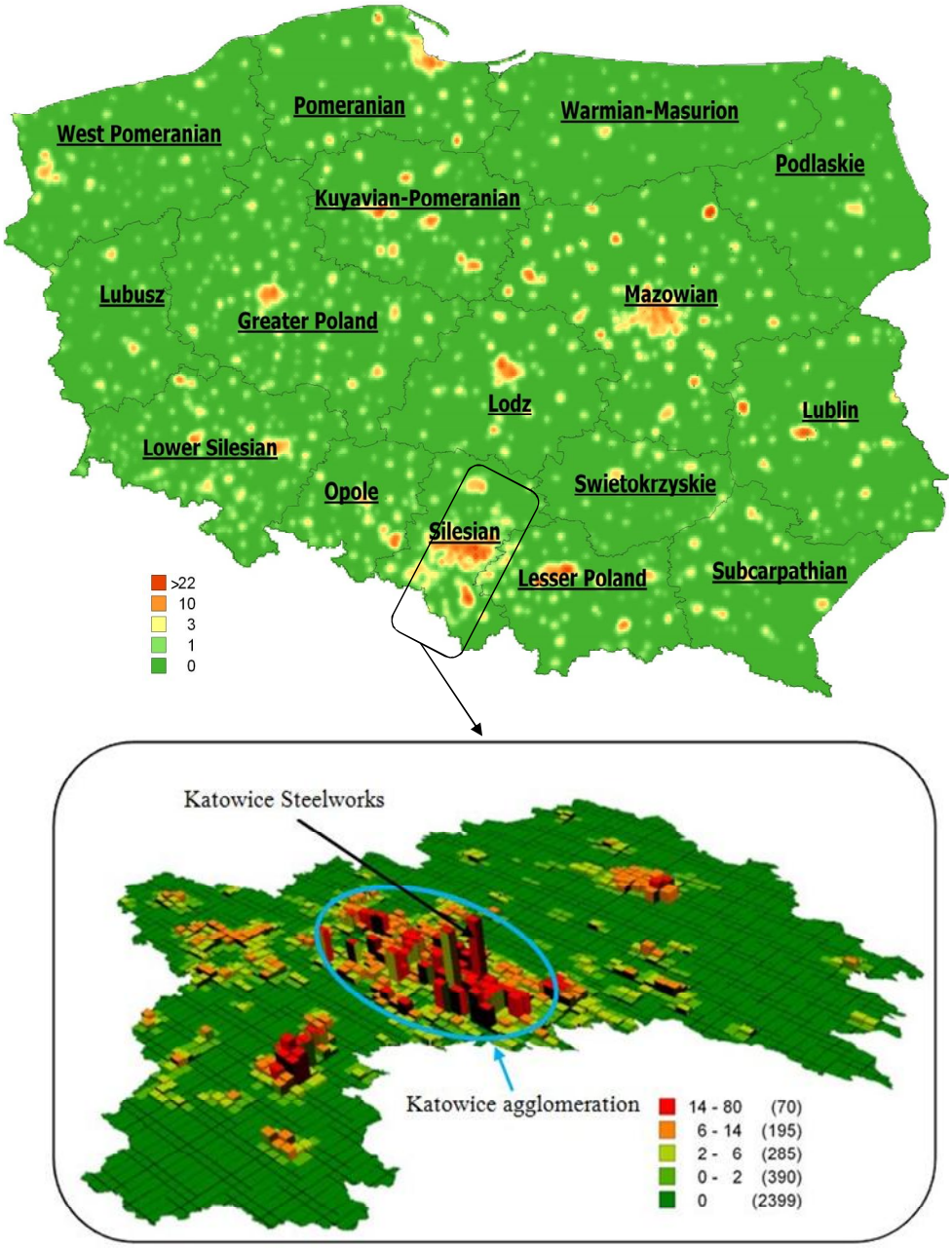

Fig. 6. The total specific GHG emissions in the industry sector in Poland, and detailed visualization of specific GHG emissions in the industry sector in the Silesian voivodeship at the level of industrial zones by using prism-map (CO_2-equivalent, Gg/km^2, grid 2×2 km, 2010)

less even if we recalculate them in CO_2-equivalent using global warming potentials of these gases. The spatial distribution of emissions can be seen in Fig. 6, where the total specific GHG emissions in the industry sector in Poland are presented. The most industrialized voivodeship, Silesia, causes the highest emissions. Therefore in this figure a detailed visualization of specific GHG emissions in the industry sector in this voivodeship is demonstrated on grid by using the prism-map. Results in this spatial form are very useful for policymakers because they show emissions where they occur.

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Double-sided analysis of the labor market in Ukraine: graduates' and employers' view

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Abstract. The current state of the labor market in Ukraine is researched. A lot of processes are irregular and uncontrollable as a result of shadow or informal employment at the market nowadays. Different structural and cyclical influences caused high unemployment and a gap between labor market needs and labor force qualification and education. The impact of the political crisis on employment has been related to a large and growing internal flow of people leaving the areas of warfare and looking for new jobs. The migration of the working age population to other countries has accelerated over the last years. Thus it is important to increase the economic activity of young people by reduction of imbalance between supply and demand for labor, reduction of shadow employment, labor migration of young people

The problems and difficulties for university graduates in the job search and difficulties for employers related to hiring educated young people in the conditions of considerable supply of labor in the Ukrainian labor market are analyzed. The gaps of labor demand and supply are considered from two directions: graduates' view – challenge of finding jobs for young people; employer's view – complexity of the employee selection with a high employment potential and an adequate psychological portrait. The measures for preventing and solving the mentioned problems are proposed, among them innovative ways of interviewing and an algorithm for employers for finding highly skilled workers.

It is stressed that the problems of employment in Ukraine can not be addressed in isolation from the global processes on the world labor market. The Association between Ukraine and the EU may have a significantl influence, increasing the number of migrant workers and mobility.

Key words: labor market, graduate, employee, employer, employment, labour potential, education, globalisation processes.

INTRODUCTION

Higher education is an important component of social and economic progress and stability of a state, its national security. In Ukraine in the 2014–2015 academic year, there were 489 higher educational institutions of I-II accreditation levels and 334 institutions of III-IV levels. 92.2 and 520.7 thousand professionals graduated from those higher educational institutions respectively [19]. Often university graduates are struggling to find jobs according their qualification, or at least any decent jobs.

The absence of adequate number of job offers leads to a high unemployment among young people. Over the last few years the demand for labor in Ukraine has tended to decrease, and the identical trend applies to the supply. During the past seven years the demand for labor has fallen by 53.9 %. This indicates an increased load on one workplace from 5 people in 2006 to 11 people in 2014–2015 [13].

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

Many works of domestic and foreign scientists, various information portals on employment problems, laws and government statistics are devoted to the research on employment.

It was discovered that at the Ukrainian labor market nowadays a lot of processes are irregular and uncontrollable as a result of shadow or informal employment [3]. Different structural and cyclical influences caused high unemployment in Ukraine over different time horizons. Thus labor supply led to growth of unemployment, while in the long run technological development may have a positive impact – an increase in employment, productivity and wages [8]. A huge gap exists between labor market needs and labor force

qualification and education, thus the quantitative and qualitative structure of the market is imbalanced and inefficient. It is important to increase the economic activity of young people by reduction of imbalance between supply and demand for labor, reduction of shadow employment, labor migration of young people, etc. In [5] the model of interaction of the participants of the youth labor market is proposed.

In [2] the basic consequences of European integration and the specific consequences of redistribution of the economically active population in the Euro area are revealed. Risk of implications of migration on the labor market is characterized, and the model of regulation of migration depending on its volume growth is peoposed. In [9] an analysis of migration processes in Ukraine, the essence and the current state of labor migration in Ukraine, the dynamics of emigration and immigration, particularly in terms of European integration processes are provided. The features of Ukrainian migration, especially to the EU, in the current economic and political conditions, are described. The influence of the association of Ukraine and the EU on migration is analyzed and forecasts of dynamics of the number of immigrants to the EU are formed.

OBJECTIVES

Among other problems of the Ukrainian labor market development there is a problem of graduates employment and hiring new employees with high professional potential. The aim of our research is analyzing the problems of employment for graduates, the processes of selection and hiring employees with high employment potential and suggesting ways to improve the competitiveness of graduates in the labor market. To accomplish this it is necessary to investigate a current state of education in Ukraine, motivation of students, algorithm for finding and hiring promising young professionals and to identify ways to address the above problems.

THE MAIN RESULTS OF THE RESEARCH

Labor market – is an area of formation of supply and demand for labor. The market affects all sectors of the economics; in particular it regulates the movement of labor resources.

According to the International Labor Organization (ILO) [27] over 201 million people were unemployed in 2014 around the world, – over 31 million more than before the start of the global crisis. And, global unemployment is expected to increase by 3 million in 2015 and by a further 8 million in the following four years. The global employment gap, which measures the number of jobs lost since the start of the crisis, currently stands at 61 million. An additional 280 million jobs need to be created by 2019 to close the global employment gap caused by the crisis.

Unemployment is falling in Japan, the USA and some European countries. In southern Europe unemployment is receding slowly. By contrast, after a period of better performance compared to the global average, the situation is deteriorating in a number of middle-income and developing regions and economies, such as Latin America and the Caribbean, China, the Russian Federation and a number of Arab countries. In most of these countries, underemployment and informal employment are expected to remain stubbornly high over the next five years.

Youth, especially young women, continue to be disproportionately affected by unemployment. Almost 74 million young people (aged 15–24) were looking for work in 2014. The youth unemployment rate is practically three times higher than is the case for their adult counterparts. The heightened youth unemployment situation is common to all regions and is occurring despite the trend improvement in educational attainment, thereby fuelling social discontent [27].

The unemployment rate in Ukraine rose from 7.6 % in the first quarter of 2014 to 9.6 % a year later. It is estimated that up to two million jobs were lost since the start of the crisis. The immediate impact of the crisis on employment has been related to a large and growing internal flow of people leaving the areas of warfare and looking for new jobs. The recent estimates point to at least 1.3 million internally displaced people, one quarter of whom are of working age. In addition, the migration of the working age population to other countries has accelerated since the crisis. The economic recession and the strained relationships with Russia mainly affected heavy industry, while other sectors such as agriculture and light industry have shown a higher level of resilience. As a result, Ukraine is not only struggling with an overall economic recession, but also with an economic transformation. They have led to an imbalance of the labor market resulting in rising unemployment, higher inactivity rates and increasing quantitative and qualitative gaps with regard to supply and demand in the labor market [14].

In our opinion, the gaps of labor demand and supply in the framework of the research topic should be considered from two directions:

1) student's view – challenge of finding jobs for graduates;

2) employer's view – complexity of the employee selection with a high employment potential and an adequate psychological portrait.

Student's view. The main factors affecting the level of student's knowledge and forming his competitiveness at the labor market are:

1. Quality of education (level of state funding for education, the existence of transfer between companies and universities, legislation and government regulation).

2. Students' motivation and self-education (self-management, time management, ways to encourage students to acquire knowledge, development of high emotional intelligence).

3. Labor market in Ukraine (the level of filling the market by various vacancies, the structure of jobs by occupational sectors).

Let us consider the mentioned factors in details.

1. Quality of education:

In 2015–2016 in the GCI ranking (Global Competitiveness Index) Ukraine's place in higher education and training is 79th out of 144 countries. This is due to the following components: high-quality education system (54th place); availability of specialized research and training services – (78 place); quality of teaching Mathematics (38 place); quality of management schools (87 place) [23].

Article 61 of the Law of Ukraine on Education determines the necessary amount of budget funding for the education sector – not less than 10 % of the gross domestic product (GDP). But never since Ukraine got the independence it has been able to reach this level of funding for education. By 2015 this percentage was 3,74 % of GDP [19]. The volume of spending has been increasing every year, but it is just nominal growth, caused by inflation.

In addition, the following issues and problems should be mentioned in the field of education:

- low competitiveness of the universities;
- mass character of higher education;
- transfer of outdated knowledge to students;
- significant emigration of active, highly promising and qualified youth;
- discrepancy of equipment in higher institutions and modern standards;
- universities are not geared to the market needs, but to those of the Ministry of Education, which often changes academic disciplines.

2. Students' motivation and self-education:

A minimal living wage in Ukraine as of 1 September 2015 is 1378 UAH for the workforce [13]. The state scholarship, which is paid to students, is 820–1000 UAH [21]. Because of this, many active and intelligent young people are forced to work in low-skilled jobs in difficult conditions. This leads to a decrease in performance and the quality of acquired professional knowledge.

The virtual absence of an open education system in Ukraine (self-selection of additional educational courses and possibilities to pass exams by a student are absent, which is limiting the students with only a basic education program plan with minimal flexible hours and can generate only low efficient results). At the same time additional study courses though Internet in many leading world universities is free of charge.

In Ukraine there are special cost items in the state budget for scholarships and grants for students who are actively involved in research or have high performance. In 2015 these costs were about 1877 million UAH and each year they have been growing by an average of 150–200 million UAH, which is a positive indicator [19].

It is possible to distinguish such reasons of low motivation of students for studying:

- underestimation of the importance of theoretical knowledge;
- pragmatic focus on nearby target (passing a test or exam);
- no possession of rational methods of knowledge;
- low self-control and emotional intelligence;
- indiscipline and disorganization;
- non-systematic self-study;
- gaps in knowledge;
- the general physical weakening of the bodies of the young students.

3. Labor Market in Ukraine:

According to statistics, one of five unemployed in Ukraine has a higher education. Only one of three graduates who were registered as unemployed in 2015 was able to find a job [4]. This creates high competition for jobs, as well as potential unemployment after graduation. The overall level of employment is 67,1 % of population which is capable to work. In average there are 11 unemployed Ukrainians applying for 1 job position. More accurate data about labor needs and quantity of applicants is shown at **Fig. 1.**

The problems of the labor market in Ukraine:

- discrimination in the labor market;
- lack of quality jobs with decent conditions and wages, especially for young people;
- decline in production and slowdown of economic restructuring.

Key trends at the labor market in the crucial period for the country according to the 9th Wave of Western Ukraine Labor Market Index conducted in July 2015 [25] are:

— 70 % of businesses were affected, as some employees were mobilized into the army. Mobilization affected both manufacturing and service companies, in almost all industries: assembly operations, machinery, agriculture, sales and retail.

— Only 5 % of companies will reduce staff.

— Demand for qualified workers with 3+ years of experience increased twofold. Mechanics, electricians, welders, locksmiths, cashiers, seamstresses are most desirable target employees.

— 13 % of respondents, mostly the retail and hospitality businesses has not reviewed pay levels and do not plan to do it at present.

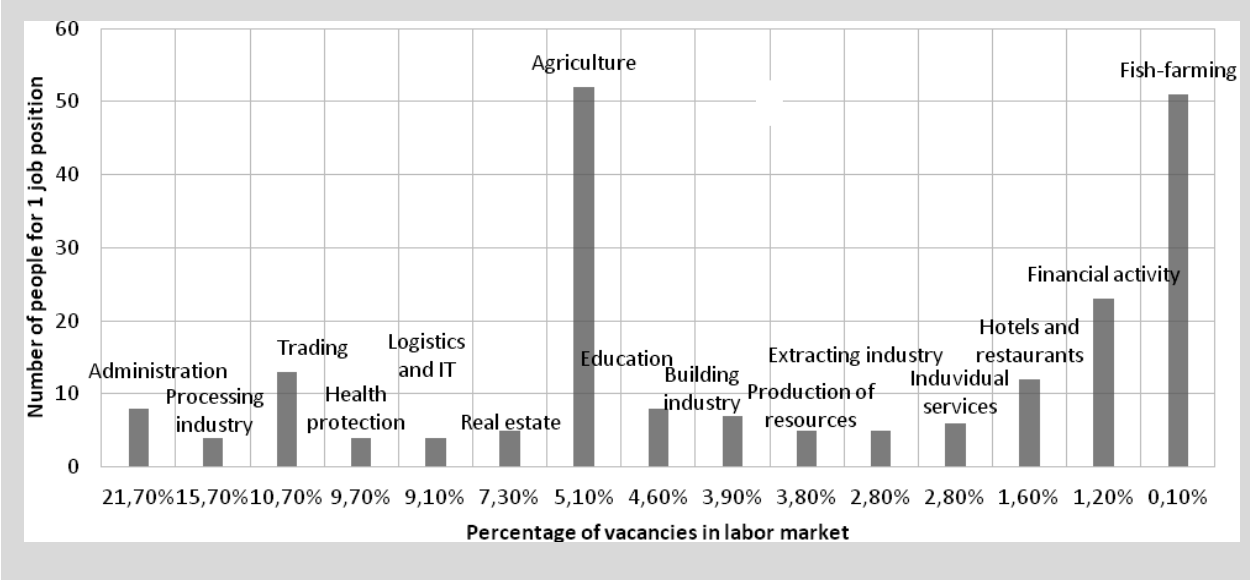

Fig. 1. Labor market needs in Ukraine in 2015 [adapted from 24]

— Average pay levels of semi-skilled workers increased by 5–20 %, skilled workers are paid 10–30 % more.

— Employers actively seek new employees in the market – 80 % respondents are involved in external recruitment.

Labor Market Index in July, 2015 has sharply declined by 0,68 point compared to March, 2015 and equals to 2,78. The market is not favorable for employers for the following reasons: shortage of qualified manpower; increasing competition for talents, caused by companies relocating businesses from Eastern and Southern regions to Western Ukraine; increased personnel related costs (military tax, increased payroll payments, hiring of contingent workforce to replace mobilized employers) [25].

The most popular among Ukrainian employers are graduates from:

— Polytechnic institutions – 97,8 %.
— Economic universities – 93 %.
— Technological universities – 92,7 %.
— Transport academies – 92,6 %.
— Construction and art – 91 % [16].

The least popular graduates among employers are from:

— Humanitarian universities – 77,3 %.
— Pedagogical universities – 80,4 %.
— Machinery building academies – 86,3 %.

The study revealed major trends in the employment system of Ukraine in 2014–2016:

1. Long-term domination of employers at the labor market, which results in lower starting salary and slower growth.

2. Aging of the laboratory equipment and low quality of education in technical universities worsen positions of Ukrainian students among graduates from other countries in hi-tech industries.

3. Low level of secondary and high school education in mathematical and economical subjects which affects further education.

4. Bankruptcy of non-modern industries is provoking new businesses to appear which creates new possibilities for young professionals.

5. Ukraine is expected to move in line with global trends in developing private educational courses. This will lead to development of companies with professional services, self-employment, growth of small businesses and growth of economic consciousness of graduates in general.

6. Developing trends of the political processes and geopolitical situation in Ukraine will increase militarization of the country which will create career opportunities for university graduates and also will create new job positions in military-industrial complex.

7. Gradual deceleration of active employment of 40-50's generation people which will create new possibilities for young professionals.

8. The number of graduates in 2014–2016 has been constantly decreasing which raises tensions in the labor market.

9. The "battle" between employers for talented youth will intensify which may create a new form of cooperation between business and universities in Ukraine. This will improve the quality of higher education and competitiveness in the labor market in general [16].

It should also be emphasized that the labor market in Ukraine is structured slightly different comparing to developed countries (**Table 1**) [9].

Table 1. Labor market segmentation in a transition economy

Sectors	Description of the sector	Segments
First	Employed at the official (formal) economy	Entrepreneurs, managers, representatives of scarce occupations related to services
		Highly qualified specialists in professions that are in demand in manufacturing
		Representatives of various professions with various qualification, educational backgrounds, who, because of economic, organizational, structural adjustment, proved to be excessive
		Employees who are unable to find stable jobs for various reasons – marginal groups of population
Second	Employed both in formal and informal economy	People who work part time in the informal sector because of the insufficient income from formal employment; employees who use their positions in the formal economy in order to obtain illegal income and benefits
Third	Employed in informal economy	Employed in profitable illegal business mainly of criminal nature
		Representatives of various types of self-employment

In developed countries though the labor markets are structured as follows: 1) Small, but highly stable segment of executives with high social status; 2) Staff and office workers, who compete in the labor market but have secure jobs; 3) Manual workers who as a result of restructuring suffer from production decline; 4) Workers of labor consuming sectors with low productivity whose occupations are excessive in the labor market; 5) The most vulnerable categories of workers: young people, the elderly, people with physical and mental disabilities, the chronically unemployed [9].

The problem of employment in Ukraine can not be addressed in isolation from the global processes on the labor market. The entry of Ukraine into the world market could mitigate the impact of unemployment in it, and exchange of human resources between Ukraine and other countries can be an effective way of lifting the country to the level of the most developed countries. However, joining the global labor market needs to overcome a kind of "entry barrier" to make Ukrainian workers competitive in the global labor market. But it will have to form a full labor market within the country itself, which will provide the necessary labor mobility. It should be tailored to suit effects of European integration processes in Ukraine.

The current political instability in Ukraine may cause an increase in work migration, including domestic. Significant cross-border emigration flows have been present in Ukraine for years. However, the causes of migration have been gradually changing. After the collapse of the Soviet Union in the mid-1990s and 2000s the ethnic factors mainly determined migration. The main factors that pushed people to migrate were poverty and unemployment. According to recent surveys 1,2–2,0 mln. Ukrainians work abroad. Today Ukraine in the international markets mainly acts as a state – exporter of labor, although there is a tendency to increase the number of foreigners working in Ukraine. Their number is about 10 times less than the number of Ukrainians working abroad. Migration flows are directed mainly to the neighboring countries – Russia (43 %), Poland (14 %), Czech Republic (13 %), and to countries with more attractive conditions – Italy (13 %), Spain (5 %), and Germany (2 %) [9, 22].

The Association between Ukraine and the EU will increase the number of migrant workers and mobility [14]. On one hand, further "brain drain" and inappropriate use of knowledge and depletion of the workforce are undesirable potential tendencies for Ukraine. On the other hand, the higher quantity of Ukrainians in the EU will increase the pressure on its labor markets, which is already quite high. According to [15] the major risks of further migration from Ukraine are not just the "brain drain" but so-called "brain loss", when talented and skilled workers are employed in unskilled work that does not match their level of education or skills. In addition, this leads to a depletion of the workforce, especially taking to consideration the aging and shrinking of Ukrainian population. Experts expect a modest increase in migration flows following the liberalization of the visa regime. Migration can "get younger" by increasing the share of Ukrainian youth going to study in EU countries, where the access to the labor markets in other countries will be open. At the same time, migration outlook indicates that the migration flows may reduce to some extent in 2026–2028 [15]. This requires from the Ukrainian government economic and social reforms aimed at ensuring sustainable economic development in the country.

Employer's view. Top four priorities, which affect process of recruitment, are:

1. The requirements of an employer to the level of training of young people (level of higher education, training and internship, knowledge of foreign languages, personal qualities).

2. Professional growth and qualification of employees (the cost of workers' training, the benefits of young specialists' training, the possibility of international business trips, willingness to work round the clock).

3. Availability of business development (ease of entry into business, national and foreign investments, the level of taxation, legal framework).

4. Interviewing (costs, time and resources for interviewing, online questionnaires, competitive selection).

1. The requirements of the employer to the employment potential of youth:

Experts of the Employment Center published the most common problems and requirements of most employers concerning young professional graduates [24]:

- there is a need for personnel with profound professional knowledge and skills, but only for those who really want to work and seek self-improvement;
- graduates lack a sense of community, – they cannot and do not want to work in a team. This creates additional problems for the manager;
- high quality and brief CV.

2. Professional growth and qualification of employees:

The possibility of formal and informal education of staff provides a wide range of varieties of learning (correspondence learning, day or evening attendance), and the services of both public and private educational institutions can be used. For employees, who combine work with study or training, current legislation provides a number of compensation, benefits and guarantees (saving an average wage of main job during training, payment for the travel to the training and back, payment of per diem for each day in way prescribed by the law for business trips, etc.) [17].

Each Euro, invested in employees' training, brings the company in average 13 Euros. Investments in training are returned usually in 3 months [12]. An example of the above is one of the sampled enterprises: the annual expenditures on training per employee were doubled – from 145 to 290 Euros. This allowed increasing the productivity of each worker in average of 1,900 Euros during the first year. The study found that training courses, conducted directly by the company, have more positive effects than those offered by specialized organization. However, out of additional earnings, owing to trainings, staff gets only a small portion – 15 percent [12].

3. Availability of business development:

In the "Doing Business" rating in 2015 Ukraine has not only improved its position by 16 points (up to 96th place from 185 countries) (**Table 2**), but also joined the list of 23 countries – the greatest reformers of business conditions in 2014–2015 [26].

This rating allows objective assessing the legal framework, related to the regulation of business, and its use in 185 countries. Table 1 shows the positions of some countries in the ranking according to the ease of doing business on their territory. This indicates a potential revival of private businesses, new working places creation and increase of the investment attractiveness of Ukraine. It should be noted that the duration of the procedure of opening a new business in Ukraine is 22 days, which is much lower than the world average of 30 days [26]. The duration of the procedure is decreasing every year, which also motivates people to create new businesses and make Ukraine more attractive for investments.

As to the protection of investors' rights, – according to a sub-index Ukraine decreased its position by 3 points (117th place). The integral index of investors' protection is only 4.7 points, at the level of Russia, but is much lower than in the U.S. (8.3 points), Georgia (7 points) and Poland (6 points) [20]. This negatively effects foreign investments into Ukrainian economy, preventing the creation of new businesses, and therefore new working places, including for graduates.

4. Effective interviewing:

Lots of questions which are asked during the interview for a position are crucial, and the answers give the necessary information about the applicant. Someone may think that interviewers are interested primarily in education and experience, but this is not always the case. Sometimes just a few words of a potential employee are enough for the employer to form an opinion about him or her. Everything is important: a manner of conversation, a kind of purity of language, and the sincerity of the applicant. The content of the response is secondary.

The problem of hiring candidates using interviews is actually outdated methods of interviewing. The method of conducting a survey on the basis of the same questions at many businesses allows applicants to prepare for the interview in advance and hide personal failures, lack of deep knowledge in an appropriate field.

Table 2. Dynamics of the position of some countries in the "Doing Business" rating [adapted from 26]

Country	"Doing Business" rating			Change (2015)-(2014)
	2013	2014	2015	
Hong Kong	2	2	3	-1
USA	4	4	7	-3
Georgia	9	8	15	-7
Germany	20	21	14	7
Japan	24	27	29	-2
Belarus	91	60	58	2
Kirghizstan	49	50	77	-27
Moldova	83	78	63	15
Russia	112	92	62	30
Ukraine	**137**	**112**	**96**	**16**

The challenges faced by employers in the Ukrainian labor market:

- low investment attractiveness of doing business in Ukraine,
- high level of taxation,
- low employment potential of the workforce,
- poor self-giving, lack of desire to improve and work in a team,
- biased selection of candidates for interviewing,
- outdated methods of interviewing.

Modern employers in the Ukrainian labor market consider a large number of applicants for a position as the most common problem. According to statistics, one of four graduates adds to his resume false information about professional and work experience, which leads to ineffective work and layoffs [15]. This happens because of the outdated technology of the job interviewing that has remained largely unchanged for many years, allowing the applicant examine the response before the interview.

To overcome the identified problems it is appropriate to consider modern innovative ways of interviewing used in foreign practice. Innovators in developing new methods are companies in so-called Silicon Valley, California. The latest technique is called «Open-Ended Logic-Problem Screening Tools» (outdoor logical selection system tools). The main objective of the method is not to get a response to a question, but observe and analyze the applicant, who is trying to answer. There aren't correct and incorrect answers, the main emphasis is on creativity, innovative thinking, and deep analysis of the solution of the problem. The questions are formulated in such a way that the answers cannot be prepared in advance in order to help employers easily distinguish a professional applicant.

IT-industry is growing quite rapidly in Ukraine and is a leader in recruiting young professionals and post-graduates, thus requiring careful selection. An effective method would be an introduction of «hidden questionnaires» – a technique of recruitment by placing complex mathematical problems on billboards, magazines and so on. Importantly, the response to the challenge might be an Internet link which contains more challenging tasks. If the applicant resolves it correctly, he would be informed about the appointment. This technique is used by some U.S. IT companies, which report their earnings in the first year grew by an average of 15–20 % [11].

We propose an algorithm for finding highly skilled workers:

1) creation of job vacancies in the company for the necessary criteria (age group, skills, experience, references and personal characteristics, etc.),

2) distribution of the questionnaires (through search web sites, newspapers, magazines, etc.),

3) accepting CVs from applicants (initial screening due to non-compliance with the criteria of vacancies),

4) the first round of interviews (typical interview to identify professional and personal qualities of applicants; secondary screening after interviewing). Rated at 50 points,

5) the second round of interviews (using the method "Open-Ended Logic-Problem Screening Tools" to test the ability of applicants to think creatively, solve atypical problems during the workflow; tertiary screening). Rated at 50 points,

6) summarizing the results of two rounds of interviews and hiring an applicant with a maximum number of points.

To improve the competitiveness of Ukrainian graduates the following advices are offered:

1. An important stimulus to achieve goals should be realistic and active promotion of the best graduates by high-education institutions. Especially because direct contacts with entrepreneurs are helpful for making necessary changes to the curriculum and training programs in order to meet the needs of the market, to ensure the development of teaching and practical base and conduct training of teaching staff, and, as a result, to contributes to the competitiveness of the graduates at the labor market.

2. Among the criteria for market competitiveness an important role is played by communication skills. It is important in guiding graduates for success to develop their skills of communication with potential employers, including CV writing. As almost all employers review resumes digitally, we suggest some useful tips, which may have a significant impact on the first impression of the applicant, introducing his psychological and aesthetic portrait:

– use fonts for CV headlines, designed for reading off a screen. For example, the most common font – Times New Roman – was designed for reading text on a printed paper, while the font Georgia for digital documents reading.

– innovative and creative CV in most cases is encouraged. In developed countries video-cards (short video presentations) have become popular. This method can be transferred to create a CV: an oral narrative about a person using mounting may catch attention of the employer and distinguish him among other applicants. This method is effective in marketing, IT and other business spheres which prefer creative and innovative thinking.

CONCLUSIONS

Despite the difficult situation on the Ukrainian labor market (high unemployment, mass higher education etc.), there is a good chance for a young professional or a university graduate to get a good job accordingly to his specialty. On the other hand, despite the low average professionalism, motivation and willingness of workers,

a Ukrainian entrepreneur has a chance to find a skilled and promising worker among young people.

Discovered objective reasons of the present crisis of the Ukrainian labor market and proposed measures may be used for further research of youth employment, which will help not only to reduce unemployment and stop the outflow of young personnel abroad, but also to improve the Ukrainian economy.

The problem of employment in Ukraine can not be addressed in isolation from the global processes on the labor market. While joining the global labor market Ukraine needs to overcome a kind of "entry barrier" to make Ukrainian workers competitive in the global labor market. But it will have to form an effective labor market within the country itself. And it should be tailored to suit effects of European integration processes in Ukraine.

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The technology of hierarchical agglomerative cluster analysis in library research

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Abstract. This article describes the simple technology of the hierarchical agglomerative cluster analysis of 20 different libraries, presented by the samples of classification attributes of the same volumes. It is necessary to construct a proximity matrix for an effective process of cluster analysis, using the data from the table "library-classification features". For separating a set of selected objects into clusters, so that each of them has objects, the most appropriate for its type, it is necessary to create a table "object-property", where libraries are objects and individual and equal dimension vectors (sets) of characteristic classification features are properties. To do this you should: form the set of libraries that are the objects of clustering; define for each library the set of classification features and its power (volume) in the same nominal scale; choose the value scale of classification features; form a table object-property. This technology is implemented in the environment of MsExcel-2003. It includes the transformation of one-dimensional data into multi-dimensional indexes, using the descriptive statistics and distributions of individual parameters, the creation of the "object-property" table, the building of the proximity matrix, the definition of the dendrogram structure and the cluster interpretation. The application of clustering method can further focus on creating algorithms of effective information search, and also building the scientifically-reasonable classification systems orientated on the library science. The method of hierarchical agglomerative cluster analysis can be used with typological or semantic distribution of library funds, or studying of their thematic and specific composition. This method can be considered as universal, that gives an opportunity to formalize the typology division of any objects of librarianship.

Key words: the cluster analysis , the object-property table, the proximity matrix, the dendrogram, clusters.

INTRODUCTION

An important role in the realization of scientific research plays the optimization of methods which are used as basic tools, the determination of possible sphere of the use of every method and the selection of most effective one in each case. The methodology of scientific activity is a process, that foresees the application of integral totality of certain ways, approaches, methods, actions, aimed to the obtaining of new scientific results, the achievement of the imposed aim and the implementation of the pre-arranged tasks. A logical construction of research work of the library specialists must base on the interdisciplinary approach of library studying in the context of social and communicative processes.

A library is an integrative social institute, as well as the library science must be diverse, that caused a choice of research methods not only from the arsenal of librarianship, but also from information technologies. And it is fully naturally, as nowadays a methodology of scientific research requires new paradigms and conceptual principles along with the use of time-tested traditional methods and approaches.

It would be impossible to have the deep modern theoretical developments without the mastering of historical experience. The working with the considerable array of works of leading scientists, both library specialists and researchers from contiguous fields of sciences, allowed to formulate a number of characteristic features of libraries with the aim to realize their typification, and more exactly carry out their division into homogeneous classes in this way, using the method of hierarchical agglomerative cluster division.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICFTIONS

The substateliness of such research is confirmed that in early 70th of the XX century the American scientist J. Solton suggested using the method of cluster analysis for distribution of library fund [1]. The method used in psychology [2,3, 4,5], for ecological data [6], bioinformatics [7], biology [8], Statistics [9], sociology [10], economy [11, 12, 13, 14, 15], the analysis results search [16, 17, 18, 19]. The tool of cluster analysis during the library research did not find implementation in Ukrainian librarianship.

OBJECTIVES

The aim of this article is to analyse the possibilities of implementation of hierarchical cluster analysis method in library science, particularly in the tasks of comprehensive research of libraries and to show its realization by means of Ms Excel in order to divide the set of libraries into homogeneous groups on the principle of similarity based on their classification characteristics given with a table “object-property”.

THE MAIN RESULTS OF THE RESERCH

The basic nature of cluster analysis

The first application as a method the cluster analysis found in the field of sociology. The subject of cluster analysis was defined firstly in 1939 and its description was given by a researcher R. Trion [20]. A cluster analysis is a statistical procedure[21], that executes multidimensional classification of data containing information about the selection of objects, that organizes the objects in a relatively homogeneous groups. Thus, the task of data classification is solved with the use of formed mathematical device.

The essence of this procedure is that the objects that must be classified are given by the same vector (by a set) of individual characteristics of these objects in the form of a table “object-property”, on the basis of which the matrix of distances (similarities) is constructed, after that the clustering is exercised. The content of clustering is that objects that are coming together can form a separate group – cluster [22]. The main criterion for classifying objects to a particular group, in other words the realization of clustering is definitely given and measured “distance” between objects.

The methods of cluster analysis [23] can be applied in different cases, including, when the question is only about a simple groupment where everything is reduced to the formation of groups for quantitative feature similarity. Depending on the certain applied task, the aim of cluster analysis can be different, for example:

- to understand the structure of the set of objects, breaking them into homogeneous groups, in any sense, and at the same time, to simplify further data processing for the decision making, working with every cluster separately;
- to distinguish unusual objects that do not belong to any of these clusters. This task is named a single class classification of exposure of non-typicality or novelty;
- to decrease, in the case of very large scale samples X, the data volume for maintenance, leaving one of the most characteristic representative from each cluster;
- to investigate the object dynamics in the process of their operation by changing the distances between classes and within classes.

The methods of cluster analysis can be applied when it is necessary to carry out the usual division of object set into groups only with a quantitative similarity of the selected attributes.

The cluster analysis algorithms are developed by software implementation that allows effectively to solve the problems of large dimension, but such software is licensed, and thus required some payment and is a little accessible. Therefore, its realization among Ms Excel is a very actual task.

The method of hierarchical agglomerative cluster analysis (is sometimes called numeral taxonomy) of existent data carries out the classification that did not exist before, or looking over data again creates new one, ignoring previous.

The result of realization of cluster analysis is given by a special chart of dendrogram that in a natural scale represents the closeness or similarity between objects that are classified.

It is possible to distinguish different on a volume, clusters on the basis of the dendrogram, thus distances between objects in a cluster will always be less than the least distance between objects from two different clusters.

In this research with the use of method of hierarchical agglomerative cluster analysis it is conducted the classification of libraries on selected features and criteria. The main purpose of using the cluster analysis in our research is to confirm the correctness and accuracy of the classical approach to distribution of libraries by their types. The main feature of these types is that libraries as a result of cluster analysis belong to the same cluster, on certain features are more similar to each other than with the objects attributed to the other clusters.

For a cluster analysis, collected data in the process of research or obtained experimentally is given in the form table “object-property”, in a way that the first column has the names of objects to be grouping, and the other columns correspond to certain properties (attributes, descriptions, indexes, etc.) and contain their certain values.

Its task is, that on the basis of the data provided by a table "object-property", to break a set:

$$G = \{ g_i : g \in G, i = 1, 2, \mathbf{K}, m \}, \quad (1)$$

of these objects to k (k – integer) clusters – subsets that are not crossed $Q_1, Q_2, \mathbf{K}, Q_k$ so that their association answer the whole set:

$$\bigcup_{j=1}^{k} Q_j = G, \quad (2)$$

and their crossing will be an empty set:

$$\bigcap_{j=1}^{k} Q_j = \varnothing. \quad (3)$$

Thus:

- every object g_i must belong to one and only to one subset of partition,
- objects that belong to one and same cluster must be similar,
- objects that belong to the different clusters must be different.

According to the received information the dendrogram should be built and its interpretation regarding the choice of a cluster number should be shown.

The implementation of methodology of this kind of cluster analysis is performed directly in the tabular processor Ms Excel without involving any additional subroutines and libraries for typological division should involve the following steps.

The formation of the table "object-property"

For separating a set of selected objects into clusters, so that each of them has objects, the most appropriate for its type, it is necessary to create a table "object-property", where libraries are objects and individual and equal dimension vectors (sets) of characteristic classification features are properties. To do this you should:

- form the set of libraries that are the objects of clustering,
- define for each library the set of classification features and its power (volume) in the same nominal scale,
- choose the value scale of classification features,
- form a table object-property.

On the basis of classic criteria of typological division, formed set of objects-libraries, with the strong typological characteristics is given in Table 1.

The library average is implemented with a number of classifications. This cluster analysis does not impose any restrictions on the type of objects, but each object has to be submitted by the same set of features. The formation of the feature set of libraries is one of the most important objectives of the study.

Table 1. The set of selected libraries

№	Name of library	Note
1	Pochaiv lavra	
2	Stauropegion brotherhood	
3	Scientific society named by T. Shevchenko	
4	Prosvita	Including reading rooms
5	Scientific theological society	
6	The union of Ukrainians	
7	Native school	Including school
8.	National museum	
9	The museum of Didushytskiy	
10	Studion	
11	National house	
12	Stauropegion institute	
13	Institution of Ossolinski	
14	Municipal public	
15	Military	
16	Archive	
17	Lviv university	Including departments
18	Lviv Polytechnic	Including departments
19	Agrarian Academy	Including departments
20	Theological Academy	Including departments

The implementation of this step is to determine the feature set that reflects the peculiarities of libraries in the best and the most complete way. As a result of selection on the basis of the analysis and processing of available primary information material, this set is the set of features:

$$X = \{ x_1, x_2, \mathbf{K}, x_m \}, \quad (4)$$

where: $m = 8$. In the Table 2, there are denominations of classification features, their characteristics and the individual value scales of quantitative assessment classifications.

Selected features of objects for clustering are given ith quantitative values, obtained from the expert assessment, taking into account specified scales that are in the table. Their values are given in points. Scores were determined based on the analysis of sources on the library history [24].

Two of the following attributes, namely "Origin of funds" and "Acquisition criteria" are presented in binary terms, the rest of them with defined and established scale on the basis of research.

Assessment values of attributes selected by our libraries are presented in Table 3 in the form of a table "object-property", more concrete in the table "library-classification features".

Table 2. Scales of library attributes

№	Attribute Name	Charac-teristic	Scale	Note
1	Motivation of foundation – x_1	Number	10	Number of reasons (justifica-tions)
2	Functional tasks – x_2	Number	10	
3	Origin of funds – x_3	Number	2	At their own expense 0 or action outside 1
4	Rooms for funds – x_4	Number	8	Geogra-phically separated rooms
5	Acquisition criteria – x_5	Number	2	Available 1 or no 0
6	Theme content – x_6	Number	12	Type of content
7	Communi-cation with persona-lities – x_7	Number	10	
8	Reader cate-gories – x_8	Number	10	

The construction of proximity matrix

The similarity or the difference between the objects, which are classified, is determined depending on the metric distance between them. If each object is described by "k" characteristics, it can be submitted as a point of k-dimensional space, and the similarity with the other objects will be defined as an appropriate distance, which is calculated by these "k" characteristics. The quantitative evaluation of similarity is based on the concept of metrics.

It is necessary to construct a proximity matrix for an effective process of cluster analysis, using the data from the table 3 "library-classification features".

A proximity matrix is constructed using the appropriate metrics, which define the distance between the objects, using the value of their features set. This procedure needs to choose the appropriate metrics to calculate the distances of closeness between each of the libraries.

One of the most known metrics of cluster analysis is Euclidean distance [25], as it corresponds to intuitive notions about proximity and describes the classical statistical designs by own quadratic form.

However, the Euclidean distance uses the quantitative values of features or preliminary fixing of their values. Therefore, the Manhattan metric is used for the construction of the proximity matrix in this study that is the best up to a procedure of determination of distances between the objects, which are lodged by the point scale.

Table 3. "Library-classification features"

№ з/п	Name of the library	Non names of classifications							
		1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**
1	Monasteries	6	5	0	3	0	4	2	2
2	Stauropegion brotherhood	3	6	0	4	0	3	2	3
3	Scientific society named by T. Shevchenko	3	4	1	2	1	7	5	4
4	Prosvita	5	4	0	1	1	6	8	4
5	Scientific theological society	4	4	0	3	1	5	5	3
6	The union of Ukrainians	4	6	1	2	0	4	9	4
7	Native school	7	9	1	5	1	10	6	6
8	National museum	6	5	1	4	1	6	7	7
9	The museum of Didushytskiy	8	4	0	3	1	7	6	5
10	Studion	3	3	0	2	0	4	4	2
11	National house	9	6	1	3	1	6	5	3
12	Stauropegion of institute	4	2	0	2	0	6	3	3
13	Institution of Ossolinski	5	4	0	6	1	11	7	8
14	Municipal public	10	7	1	8	1	12	5	8
15	Military	4	6	1	4	1	10	3	3
16	Archive	3	8	1	6	1	9	2	5
17	Lviv university	10	10	1	8	1	12	8	5
18	Lviv Polytechnic	10	10	1	8	1	7	5	5
19	Agrarian Academy	7	5	1	2	1	3	2	5
20	Theological Academy	5	3	1	1	1	2	3	2

The distance (metric) between the objects in a space of parameters is assumed as d_{ab} value, which meets the requirements of following axioms:

$$\text{A1. } d_{ab} > 0,\ d_{ab} = 0, \tag{5}$$

$$\text{A2. } d_{ab} = d_{ba}\ , \tag{6}$$

$$\text{A3. } d_{ab} + d_{bc} \geq d_{ac}. \tag{7}$$

The Manhattan metric is chosen for matrix construction in our study, that corresponds to the Euclidean metric of the order one. The Manhattan metric meets these axioms in accordance with a physical meaning of objects, which are classifying. Thus, the distance d_{ij} between i and j objects is defined as the sum of the absolute values of differences between the two features of these objects. Analytically it looks like:

$$d_{ij} = \left|x_{1i} - x_{1j}\right| + \left|x_{2i} - x_{2j}\right| + \ldots$$

$$+ \left|x_{8i} - x_{8j}\right| = \sum_{k=1}^{8} \left|x_{ki} - x_{kj}\right|. \quad (8)$$

We get the proximity matrix in the table 4 using the computing capabilities of Ms Excel, namely the tabulation functions by AutoComplete and fixing the column name and the line number, with use of simultaneous reading of classification features from the table "library-classification features" and its copy for $N = 20$ iterations(Table 4).

This matrix is symmetric to diagonal, where the values are zero. The equality of zero means the distance between the same object, which of course is zero.

The construction of dendrogram

The final procedure of agglomerative hierarchical cluster analysis is the determining of the dendrogram parameters, its construction and interpretation on choosing clusters and their numbers. A dendrogram based on the proximity table and the chosen strategy of association, which consists of the combining of objects from the table in group-clusters. The hierarchical agglomerative cluster analysis uses the following strategies for work with proximity matrix. They are the nearest neighbour, the distant neighbour, the group average and so on.

The initial steps in the procedures of hierarchical agglomerative cluster analysis are identical. First of all, looking for a pair of the objects with the least distance among all objects of proximity matrix and combining them into one group. The columns and rows of these objects are eliminated, and a new column and row with listed values of the features are inserted in their place, so as not to disrupt the diagonal of zeros. As a result, the proximity matrix size decreases by one and the smallest value becomes a parameter of dendrogram because it determines the distance between objects, and indicates the group number $n+1$. Each next step has a merge between two objects or between an object and a group or between the two groups for which the degree of proximity is minimum, then it's carried a similar recalculation and the merged groups are denoted as:

$$n+2,\ n+3,\ \ldots,\ n+(n-1). \quad (9)$$

The procedure is completed when the dimension of the proximity matrix is 2×2. The mathematical basis for the merging in the groups is expression of Williams-Lance [21]:

$$d_{nk} = a_i \cdot d_{hi} + a_j \cdot d_{hj} + b \cdot d_{ij} + g \cdot \left|d_{hi} - dhj\right|, \quad (10)$$

where: a_i, a_j, b, g – are determined by the type of strategy, d_{hi} and d_{hj} columns, which are combined, d_{hk} – the column as a result of the merging.

This study uses a flexible strategy, which is applied to any measures of proximity and determined by the following parameters $\alpha_i = \alpha_j = 0.625$, $\beta = -0.25$ i $\gamma = 0$. The use combining for this strategy is implemented by the following algorithm:

$$d_{rs} = 0{,}625 \cdot \left(x_{rs} + x_{(r+1)s}\right) - 0{,}25\left(\min\left(x_{r(s-1)}\right)\right), \quad (11)$$

where: r – column number, $r = \overline{1, n}$, and s – line number, $s = \overline{1, n}$.

The combining strategy is that we find the proximity matrices with the least value d_{rs}, which is equal to 6. It gives an opportunity to merge the objects 3 and 5 in one group and to appropriate a number 21 to this group, then it is recounted column and row by the expression (2) for this group. The recount comes during all work of algorithm for every new group according to the value of groups, which are merging, so it acquires a new value.

Then we look for the smallest value again – it corresponds to the distance between the groups 10 and 12 and is equal to 6. Similarly, we make a recount of features values and mark the merging by number 22, and so on. The results of procedure are given in Table 5.

Table 5. Step merging of clusters

Value of dendrogram		
Merging of groups	Distances between groups, which are merging	Newly formed group
d 3-5 =	6	21
d 10-12 =	6	22
d 1-2 =	7	23
d 17-18 =	8	24
d 21-4 =	8,5	25
d 8-9 =	9	26
d 15-16 =	9	27
d 26-11 =	9,63	28
d 22-20 =	9,75	29
d 23-19 =	10,13	30
d 14-24 =	10,5	31
d 25-6 =	11,16	32
d 7-13 =	13	33
d 30-29 =	13,89	34
d 32-28 =	15,43	35
d 33-27 =	16,59	36
d 34-35 =	22,51	37
d 36-31 =	24,94	38
d 37-38 =	54,67	39

Unfortunately, the graphic providing of Microsoft Excel does not have the opportunity directly to build a dendrogram, as her construction conjugates not only with the scale of distances but also with the place of objects, which belong to the certain clusters now. That's why, the first step of a construction is manual, and the

process of construction begins from the root of tree. For example, the number 39 indicates the merging of two groups 37 and 38 that mean we can build in any scale two rectangular branches. In turn, the number 37 is a group of two primary objects 34 and 35. Instead, the number 38 combines groups 36 and groups 31, moreover group 31 is a merging of 14^{th} group and 24^{th} group. Similarly we analyze the rest of the group. The procedure is repeated to complete full construction of the tree, until we reach the most non-merged objects. After the construction of the tree, it is clear the hierarchical order of objects clusters, which means: the higher level (bigger distance between clusters – vertical axis), the more objects are included by clusters. The next is resulting of vertical segments in accordance with the scale of the distances on the vertical axis. As a result, the dendrogram has the form shown in Figure 1.

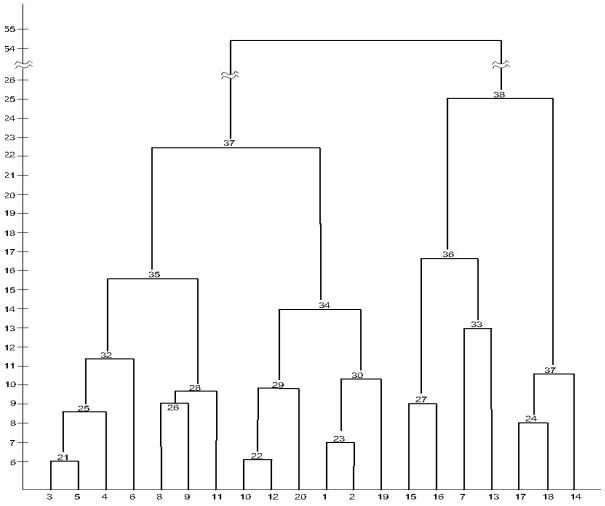

Fig. 1. Dendrogram of library clustering

Table 4. Proximity matrix

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX
I	0	7	15	15	9	14	23	15	14	8	12	10	24	30	14	19	33	25	8	10
II	7	0	14	18	10	13	24	18	19	9	15	11	25	31	11	14	34	26	11	13
III	15	14	0	8	6	11	18	12	9	9	11	9	17	25	11	14	28	20	13	13
IV	15	18	8	0	8	9	20	10	9	13	13	11	15	29	17	22	26	24	15	13
V	9	10	6	8	0	11	20	12	9	7	9	7	17	27	11	18	30	22	13	11
VI	14	13	11	9	11	0	21	13	16	12	14	14	22	30	16	21	27	25	14	16
VII	23	24	18	20	20	21	0	12	13	27	15	25	13	13	13	12	12	12	19	27
VIII	15	18	12	10	12	13	12	0	9	19	11	17	11	19	15	18	22	18	13	19
IX	14	19	9	9	9	16	13	9	0	16	8	14	14	20	16	19	21	15	12	18
X	8	9	9	13	7	12	27	19	16	0	16	6	24	34	16	21	37	29	14	8
XI	12	15	11	13	9	14	15	11	8	16	0	14	22	18	12	19	21	13	12	16
XII	10	11	9	11	7	14	25	17	14	6	14	0	22	32	12	19	35	27	14	10
XIII	24	25	17	15	17	22	13	11	14	24	22	22	0	14	16	17	19	23	24	26
XIV	30	31	25	29	27	30	13	19	20	34	18	32	14	0	20	19	9	11	26	34
XV	14	11	11	17	11	16	13	15	16	16	12	12	16	20	0	9	23	21	16	16
XVI	19	14	14	22	18	21	12	18	19	21	19	19	17	19	9	0	20	16	17	23
XVII	33	34	28	26	30	27	12	22	21	37	21	35	19	9	23	20	0	8	29	37
XVIII	25	26	20	24	22	25	12	18	15	29	13	27	23	11	21	16	8	0	21	29
XIX	8	11	13	15	13	14	19	13	12	14	12	14	24	26	16	17	29	21	0	10
XX	10	13	13	13	11	16	27	19	18	8	16	10	26	34	16	23	37	29	10	0

CONCLUSIONS

It was conducted in the “manual mode” the hierarchical agglomerative cluster analysis only for the small selection of libraries. In case of their large number (thousands and tens of thousands of elements) manually to realize such technology is impractical and impossible. Appropriate software must be used for this purpose. The deep analysis of clustering results of plenty of libraries can serve as a basis for the construction of relevant ontology in the field of library science.

The application of clustering method can further focus on creating algorithms of effective information search, and also building the scientifically-reasonable classification systems orientated on the library science. The method of hierarchical agglomerative cluster analysis can be used with typological or semantic distribution of library funds, or studying of their

thematic and specific composition. This method can be considered as universal, that gives an opportunity to formalize the typology division of any objects of librarianship.

The received results of cluster analysis do not only confirm the classical classification scheme of the investigated libraries, they simplify the procedure of division and also can be used for further theoretical developments of classification schemes of libraries.

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Model of sustainable development of the national economy of Ukraine: assessment of current state and prospects of development

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Abstract. The article considers the research of sustainable development model of national economy of Ukraine at the modern conditions. Determine the structural changes of national economy of Ukraine at the period of 2001 – 2012. During the period from 2001 to 2012 increase of the share of economic activities of the sphere of immaterial production, while reduction of the share of economic activities of the sphere of material production. The lack of progress in the development and implementation of new technologies prevented the improvement of industrial competitiveness, which partly led to a deep structural crisis and drop in production. The share of type of economic activity in the structure of the national economy does not affect its importance for the development of national economy. The poor energy efficiency of Ukraine poses a serious threat to its economic security that results in a deformed structure of production and consumption, in the usage of old technology of production of energy and in slow implementation of energy saving technologies. For sustainable development of Ukrainian national economy at unstable modern conditions must improving public-private partnership in the field of energy efficiency are substantiated.

Key words: economic model, sustainable development, structural changes, national economy, system of public administration, energy saving, Ukraine.

INTRODUCTION

The transformation of the global economy results in the changes of the public perception of global economy and the modification of values, where special attention is getting the value of the individual, self-realization, human life and health, social stability, preservation of natural resources and biodiversity.

Conceptual grounds of the model of sustainable development were established in numerous international contracts, “Rio Declaration on Environment and Development” [1], United Nations Millennium Declaration [2], Johannesburg Declaration on Sustainable Development and Plan of Implementation of the World Summit on Sustainable Development [3], “The Future We Want” [4]. The issue of sustainable development occupies prominent place in the Sustainable Development Strategy “Ukraine – 2020”, in which “...creation of a country with a strong economy and significant innovations...” and “...Ukraine's achievement of the leading position in the global economy” were defined [34].

Sustainable development is defined as a form of interaction between society, the state and nature, which provides human survival and preservation of the environment; today's generation provides its vital needs without depriving future generations’ opportunity to meet their own capabilities and needs.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

The problem of the formation and development of national model of sustainable development is widely explored by Ukrainian scientists: [5; 6], [7], [8], [9], [10], [11; 12], [13; 14], [15], [40] and others.

Thus, the founder of the national theory of "sustainable development" [13, 8; 14] defines it as a permanent reproduction of the so-called state of homeostasis (dynamic equilibrium) with a periodic change in its level at which there is a permanent solution to the contradictions between the internal components of the system, meanwhile change of the parameters of the biosphere does not exceed beyond catastrophic transformations for the system. Sustainable development, as noted by [13; 14], characterized by dynamic equilibrium with periodic changes of its level and elasticity.

[12, 14] gives a definition of the "sustainable development": "The process of harmonization of the productive forces, providing of guaranteed satisfaction of needs of all members of society for the preservation and reproduction of integrity of the natural environment, creating opportunities for a balance between the potential and requirements of all generations". This interpretation of the term "sustainable development" was recorded at the national level in the Concept of Sustainable Development of Ukraine in 1997.

[16] interprets "sustainable development" as a "development that can satisfy the needs of the current generation of people without putting at risk the capacity of future generations to meet their own needs". At the same time, the economy should provide people with capability to meet their needs and legitimate desires, but their growth should not go beyond the environmental capacity of the ecosphere.

[15, 84] defines "sustainable development" as development of society with the growth of gross domestic product in which the needs of natural resources present generations are met and should not jeopardize the ability of future generations to meet their needs under the conditions when economic, environmental and social components of development are aligned and human impacts do not exceed the ability of the natural environment to restore itself, and society will realize an advantage of environmental priorities over others.

Examining the nature of the concepts "development" and "sustainable", [17] gives the following definition: "sustainable (harmonious, balanced) development – it is a development that provides specific type of balance, i.e. the balance between the socio-economic and environmental components; balance should be the basis of a regional development".

Sustainable development is considered as a process of harmonization of productive forces, while ensuring that the essential needs of all members of society under conditions of maintaining the integrity of environment and creating opportunities for the balance between the potential and requirements of all generations [18].

OBJECTIVES

The aim of this article is the empirical research of sustainable development model of national economy of Ukraine at the modern conditions.

THE MAIN RESULTS OF THE RESEARCH

Model of sustainable development of the national economy is characterized by a balanced solution of problems of economic and social spheres with concurrent solution of environmental problem, maintaining good conditions, which is a prerequisite for the viability of current and future generations of humanity.

The economic component consists of the optimum use of scarce resources and usage of energy and technology to create gross income flow, which would provide the saving of gross capital (physical, natural or human) using which this gross income was generated. The transition to post-industrial (information) society causes changes in the structure of gross capital, by increasing intangible flows of finance, information and intellectual property. Already, these flows exceeded the volume of material goods in seven times. The development of the new economy is stimulated not only by the shortage of natural resources, but also by increasing amounts of information and knowledge, which are emerging as an important commodity.

The environmental component focused on ensuring the integrity of natural systems and their sustainability, which determines the global stability of the whole biosphere. Particular importance obtains the ability of such systems to self-restoring and adaptation instead of staying in a static state or degradation and losing of biological diversity.

The social component focused on human development, preservation of social stability and cultural systems, reduction of the number of conflicts in the society. Human becomes a subject of development rather than an object of development. The social component should participate in the formation of human activity, making and implementation of decisions, monitoring of implementation of decisions. In order to ensure these conditions, an equitable distribution of wealth among people, pluralism and tolerance in relations, preservation of capital and its cultural diversity are essential.

System alignment and balance of these three components are the main tasks of enormous complexity. In particular, the interconnection of social and environmental components results in the necessity to preserve the equal rights of present and future generations to exploit natural resources. The interaction of social and economic components requires the achievement of equity in the distribution of wealth between people and the provision of targeted assistance to the poor segments of society. The interconnection of environmental and economic components requires evaluation of technogenic impacts on the environment and reassessment of the value of the natural environment and resources, the increasing role of natural capital as such.

Thus, the model of sustainable development assumes biocentric (anthropocentric) way of providing vital needs of society with the active and equitable use of factors of production.

The national economy of Ukraine can be characterized by the following features: instability of growth, a high level of shadow economy, technical and technological backwardness, significant physical and moral depreciation of fixed assets, low utilization of production capacity, high level of material and energy input, lack or low level of innovation.

The lack of progress in the development and implementation of new technologies prevented the improvement of industrial competitiveness, which partly led to a deep structural crisis and drop in production. Since declaration of independence of Ukraine, large high-tech complexes (aviation, electronics industry, production of machine tools, instrumentation, etc.) had degraded as well as the potential, which could be the basis of economic development of the state.

The structure of the national economy of Ukraine by the types of economic activity for the period 2001 – 2012 is shown in Table 1.

Table 1. Structure of the national economy of Ukraine by the types of economic activity for the period 2001–2012, in % to GVA

Type of economic activity	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Comparison of, 2012 to 2001 (p.p.)
Agriculture, hunting and forestry	16.05	14.62	11.89	11.70	10.24	8.42	7.22	7.57	7.76	8.26	9.49	9.30	-6.75
Fishery and fish farms	0.07	0.06	0.05	0.04	0.04	0.03	0.02	0.02	0.03	0.03	0.02	0.02	-0.05
Industry	30.19	30.73	29.79	27.98	30.30	30.81	30.20	28.80	25.30	25.90	25.61	25.74	-4.45
- mining industry	4.64	4.97	4.43	3.93	4.53	4.52	4.824	6.31	4.81	6.56	7.47	6.78	2.13
- processing industry	19.41	20.07	20.32	20.14	21.93	22.46	21.83	19.14	16.74	15.85	14.28	14.65	-4.77
- production and distribution of electricity, gas and water	6.12	5.67	5.02	3.91	3.830	3.82	3.53	3.34	3.75	3.50	3.86	4.32	-1.81
Construction industry	3.98	3.80	4.20	4.54	4.13	4.35	4.64	3.39	2.54	3.25	3.19	3.33	-0.65
Trade, repair of motor vehicles, household appliances and goods for personal use	12.23	12.22	12.93	12.90	14.15	14.08	14.50	15.25	15.34	16.48	17.48	17.26	5.04
Hotels and restaurants	0.63	0.65	0.66	0.72	0.60	1.11	1.04	1.13	0.95	1.03	1.01	0.94	0.30
Transport and communication industry	13.41	13.68	14.35	13.41	11.98	11.51	10.67	10.12	11.45	11.10	11.43	8.53	-4.89
Finance	2.87	3.08	3.83	6.68	4.99	5.21	6.45	8.01	7.87	7.05	5.50	5.12	2.24
Real estate, lease, engineering and services for entrepreneurs	6.91	7.44	6.91	7.39	7.71	7.98	9.70	9.92	11.28	9.97	10.18	12.06	5.14
Public administration	4.05	4.37	4.17	4.43	5.17	5.38	5.10	5.23	5.54	5.22	4.88	5.28	1.23
Education	4.86	5.38	5.64	5.11	5.27	5.39	5.01	5.06	5.81	5.57	5.33	6.17	1.31
Healthcare and social assistance	3.28	3.66	3.74	3.44	3.53	3.64	3.43	3.39	4.08	4.22	3.93	4.37	1.09
Public and personal services, cultural activities and sport	1.45	1.86	1.85	1.66	1.88	2.11	2.03	2.12	2.04	1.91	1.94	1.90	0.45
Total	100	100	100	100	100	100	100	100	100	100	100	100	-

Note: compiled and calculated by the authors according to [19 – 26]

Table 2. Results of regression analysis between the growth rate of gross value added (*Y*) and investment in fixed assets (*X*) for the 2001–2012 period

Type of economic activity	Coefficient of determination (R^2)	Equation of linear regression
Agriculture, hunting and forestry (X_1)	0.0243	$Y = 0.1135X_1 + 93.766$
Fishery and fish (X_2)	0.1725	$Y = -0.2644X_2 + 130.689$
Industry (X_3)	0.8313	$Y = 0.9303X_3 + 9.083$
Mining industry (X_{31})	0.8173	$Y = 1.2281X_{31} - 20.934$
Processing industry (X_{32})	0.8559	$Y = 0.5669X_{32} + 45.407$
Production and distribution of electricity, gas and water (X_{33})	0.4824	$Y = 0.9545X_{33} + 8.224$
Construction industry (X_4)	0.7959	$Y = 0.3151X_4 + 73.566$
Trade, repair of motor vehicles, household appliances and goods for personal use (X_5)	0.6266	$Y = 0.3708X_5 + 65.011$
Hotels and restaurants (X_6)	0.3413	$Y = 0.2229X_6 + 80.422$
Transport and communication industry (X_7)	0.7066	$Y = 0.8330X_7 + 16.109$
Finance (X_8)	0.6370	$Y = 0.2989X_8 + 72.088$
Real estate, lease, engineering and services for entrepreneurs (X_9)	0.5536	$Y = 0.4346X_9 + 57.225$
Public administration (X_{10})	0.1650	$Y = 0.5310X_{10} + 51.987$
Education (X_{11})	0.1760	$Y = 0.7867X_{11} + 25.485$
Healthcare and social assistance (X_{12})	0.2244	$Y = 1.0457X_{12} - 1.808$
Public and personal services, cultural activities and sport (X_{13})	0.7148	$Y = 0.5876X_{13} + 42.559$

Note: compiled and calculated by the authors according to [19–26]

During the period from 2001 to 2012, certain structural changes in the Ukrainian national economy took place:

– increase of the share of economic activities of the sphere of immaterial production (11.92 p.p.), while reduction of the share of economic activities of the sphere of material production;

– during the studied period the real economy as a whole fell almost by 1.3 times, mainly in agriculture, its share fell by almost half (from 16.05 % to 9.30 %), industry – by 4.4 p.p. (from 30.19 % to 25.74 %) and construction industry (from 3.98 % to 3.33 %). Among the economic activities that belongs to the non-material production: proportion of transport and communication services decreased (from 13.41 % to 8.53 %), while the share of the following industries increased: trade (from 12.23 % to 17.26 %), real estate (from 7.44 % to 12.06 %) and public and personal services, community services (1.45 % to 1.90 %).

The type of economic activity that lays in the basis of the financial sector – financial activities, during the study period, increased its share by more than 1.8 times (from 2.87 % to 5.12 %). This increase may indicate the gradual formation of the financial market and the gradual development of financial services in Ukraine.

During the research, regression analysis of the relations between economic development of Ukraine and types of economic activities was conducted (Table 2).

Regression analysis of the "impact of growth of types of economic activity on the economic development of Ukraine" for the period 2001–2012 allowed us to classify the types of economic activity by the coefficient of determination, *F* – criterion and *t* – criterion as follows:

First Group – types of economic activities that are crucial for the economic development of country during the studied period (R^2 > 80 %). This group includes traditional types of economic activities of the national economy of industrial society: Industry (X_3) (R^2 =83.1 %), including the Mining industry (X_{31}) (R^2 =81.7 %) and Processing industry (X_{32}) (R^2 =85.5 %).

Second Group – types of economic activities that have medium impact on the economic development of the country during the studied period (50 % < R^2 < 80 %). This group includes Construction industry (X_4) (R^2 =79.5 %), Trade, repair of motor vehicles, household appliances and goods for personal use (X_5) (R^2 =62.6 %), Transport and communication industry (X_7) (R^2 =70.6 %), Finance (X_8) (R^2 =63.7 %), Real estate, lease, engineering and services for entrepreneurs (X_9) (R^2 =55.3 %) and Public and personal services, cultural activities and sport (X_{13}) (R^2 =71.4 %).

Third Group – economic activities that are potentially crucial for economic development in the conditions of post-industrial society. This group includes Education (X_{11}), Public administration (X_{10}) and Healthcare and social assistance (X_{12}), Agriculture (X_1) and Production and distribution of electricity, gas and water (X_{33}). Despite the fact that all these types of economic activities in the structure of the national economy have shares in the range of 4–6 % and their

actual correlation with economic development is average (40–47 %), but change (increase) by 1 % can stimulate the growth of the national economy: Education – by 0.7867 %, Public administration – by 0.5310 % and Healthcare and social assistance – by 1.0457 %.

According to the "Rio Declaration on Environment and Development" [1], the sustainable development defined as a priority of human development, which involves minimization of human impact on the environment (environmental aspect).

Governments in many countries are increasingly aware of the urgent need to make better use of the world's energy resources. Global energy intensity decreased by 1.3 %/year between 1990 and 2011 [39] that is explained by the combined effect of high energy prices, energy efficiency programs and, more recently, CO2 abatement policies in OECD countries, as well as other economic factors, such as the move by economies towards tertiary activities. The global economic crisis in 2008–2009 induced a net slowdown in the energy intensity reduction in all regions. This poor performance was mainly caused by industry, a sector in which energy consumption did not decrease at the same pace as the value added due to the fact that part of the consumption is independent of the production volume and that industrial equipment operates with lower efficiency during periods of recession.

Ukraine has a very high energy intensity of GDP (high energy consumption) and it is the least energy efficient country in Europe. The amount of energy that was used to produce a unit of goods and services has been still 3.8 times higher than the average indices in the European Union [37]. The researchers found that poor energy efficiency of Ukraine poses a serious threat to its economic security that results in a deformed structure of production and consumption, in the usage of old technology of production of energy and in slow implementation of energy saving technologies. Ukraine needs to overcome the drawbacks of the real sector by reducing the proportion of resource- and energy-intensive activities, promoting the reduction of energy- and ecology-intensive production through the introduction of modern technologies, rationalization of resource usage, and optimization of territorial distribution of production.

The main drivers of the industrial sector growth should be industries that have lower energy intensity and technological processes, which can be characterized as high energy-efficient. Production and distribution of electricity, gas and water occupies only 4.32 % in the structure of national economy and stimulates 0.9545 % growth of the national economy. However, we believe that this type of economic activity for Ukraine should be developed more, especially taking into account the current critical situation in the Eastern Ukraine and strained relations with Russian Federation.

German Advisory Group with Ukrainian Institute for Economic Research and Policy Consulting [37] studied the trends of primary energy consumption for the period 1990–2010, and found that the energy intensity of the Ukrainian economy has evolved according to economic growth:

1) structural recession during 1990–1996 resulted in a significant decline in demand for primary energy (demand fell by more than 40 % over the period). However, energy intensity to weighted purchasing power parity increased from 0.58 kg of oil equivalent (kgoe) in 1990 to 0.82 kgoe in 1997. This explains the fact that industrial production and total output fell faster than overall energy consumption;

2) in the period of economic recovery (1997–2008) demand for primary energy had stabilized at average level of 136 Mtoe. Meanwhile, energy intensity was declining gradually and reached 0.44 kg of oil equivalent per unit of gross domestic product in 2008, due to the strong recovery of economic growth and the emergence of more effective types of economic activity;

3) during the period 2009–2012, positive trend changed in reverse because of the global economic crisis, which severely affected Ukrainian economy, and in 2012 energy intensity rose again to 0.49 kgoe.

The structure of energy consumption in Ukraine is dominated by fossil fuels (oil, natural gas and coal), which constitute 80.4 % of the total energy consumption. Given the dominance of fossil fuels in energy balance structure and inefficient energy use, Ukraine has one of the world's carbon intensive economies. This leads to significant pressure on the environment and complicates the country's fulfillment of possible future commitments under international agreements on reduction of carbon emission. Pollution limits the development of industries that are based on the use of high technology, such as nanotechnology, because they need the relevant environmental quality standards [36].

In 2013, according to Ukrainian Energy Index (UEI) [38] Zakarpatska, Chernihivska and Vinnytska regions were the most energy efficient regions in Ukraine, with 64.3 %, 63.8 % and 62.9 % of the EU level respectively. During the period 2011–2013 Zakarpatska and Vinnytska regions were in the top three most energy efficient regions, however for the Chernihivska region it was first time on the second place in 2013.

Thus, during the period 1990–2012 energy intensity of the national economy decreased by 20 % as a result of reduced economic activity, and not due to the efforts to reduce power consumption. Low level of energy efficiency of Ukrainian economy can be explained by two factors:

1) excessive market regulation ("The state failure argument");

2) insufficient measures to encourage energy efficiency practices ("The market failure argument").

According to a study conducted by UN representatives in Ukraine [36], 32.2 % of the participants prefer the protection and restoration of the environment as a priority of development; a significant

proportion (43.4 %) of respondents does not just agree with the need to save energy, but also confirms willingness to do so in their own houses/apartments. This indicates a fairly high level of understading of the importance of environmental issues in Ukrainian society, especially given the relatively low standards of living and priority focused on satisfaction of primary needs. The significance of fuel resources for the national economy cannot be overestimated: lack or insufficiency of fuel resources prevents the production process in all types of industry, agriculture, transport and public services.

Energy Strategy of Ukraine [35] determines the goals and ways to implement the energy policy of Ukraine for the long term (until 2030) and outlines mechanisms for its implementation. The key objective is to develop systems which can ensure energy security of the country and guarantee a stable energy supply of the national economy and social needs. Energy Strategy foresees that the fixed capacity of renewable energy to 2020 will reach almost 12000 megawatts, and production of "green" energy will reach the level of approx. 25 billion kilowatts.

The main factor of improvement of energy efficiency of the Ukrainian economy is creation of efficient system of public administration of energy saving practices that will improve the structure of energy consumption, in particular through further expansion and deepening of electrification in all sectors of the economy by replacing scarce fuels while increasing efficiency of production. National strategy of energy conservation and alternative energy sources implemented through special laws of Ukraine "About Energy Saving" [27] and "About Alternative Energy Sources" [28]. However, state only declares development of bioenergy, but currently economic instruments of encouragement have virtually no legal binding.

According to art. 6 of the Law of Ukraine "About Energy Saving" [27] national, regional, local and other programs were developed for effective and focused governmental regulation of the organization and coordination of actions in the field of energy conservation.

According to the Energy Strategy of Ukraine, 49 project proposals (with total cost of 1.3 bln. UAH) were prepared and will be funded exclusively through the balance of funds, that were received from the European Union to the special fund of the state budget.

Ukrainian cities organized five consortia and in 2014 with the support of the government signed a memorandum with the German Office of International Cooperation (GIZ) for implementation of the project "Energy Efficiency in the Communities". The Project GIZ will provide technical assistance to Ukrainian cities for the amount of 4 million EUR. During 2010–2013, Project GIZ "Energy Efficiency in Buildings" was successfully implemented in four Ukrainian cities (Chernihiv, Ivano-Frankivsk, Myrhorod, Novograd-Volynskiy), where modernization of buildings for energy conservation was conducted. With the support of the GIZ each of the four cities will develop a municipal plan of energy efficiency for buildings with a particular focus on the following measures:

–collection of data on energy consumption;

– development of a long-term strategy, i.e. energetical plan and measures of demand management;

– development of an action plan and preparation for its implementation;

– development of funding mechanisms and incentives;

– conducting of public information campaigns;

– development of monitoring and reporting systems.

Thus, within the framework of GIZ "Energy Efficiency in Communities", energy conservation project "Modernization of street lighting by using innovative energy efficiency of renewables (solar energy) of the city of Myrhorod" was implemented.

According to the dynamic of energy efficiency indices of the regions [38], L'vivska region achieved the biggest improvement during 2011–2013 by rising in the overall ranking by 10 positions (from 22 to 12 place). Efficiency of energy consumption has increased from 42 % to 57 % due to the improvements in the service and residential sectors, as well as in the mining and food industries.

As part of the "Governmental economic program of energy efficiency and the development of energy production from renewable energy sources and alternative fuels for 2010–2015" [32], budget program "Regional energy efficiency program of Lviv region for 2010–2014" [33] was implemented. This program provides refund of the interest rates on loans that were granted to owners of individual households for energy projects or for acquisition of appropriate equipment. According to the Lviv regional state administration, as a result of implementation of this program in 2011 natural gas consumption in the population decreased by 8.6 % or by 98.6 mln. m^3 compared to 2006.

Regional and local authorities solve problems of energy efficiency through the development and implementation of energy efficiency programs and joint projects with international organizations. Thus, Lviv participates in several loan programs of the European Bank for Reconstruction and Development and Scandinavian project "NEFCO" on energy conservation and rehabilitation of residential buildings; moreover an energy audit of municipal buildings of medical and educational organizations was scheduled. Since 2012, German-Ukrainian project "Energy Efficient Cities" has been implemented in the city Zholkva (Lviv region). In 2014 in the framework of competition EuropeAid / 131230 / L / ACT / UA "Support of the implementation of energy saving technologies in the small towns of Ukraine", project

"Implementation of energy saving technologies in Hlynyanska regional hospital" (Hlyniany, Lviv region) was completed, which was funded by the European Union (80 %) and local government (20 %).

Pilot project on energy efficiency and alternative energy, which was carried out with the support of GEF / UNIDO "Improving energy efficiency and promoting the usage of renewable energy in the agrarian and food and other small and medium-sized enterprises (SMEs) in Ukraine" was implemented in the village Luky (L'vivska region). The local plant had installed biodiesel production line that based on cavitation technology, which can reduce power consumption for production of 1 ton diesel by 50 kW×hour, as well as can use less methanol due to more precise dosages system. This project involved technical assistance grant funds in the amount of 147 000 USD.

Moreover, within the framework of the Project GEF/UNIDO, the heat recovery systems for four baking ovens were installed at the L'viv Bakery №5, which belongs to PAT "Konsern Khlibprom", one of the largest companies in the grain market of Ukraine. Heat recovery systems were designed to produce low-pressure steam and hot water for technological needs. Grant funds in the amount of 160000 USD were used to implement this project. Experts estimate that the expected savings of natural gas amount to 170 000 cubic meters per year.

Implementation of pilot projects in Ukraine, and especially in L'vivska region, facilitates the adaptation of the national economy to the principles of sustainable development .

So, in conditions of worsening economic and political crisis, the most important become issues of intensification of energy saving technologies, improvement of public-private partnerships in the effort of energy saving and as a result, reduction of gas dependence of the national economy from the Russian Federation.

CONCLUSIONS

In conclusion of the research, we can identify the following features of the national economy development in the context of the model of sustainable development:

1) the growth of the national economy for the period from 2001 to 2012 is provided by traditional for Ukraine economic activities – Mining and processing industry;

2) despite the priority of economic activities of industrial society for the national economy, during the studied period non-material production sphere gained value, which is characteristic of post-industrial society: Financial activity and Real estate, lease, engineering and services for entrepreneurs;

3) the share of type of economic activity in the structure of the national economy does not affect its importance for the development of national economy. Thus, the growth of the Financial sector (X_8), which holds 5.12 % of the national economy (for the year 2012), 1 % stimulates only 0.2989 % growth of the national economy, while the growth of Transport and communication industry (X_7), which holds 8.53 % for 1 % stimulates 0.8330 % growth;

4) low level of energy efficiency poses a serious threat to the sustainable development of the national economy of Ukraine, hence improving public-private partnership in the field of energy efficiency becomes the main task for the authorities.

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Evaluation of commercial prospects for innovative product machine building enterprises

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Abstract. Forecasting of successful implementation of innovative product is the crucial element of decision making process. The purpose of forecasting innovative product realization is to define probable commercial level according to consumer demand. This article highlights the necessity of evaluating the commercial prospects for innovative products. It reviews the most popular methods of assessment of commercial prospects of the innovative products and reveal main drawback of them. The results show, that approaches to commercial prospects assessment for innovative products enables enterprises to go beyond the solely understanding of customer needs, thus enabling them to develop new way of. The authors argue for the improving procedure to assess the commercial prospects through innovative product rating Rankings innovative ideas. It is based on the following criteria's: level of product uniqueness, level of satisfaction of the consumers' hidden needs, value of the market segment, expected life cycle, products price, quality level, products design, service, amount of marketing costs, expected rate of innovation profitability. The proposed rating method of assessment of innovative products commercial perspectives would enable engineering enterprises to determine the most successful innovative ideas and to timely reject the ideas predestined to fail. Obtained results due to ranking also help enterprises to overcome barriers, associated with innovation commercialization. At the same time this method can be a start point for marketing innovation.

Key words: innovation, commercial prospects, rating.

INTRODUCTION

In the market economy survives without innovation machine-building enterprises are virtually impossible. However, implementation of enterprise innovation activities is not a guarantee of its competitiveness in the market. The main objective is to create a product that is in demand at the consumer. The implementation is failed innovation project can not only lead to significant losses, but also to bankruptcy. Therefore the problem of evaluating the commercial prospects of an innovative product is now fairly acute to domestic machine-building enterprises. Addressing these issues will help to improve the market position of innovative engineering companies, by reducing the risk of failure of the innovation project and avoiding unnecessary time and cost.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

The research of general issues of innovation development process and evaluation of their commercial prospects of were engaged a lot of foreign and domestic scientists in particular should allocate V. J. Kardash [2] F. Kotler [3], J.J. Lambe [5], T.N. Double [6] A. Sumets [10] R. Cooper [13]. However, despite the large number of works until today have not found a sufficient solution to the problem associated with the evaluation of the adequacy of market innovation machine building enterprises.

In practical activity the enterprises involved in innovation activities often have a situation where product innovation is not the consumer that is experiencing failure. The failure of the innovation can be of three types [4, 6, 9]:

- Absolute – when revenues from innovation are lower than the costs incurred on its creation, production and sales,

- Partial – when the revenues from innovations allow only cover the costs incurred on its creation, production and sales,
- Relative – when the company makes a profit less than planned.

Therefore, to achieve the expected level of return on innovation activities of enterprises need to enter the market with such a product-innovation that will interest consumers that will be commercially promising.

The economic literature which explores the behavior of consumers distinguishes the following methods of evaluating the commercial prospects for innovation:

- multi-level goods' model by F. Kotler,
- multi-level goods' model by V. Blagojew,
- multi-attributive goods' model by J.J. Lamben,
- matrix of preliminary assessment of the commercial chances of the new goods by the American consulting group MDA,
- block model: 4P, 4P + 1S, 5 P, 5 P + 1S, 6 P, 7 P, 10 P, 12 P, 4A, 4C, 4E, SIVA, 2P +2C +3S,
- evaluation matrix is a new product of the American consulting firm "AS Nielsen ",
- methodology of "New Prod".

All these methods have in common is that they should be used at the stage of selection of innovative ideas, and their product is based on the representation as a combination of commercial characteristics, benefits that satisfy customer needs.

Multilevel model of product Kotler [3] contains three levels:

- planned product,
- product in realization,
- product with support.

At the first level it is very important for the enterprise to find out the hidden consumer needs and form the main benefit of using the product.

The second level defines the main commercial product characteristics, such as: quality, functional properties, exterior design, packaging, and trade mark.

At the third level establishes additional commercial product characteristics such as delivery, installation, guarantees after sales service, credit.

Multilevel product model B. Blagoev [1] is improved version of the multilevel model by F. Kotler. B. Blagoev identifies four levels:

- core of innovative product,
- physical characteristics of innovative product,
- advanced features of innovative product,
- characteristics related to personal features of potential customers.

The innovative product's core is the product's main merit, which is valuable for potential customers.

The physical characteristics of an innovative product B. Blagoev include: brand; quality; function; style; packaging.

Advanced features innovative product is: price; lending; installation; warranty service.

Characteristics that are related to personal characteristics of potential buyers, according to B. Blagoev are: reputation of the manufacturer; prestige; fashion; universally benefit from the use of new products.

Multi-attributive goods' model by J Jean-Jacques Lambe defines a set of product attributes (benefits to consumers), which allow the consumer to provide both nuclear service (basic functional benefit that provides any trademark for a particular product group), and a number of secondary benefits. Secondary benefits may be necessary (relating to nuclear service – efficiency, comfort, etc.) and reinforcing (unrelated to nuclear service – packing, terms of delivery, payment method, after-sales service, etc.).

When buying the goods consumer assesses all important attributes. Price is an important attribute, but not always decisive. Overall the product is based on the degree values of each, as well as consumer perceptions of the presence or absence of certain important attributes for a particular trademark.

Matrix preliminary assessment of new product commercial chances American consulting group MDA, which refers in his book Jean-Jacques Lambe [5], identifies the key factors of market prospects innovation its attractiveness and competitiveness. Each of these factors combines several components and their level is determined by the estimated scale: very high, high, low, very low.

The attractiveness of the product includes the following criteria: the needs of consumers; term life cycle of new products; direction of the market; physical and money market potentials; velocity of propagation of innovation in the market; availability of innovation in the market; need for advertising actions; related to innovative product sellers.

Competitiveness of the goods includes the following elements: the quality of goods in general and compared to similar competitive products; period of exclusivity novelties; attractiveness of the goods; price; compliance novelties direction of industrial and economic activity; professionalism of sales staff; level of competition; compatibility sellers and buyers [28].

Block model allow assessing the commercial prospects of innovation through the prism of marketing tools. The best-known types of block models today are: 4P, 4P + 1S, 5P, 5P + 1S, 6P, 7P, 10P, 12 P, 4A, 4C, 4E, SIVA.

The traditional model is 4P, which was proposed in 1960 by the American scientist G. Mac Carti [16]. This model includes product, price, place and promotion.

OBJECTIVES

The theoretical foundations and applied problems of evaluating the commercial prospects of an innovative product formulation lead to the following objectives:

- substantiate the need for evaluating the commercial prospects for innovative products;

- consider the most common methods of evaluating the commercial prospects for innovative products;
- improve the process of evaluation of commercial prospects of innovation.

THE MAIN RESULTS OF THE RESEARCH

The main objective of the company is to create a product which meets the requirements of customers. This item has been revealed through the following criteria: the trade mark; quality; range; design; packaging; warranty service.

Price is an important marketing tool because it affects the profitability of the enterprise and consumer willingness to purchase innovative products. The main components are wholesale and retail price, payment terms, discounts, markups, loans etc.

Place aimed at ensuring the delivery of innovations from the producer to the consumer in a specific place and period of specified. These include channels of distribution, logistics, and warehouse stock.

Promotion aims to stimulate demand for innovative products and includes all types of marketing communications.

All other models P and P + 1S are 4P model varieties of that are complemented by a certain number of items. Thus, the model 4P + 1S – this improved model 4R, which is supplemented by such element as service.

The model 5P has three variants. The first variant includes product; price; place; promotion; package. The second option is to use criteria such as product; price; place; promotion; publicity. The third variant of the model 5P consists of product; price; place; promotion; staff. Model 5p + 1S includes the following criteria: product; price; place, promotion; staff; service.

Model 6P was created by Kotler [4] in 1986 and developed 4P model by new elements: public opinion formation (formation of public opinion) and political power (political influence).

In 1981 B.Bums and Dzh. Bytner [11] proposed 7 P model that improves the 4P by adding the following criteria: people; buying process; physical attribute.

The criteria "people" includes main personnel, staff, of other organizations and individuals (experts of the market), consumers and those that affect them.

The criteria "process" includes level of standardization and quality innovations; level modifications innovative product; availability of after-sale service.

The criteria "physical attribute" includes tangible and intangible assets, the environment of enterprise and different presents and gifts (badges, certificates, medals, etc.) and certificate (quality mark) of an enterprise.

Model 10P consists of the following elements: product; price; place, promotion; people; personnel; packaging; purchase; probe, public relations.

Model 12P includes the following criteria: product; price; place; promotion; people; personnel; packaging; purchase; public relations; process; physical premises and profit.

Analysis of the constituent elements of the model "P" suggests that the most grounded model is Jerome McCarthy 4P model. Because it is include all the elements which used in models 5P, 6P, 7P, 10P, 12P, while some other elements could not be marketing tools are not included in it. Particular, "packaging" and "approbation" are parts of the criterion "product". "Public relations", "physical premises" and "profit" are included in the "promotion" criterion. "Personnel" is included in all four most important criteria (product, price, place, promotion). "Purchase", "process", "people", "consumers" are the elements of the environment and the enterprise has no direct influence on them, it can affect them only indirectly with the help of marketing tools.

The conducted analysis models "P" revealed that all of them are supply-oriented. Since the main objective of which is in the creation of innovation is to develop a product that meets the expectations and needs of consumers, scientists and economists have proposed models that aim to acquirer, 4A, 4C.

Model 4A offered Yahdysh Shet [14] in order to upgrade the model "4R". The component models "4A" are: acceptability – the admissibility of the goods to the consumer; affordability – the opportunity to purchase; availability – goods presence on the market; awareness – information about product.

Bob Loteborn [15] proposed a model of "4C" in 1990. He created it because the model "4R" does not correspond of new economic conditions. The main elements of the model "4C" are: customer needs and desires; cost to the customer; convenience; communication.

In 2005 Chekitan S. Dev and Don E. Schultz [12] proposed a model "SIVA", the components of which are: solution, information, value and access. This model is an alternative model to the "4P" and reflects consumer perception of such elements as products (SIVA – this solution); price (in SIVA – this value); place (in SIVA – this information); promotion (in SIVA – access it).

Our research showed that models 4A, 4C, SIVA are more theoretical than practical. Whereas when assessing commercial prospects of innovative products is difficult to predict reaction of consumers to novelty and the more effectively manage them.

According to T. Mahrova [7] developing innovation expedient with consider moral aspects. Therefore, it was proposed humanistic model of "4E", which is in addition to the traditional model of "4P" and includes the following elements: marketing ethics, esthetics, consumer emotions and eternity.

Certainly the elements determined by Terry T. [2] should use when enterprise creating and promoting innovation product. However, this model cannot be used separately.

Estimative matrix of a new product created the American consulting firm "A.S. Nielsen" for corporation Dun and Brandstreet based on the following studies:

- innovation market, its present and possible conditions;
- the level of competitiveness of innovation in the market;
- probable volume of sales innovation in the market;
- opportunities of enterprise to carry out uninterrupted production of innovative products according to the needs of the market.

These directions of analysis are measured at market (the need for innovation, the likely possibility of the market, competitors, fluctuations in market conjuncture), trademarks (technical innovation features, pricing method, unique packaging), sales (connectivity innovations with items that are made the company; distribution channels of innovative products, advertising) and production criteria (production capacity and the need for additional staff, materials, level engineering qualifications and experience of staff).

Each of the criteria given rating: higher than average degree, average degree and degree below average.

"New Prod" methodology was developed by R. Kuper in the 1979 [13]. According to him, factors of the innovations' success on the market are:

- novelties' uniqueness;
- compliance with the requirements of the market;
- export orientation;
- the necessity of extensive preparatory work before the development of innovative products;
- early development of marketing concepts innovative products;
- reasonable planned market entry;
- microclimate in the enterprise;
- availability of the necessary resources.

Analyzing different approaches to the evaluation of the prospects for commercial innovations proved that none of them is comprehensive and versatile. Their use will not allow machine-building enterprises protect themselves from the possibility to choose for implement an innovative idea, embodied in innovative product does not meet the needs of customers, and thus resulting in poor financial condition.

Foreign innovative firms argue that the creation of commercially successful innovations preceding review by at least 60 ideas [8]. Therefore, we propose to carry out the evaluation of commercial prospects of innovative ideas by rating. The use of the rating method will allow the company-innovators to have quantitative assessment of the commercial prospects of novelty goods at the stage of design.

Taking into account the experience of different authors and using our own research in this direction we select 10 major elements and their importance that most closely reflect possible future buyer's attitude to innovation (Table. 1).

We propose to assess the rate of the commercial effectiveness of the innovation by using this formula:

$$R_{i,j} = \frac{\sum_{n=1}^{l} C_{i,n}}{\sum_{n=1}^{l} C_n^{\max}} \cdot v_n, \qquad (1)$$

where: l – number of elements, which characterize commercial perspectives of the innovation; $C_{i,n}$ – sense of n-element for i-innovation, $C_n^{\max}$ - is max n-element between all estimated innovations; v_n – weight of n-element.

$$\sum_{n=1}^{l} v_n = 1. \qquad (2)$$

The higher Rij illustrate the better commercial perspectives of the innovations.

CONCLUSIONS

The results of analysing a number of approaches to the evaluation of commercial prospects innovation shoved their limitations and argued that they cannot be used separately. Therefore, we proposed a rating method of evaluation innovation commercial prospects which will enable the company to rank innovative ideas by the level of commercial appeal. The proposed method is based on the ranking of innovation on ten key criteria, validity of which was determined by experts. The list ranking evaluation criteria commercial prospects of innovation can be extend in each individual case according to the specificity of any given innovative product.

Table 1. Criteria for rating assessment of the commercial perspectives of innovations

№	Criterion	Criterion's validity
1	2	3
1	Level of product uniqueness	0,25
2	Level of satisfaction of the consumers' hidden needs	0,25
3	Value of the market segment	0,08
4	Expected life cycle	0,05
5	Products price	0,07
6	Quality level	0,06
7	Products design	0,08
8	Service	0,08
9	Quantity of necessary marketing revenues	0,04
10	The expected rate of innovation profitability	0,04
TOTAL		1,00

The proposed method for ranking evaluation of commercial prospects of innovative product will allow machine-building enterprises identify the most successful innovative ideas and timely to abandon those ideas whose implementation would be a failure. The success of innovation is extremely important detail to think and to properly implement market entry. This cannot be done without a proper marketing plan. Therefore, the prospects for future research will be to develop a sequence of marketing innovation.

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The detection and estimation of contradictions between logistics and ecologization processes for the ecologistic strategy implementation at the enterprise

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Abstract. The article considers the importance and aims of implementation of ecologistic strategy at an enterprise. The author analyzes the factors of harmful effect of logistic processes at an enterprise on industrial and natural environment. The place of logistics and ecologization processes at an enterprise and their interconnection were efficiently estimated. The figure of Green Supply Chain Model (GrSCM) at an enterprise was constructed. The contradictions between logistics and ecologization processes were revealed, which allows esteeming the real perspectives and obstacles in ecologistical strategy implementation.

Key words. Ecologistics of an enterprise, ecologization processes, green supply chain model (GrSCM), ecologistic strategy, sustainable development.

INTRODUCTION

Contemporary developments in the sphere of logistics are accompanied by a gradual industrial processes as well as social production ecologization. One of the main ecologizational aims should be oriented towards the reduction of eco-destructive effect that industrial and logistic processes cause as well as intensive goods and services consumption [1].

The enterprise's urgent issue is the lack of well-laid strategy, which would allow not only to ecologizate industrial and logistic processes but to receive the useful economical effect for an enterprise. However, it is not always when the efficient logistics correlate with real processes aimed on environmental protection in behalf of an enterprise. The contradictions occur which are to be revealed and evaluated by managers of logistics on the middle and upper levels of management. It is only the timely evaluation and efficient contradictions study that can help to create the ecologistic strategy which would ensure the high rates of profitability of an enterprise and remain ecologically optimal form the viewpoint of social values.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICFTIONS

The issue of economy ecologization to achieve sustainable development was studied by such Ukrainian scholars as [1, 18, 20]. [2] compared the enterprise's strategy with logistics strategy. [8] researched the development of the green business and the potentials of its application in Ukraine.

Such foreign scholars as [5, 6, 7] researched the influence of logistic processes of an enterprise on the environment. The scientific researches related to logistic supply chains functioning were elaborated by [3, 4, 9, 10] were engaged in reveling and estimation of the contradictions between logistics and ecology.

The development of ecologistic strategy remains the criterion of quality and the competitive advantage of enterprises on a way to sustainable development. Therefore, the objective necessity of scientific researches in this field emerges.

Logistic strategies are frequently compared with competitive strategies and are treated as those directly

influencing the development of competitive strategies. The enterprises strategies and logistics strategies are actually correlated as a whole and a half. This displays the fact that in certain periods and in certain circumstances logistic strategy gains the characteristics of determinative corporate strategy. We can also observe tendencies to increase the importance of logistics in the integrated strategy of an enterprise [2, p. 205-213].

On the current stage of logistic strategies development the important issue is logistic processes optimization and ecologization. No doubt that ecologization is the main competitive advantage of logistic practice and must stay in consistency with it. The aim of ecologistic strategy implementation is to get the integrated ecological and economic effect, displayed in such enterprise activity indicators:

- the increasing of production resources usage efficiency,
- the reduction of non-renewable or partially renewable natural resources usage and their economical and efficient usage [3, 4],
- the decreasing of amount of harmful emissions, refuses and waste accumulation,
- turning back the remains, packing, collection and restoring the recourses back into the distribution channel, materials recycling for further usage,
- the reduction of deficiency and resources losses while being stored and transported [5],
- the additional economic and ecological effect from competent encouraging system for energy and recourses saving technologies and innovative projects implementation (energetically efficient storages and buildings arrangement, alternative energy sources usage),
- the increasing of general and ecological quality of produced goods and provided services, which increase its competitiveness,

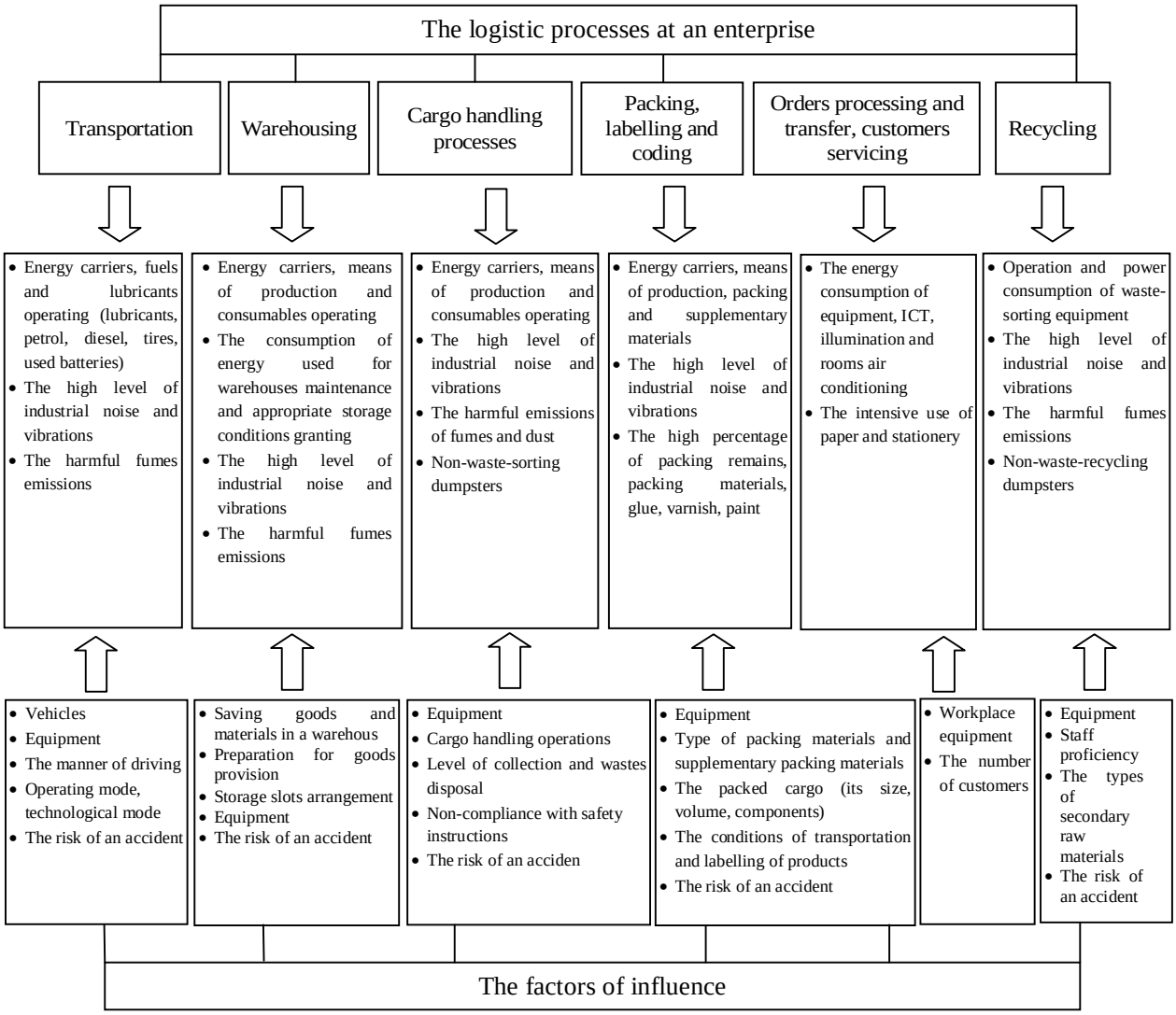

Fig. 1. The factors of logistic processes negative influence on productive and natural environment*
** Developed on the basis [6]*

- the formation of corporative eco-culture among the staff, motivation principles improvement, that widens the economic actions space of corporative and social standarts in logistics and production sphere; the enterprise's capitalization growth due to the advantages over competitors, its image improvement,
- the increasing positive influence of eco-oriented enterprises on the market capitalization of industry,
- the decreasing of investing risks due to the creditor's, investor's and state's promotion and interest,
- the additional taxing effect due to the privileges for eco-projects,
- the increasing of partnership capital developing rates due to the enterprise clients' loyalty,
- the decreasing of external transactions expenses due to the simplified work with authorities and the relief of the informational and administrative resources access.

The aforementioned results prove the urgency of ecologistic strategy implementation in an enterprise. Therefore, the creation of the strategy in practice requires the diligent study of factors of logistics processes on the environment. The analysis of the main factors of logistics processes of negative industrial and natural environmental effects are schematically shown on the pic. 1.

In the specialized literature it is stated that logistic managers are the most sufficient specialist to solve the problems of logistic processes influence on the industrial and natural environment, especially when it is about intensive traffic and resources protection due to the power, water and wood saving, alternative energy sources orientation, effective land plots usage and recycling [7].

However, it is not about the staff to solve these problems. In Noymann's opinion in sake of doing the "green" business successfully in Ukraine it must be supported by the government's encouragement and not conversely when the state is maintaining ecologically harmful industries (metallurgy and coal mining) [8]. The government regulation is a fair attempt of reimbursement for ecological burden including the environmental pollution fee and transport infrastructure usage fee. However, the local business frequently avoid the reimbursement fee that leads to the negative external effects for which the enterprise being not financially responsible [9, 10, 11].

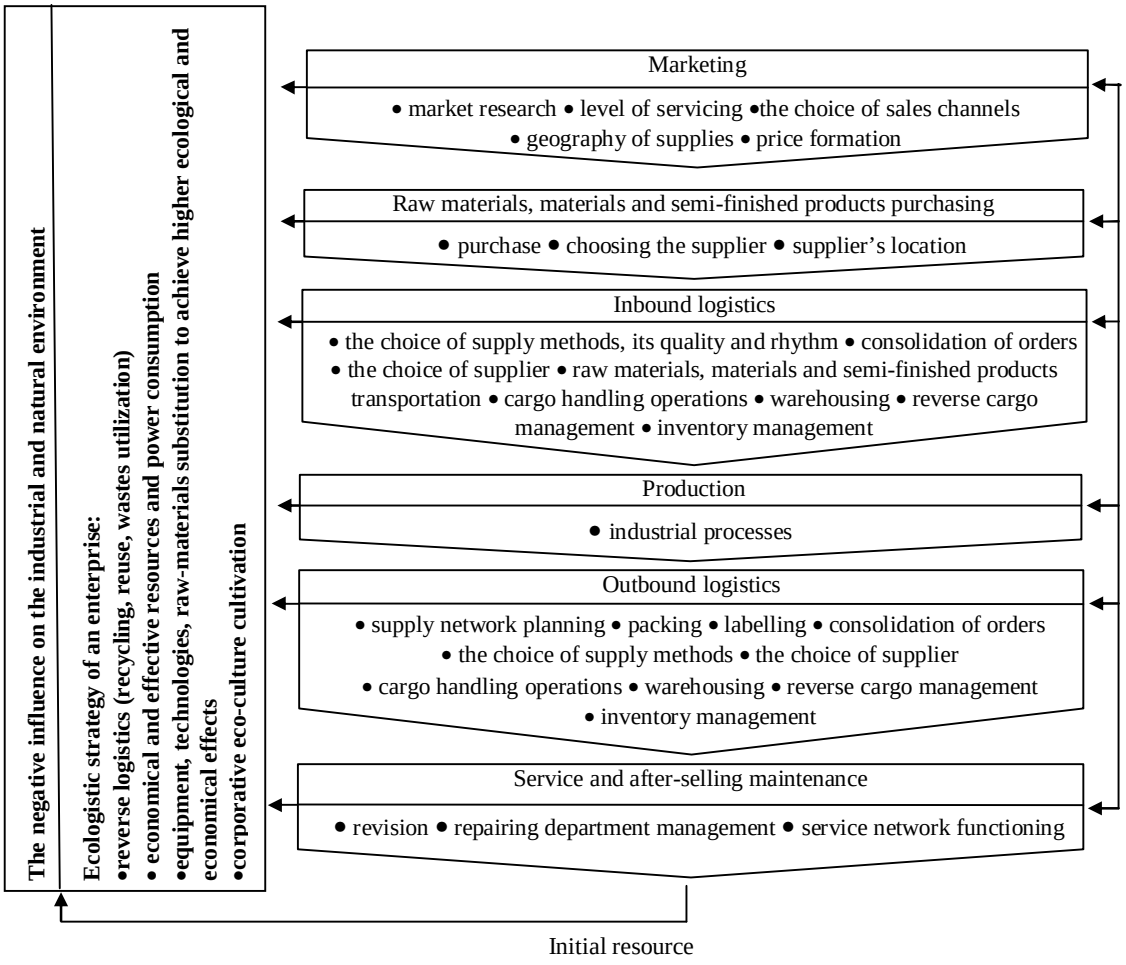

Fig. 2. Green supply chain model (GrSCM) at an enterprise*
** Elaborated on the basis [3]*

OBJECTIVES

The aim of this article is to analyse importance and aims of implementation of ecologistic strategy at an enterprise, particularly analyzes the factors of harmful effect of logistic processes at an enterprise on industrial and natural environment.

THE MAIN RESULTS OF THE RESEARCH

The negative influence on the industrial and natural environment frequently results from an amount of logistic decisions in supply chains. Apart from the economic interests of an enterprise in the system of supply chains model management while planning and making decisions is important to take some ecological issues into account. This is achievable by projecting the ecological aims, starting with pricing chains, along the whole process of production and on its different steps [5].

The picture 2 depicts the negative environmental influence during the logistic supply chain functioning, therefore it's important for each of the chain's phase match the appropriate enterprise's ecologistic strategy aims.

At the first place the logistic systems and chains are to be considered from the viewpoint of costs cutting. However, the environmental saving measures spending run higher, which contradicts the desire to retrench the general enterprise's expenses. Therefore it is important in logistic systems and chains management to take such decisions which would be based on the ecological expenses of an enterprise as a part of general logistic expenses.

But at first, it is important to detect and appraise the contradictions between logistic and ecologistic component. The contradictions' review is presented in the table.

It is possible to outline a number of opened questions concerning the enterprise's logistic and ecologistic processes troubleshooting as well as the interest of state institutions and enterprises in solving them. In conditions of overall globalization and stable developing concept this issue becomes increasingly topical. One of the ways is developing and implementation of the coherent ecologistic strategy at an enterprise when the social criterion of commodity producer's worth is ecological cleanness of production and goods distribution and also the extension of economic area of eco-standards in action in the relation framework "supplier – producer – consumer" in conditions of deep control of their following from behalf of specialized institutions and public. Such an innovative approach to the strategic development of an enterprise on ecological principles broadens the scientific management of enterprise's value and processes of capitalization in economics [12].

Table 1. The logistic and ecologization processes contradictions at an enterprise*

Notions	Logistic application result	Contradictions
Costs	The attempts of an enterprise to retrench expenses, for instance by packing and waste recycling systems improvements. Extension of advantages for producers, logistic mediators, distributors.	The environmental saving expenses are regulated by external factors (political, social and economic aspects of society's development, governmental resolutions and institutional frameworks). They are usually beyond the enterprise's control.
Time/ flexibility	Integrated supply chains. Just in time technology (precise in time supplies) and DTD (the artificial language of pattern used to define the type of document) offer flexible and effective systems.	The production of wide range, distribution and structures of retail trading require more space, more energy and produce more emissions (CO_2, NO_x and others harmful substances).
Network / reliability	Increasing the general effectiveness of distributive system. Star-shaped system "Hub and spoke" – this logistic structure ensures optimal transport expenses, reliable and opportune cargo supply and passengers transportation.	Due to the high traffic concentration near the distribution centers and along the highways the local environmental pollution emerge, such as air pollution, noise and traffic overload, problems with a certain plot preparation for center location, which approaches the subject of rational land use. Cargo transportation regimes make for pollution level growth which contradicts the population's ecological security.
Warehousing	Decreasing in demand of private warehouses.	The flow of supplies of goods and materials on public roads (increasing of a number of containers in particular) rises annually, provokes the traffic jams, reduction of free space and overloading the pavement.
E-commerce	Conducting the commercial deals via the Internet, allow to increase the business potentials and branch the supply chains.	The increasing of resources and power consumption in the systems of physical goods distribution.
Recycling	The waste processing plants give the chance to recycle the production waste or rubbish. Diminution of the amount of waste, appearing of the new market sectors, costs reduction, enterprise's management system improvement.	The environmental pollution and ecology aggravation around the waste processing plants. Indignation and severe criticism from the locals.
Transport	1. The readiness for goods supply to any point just in time (JIT) leads to the intensification of motor transport use. 2. The tendency to divide cargo to smaller consignments. 3. Proceeding form the theory of transportation expenses decreasing, the transport means's weight should diminish.	1. Although the railway transport is the ecologically cleanest, the tendency is observed that amounts of rail shipping decrease. 2. The problem of increasing factor of transport empty run arises. 3. However, the transport facilities' weight increases because of the demands of safe traffic. This leads to the transport system overloading.

** Developed by the author on the basis [9, 342–344]*

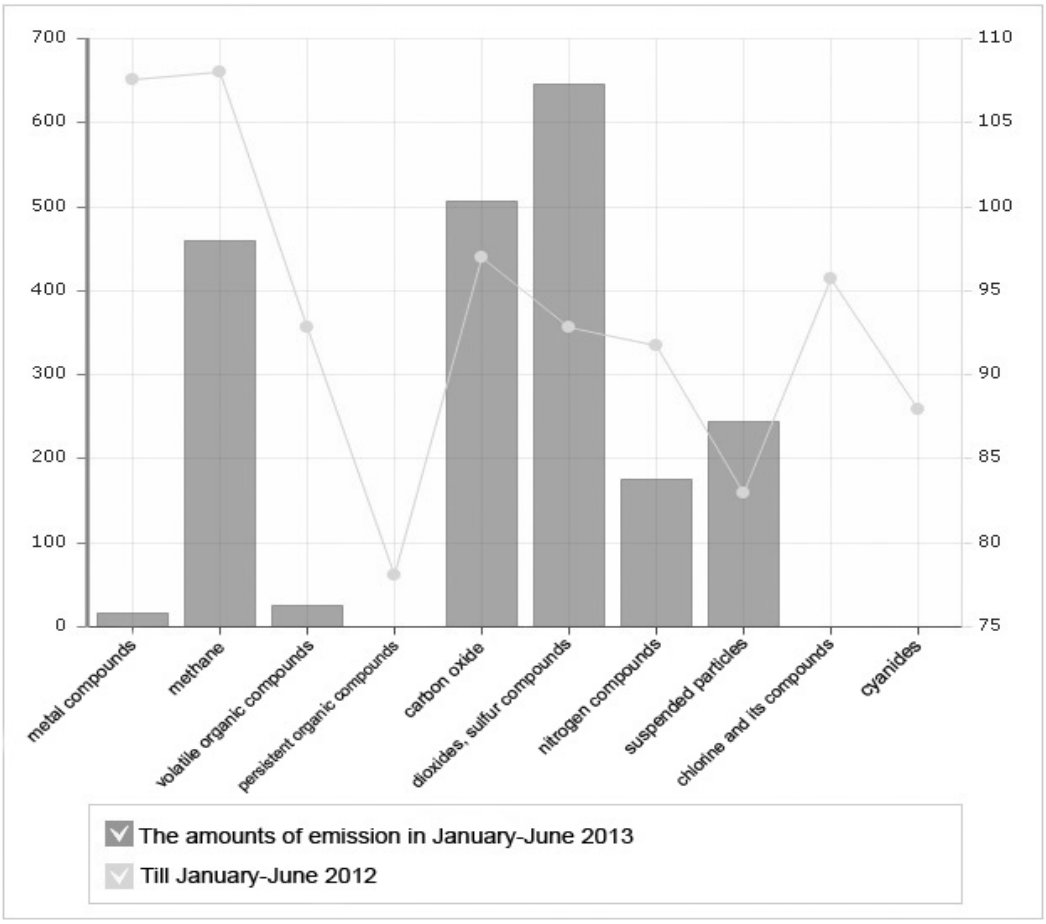

Fig. 3. The pollutant emissions into the atmosphere from stationary sources of pollution [23]

It is worth mentioning that ecologization processes do not have strict organizational limits of business, as when realized the sphere of clean technology implementation or other eco standards on packing or storage are indefinable from different viewpoints – law and politics, marketing, logistics, social, economical etc. The "contribution" of each manufacture depends on the choice of priorities of the state industrial policy. The contribution to waste pilling and recycling; the change of amounts and intensity of transport flows, including transit; speeding up the shift of industrial enterprises and motor cars owners to biofuel; restructuring of the technical service stations etc. The pollutant emissions into the atmosphere from stationary sources of pollution are shown at the pic. 3 [23].

The industrial regions emit about 90% of all the industrial wastes though real perspectives of stable development principles implementation and slowdown of environment exploitation will much depend on clearness of technological and logistical processes. Correspondingly, the question of urgent importance at this point is renovation of technical and technological basis of industrial enterprises in order to decrease the amounts of particularly dangerous pollutants emission, especially carbon dioxide.

Without the improvement of the state regulation mechanism of industrial manufacture in Ukraine in ecological direction it is impossible to overcome the contradictions of logistical and ecological processes at an enterprise. In order to implement the declared Law of

Ukraine on Nationwide Program of National Ecological Network Formation in 2000-2015 not only the intellectual, financial and investment resources are needed in each level of enterprise or industry management but also competent technologies of ecologistic management. Therefore, a need of competence development of enterprise workers and managers in state authorities increase a need of critical reinterpretation of logistic functioning assessment criteria that naturally results from the principles of stable economical and social development.

CONCLUSIONS

In the specialized literature it is practically impossible to find the common definitions of ecologistic strategy of an enterprise and green supply chains model management. It is not easy to combine logistics and ecology in practice of Ukrainian business which is in the conditions of deep political and socio-economic crisis

and driving out. However, considering the substantial shift from CIS markets towards the EU's ones in accordance with strategic aims of euro-integration, the logistics becomes an enterprise's key component and ecological – the innovative one. And yet, it is not always so when the vivid development of logistics coincide with decreasing in negative environmental effects, which demands the monitoring the ecological environment and ensuring free access to its results for any interested parties including investors and public.

The ecologistic strategy expects development of the new price formation models due to the changes in correlation between external and internal enterprise's costs. The part of so-called conditionally-stable expenses would grow in product cost (in case of eco-cleaning facilities use and eco-standards implementation). The structure of marginal income would also change, determining the level of operational and marketing leverages. This means that the principles of marketing and ecologistics interaction would be intensified to achieve the particular social, economic and ecological effects which become an important tendency of special scientific and applied studies.

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Development trends of the international derivatives market

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Abstract. The factors forming international derivatives market trends are researched in this article. The history of the formation of the global derivatives market was analyzed, in particular, events which have led to the growth of the derivatives market. Global derivatives market has revealed major changes in its trends and witnessed the gradual transformation of its structure, observed in recent years. Global derivatives market has revealed major changes in its trends and witnessed the gradual transformation of its structure, observed in recent years.

Derivative risks were considered. Benefits of derivatives make them indispensable to the global financial system and the economy The essence, purpose and benefits of the use of derivatives and their role in the modern global financial markets analyzed. The classification of derivatives considered. The main uses for derivatives were single out. The dynamics of global exchange and OTC derivatives markets were analyze. Volatility of the economic environment was significantly improved, leading to a significant increase in financial risks and caused both the professional market and to institutional investors in dire need of new types of derivatives that would enable to effectively hedge to reduce losses in the event of unfavorable changes market and receive additional income from speculative transactions in the market. Possibility of exchange trading for OTC derivatives was emphasized. Courtesy comparative description of the scope and structure of the exchange and OTC derivatives markets were provided. The dynamics of world markets, interest rate derivatives and currency derivatives and studied their structure. The main trends and prospects of the modern international derivatives market are determined.

Key words: derivatives, interest rate derivatives, foreign exchange derivatives, commodity derivatives, equity derivatives, credit derivatives, futures, options.

INTRODUCTION

The international derivatives market is very dynamic and has quickly developed into the most important segment of the financial market. Competing for business, both derivatives exchanges and OTC providers, which by far account for the largest part of the market, have fuelled growth by constant product and technology innovation. The competitive landscape has been especially dynamic in Europe, which has seen numerous market entries in the last decades. For instance strong European players have emerged that today account for around 44 percent of the global market in terms of notional amount outstanding [4]. In terms of globalize world financial markets, volatility of global financial system and increased competition the necessity to analyze market trends derivatives increases.

The derivatives market has recently attracted more attention against the backdrop of the financial crisis, fraud cases and the near failure of some market participants. Although the financial crisis has primarily been caused by structured credit-linked securities that are not derivatives, policy makers and regulators have started to think about strengthening regulation due to increase transparency and safety both for derivatives and other financial instruments.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

According to [1, 3] global derivatives market has revealed major changes in its trends and witnessed the

gradual transformation of its structure, observed in recent years. During the last quarter of the twentieth century the volatility of the economic environment was significantly improved, leading to a significant increase in financial risks and caused both the professional market and to institutional investors in dire need of new types of derivatives that would enable to effectively hedge to reduce losses in the event of unfavorable changes market and receive additional income from speculative transactions in the market. Derivatives international market - futures, options, forwards, swaps - by name and content coincide with instruments that are traded on national markets, but their production and circulation regulated agreements, regulations and agreements that exist in the international market. The volume of OTC transactions on international derivatives market greatly exceeded the amounts of stock, but in recent decades the share of the OTC market increased from 60 % to 90 %. Market volume is increased in absolute terms during that time 133 times. The volume of stock market rose about 30 times, OTC - 200 in the world's largest derivatives market is North American (54 %), followed by a fairly close in terms of European (38.71 %). After the global financial crisis in 2008 the stock market there is a significant drop in trade, further stabilization and gradual increase to 70 % of pre-crisis turnover in 2013 At the same time, the global OTC derivatives market is almost not responded to the crisis in 2008.

On the stock market open interest positions in instruments at par value in 2013 amounted to 94 %, over the counter - 81 %. This is important as a hedge of interest rate risk, and significant amounts of loans and investments that need to insure against the risk of financial intermediaries, corporations and institutional investors. As the number of contracts trading on the stock market is dominated by instruments linked to shares that make up more than 50 % of all exchange derivatives. While the interest rate derivatives market in US dollar and Euro play almost the same role at the market exchange - the first place in terms of contracts consistently ranks the US dollar, the second and third place respectively occupy the euro and the Japanese yen. The volume of transactions in the OTC credit derivatives are in third position after interest and foreign exchange, and commodity derivatives account for only 1 %. Study in [2] can conclude that the trends that are taking place both at global and national derivatives markets indicate the objective necessity of activation of the domestic market. After increasing the current level of uncertainty in which there are domestic entities, including banks, causing the need to create effective mechanisms to hedge economic risks.

Derivatives are invented in response to some fundamental changes in the global financial system. They, if properly handled, should help improve the resilience of the system and bring economic benefits to the users. In this context, they are expected to grow further with financial globalization. However, past credit events exposed many weaknesses in the organization of derivatives trading. The aim is to minimize the risks associated with such trades while enjoying the benefits they bring to the financial system. An important challenge is to design new rules and regulations to mitigate the risks and to promote transparency by improving the quality and quantity of statistics on derivatives markets [14, p. 3].

The analysis of recent researches and publications of the global derivatives market allows to distinguish the following trends observed in this segment of global finance, such as:

1. Despite the decline in transactions with derivatives, derivatives market is an essential component of the global financial system;

2. Banks continue to significantly influence the development of the derivatives market;

3. Increase in interest and currency derivatives combined with a reduction in the volume of transactions on credit derivatives, indicates the derivatives market recovery to its primary function - hedge financial and commercial risks.

OBJECTIVES

In recent years financial environment characterized of dynamism and volatility in global financial markets is not known precisely. This paper aimed to examine features of the derivatives market, his types and identify main trends of exchange-traded international derivatives market and OTC international derivatives market. This article also identifies key factors that describe main trends on derivative markets and outline ways for supporting market resiliency.

THE MAIN RESULTS OF THE RESEARCH

Derivatives are defined as instruments whose value depends on some underlying financial asset, commodity or predefined variable [8, 339]. Originally derivatives were used to hedge risk on agricultural commodities. Since the 1970’s there has been a surge in the growth of derivative markets. There are a number of events which have led to the growth of the derivatives market as stated by Michael Chiu [14].

One such event is the collapse of the Bretton Woods System in 1971. This led to the creation of a market for derivatives for currency exchange rates. The other was the adoption of a target for growth of money supply by the US Federal Reserve in 1979. This created a demand for interest rate derivatives. The many financial crises in the emerging markets in the 1990’s and the associated corporate bankruptcies resulted in a

growth of the derivatives market to serve as a hedge against credit risk. The developments in the Theory of Finance and advances in Computer Technology in the 1990's and the resulting innovation of new products was another reason that spurred the popularity and growth of the derivatives market.

Derivatives are an important class of financial instruments that are central to today's financial and trade markets. They offer various types of risk protection and allow innovative investment strategies. Around 25 years ago, the derivatives market was small and domestic. Since then it has grown impressively – around 24 percent per year in the last decade – into a sizeable and truly global market with about €457 trillion of notional amount outstanding. No other class of financial instruments has experienced as much innovation. Product and technology innovation together with competition have fuelled the impressive growth that has created many new jobs both at exchanges and intermediaries as well as at related service providers. The derivatives market is predominantly a professional wholesale market with banks, investment firms, insurance companies and corporation as its main participants [4].

Unless derivatives contracts are collateralized or guaranteed, the ultimate value of a derivative depends on the credit worthiness of the counterparties. The counterparty risk can also be reduced by better collateralization of credit exposures though bi lateral credit support agreements [16]. Another problem about derivatives is that they can exacerbate trouble that a company has run into for completely unrelated reasons [15].

Derivatives make future risks tradable, which gives rise to two main uses for them. The first is to eliminate uncertainty by exchanging market risks, commonly known as hedging. Corporation and financial institutions, for example, use derivatives to protect themselves against changes in raw material prices, exchange rates, interest rates etc., as shown in the box below. They serve as insurance against unwanted price movements and reduce the volatility of companies' cash flows, which in turn results in more reliable forecasting, lower capital requirements, and higher capital productivity. These benefits have led to the widespread use of derivatives: 92 percent of the world's 500 largest companies manage their price risks using derivatives [4]. The second use of derivatives is as an investment. Derivatives are an alternative to investing directly in assets without buying and holding the asset itself. They also allow investments into underlying and risks that cannot be purchased directly. Examples include credit derivatives that provide compensation payments if a creditor defaults on its bonds, or weather derivatives offering compensation if temperatures at a specified location exceed or fall below a predefined reference temperature.

Benefits of derivatives make them indispensable to the global financial system and the economy:

– derivatives provide risk protection with minimal upfront investment and capital consumption,

– allow investors to trade on future price expectations,

– have very low total transaction costs compared to investing directly in the underlying asset,

– allow fast product innovation because new contracts can be introduced rapidly,

– can be tailored to the specific needs of any user. [12].

There are two competing segments in the derivatives market: the off-exchange or over-the-counter (OTC) segment and the on-exchange segment. Only around 16 percent of the notional amount outstanding is traded on exchanges. From a customer perspective, on-exchange trading is approximately eight times less expensive than OTC trading.

The OTC derivatives market is wider in volume in comparison with the exchange traded derivatives market. It is not possible to have all OTC derivatives traded on an exchange because OTC derivatives are not all standard. They are tailor made to suit requirements of the market. The flexibility of OTC derivatives makes them more suited to meet special requirements and lack a high order flow [14].

The Bank for International Settlements (BIS) publishes information regarding the total outstanding value of over-the-counter (OTC) and exchange-traded derivatives positions on a semi-annual basis. The notional value outstanding for the global exchange-traded derivatives industry, e.g., organized futures exchanges, including futures and option markets, declined to $64.6 trillion in December 2013 from $69.1 trillion in June 2013, representing a 6.5 % decline advance over the six-month period. The exchange-traded derivatives industry remains some 22.1 % below a peak of $82.9 trillion achieved in June 2011 and 32.1 % below the all-time high of $95.1 trillion established in June 2007 (Table 1) [13].

The use of exchanges for trading of OTC derivatives where possible is to be mandated. The US commenced trading of OTC derivatives on Swap Exchange Facilities (SEF's) and Designated Contract Markets moving away from dealer networks from February 2014. SEF's are trading platforms similar to traditional exchanges. The EU is expected to mandate exchange trading for OTC derivatives once the task of central clearing of OTC derivative trades is accomplished. Exchange trading promotes transparency, price discovery and liquidity [15].

Table 1. Derivative financial instruments traded on organized exchanges*

	Interest rate		Currency		Equity index		Total	
Date	In billions of USD	In per cent	In billions of USD	In per cent	In billions of USD	In per cent	In billions of USD	In per cent
II-2009	67062	91,71	293	0,40	5770	7,89	73125	100
I-2010	69557	92,22	349	0,46	5521	7,32	75427	100
II-2010	61948	91,18	316	0,47	5676	8,35	67940	100
I-2011	76041	91,74	390	0,47	6457	7,79	82888	100
II-2011	53299	91,37	312	0,53	4720	8,09	58331	100
I-2012	55581	90,36	328	0,53	5601	9,11	61510	100
II-2012	48546	89,70	336	0,62	5240	9,68	54122	100
I-2013	62178	89,95	344	0,50	6602	9,55	69124	100
II-2013	57007	88,21	384	0,59	7237	11,20	64628	100
I-2014	65620	89,34	375	0,51	7457	10,15	73452	100
II-2014	57222	88,25	377	0,58	7244	11,17	64843	100
I-2015	61823	88,04	388	0,55	8012	11,41	70224	100

** adapted from [11,13, 6]*

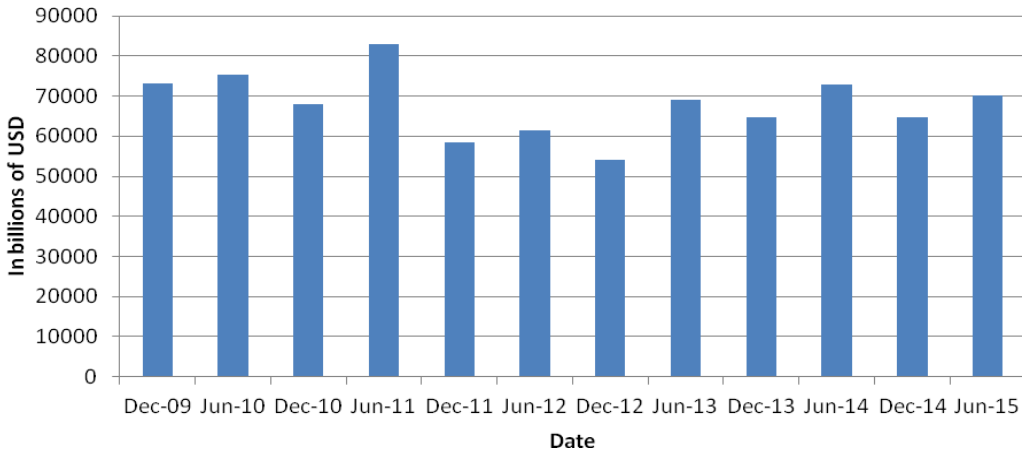

Fig. 1. Trends of the exchange-traded international derivatives markets*
** adapted from [6,11, 13]*

Table 2. Outstanding Notional Value of Global OTC Derivatives Markets[1*]

	Open interest (Notional principal, in trillions of USD													
	Interest rate		FX		Equity		Commodities		CDS		Unallocated		Total	
Date	In trillions of USD	In per cent	In trillions of USD	In per cent	In trillions of USD	In per cent	In trillions of USD	In per cent	In trillions of USD	In per cent	In trillions of USD	In per cent	In trillions of USD	In per cent
II-2007	393,1	67,09	56,2	9,59	8,5	1,45	8,5	1,45	58,2	9,93	61,4	10,48	585,9	100
I-2008	458,3	68,14	63,0	9,37	10,2	1,52	13,2	1,96	57,4	8,53	70,5	10,48	672,6	100
II-2008	432,7	72,33	50,0	8,36	6,5	1,09	4,4	0,74	41,9	7,00	62,7	10,48	598,2	100
I-2009	437,2	73,54	48,7	8,19	6,6	1,11	3,6	0,61	36,1	6,07	62,3	10,48	594,5	100
II-2009	449,9	74,50	49,2	8,15	5,9	0,98	2,9	0,48	32,7	5,41	63,3	10,48	603,9	100
I-2010	451,8	77,52	53,2	9,13	6,3	1,08	2,9	0,50	30,3	5,20	38,3	6,57	582,8	100
II-2010	465,3	77,42	57,8	9,62	5,6	0,93	2,9	0,48	29,9	4,98	39,5	6,57	601	100
I-2011	553,2	78,27	64,7	9,15	6,8	0,96	3,2	0,45	32,4	4,58	46,5	6,58	706,8	100
II-2011	504,1	77,82	63,4	9,79	6,0	0,93	3,1	0,48	28,6	4,41	42,6	6,58	647,8	100
I-2012	496,2	77,37	66,7	10,40	6,3	0,98	3,0	0,47	26,9	4,19	42,2	6,58	641,3	100
II-2012	492,6	77,48	67,4	10,60	6,3	0,99	2,6	0,41	25,1	3,95	41,8	6,57	635,8	100
I-2013	564,7	81,09	73,1	10,50	6,8	0,98	2,5	0,36	24,3	3,49	25,0	3,59	696,4	100
II-2013	584,8	82,29	70,6	9,93	6,6	0,93	2,2	0,31	21,0	2,95	25,5	3,59	710,7	100
I-2014	563,3	81,44	74,8	10,81	7,1	1,03	2,2	0,32	19,5	2,82	24,8	3,59	691,7	100
II-2014	505,5	80,33	75,9	12,06	7,0	1,11	1,9	0,30	16,4	2,61	22,6	3,59	629,3	100
I-2015	434,7	78,64	74,5	13,48	7,5	1,36	1,7	0,31	14,6	2,64	19,8	3,58	552,8	100

[1] *At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.*
** adapted from [5]*

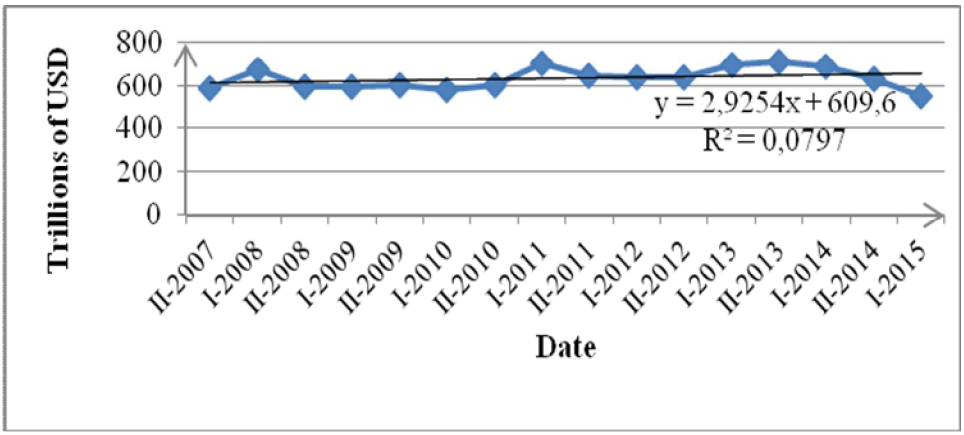

Fig. 2. Trends of the OTC international derivatives market*
* *adapted from [5]*

Activity in global OTC derivatives markets fell in the first half of 2015. The notional amount of outstanding OTC derivatives contracts, which determines contractual payments and is one indicator of positions, fell by 12 % between end-December 2014 and end-June 2015, from $629 trillion to $553 trillion. Over this period, exchange rate movements exaggerated the contraction of positions denominated in currencies other than the US dollar. Yet, even after adjustment for this effect, notional amounts at end-June 2015 were still about 10 % lower than at end-December 2014. (Table 2, Fig. 2) [5,6,19].

The interest rate segment accounts for the majority of OTC derivatives activity. At end-June 2015, the notional amount of outstanding interest rate derivatives contracts totaled $435 trillion, which represented 79 % of the global OTC derivatives market (Table 2). At $320 trillion, swaps account for by far the largest share of this market segment. Notional amounts fell sharply in the first half of 2015, driven by a contraction in euro denominated interest rate contracts [5]. The notional value of euro contracts declined from $167 trillion to $126 trillion between end-December 2014 and end-June 2015 (or, equivalently, from €138 trillion to €113 trillion). Trade compression to eliminate redundant contracts was the major driver of the decline. The overall volume of compressions continued to grow in the first half of 2015, mainly affecting interest rate swaps cleared through central counterparties (CCPs).

The notional value of interest rate contracts in other currencies also declined in the first half of 2015. US dollar contracts decreased from $173 trillion to $160 trillion between end-December 2014 and end-June 2015. Yen, sterling and Swiss franc contracts also decreased, after adjustment for the impact of exchange rate movements on the reported US dollar positions of interest rate derivatives denominated in those currencies.

The overall decline in notional amounts was not accompanied by a significant change in the maturity distribution of interest rate derivatives. As a share of all maturities outstanding, short-term contracts (with maturities of under one year) rose slightly, from 40 % to 42 %, between end-December 2014 and end-June 2015, while the percentage of medium-term contracts (with maturities between one and five years) dropped marginally, from 37 % to 35 %. In the meantime, the share of long-term contracts (with maturities of over five years) was unchanged, at 24 % [5].

The distribution of interest rate derivatives by counterparty points to a continued shift in activity towards financial institutions other than dealers, including CCPs. The notional amount of interest rate contracts between derivatives dealers, which had been falling more or less steadily since reaching a peak of $189 trillion at end-June 2008, declined further during the first half of 2015 – from $70 trillion at end-December 2014 to $61 trillion at end-June 2015 [5]. Contracts between dealers and other financial institutions, including CCPs, stood at $360 trillion at end-June 2015, down from $421 trillion at end-December 2014. One potential l explanation for the large size of the latter decline is that trades were moved to CCPs, which facilitated the compression process. Notwithstanding this absolute decline in notional amounts, contracts with other financial institutions continued to account for the majority (83 %) of interest rate derivatives contracts as of end-June 2015.

Turning to the concentration of derivatives activity among reporting dealers, as of end-June 2015 in many segments the concentration of dealers' positions had fallen to levels close to or below those reported prior to 2008. Herfindahl indices for the yen interest rate swap (IRS) market had fallen back to 2006 levels and for the US dollar and euro markets to 2004 levels. However, in

the sterling and Swiss franc IRS markets, concentration remained well above 2007 levels.

Foreign exchange derivatives (FX) make up the second largest segment of the global OTC derivatives market. At end-June 2015, the notional amount of outstanding foreign exchange derivatives contracts totaled $75 trillion, which represented 13 % of OTC derivatives activity. Contracts against the US dollar represented 86 % of the foreign exchange derivatives market [5].

The latest data show little change in the instrument composition of foreign exchange derivatives. Forwards and foreign exchange swaps jointly accounted for exactly half of the notional amount outstanding. However, currency swaps – which typically have a longer maturity than other foreign exchange derivatives and thus are more sensitive to changes in market prices – accounted for the largest proportion (50 %) of the gross market value.

In contrast to the interest rate derivatives market, in the foreign exchange derivatives market inter-dealer contracts continued to account for nearly as much activity as contracts with other financial institutions. The notional amount of outstanding foreign exchange contracts between reporting dealers totaled $31 trillion at end-June 2015, and contracts with financial counterparties other than dealers $33 trillion. The inter-dealer share has averaged around 43 % since 2011, up from less than 40 % prior to 2011. Among instruments, inter-dealer activity accounts for a greater share of more complex contracts, such as currency swaps (52 %of notional amounts) and options (47 %).

The steady reduction in the size of the global credit derivatives market, which started in 2007, continued in the first half of 2015. The notional amount of outstanding credit derivatives contracts fell from $16 trillion at end-December 2014 to $15 trillion at end-June 2015, which represented only a quarter of its end-2007 peak of $58 trillion (Table 2).

The default swap is a bilateral contract that allows an investor to buy protection against the risk of default of a specified reference credit. Following a defined credit event, the protection buyer receives a payment usually in-tended to compensate him for the loss made on this reference credit. A default swap is an over-the-counter contract. There are, therefore, several important features that need to be agreed between the counterparties and clearly defined in the contract documentation before a trade can be executed [7].

The market value of credit default swaps (CDS) also continued to decline, to $453 billion at end-June 2015 in gross terms and $120 billion in net terms. The net measure takes account of bilateral netting agreements covering CDS contracts but, unlike gross credit exposures, is not adjusted for cross-product netting.

Recent declines in overall CDS activity reflected mainly a contraction in inter-dealer activity. The notional amount for contracts between reporting dealers fell from $7.7 trillion at end-December 2014 to $6.5 trillion at end-June 2015. Notional amounts with banks and securities firms also decreased in the first half of 2015, from $1.3 trillion to $1.2 trillion [5].

Central clearing, a key element in global regulators' agenda for reforming OTC derivatives markets to reduce systemic risks, made further inroads. In line with the overall trend in OTC derivatives markets, notional amounts cleared through CCPs declined in absolute terms between end-December 2014 and end-June 2015, from $4.8 trillion to $4.5 trillion. The share of outstanding contracts cleared through CCPs rose from less than 10 % in 2010 (when data for CCPs were first reported separately) to 26 % at end-2013 and 31 % in the first half of 2015 [19].

The latest data indicate that the trend towards netting may have stalled. Until recently, the post-crisis shift towards central clearing had contributed to an increased use of legally enforceable bilateral netting agreements. As a consequence, net market values as a percentage of gross market values had fallen from 26 % at end-2011 to 21 % at end-2013 (Graph 6, right-hand panel). Nevertheless, this trend has been reversed over the past couple of years, with the above ratio rising back to 26 % by end-June 2015. The prevalence of netting is greatest for CDS contracts with other dealers and CCPs, where it reduced net market values as a percentage of gross values to 20 % and 21 %, respectively, at end-June 2015. Netting is least prevalent for contracts with insurance companies (79 %) and non-financial customers (72 %).

The distribution of underlying reference entities indicates that the relative presence of contracts referencing sovereigns has increased steadily since the global financial crisis. The share of such contracts in the total notional amount of credit derivatives outstanding rose from 4 % at end-2008 to 16 % at mid-2015. In absolute terms, the notional amount of sovereign CDS contracts grew from $1.7 trillion at end-2008 to $3.0 trillion at end-2011. Thereafter, it declined back to $2.3 trillion as of mid-2015. Nevertheless, sovereign CDS contracts' share has continued to increase due to the fact that, as discussed above, the overall notional amount of credit derivatives outstanding has shrunk at an even faster pace.

The distribution of outstanding CDS by location of the counterparty showed little change at end-June 2015. The CDS market continues to be very international. CDS with counterparties from the country in which the

dealer is headquartered accounted for only 24 % of outstanding contracts at end-June 2015, or $3.5 trillion. Most of the foreign counterparties were from Europe, followed by the United States.

The notional amount of OTC derivatives linked to equities totaled $7.5 trillion at end-June 2015, and the gross market value $0.6 trillion. The two largest geographical segments of the market appear to be headed in opposite directions. Derivatives linked to European equities, which had stabilized at around $3 trillion for a few years after the sharp reduction they saw during the 2007–09 crises, are back on a downward trajectory. They recorded a sharp drop in the second half of 2014, which brought their outstanding notional amount down to $2.4 trillion at end-December 2014. That was only partially offset by the latest semiannual increase, which took them to $2.7 trillion at end-June 2015. By contrast, derivatives linked to US equities have grown steadily over the past few years and have doubled, from $1.6 trillion at end-2010 to $3.2 trillion at mid-2015.

For OTC derivatives linked to commodity contracts, the latest data show no sign of a rebound from the sharp correction that occurred after the 2007–09 crises. The notional amount of outstanding OTC commodity derivatives contracts declined from a peak of $13 trillion at end-June 2008 to $3 trillion at end-2009 and less than $2 trillion at mid-2015. The gross market value of OTC commodity contracts stood at $0.2 trillion at end-June 2015, down from the mid-2008 peak of $2.2 trillion.

In contrast to the traditional argument for the systemic benefit of risk sharing, paper [9] argues that the complex design of financial derivatives – characterized by multiple derivations of pooling-based derivatives – increases the potential for a systemic crisis substantially.

The argumentation for this relationship between the complexity of financial derivatives and systemic risk starts with an analysis of the decision behavior under uncertainty. In particular, the difference in the perception of (determinable) risk on the one hand, and ambiguity on the other hand builds the foundation of the following argumentation. The next step points out the relevant contractual mechanisms of financial derivatives and their economic consequences: The pooling of risk sets a strong incentive for the issuer to communicate only a part of the valuation-relevant information to third-parties (information destruction effect). The structuring of risk by the principle of subordination causes the relevance of influencing factors on the overall risk structure of the derivative to shift materially. If, finally, these derivatives are once again pooled and structured, the economic effects of estimation errors on the identified value of the derivative of 2nd degree are systematically enforced. The paper concludes, that there will be simply too little information available from a certain (a priori undetectable) level of derivation on, to provide a reliable risk assessment in the light of the material impact of estimation errors. Thus, the multiple derivation of pooling-based derivatives goes hand in hand with enormous operational risk and model risk.

The truth is that the danger that we face from derivatives is so great that Warren Buffet has called them “financial weapons of mass destruction”. Unfortunately, he is not exaggerating. It would be hard to understate the financial devastation that we could potentially be facing. A number of years back, French President Jacques Chirac referred to derivatives as “financial AIDS”. The reality is that when this bubble pops there won’t be enough money in the entire world to fix it. But ignorance is bliss, and most people simply do not understand these complex financial instruments enough to be worried about them. Unfortunately, just because most of us do not understand the danger does not mean that the danger has been eliminated [17].

OTC derivative contracts pose systemic risk if they continue to be unregulated. Hence the need for regulation. Exchange traded derivatives pose less of a danger because counterparty risk is mitigated. Derivative contracts are of great economic benefit to users to manage risk. This fact is supported by the growth of the derivatives market in recent times [15].

The challenge faced by regulators is to design a regulatory framework which prevents excessive risk taking by players in the derivatives market. In September 2009, at the Pittsburgh G20 Summit many decisions were taken to achieve this objective. These decisions are known as the G20 commitments. Most G20 commitments have been incorporated into the Title V11 of the Dodd Frank Wall Street Reform and Consumer Protection Act in the US and into the European Market Infrastructure Regulations (EMIR) in the EU. The Markets in Financial Instruments Directive (MiFID) in the EU is also being reviewed as regards provisions relating to derivative trading.

Delivers a total strategy for risk control based on following: integrated with the organizations wider systems, strategies and culture; focused on managing the future and not merely auditing the past; designed to move risk management from a dead weight cost to a driver of value [10].

So many risks inherent derivatives market and exists problem of lack information about how to distinguish them. After a very dull spring and early summer when the Chicago Board Options Exchange Volatility Index (VIX), often referred to as the Market’s

Fear Gauge, stayed below 16 % except for a handful of days, we saw a spike to over 40 % for a day in late August. Since then, however, it has been falling steadily, receding to 14 %–16 % as of early November. The market plainly seems not too fearful these days [18].

Objectively, considering the size and variety of uncertainties that we currently face, we should probably be terrified. Once again, this situation illustrates the difference between volatility as it is estimated from returns data and volatility that leads to a major change in the level of stock prices over the relatively short lifetime of an option. If an asset's price follows a logarithmic random walk with constant instantaneous volatility, the two manifestations of "volatility" amount to the same thing: Over a period of any length T, the standard deviation of the return is volatility per period multiplied by the square root of T. But even with constant volatility along a random walk path, the realized final asset price and option payoff can end up anywhere within a broad range. Thus, it is not inconsistent to expect low volatility over the immediate short run, because new information becomes available slowly, while anticipating that the total price change over a longer holding period may be very large. This distinction plays out in terms of a potentially vast difference between how an investor might think of volatility over an option's life in terms of the effect on its payoff at maturity, versus how day-to-day volatility affects the hedging cost for a market maker who takes the opposite side of the investor's trade. The investor wants a big price move and does not care which path the stock takes to get there, whereas the market maker wants smooth price paths without large changes of direction that would whipsaw his or her hedge. It does not matter much to the market maker where the stock price ultimately goes. Sharp price jumps are fine for the investor (in the right direction), but they are terrible (in either direction) for the market maker's delta hedge.

OTC derivatives can move dynamically within volatile markets, creating the potential for pre-defined risk limits to be breached following sizeable market movements. To address this, active management of counterparty risk may be necessary by:

1. Re-couponing/resetting the mark-to-market of the derivative.

2. Unwinding positions based on certain market movements.

3. Transfer of positions from over-threshold names to third parties ('novation') where risk limits are being under-utilized.

4. Hedging the exposure using credit derivatives with a third party.

5. Incorporating a credit support annex (CSA) with daily settlements, thresholds, minimum transfer amounts, independent amounts Given the bilateral nature of derivatives contracts in many of the cases above, consent from the over-threshold counterparty may be required to effect these actions [21].

The top vendors in derivatives market are focused on the supervision of the financial systems and identifying cross-border systemic risks so that there can be transparency in the system to bring in potential investors to invest in the market over the forecast period. Technavios market research analysts predict a market growth rate of over 14 % over the next four years. Innovative products like volatility index derivatives are gaining a lot of importance in the Europe and the US. The markets like equity, commodity, and currency would be bullish during the forecast period due to an increase in the number of trade volumes. Due to long-term interest rate options and single stock derivatives the revenue generation is expected to be more in the currency and commodity derivatives market during the forecast period.

The foreign exchange turnover was around USD 6 trillion at the end of 2014 which is an all-time high. Many investors have tried to diversify their portfolio into riskier assets like international equities and local currency emerging market bonds. Therefore, as investors are more focused on rebalancing their portfolios more frequently, it has led to the increasing need to trade in foreign exchange in large quantities. This trend is likely to boom the global derivatives market through 2019 [20].

CONCLUSIONS

Activity in global OTC derivatives markets fell in the first half of 2015. The notional amount of outstanding contracts declined from $629 trillion at end-December 2014 to $553 trillion at end-June 2015. Even after adjustment for the effect of exchange rate movements on positions denominated in currencies other than the US dollar, notional amounts were still down by about 10 %. Trade compression to eliminate redundant contracts was the major driver of the decline.

The gross market value of outstanding derivatives contracts - which provides a more meaningful measure of amounts at risk than notional amounts - declined even more sharply in the first half of 2015. Market values decreased from $20.9 trillion to $15.5 trillion between end-December 2014 and end-June 2015. The fall is likely to have been driven by the reduction in notional amounts outstanding as well as increases in long-term interest rates, which took yields back closer to those on outstanding swaps.

Central clearing, a key element in global regulators' agenda for reforming OTC derivatives markets to reduce systemic risks, made further inroads. In credit default swap markets, the share of outstanding contracts cleared through central counterparties rose from 29 % to 31 %

in the first half of 2015. In interest rate derivatives markets too, central clearing is becoming increasingly important.

At present development trends of the market derivatives are determined by the following key factors:

– increased globalization and interconnection of national and regional markets, as a result of which changes in one of the centres of world trade directly affect the general state of the derivatives international market,

– increase in the volatility level of financial markets that increase global instability of the derivatives world market,

– technology standardization of currency transactions performing in the context of globalization of economic processes and the increase in the carried out transactions,

– transparency of the market, that is connected with the virtually unlimited access to information on the formation of derivatives markets conjuncture,

– liberalization of market participants derivatives,

– increase of the risks level at the derivatives market.

The above mentioned trends reflect the increased sensitivity of derivatives market transactions to environmental changes and enhance the predictability of its member's activities. Too liberal terms of the derivatives market can be a factor of macroeconomic and financial currency instability in the conditions of the low level of development of market institutions in transitional economies.

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Modernization of the manufacturing system of national enterprises by implementing modern information technologies

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Abstract. This article concerns the issue of modernization of the manufacturing system of national enterprises by implementing modern information technologies. The analysis of the need for the industrial transformation of Ukraine at the macro level has been conducted. The role of modernization of the manufacturing structure of the enterprise is determined. Changes in technology have significant influence on the transformation of enterprise management system. The role of modern information systems in management of technological processes is analyzed.

Effective Enterprise Management System (EMS) shall harmoniously combine diverse targeted components into the new competitive socioeconomic system. Changes in areas of EMS improvement during the process of formation of information infrastructure are shown in this research.

MES system is a key element of the overall enterprise information structure; it is able to meet the challenges of the manufacturing sphere.

The existing barriers to the development of production systems for national enterprises are also analyzed and summarized.

Key words: Enterprise Management System, MES-system, manufacturing process, modernization, information technology.

INTRODUCTION

Since 1990 a deep transformation has occurred in the Ukrainian economy. In particular, machine-building complex had experienced long crisis accompanied by significant losses in production and human resources, more than two-fold decrease in the share of engineering products in industrial production of Ukraine, lack of innovation and investment. At the same time, the machine-building complex in general has managed to preserve its potential, and has found the way to adapt to the new market conditions and to the development of new industrial markets.

Every society is constantly accumulating technological capabilities and potential. Scientific and technological progress has become a determining factor in the transformation of management of manufacturing processes. Economic globalization has become possible due to the technological revolution based on the development of the inventions of the fifth technological structure: speed of production and capital movements through the world has increased dramatically. Today, almost all scientists agree that such factors as constant changes and continuous modernization affect business in today's world.

It should be noted, that changes in technology have significant influence on the transformation of enterprise management system. However, organizational changes mostly precede changes in technology and take place irrespective of such changes, preparing methodological basis for the implementation of this methodology. For example, automation of production was preceded by division of the work into tasks and simple operations that can be performed by low-skilled workers. Organizational technology was not just a simple result of the technological changes; it rather determined the appearance of automated technologies. For example, the Kanban system used by Toyota in the early 50s was based on certain standardized circulation of documents. Summarizing these findings, one could argue that the best results can be obtained by combining the strategic management with the development of manufacturing technologies.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

The issue of modernization of the national economy and individual companies draws the attention of national and foreign economists. Recently, a lot of researches highlighted such issues as lack of resources in the national economy at the macro level [1], management capabilities and enterprise development based on modernization [3, 12, 17-18], modernization as an essential condition for the economic reconstruction of the national socio-economic system [9], the issue of innovation and technological modernization [2]. But even more scientists are highlighting the essential need for purposeful transformation of the production management structure with a focus on converting management information system [16]. The most important researches in the field of industrial technologies were conducted by Chernov S.K., Chukhray N.I., Dzhonson M., Flys I., Koshkin K. V., Kristensen K., Kagermann Kh., Kiyentsle O., Kuzmin O.Ye., Mayorova S.A., Meleschenko Yu.S., Svidersky V.I., Habel H. [4-7, 11, 14-15] and many others. On the basis of theirs researches we can identify patterns of influence on production technologies in the industry (Table 1).

OBJECTIVES

The aim of the research is to develop the concept of modernization of industrial enterprises taking into consideration the conditions of production system.

The authors had the following tasks:

• conduct the analysis of needs for the industrial transformation of Ukraine at the macro level;

• identify the role of modernization for the manufacturing structure of the enterprise;

• summarize the existing barriers to the development of production systems for national enterprises;

• form a concept of modernization of the industrial enterprises of Ukraine.

Table 1. Patterns that have an impact on the manufacturing technologies in the industry

№ n/n	Patterns
	Improvement of the incorporated materials
1.	Changes in the use of materials
1. 1.	Searching and diversification of the natural materials
1. 2.	Creation of new materials for technical use
1. 3.	Identification and using of new features of the natural and synthesized materials
1. 4.	The increasing focus for technical equipment of the application materials
1. 4. 1.	Purposeful selection of materials in accordance with the structure and properties of the technical equipment
1. 4. 2.	Rational use of materials in quantitative terms
2.	Improving the organization of the natural processes
2. 1.	Mastering the more complex forms of motion and expand the range of processes in the engineering
2. 2.	Using increasingly sophisticated and powerful sources of energy
2. 3.	Intensity of the processes increasing (pressure, temperature, speed, voltage)
2. 4.	The purposeful use of the manufacturing processes to increase their utility and rationality
2. 4. 1.	Improvement of the selected principle of action
2. 4. 2.	The transition to a fundamentally new principles of action
3.	Improvement of the work equipment, its structure and function
3. 1.	Wide range of industrial automation tasks
3. 2.	The principle of increasing complexity of the technical objects
3. 3.	Differentiation and specialization of the technical systems, its elements
3. 3. 1.	Functional specialization of the work equipment for a typical operations
3. 3. 2.	Specialization of the work equipment to perform limited and rigid action program
3. 4.	The harmonious relationship of technical parameters of the object
3. 5.	Correlation parameters of the one a number of the technical objects
3. 6.	Selection, extension and consolidation requirements of set-functions
3. 7.	Systematized phasic development of the technical objects
3. 8.	Progressive structural evolution of the technical objects
4.	Evolution of anthropogenic systems
4. 1.	Saving the basic functions of the developmental systems
4. 2.	Relative and partial workaround contradictions of the anthropogenic systems
4. 3.	Increased functional and structural integrity of the systems
4. 4.	Continuity of the functional and structural organization of the multilevel systems
4. 5.	Adequacy of a functional and structural organization of the appointment system
4. 6.	Reducing the stages of development by reducing periods of evolution spirals
4. 7.	Development of the methods for the synthesis of the evolutionary systems
4. 8.	Development of the structural synthesis of the system

Source: grouped and summarized by the author(s) on the basis of the processing of sources:[4, 6-7, 19]

Table 2. Areas of the improvement of the EMS in a process of the information infrastructure building

Management model	Traditional	Modern
Type of management	Focus on functional management	Focus on process-structured management
Goal of the production	The desire for maximum performance	Ensuring flexibility
System of relationships	Inadequate in problem solving	Developed system of the direct and feedback processes
Level of degree of the decision making process	Medium to high	Low
Knowledge base	Absence	Availability
Directions of an optimization	Features	Processes
The level of data concentration	High degree of data integration	Low degree of data integration
The level of data integration	Centralized	Distributed

Source: developed by the author(s)

THE MAIN RESULTS OF THE RESEARCH

The formation of effective Enterprise Management System (EMS) shall harmoniously combine diverse targeted components into the new competitive socioeconomic system. These combinations often require restructured traditional approaches and development of new configurations with unique properties.

Every enterprise is a unique production and technical mechanism. The structure of the enterprise is a composition and collaboration of its internal units, such as: productions facilities, departments, offices, laboratories and other components which are combined into one business unit. There are such factors that determine the structure of the company: the nature of products and technologies, scale of production, a level of specialization and cooperation with other factories and plants, as well as a measure of specialization in manufacturing inside of the enterprise.

Operating structure of the enterprise is dynamic. Production structure is improved together with the improvement of processes and technology, production and workforce management. Modernization of industrial structure creates conditions for intensification of production, efficient use of workforce potential, material and financial resources, and improvements of product quality.

Currently, the development of the system of management for business with an interaction component, in order to support the decision-making process, draws much attention. Management information systems have ensured forward and backward linkages in the broad information infrastructure of the specific business partners that are involved in the economic process in different forms. The changes in areas of EMS improvement during the process of formation of information infrastructure are shown in Table 2.

Very often something new in this area is created not by improving existing management mechanisms but by creating new combinations of them. This can be explained by the fact that current management tools are highly diversified and therefore their convergence may provide a synergistic effect.

There is an essential need for purposeful transformation of the production management structure with a focus on converting management information system, which explains the natural transfer of personnel from production into information area. These phenomena are associated with the typical features of the information society:

- increased need for operational processing of large amounts of data, in order to control the production and marketing business processes, requires periodic update of the existing processing facilities, transmission, storage and integration of the data. This leads to more complicated business processes in terms of meaningful use and effectiveness of control. It is worth noting that amount of scientific knowledge have doubled in about 2-3 years,
- capital material costs for storage, transmission and processing of information in the information environment are rising substantially. This requires highly effective management for planning the development and organizing its use,
- the lack of common universal software tools greatly complicates description, integration, identification of knowledge in various subjects and areas of business. These processes enhance relevant requirements to the control and revision of information by personnel,
- different data banks are being continuously updated and distributed to global information networks. They reveal opportunities for study or training (including distance learning) for professionals in design centers, academic and industrial organizations.

National industry requires modernization of production, both in the areas of capital equipment and management methodology.

Modernization of technical infrastructure means here introduction of new, more functional equipment with computer management and modern features. The purpose of these changes is to enhance technological

development of the enterprise to the level of modern leading industries. However, if you upgrade only certain elements of the process, the drawbacks at the other stages will arise. It is, therefore, necessary, together with the modernization of technical infrastructure, to improve the organization, planning and management of production and implement methods such as lean manufacturing, calendar resource planning and other methods.

Administration and management of most enterprises already use computer information systems, but there are many gaps between national enterprises in the area of production management. MES system is a key element of the overall enterprise information structure; it is able to meet the challenges of the production. Implementation of MES system and re-equipment of manufacturing enhances business efficiency. To link the technological capabilities of equipment and modern management techniques such as lean manufacturing, "Just in time" and others we need a management system that is integrated with numerical control machines at the same time. This particular instrument ensures that modernization tools used in manufacturing sphere work effectively.

MES-systems control the current production activities by using data from plans and check it according to orders, incoming requirements of design and technological documentation, actual condition of the equipment, pursuing the goals of maximum efficiency and minimum cost of execution of production processes.

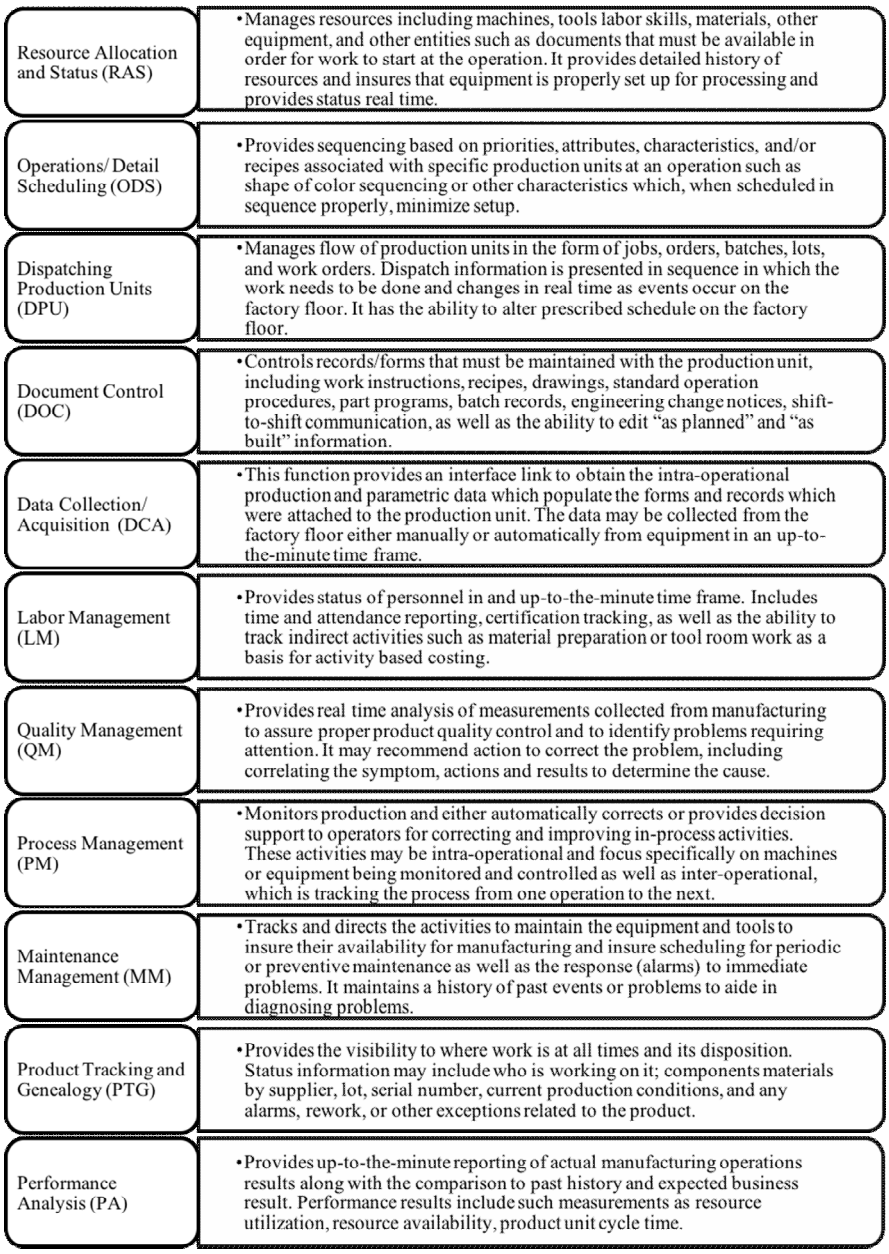

Fig. 1. Functions of MES-systems have been identified by International management enterprise systems association (MESA)

Source: [8, 13]

International management enterprise systems association (MESA) has identified eleven functions of MES-systems (Fig. 1). In a generalized sense MES-system is a source of complete, relevant and reliable information about all aspects of economic enterprises, due to which enterprises can upgrade via timely and reasoned decision-making at all levels of management.

The implementation of MES-systems is complicated because one needs to consider both technical installation of software and hardware from the one side, and organizational processes of personnel and operators working with machines from the other side.

According to MESA international [13] implementing MES in most cases allows achieving the following economic effects:

- reduction of the duration of the production cycle> 45 %.
- increase in work productivity> 30 %.
- reduction of the time for manual data entry> 75 %.
- reduction of the amount of work in progress > 20 %.
- reduction of the time for reporting, filling documents> 60 %.

MES is a part of a unified ERP system for production management with long cycles.

The development of the concept of production in Ukraine has a positive trend; many companies have achieved success in this area. However, there are some issues and limitations that slow down the implementation of ideas, methods and tools for manufacturing systems.

All constraints of production systems can be classified as follows: external factors that prevent the spread of the concept among the enterprises of the national industry and internal constraints that hamper the development of the production system of the enterprise. The external factors are the following [2, 10, 20]:

- controversial, contradictory, diverse terminology,
- lack of information about the phenomenon and practical application of the tools of production system,
- lack of qualified professionals,
- unfavourable market (financial) situation,
- absence of external requirements (from suppliers and customers).

The most common internal factors include:

- insufficient financial resources,
- lack of time for the personnel that is fully involved in current operations,
- unwillingness of employees to develop production system or to participate in the process in any way, natural resistance to the change,
- current organization of workplaces and existing production facilities are also a substantial constraint and hamper the implementation of new tools,
- piecework salaries, which, according to many scientists, limits the possibility to minimize losses by enhancing employees' productivity.

Having analyzed the existing barriers to the development of production systems for national enterprises we came to the following conclusions:

1. According to our estimates, development of new concepts (mentioned above) will be relevant not more than 2-3 years.

2. Development of external and internal evaluation systems for industrial systems has already begun, so their lack will be resolved within 5 years.

3. Factors that hinder the development of the production systems in enterprises will constantly arise, neither Japanese, nor German and American companies can avoid them using their own estimates.

CONCLUSIONS

1. At the present stage the national industry needs modernization of the production in the area of means of production and management methodology. MES system implementation is one of the effective tools.

2. The automation of manufacturing sphere aimed at giving quick response to changing market requirements should be based on the use of the process approach, focused on improving quality and shortening production with minimal costs of all resources.

3. Formation of positive attitude towards the implementation of the manufacturing system, active participation of managers in the implementation, organization of teams and working groups in the workplaces, regular evaluation of the performance of production system professionals, reduction of the distance between the management board and the employees, good financing of the implementation process are those success factors that affect the development of production system that will eliminate the inherent limitations to its effective implementation.

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Intellectual innovative system for personalized support of tourist trips

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Abstract. The main goal of the article is generalization of intellectual innovation project of information system "Mobile information assistant of the tourist" (MIAT), which provide a full-featured integrated information and technological support to tourists during planning and implementation stages of his journey using a wide range of modern information technologies. About two-thirds of today's tourists use information technology to plan and support their journey, while a significant number of them use mobile computer and telecommunications devices. The result of the research made by the group of researchers of the University "Lviv Polytechnic" is the project of innovative intelligent system "Mobile information assistant of a tourist" oriented on IT support of the user in planning and realization of his/her tourist trip in accordance with information technology slogan "EVERYTHING! HERE! IMMEDIATELY!!!".

Key words: tourist mobile application, tourism, location-based services, location-based recommendations, travel guide, route planning, navigation, indoor navigation, global positioning system, mobile technology.

INTRODUCTION

Tourist industry is rapidly developing and gaining popularity sphere. Despite the unstable situation in Ukraine in the first half of 2015more than 2.9 millions of tourists had crossed its border [1]. The analysis also shows a significant growth of intrastate tourism.

Every tourist meets a significant number of problems and obstacles that arise in almost all stages of the tour (pre-, during and post realization stages). Tourists are usually looking for answers to the question "*Where?*", "*When?*", "*How?*", "*Where?*", "*What?*", etc. [2]. Good quality tourist trip implementation needs powerful information support.

About two-thirds of today's tourists use information technology to plan and support their journey, while a significant number of them use mobile computer and telecommunications devices [3]. This in turn generates the need to create good quality mobile travel information technologies to provide users with a wide range of appropriate information-technology services for the full planning, maintenance, support and analysis of travel-based integrated full-featured software and algorithmic applications implemented on a mobile platform.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

Researchers and IT companies and corporations are actively working on developing new tools and methods for providing and processing of tourist information and systems to generate personalized problem-oriented recommendations [4-7].

Here are some typical examples of mobile software and algorithmic applications used during the planning and implementation stages of tourist travel.

Travel systems that have gained great popularity among mobile users are so-called computer-guides. Modern tourists need personalized access to comprehensive travel information in any place and any time. Mobile computer-guides are usually created taking into account mentioned requirements [8].

Bright example of such kind of applications is Latvia.Travel, that was created by specialists of the profile organization The Didgital Tourism Tink Tank to meet the information-technology requirements of tourists traveling in Latvia, and according to the peculiarities of this country. Functional mobile application provides tourists providing access to quality tourist information in the realization of the trip. The developers claim that by using the application user gets much more promoted than he expected. Functionally Latvia.Travel can zamictyty a website containing information about the direction and tourist attractions, cafes, restaurants, hotels and events that may be of interest to tourists. [9] Application Developer, Didzisom Spruds, argues that a growing number of users visiting the site Latvia.Travel is using a mobile device. This is yet another confirmation of the need to ensure travelers mobile software applications that can facilitate their information-technology support at home. [9]

Another popular application is Voyager: Route Planner, which was created to provide information technology to help tourists when planning optimal (fastest, minimum cost and so on. Al.) Route consists for travel between multiple destination points of the trip. The system focused on the following groups of users: travelers visiting the various sightseeing attractions; researchers plan to road trip; enterprises engaged in freight and delivery (such as courier / transport of passengers). Feature of Voyager is a mobile application usability and adaptability to use [10].

Mobile information technology is rapidly gaining popularity – a technology of Augmented Reality (Augmented reality, DR). DR imaging technology is based on information provided in the form of text, video, graphics overlay actual images of the object taken with camera mobile device [11].

Famous mobile system additions reality is tourist oriented mobile software platform MobiAR, which is created in the operating environment Android. MobiAR provides users with comprehensive travel information on a certain city or the object, while the tourists have the opportunity to use algorithmic application on mobile devices. The system informs about the events that occurred in the user's location using multimedia content, and access to necessary information when planning tour routes in [12]. The system consists of subsystems registration, user configuration, visualization map of the designation of tourist sites and generating content for each tourist site. Developers using cloud technology to implement communication between the mobile application and knowledge base [12].

Analysis conducted by the authors of paper confirms the fact that the problems associated with the formation of highly efficient high-quality information technology systems and mobile software and algorithmic applications targeted to meet the needs of modern tourists complete, accurate and quality information on travel planning and implementation are important and actively studied [13].

OBJECTIVES

The main goal of the article is a generalization of intellectual innovation project of information system “Mobile information assistant of the tourist” (MIAT), which provide a full-featured integrated information and technological support to tourists during planning and implementation stages of his journey using a wide range of modern information technologies.

To achieve this goal it is necessary to solve the following problems:

- to analyse of information systems for planning, support and debriefing of tourist trip,
- to identify the main features of the processes of planning and implementation of tourist travel,
- to identify the functionality of MIAT system,
- to identify a package of technical and technological features of this class of systems,
- to identify information resources that will be needed to create MIAT.

The Object of the research is information technology in the tourism industry. The subject of the study is mobile algorithmic applications designed for information technology support of the planning and implementation of the tourism trip. To describe the MIAT system design its developers use methods and tools in standardized UML notation [14].

THE MAIN RESULTS OF THE RESEARCH

A group of researchers from Lviv Polytechnic National University developed innovative technological project of intellectual information system “Mobile information assistant of the tourist” and worked out a prototype of the next-generation integrated mobile computer and algorithmic complex [17].

The aim of this research project is to develop the innovative intellectual software and algorithmic complex aimed to IT support and maintenance of tourist at all stages of his trip (before, during and after its implementation).

So, the initiative of the project is the development of intellectual information system “Mobile information assistant of the tourist” to provide highly professional virtual support to tourist trips to the castle “Palanok” which is located in Mukachevo, the castle in town of Khust (Transcarpathian region) and castles that are included in “Golden Horseshoe of Lviv region”: a tourist route that includes a visit to Pidhirtsi, Olesko and Zolochiv castles and also to support tourist during their trip to the center of the city as a historical monument that is a part of the historical heritage, protected by UNESCO [18]. Intelligent information system must be

designed and built in accordance to the information technology slogan "EVERYTHING! HERE! IMMEDIATELY!!!".

Functional features of the system. According to the goals, objectives and proposed content of the project following requirements for functional content of intellectual information system were formed: providing the tourists a consolidated and personalized information at any time, forming personalized routes with the possibility of implementing any changes during the trip, assistance in choosing and reserving vehicles and accommodation, locating and navigating the user during the tourist trip, travel budget calculation, forming the report of spent costs and automatic creation of travel journal, information systems support in off-line mode (Fig. 1) [17].

The main feature of the system is to provide a user with reliable, uncontradictory, full information in accordance with the basic information and technological slogan "EVERYTHING! HERE! IMMEDIATELY!!!". Mentioned intelligent information system should provide tourists with appropriate comprehensive IT support at anytime and anywhere [17]. There is no doubt that the system is in the final embodiment must satisfy the requirements of the usability and aesthetic presentation.

The main user of the system is the average tourist with his real requests for information, specific preferences, tastes, character, attitudes and needs. Moreover, the functionality of the system must give the opportunity for planning and information-technological support of the group (family) tourism trip. The possibility of using the information system by different classes of users is shown in Fig. 2.

Expert and system administrator are responsible for the proper functioning and correct filling of data base (DB) with tourist information and knowledge bases (KB) with training examples. Further knowledge base updates automatically during interaction sessions with the tourist system.

Technical and technological features of MIAT. MIAT – is a complex structure of software and algorithmic complex that involves the use of a wide range of information resources (databases and knowledge bases) and powerful mathematical and algorithmic software. Thus the main end-user hardware system is a powerful mobile device with GPS antenna and the ability to connect to the Internet (see Fig. 4).

Architectural design of this software and algorithmic complex involves locating "system engine" on the mobile device to make the realization of the off-line mode possible (see. Fig. 3).

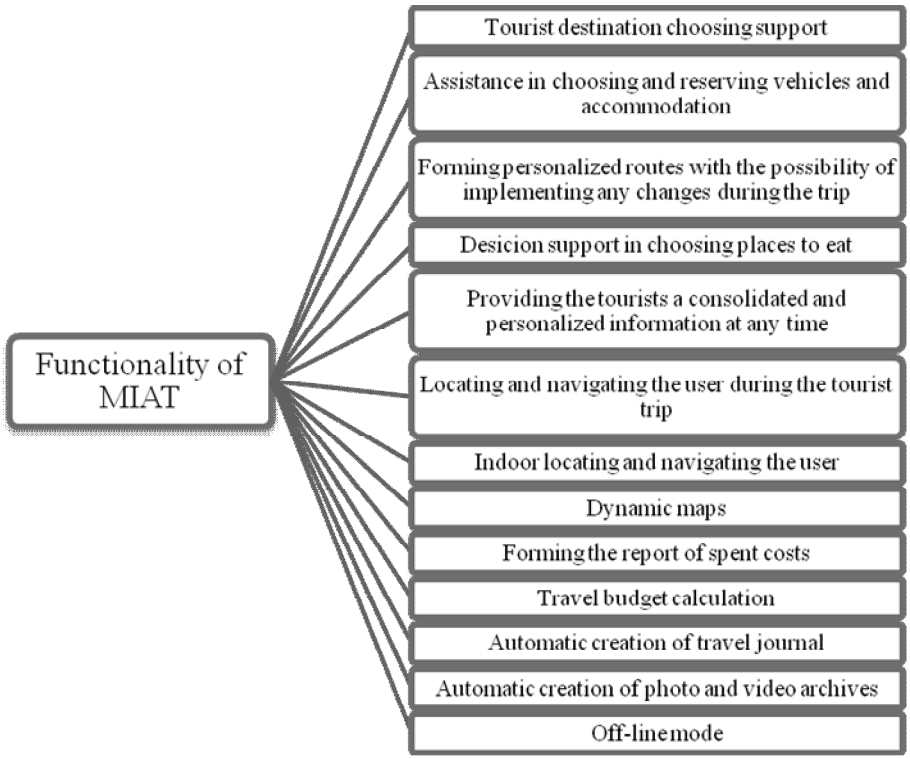

Fig. 1. Functionality of MIAT*
** Self developed*

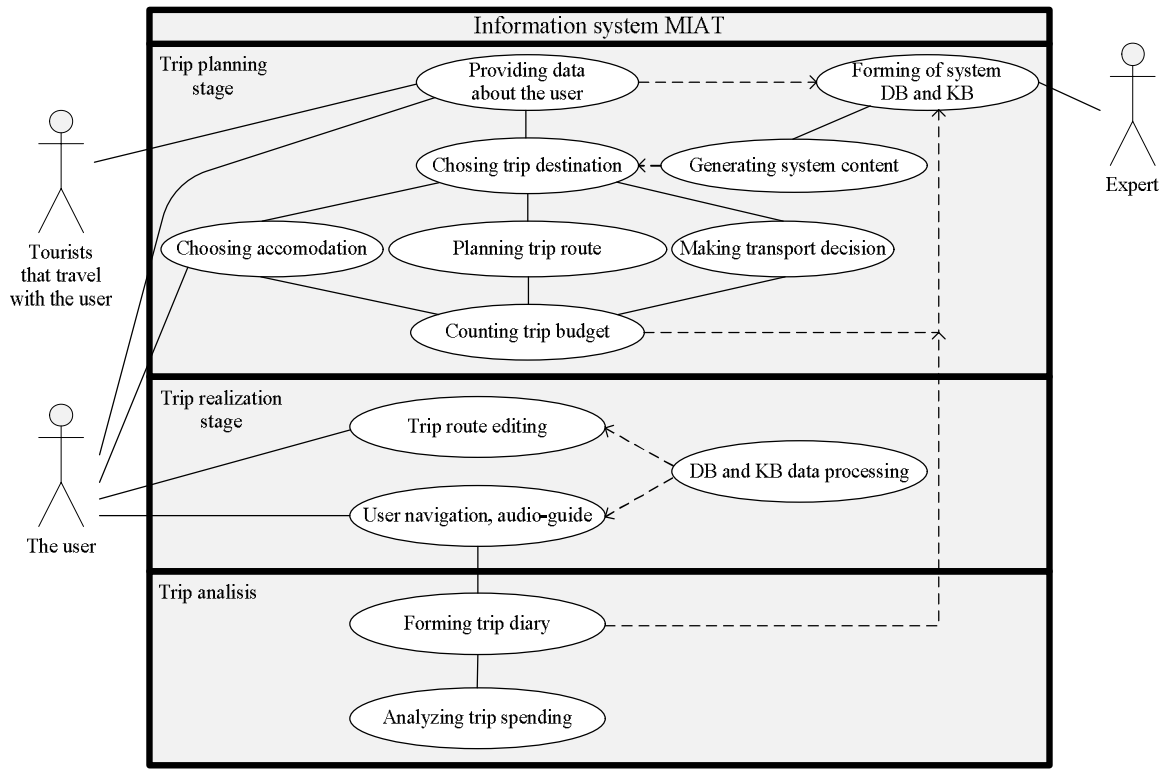

Fig. 2. UML use-case diagram. The roles of the users of MIAT*
** Self developed*

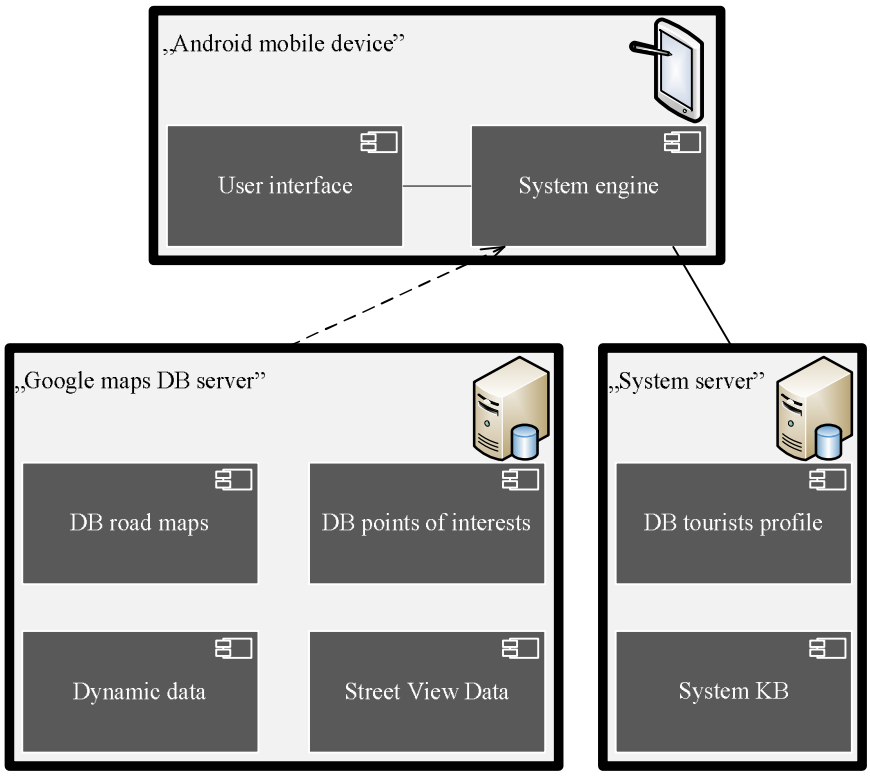

Fig. 3. UML deployment diagram. General architecture of the system*
** Self developed*

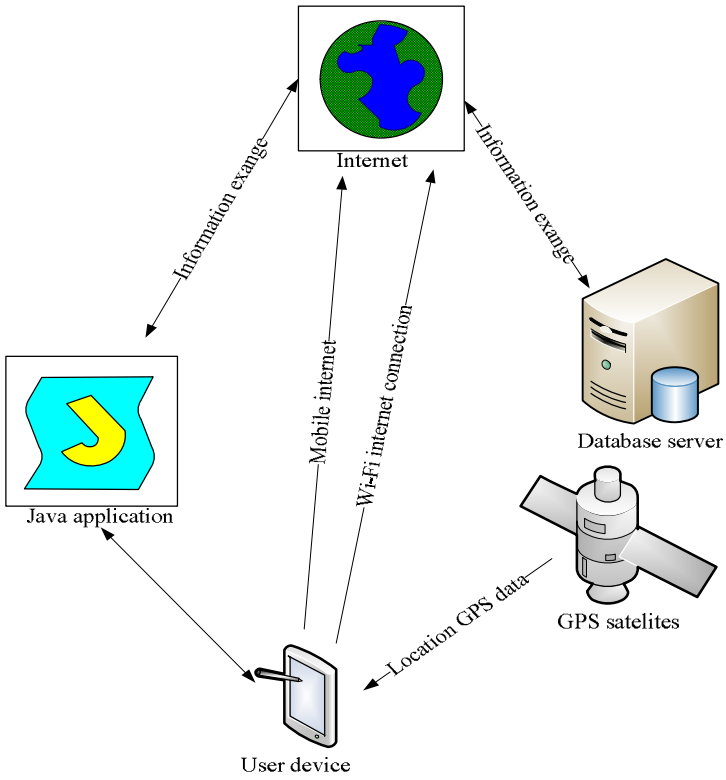

Fig. 4. Hardware of the system designed by Savchuk*
** Self developed*

The data base and knowledge base of system is located on a separate server and when planning the trip needed data is saved directly on the mobile device.

In addition, the MIAT system is going to use Google Maps service in order to add necessary tourist map information. The authors have selected this service because of its powerful algorithmic information content and functionality. Google Maps service includes a set of databases that are based on the free map service and technology provided by Google. Service enables cartographic data and satellite images of the earth's surface, and provides access to the integrated directory "points of interests" (POI) and maps of roads, with the function of optimized routes search [19]. It should be specifically highlighted the subsystem "StreetView" specified service that provides a spherical images of streets of cities in Ukraine and worldwide [20]. All relevant data are on the server (see. Fig. 4).

The system engine is described separately in the Fig. 5.

It contains the following components:

- *User poll* – this component is responsible for the survey, and formation of the user profile information, records obtained personal data to the system data base.
- *Decision support subsystem* – the component that is responsible for assisting the tourist in making such decisions as choosing the accommodation and transport, places to eat and POI to visit. In addition to this the component will give an opportunity to make reservations and buy tikets to different facilities.
- *Panning tourist route* – this intellectual component has is responsible for a personalized travel planning optimal routes according to the results of the survey, decision support subsystem and the possible duration of tourist trip. An additional feature is the ability to change components of the tourist route during the trip, depending on the wishes of the current user and information about its location.
- *Forming DB and KB* – this component is responsible for adding new information to the system.
- *Navigation mode and "audio guide"* – the component that provides information about user's location, his travel route navigation and provide users with information about tourist sites that are nearby. When the "audio guide" mode is turned on the component, in addition to voice driving directions, provides detailed comprehensive tourist information in audio format on the points of interest that are in close proximity to the user. Without GPS, or Internet connection, the user will have the opportunity to inform the system about his/her current location.

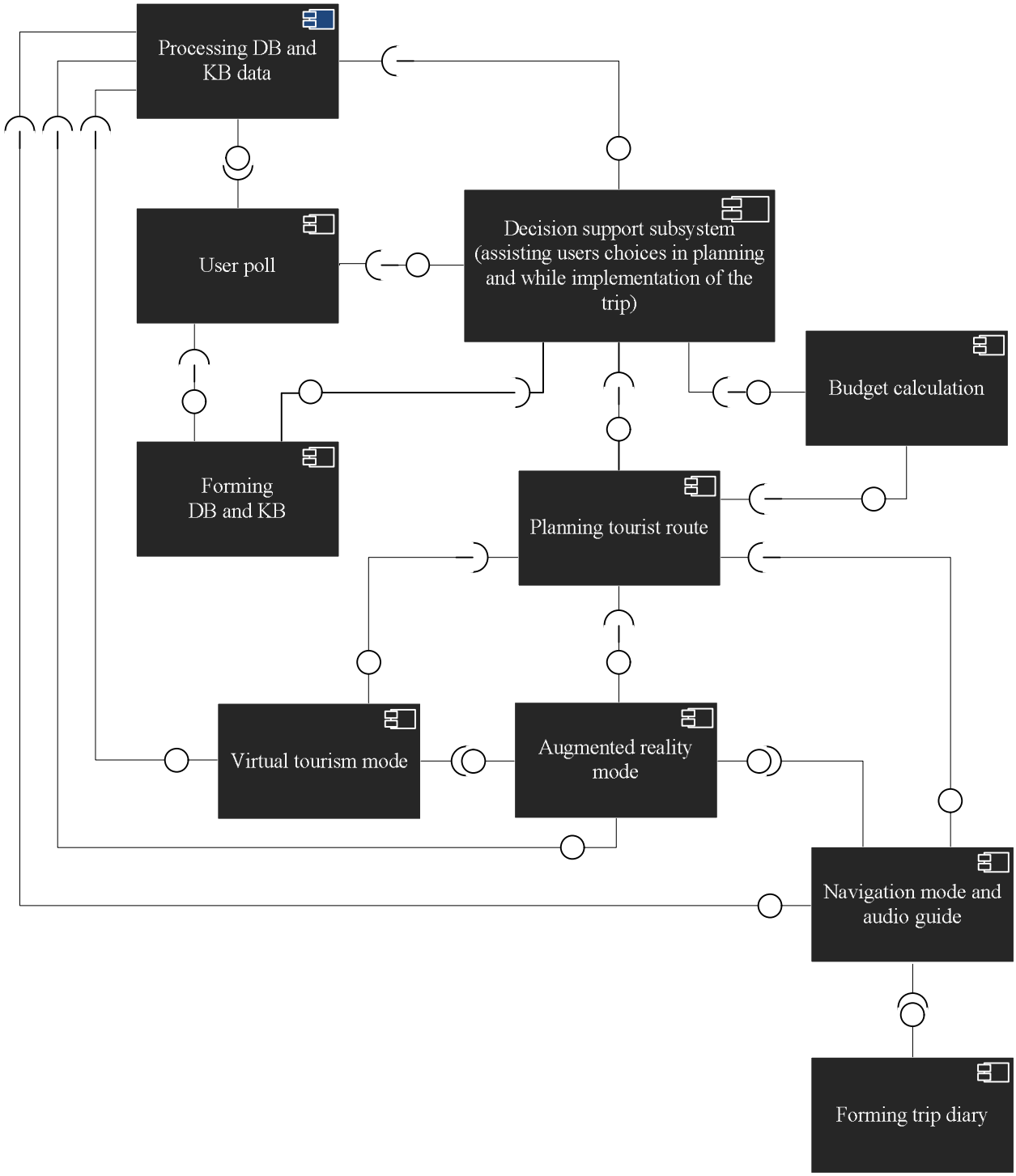

Fig. 5. UML component diagram. The architecture of system engine designed by Savchuk*
** Self developed*

- *Processing DB and KB data* – the component, that processes DB and KB data according to the inputted query. The output of the component is information that is needed for functioning of other components o directly for the user.
- *Augmented reality mode* – a component that will implement the operation augmented reality mode during a trip. It means that the video and pics from the camera in users mobile device in real-time is processed and tag with information about further recommended direction of travel (using the data components of the "Navigation mode and "audio guide"), and with information about tourist sites that fall into the field of view of the camera mobile are placed under the taken picture.

- *Virtual tourism mode* – a component that is responsible for obtaining data on the planned route of subsystem "StreetView" of GoogleMaps service (see. Fig. 3) and sending them to the components of the "Augmented reality mode" to be used instead of the images obtained by a camera device. As a result, the user will be able to see the pre-planned tourist route on your mobile device.
- *Budget calculation* – a system component that is responsible for the preliminary calculation of the planned trip budget and forming report on costs spent during its implementation. It uses data on cost of living, vehicles, food (the user is offered to provide a report on the funds spent in catering establishments), entertainment and so on.
- *Forming trip diary* – a component that is responsible for the preservation, sorting and forming the description of the data generated and activated during the trip, such as maps of routes traveled, photo, video files, and information on geolocations.

Processes of users interactions with the system. First of all, after starting the system takes on your mobile device a request for authorization or user registration. User registration involves entering the email address and password, and tourist potential responses in the survey designed to determine the travel profile. Obtained registration in the presence of personal data Internet communications are recorded in the database, containing information about tourist tourists (see. Figure 3–5).

Authorizations user provides input your email address and password, then they are checked for conformity and resemblance to the patterns and standards. When using email, which is connected to the mobile device operating system, authentication occurs automatically when the relevant connecting to the Internet.

Planning tourist trip. After completing the registration / authentication, the user, if a travel plan it is proposed to choose a personalized list of tourist destinations, which sorted in order according to the user profile and time of the visit (Every tourist destination has specific advantages seasonal). All items of the list are accompanied by detailed tourist information tourist destination and its features. The user must choose the most appropriate for a tourist destination.

After that the tourist has the opportunity to choose and book and vehicles, and plan travel routes and calculate the necessary budget travel realizing these steps in an easy to order it.

When planning the tourist route the user is given a list of tourist sites to visit with detailed information about each of them, as well as personalized tours created taking into account user preferences and duration of travel. The user must choose the most interesting tourist attractions. Under this proposed system adjusted routes. In case the customer is satisfied with the result, information on the planned route is stored for later use and changes during the realization of the trip.

When choosing a place of residence to provide users with a personalized list of hotels, motels, campsites and apartments for rent and redundancy detailing the location, conditions and prices. When choosing a place of residence registration the user the opportunity to request a reservation concerning habitats. Reservations vehicle is a similar procedure.

The calculation of future travel budget based on past actions and is approximate.

In addition to planning a travel proposed implementation of virtual tour on your mobile device to review previous user's tourist routes. Virtual tour implemented using a separate system components MIAT (see. Fig. 5).

After downloading the "*Virtual tourism mode* " user to plan a route for travel, select a saved route or choose the starting point of the virtual tour on the map. Then the system loads the appropriate data service "Google StreetView", namely spherical images of streets and tourist sites and tourist route chosen direction.

Further loaded component "*Augmented reality mode*" that provides information generating tags and their corresponding overlay image objects. It is proposed to use the following types of information labels:

- recommended direction indicators,
- orientation map (pointers of center or famous tourist sites location),
- information on objects that are in close to the user.

Supporting the user during the trip. The most important and meaningful application of perspective is the practical use of MIAT during implementation of tourist travel. First of all, the user gets the opportunity to plan future actions at any convenient time, and secondly tourist ensured constant IT support during the exercise of the trip.

After starting the system the user needs to go through the authorization or registration, as described above. Provided that the trip has been planned program displays previously saved tourist route on the user's mobile device screen indicating the location of the user. If the trip is not pre-planned, the system displays a map according to the location data of the tourist.

For determining the place of residence is responsible component "*Navigation mode and "audio*

guide" system engine (see. Fig. 4). To determine user location using GPS positioning technology, GSM and Wi-Fi networks [19].

In addition to dynamic map system designated place, located next to the user and his might and provided detailed travel information about each of them.

At any time the user can create a request for withdrawal of the necessary data, such as information about recommended places food, entertainment, etc., and change the planned route.

Anticipated development of tourist guide mode, providing the user navigate through the travel direction and sounding more information about the tourist facilities are nearby.

Augmented reality mode technology is the most difficult in algorithmic implementation and organizational support. The specified mode is implemented based on this information technology:

- machine vision technology,
- images and video processing technology,
- positioning technologies based on GPS and digital compass,
- texts processing technologies.

After selecting a user profile additions reality loaded on system components. Operation mode additions reality essentially depends on the results of the components of the Navigation and "audio guide".

Following booting the system and information technology components of the data processing to determine the user's location and fixed line "view" photo / video camera device, and the analysis of data availability additions reality on given situation. Next stage after generating relevant information tags are superimposed on the camera image obtained mobile device.

The user can at any time choose to change the type or mode of use of additions reality: standard or "audio guide". When choosing the type of "audio guide" system loads the planned or optimal travel itinerary and visit tourist object (for example, the castle, museum, etc.). After the selection is generating information about objects that are in "sight" camera on his mobile device screen displays tag information", and detailed information is made public. Regularly check is the location of the user and the direction of "sight" camera mobile device to provide comprehensive relevant tourist information.

In augmented reality usual user chooses the direction of motion, and the system provides information based on the data obtained from the camera device. To clarify the information on certain tourist sites the user can form in response to a request that will receive information in the format text, photo, video and audio that are displayed under the screen of the device.

Augmented reality mode is designed to improve the completeness and amenities provide tourist information on tourist routes, facilities and areas for better assimilation and acceptance by the user, the quality and precise location on map user, including versions of his time indoors and buildings.

The result of the research made by the group of researchers of the University "Lviv Polytechnic" is the project of innovative intelligent system "Mobile information assistant of a tourist" oriented on IT support of the user in planning and realization of his/her tourist trip in accordance with information technology slogan "EVERYTHING! HERE! IMMEDIATELY!!!".

The aim of the research project "Mobile information assistant of a tourist" (MIAT) is developing the intellectual innovative software and algorithmic complex to provide IT support and maintenance to tourists at all stages of the trip (before, during and after its implementation).

System requirements and its functional features are formed as a result of the analysis of up-to-date researches in the field of mobile information technologies in tourism, and the needs and problems faced during a tourist trip. According to this goal, the authors analyzed the processes of planning and implementation of tourist travel in terms of project management methodology [17].

System architecture and its engine are designed and presented graphically, the role of major classes of users is distinguished and the processes of user interactions with the system that depend on the goal are described.

The main users of the system are ordinary tourists, while there are opportunities to provid information technology support for family and group tours, taking into account the individual characteristics of every traveler.

The system has quite complex structure and extensive architecture. It requires serious technical, program and algorithmic information tools and resources for full implementation. Its main components and functions are database and knowledgebase, navigation and mode "audio guide" planning travel routes, virtual tourism mode, additions reality mode, budget calculation, decision support subsystem and others. The structure allows timely and high quality processes to generate recommendations to the user and provide support at all stages of the trip.

The proposed implementation of the processes of interaction of tourists with the system aims to ensure high quality and usability of MIAT for both simple and advanced users of mobile applications.

The article contains description of the project innovative intelligent system "Mobile information assistant of a tourist". The analysis of functional and technological features of the system, the purpose and content of the main stages of its implementation was made.

Nowadays, individual components of the city, its database and knowledgebase are being designed. The

above functionality requires the formation of high-quality information resources on which developed the database “places of interest”, “road maps” knowledge base and decision support subsystem that contains personalized information about users.

CONCLUSIONS

The result of the research made by the group of researchers of the University “Lviv Polytechnic” is the project of innovative intelligent system “Mobile information assistant of a tourist” oriented on IT support of the user in planning and realization of his/her tourist trip in accordance with information technology slogan “EVERYTHING! HERE! IMMEDIATELY!!!”.

The article contains description of the project innovative intelligent system “Mobile information assistant of a tourist”. The analysis of functional and technological features of the system, the purpose and content of the main stages of its implementation was made.

The priority tasks facing the developers of the system at the next stage of its creation is to develop basic algorithms of the system, including algorithm for optimal personalized route planning, algorithms for generateing personalized information, calculating the exact location, algorithms for automated formation of the travel diary, navigation, calculating budget of the trim, ets.

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ECONTECHMOD. AN INTERNATIONAL QUARTERLY JOURNAL – 2016. Vol. 5. No. 1. 89–96

Economic problems of aircraft equipment recovery

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Abstract. The formation of effects of different order in the process of aircraft equipment recovery is investigated. Changes of idle time of aviation equipment, depending on the cost of its recovery and maintenance are estimated. Economic problems of reasonable implementation of qualitative aircraft recovery are considered.

Unlimited theoretical limits of costs on assuring the quality of aircraft equipment recovery are shown on the graphs. Suggestions for reasonable limits of the cost on aircraft equipment recovery are grounded.

It was established that the definition of economic efficiency of providing quality of aircraft equipment recovery requires accounting not only the cost but also the obtained effects. The model showing the possible operating modes of aircraft equipment is presented. Its partial review allows to evaluate the difficulties of calculating the economic effect of providing quality of aircraft equipment recovery.

Theoretical aspects of economic effect formation of quality of aircraft equipment recovery are investigated. It is stated that the annual economic effect from assuring quality of recovery and maintenance of aircraft equipment, resulting in operation of aircraft equipment (the effect of the second-order), occurs in the form of savings and avoided losses for two reasons. First, eliminate losses due to non-compliance of technical parameters of aircraft equipment to normative and technical values. Second, due to changes in the operating costs connected with the elimination of aircraft equipment idle time due to technical reasons. Also, certain effect can be created in general within the whole branch of economics where aircraft equipment is used. Calculation of economic effect requires distinguishing between savings and avoided losses. Potential loss can be the cost of the aircraft equipment itself and damages that it may cause in case of falling. Also, losses can occur due to bad providing of technical condition indicators, and therefore efficiency of aircraft equipment causes inadequate change of operating costs and process in which it participates.

Key words: aircraft equipment, recovery, repair, efficiency, economic effect.

INTRODUCTION

Analysis of the problem of providing the aircraft equipment recovery involves detection of the objective nature of this category, peculiarities of quality of aviation technology recovery in specific conditions of exploitation and recovery. The key to a proper understanding of the nature of the concept of "quality aircraft equipment recovery" gives the analysis of relationship between the concepts of "quality of work" and "product quality". An important issue of aviation equipment recovery is an identification of economic appropriate boundaries of improving the quality of recovery. Also the subject of the study is the effects that result from improving the quality of aircraft equipment recovery.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

Research of the problem of different order effects formation in the process of aviation equipment recovery involves detection of the objective nature of this category, peculiarities of quality of aviation equipment recovery in specific conditions of exploitation and recovery.

The peculiarity of aircraft equipment repair is a large range of repair facilities. There are thousands of parts, components and units of aviation engineering. They all have their special design features, the size, and shape is made of different materials [18].

The author [20] gives the following definition: repair is the complex of activities for restoring ope-

rability or efficiency of products and their resources. Repair of aircrafts can be planned and unplanned.

The timing of planned repair is defined by normative documents. Unplanned repair is performed without appointment. Scientists [1] determine the following characteristics of aircraft repair:

1. Aircraft repair – the change of the construction aiming at renewing the flying ability of a product after its damage or wear [16].

2. Aircraft repair – main measures to maintain the aircraft flying ability in the process of its exploitation [13,19]. The basic principles of aircraft recovery used in Ukrainian literature were grounded during the Soviet period. Thus, the scientist [4] notes the importance of maintaining the efficiency of aviation equipment.

The best description of the problem of aircraft equipment recovery nowadays among Ukrainian scientists is given in the thesis "Perspective planning of aircraft repair and economic estimation of its efficiency" [16]. The highest number of scientific publications on the investigated subject in Ukraine is at the National Aviation University.

OBJECTIVES

The goal of the research is an economic analysis of the scientific and methodological foundations of service organization and aircraft recovery, disclosure of practical problems of its implementation in real conditions of Ukrainian aviation industry. The aim is to determine the economic appropriate boundaries of ensuring the quality of aircraft recovery taking into account different economic effects.

THE MAIN RESULTS OF THE RESEARCH

Ukraine is one of the few countries which have a full cycle of aviation activities from designing aircraft engines and aircrafts to their operation, service and repair. Educational and scientific activities are also very important as they provide staff training, efficiency and safety of aviation industry [3, 13].

For the development and efficient operation of aircrafts one must constantly carry out measures to ensure its efficiency. So, formation and development of the aircraft repair industry is very important [20].

Generally, a gradual decrease of enterprises in the aircraft industry is observed as well as in machine – building enterprises due to a low innovation development. Such situation is caused by an absence of effective management of enterprises economic behavior [14].

An important economic indicator of aircraft equipment recovery is the quality of performed work, as well as indicators of the quality of the recovered vehicles. The problem of quality of work at this stage is broadly interpreted. In general quality of work characterizes the quality of all management activities, planned activities, quality of industrial organizations, labor groups and scientific institutions. In this sense the quality of work combines the final outcomes of economic activity and as a category applicable to all levels and sides of business. There is also the interpretation of quality of work in the narrower sense, in relation to a particular level. Quality of work is understood as the accordance of performed work to regulations and other specified requirements. An important part of the concept of quality of work is a product quality [10]. As part of the concept of quality of work it is directly connected with the concept of production efficiency and is expressed together with other indicators of productivity (labor input, capital intensity) in increasing technical and economic product characteristics and improving of its consumer properties [6, 7].

Due to its socio-economic nature, product quality is one of the fundamental characteristics in achieving production best outcomes and can't act as an addition to the concept of quality of work. Product quality is the defining characteristic of the quality of work, and therefore part of final national economic results. The resulting characteristic of a problem of quality recovery is a working condition of repaired aircrafts and of such that passed the repair services. That is, improvement or maintenance of quality recovery is aimed at achieving the most important economic result – ensuring the working condition of the aircraft. Such an approach eliminates the possibility of identification the recovery quality with the quality of repaired aircrafts [2].

Researching the quality of repaired aircrafts we mean functional aircrafts which meet the requirements of regulatory documents. Aircrafts, restored in violation with standards and specifications are considered to be unserviceable aircrafts [15, 17]. When in the process of exploitation after the recovery the aircraft is not able to provide a specific need, it shows not only its initial low technical level, but also the violation of technology of exploitation and recovery [8].

Distinction between recovery quality and quality of repaired aircrafts is caused by the need of taking into consideration the possible additional costs and potential effects of these costs while estimating the recovery quality. The methodological approach to assessing the economic efficiency of providing the recovery quality is as follows: various types of economic effects can result while improving the recovery process and ensuring its quality caused by improving the recovery quality, consequently providing an efficient condition of aircraft. The basic principle of this approach is that ensuring of recovery quality affects the costs and effects as their differences relating to the same process of recovery (works to ensure the working condition of aircraft – the effect of 1st order); process of exploitation of repaired aircraft (providing working condition of aircraft, elimination of technique idle time – the effect

of 2nd order); the transport of goods and people running in the renovated aircraft (increase in traffic (for airlift) to increase combat readiness (military vehicles) – the effect of 3rd order). The general scheme of the formation of a different order effects is presented in Fig. 1.

Providing the recovery quality has a number of coherent actions which form different effects caused by a change of quality of aircraft recovery which is shown in the scheme in Fig. 1. Efficiency is defined by comparing the costs of its maintenance to different effects. General block diagram with definition of economic efficiency of aircraft recovery is shown in Fig. 2. The presence of different effects determines their place of occurrence.

The effect can be beneficial for both the repair company and for the organization that operates the aviation equipment. Though repair of aircrafts is not related to production, we can distinguish conventional producer – aircraft repair company. The main reason for this assumption is: a typical organizational structure of the aircraft repair enterprise offers the availability of repair units, responsible for different stages of repair, such as aircraft manufacturing enterprise. The above considerations give opportunity to separate the producer of repair products (aircraft Repair Company) and consumers of repaired products (organization – owner of aircrafts) [12].

The above, determined the primary factors to consider in determining the economic efficiency of aircraft equipment recovery [11].

The important factor of economic efficiency in general and aircraft recovery in particular is labor saving. Quantitative estimation of this efficiency can be given by using the index – the total economic effect. This index can show the effectiveness of all recovery options. It is necessary to define a mathematical condition for economic efficiency.

Despite the variety of different methods, techniques and formulas to determine the economic efficiency of aircraft recovery, most of them are not perfect.

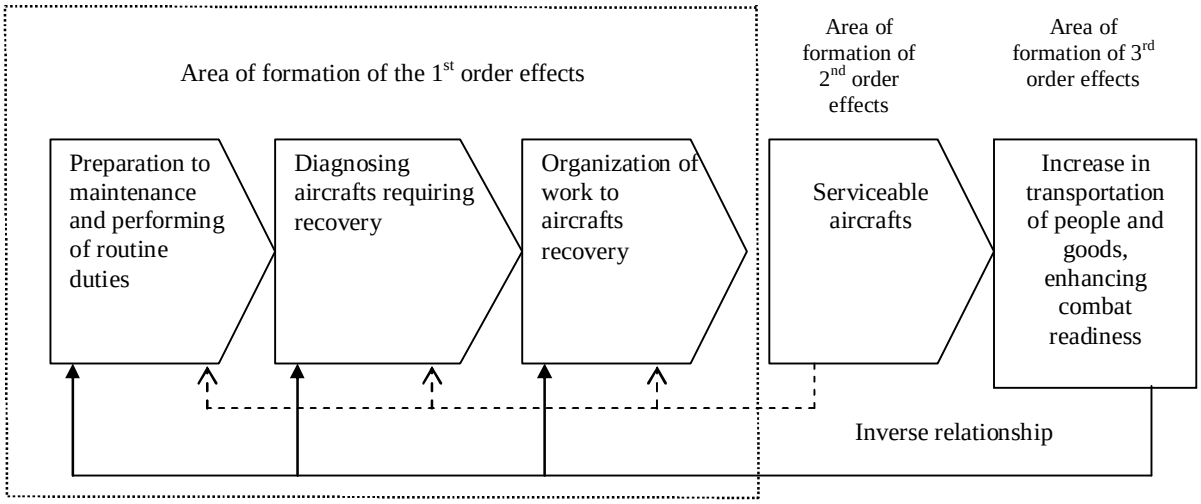

Fig. 1. Areas of formation of economic effects of different orders in the process of aircrafts recovery

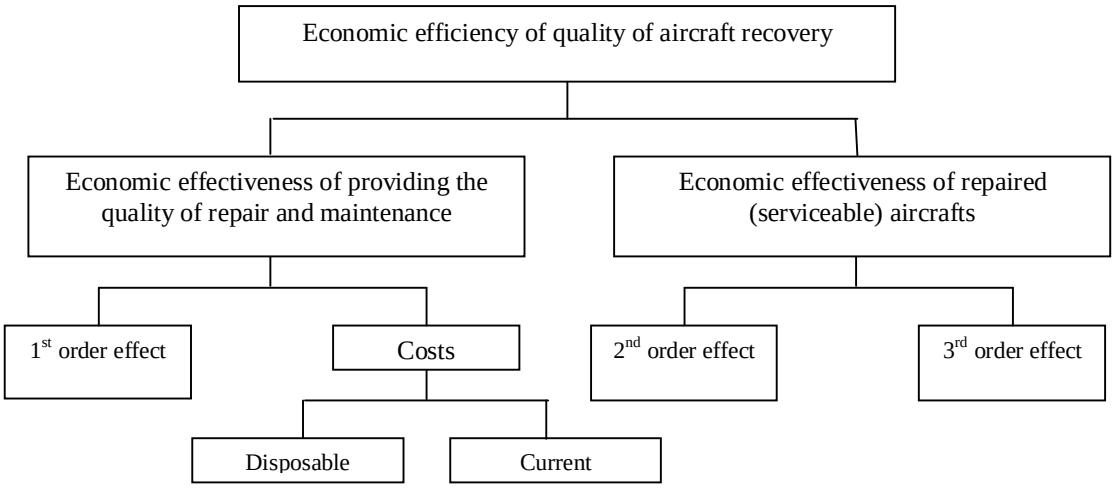

Fig. 2. General structural scheme of determining the economic efficiency of aircraft recovery

Mathematical condition for economic efficiency from providing maintenance and aircraft repair are (in general):

$$E>O. \quad (1)$$

Obviously, the terms in the formula (1) can be either positive (savings) or negative (loss). In general, the rate of economic effectiveness from providing the quality of aircraft recovery is:

$$E = Ep – Bp, \quad (2)$$

where: Ep – positive effect that is prevented damages not arising due to provided level of technique efficiency, hrn., Bp – the cost of providing a given level of aircraft performance, hrn.

The economic nature of quality index of technique service and aircraft repair is caused by the recovery function in the manufacturing process at aircraft Repair Company. This index should consider all possible costs on aircraft recovery works and economic consequences of this work for aircraft repair enterprise as a whole.

Following formula (2), it is possible to achieve a positive result and further increase of economic efficiency from providing maintenance and aircraft repair index due to increase or positive effect in production or by reducing the cost of repairs and maintenance at a constant or increasing positive effect. The choice of a quality parameter as well as a nature of its components change is very important in the construction of economic model for evaluating the quality of aircraft recovery.

Aircraft efficiency factor is a parameter that determines the quality of the aircraft recovery is calculated as follows:

$$Kw = 1 – (Frp / Fp), \quad (3)$$

where: Fp – real fund of working time of an aircraft for the planned period, hours; Frp – time spent on unscheduled repair and idle time of aviation equipment for technical reasons and for the operation that does not meet the technical requirements due to deviations of technical parameters from its normative values.

Reasons for selecting this option for quality assessment of repair and technical condition of aircrafts are as follows. Firstly, the quality of recovery appears to operate through the reliability of aircraft. Secondly, it takes into account the cost of living labor, related with F component which allows maintaining a working state of aircraft. This arouses the interest to investigations related with discovery of the relationship between the cost of repair and maintenance, and efficiency of aircrafts that took place in specific conditions in aircraft repair companies. The presence of a stable feedback between the idle time of aircrafts and the repair costs was experimentally confirmed. According to the methodology used in work [4] we offer to build correlation fields which confirm the existence of a stable feedback between the studied objects. Analysis of the forms of relations for different functions showed that the largest correlation value corresponds to the functional transformation of variable y = (1 / x).

Testing the stability of the connection between variables was carried out on the criterion Z Fisher. Essentiality of relation between the studied factors can be argued with a probability of 99%.

Asymptotic nature of the permanent reduction of values obtained by correlation dependencies Yk = f (Xk) proves that achieving the complete elimination of aircrafts idle time is very difficult. The asymptotic nature of reduction per unit of time needs more funds. There is a decrease in the efficiency of costs for the working condition of aircraft. Foreign researchers also indicate the existence of such form of relation between the repair cost and aircraft idle time [5].

Due to the fact that the cost of providing recovery quality is part of the costs of maintaining the working condition of aviation equipment, we can assume that the form of relation will have curve shape, as shown in Fig. 3 This assumption allows us to conclude that the relatively constant improvement of recovery quality parameter is achieved by costs increasing as we approach the maximum quality parameter. The closer to the maximum is the parameter of aircrafts idle time, the bigger is an increase of costs for quality repair and maintenance**.**

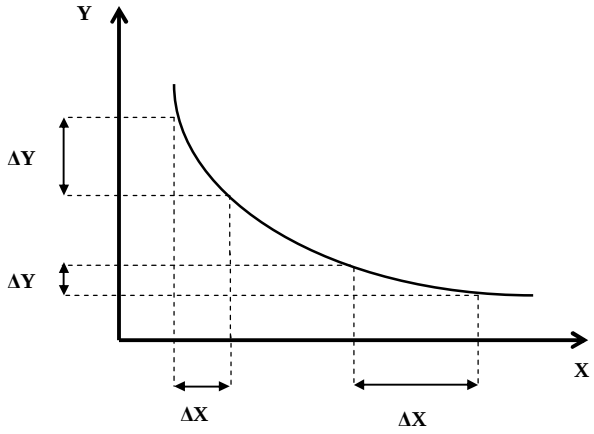

Fig. 3. Graph that describes the change in the aircrafts idle time depending on the cost of repair and maintenance of aviation equipment [9]: Y – total aircrafts idle time for technical reasons; X – costs on repairs and maintenance; ΔY – increase of total aircrafts idle time ; ΔX – increase of costs on repair and maintenance

While improving quality parameter of aircraft recovery the limit value of costs tends to infinity, ie when Kw → 1 the costs of recovery increases Zkr → ∞.

The limit value of positive effect Ep along with a change of aircraft recovery quality, which leads to an increase in working condition of aircrafts Kpd → 1

tends to a finite value. Theoretically, this finite value is the total costs occurred in the process of aircraft exploitation that can be saved by using aviation equipment with "ideal" technical condition. The nature of the functional relationship between the recovery quality parameters in general, is a curve that asymptotically approaches to the boundary of the final value.

If the nature of two curves (the positive effect curve Ep and costs curve Zk) are just the same as that according to the study, it is obvious that the total economic impact E will look like a curve shown in Fig. 4.

Fig. 4 graphically shows the theoretical dependence of economic indicators of quality maintenance and aircraft repair from changing of its quality parameter which characterizes the level of aircraft efficiency. It shows the functions that reflect changes in costs to provide recovery quality Zκ, the positive economic effect from ensuring recovery quality and total economic effect as the algebraic sum of the two curves Ep and Zκ, depending on the parameter of quality recovery. Due to the fact that the quality parameter varies from zero to one, the graph is limited by theoretical limit of the parameter K max, which is possible only if the average recovery time after failure is zero [5].

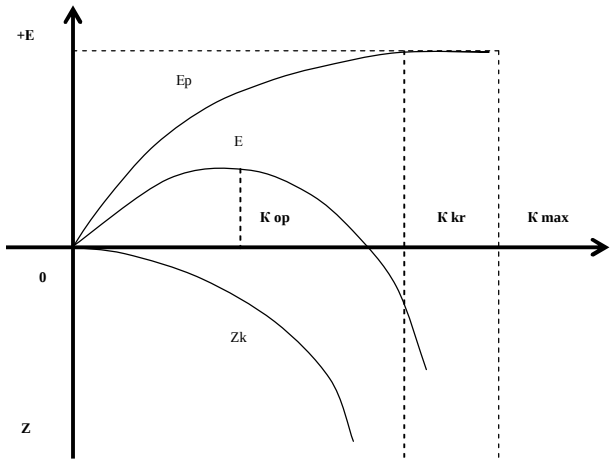

Fig. 4. Graphic representation of total economic effect method to optimize the parameter of aircraft recovery quality

The character of the Ep and Zk dependence from a quality parameter determines the extreme nature of the total economic effect curve E, which allows optimizing the level of aircrafts efficiency. If there are no other restrictions of non-economic nature the level of aircrafts efficiency should be on the limits of economically efficient values of the cost-effectiveness parameter, corresponding value E> 0.

Symbols used in Fig. 4 .: Zk – the costs of providing the aircraft recovery quality, hrn. / hr .; Ep – economic effect of providing aircraft recovery quality, hrn. / hr .; E – the curve of the total economic effect, hrn. / hr .; K op – optimal value of an aircraft recovery quality appropriate to a maximum value of total economic effect; K kr – critical value of an aircraft recovery quality level; K max – the maximum value of an aircraft recovery quality level.

In each certain specific situation, the following options for changing values of relationships are possible. Parameter of recovery quality decreases, and therefore the efficiency by reducing its effect at a cost that survived by his conduct. The value in an extreme point of the positive effect curve Ep in its limit is less than the initial calculation. Accordingly, the total economic impact will change, and the optimum point will shift to the origin. To preserve the optimal level of a quality parameter, it is necessary to reduce the costs of its support with the help of different organizational and technical activities. There is another possible option of changing the optimal value of the quality parameter when its decline is caused by increase of costs for repair and maintenance of aircrafts at the primary level of positive effect.

Determining the economic efficiency of providing quality of aircraft equipment recovery requires not only accounting of the cost but also the obtained effects.

In the process of aircraft equipment use as a result of inspection, overhaul service, supervision, planned repairs some failures and rejections may occur according to which aviation equipment is determined as invalid. If establishing failures and rejections aviation equipment needs to be recovered. Realization of any recovery requires decommissioning of aviation equipment. Due to various reasons the accuracy of control is not full. False establishing of failures (false failures) and rejections (false rejections) together with non detection of real rejections (open rejections) can occur. When false failures occur aviation equipment is removed from service in working condition. When false rejection occur it is removed from service, though in fact is in working condition, but this efficiency will not be used. If latent rejection of aviation equipment – it is not removed from service, but is invalid. Condition of latent failure can be detected in maintenance, planned repairs, main technical parameters control of the aircraft or during operation. Latent rejection is very dangerous for aviation equipment.

After aviation equipment recovery technical parameters are tested and monitored according to Ukrainian State Standard and ISO quality standards and equipment is passed for service. Aviation equipment is in working condition ready for operation.

The above model sufficiently reflects possible operational modes of aircraft equipment, but even its partial review allows evaluating the difficulties of calculating the economic effect of providing the quality of aircraft equipment recovery.

As mentioned above, providing of quality recovery largely affects aircraft equipment efficiency. The volume of these works, the cost should depend on the purpose and conditions of aircraft equipment, operating conditions and economic effects of their conduct.

Purpose of aircraft equipment, its role in modern society influences the nature of its service. Differences in requirements for technical parameters of aircraft equipment cause differences in providing the quality of recovery. But the main principles of costs and economic effect remain common.

The main difference caused by the functions performed by aircraft equipment in the process of its operation, lies in determining of the economic effect of providing aircraft equipment quality recovery.

Aircraft equipment refers to the vehicles, and so the economic effect of providing the quality of recovery can be created by reducing the costs of maintenance and repairs. Also, the effect can be created by reducing transportation costs. Also, certain effect can be created in general within the whole branch of economics where aircraft equipment is used. Thus, providing a fixed level of aircraft efficiency, by providing quality of recovery leads to non increase of operating costs (repair, maintenance), as well as loss from aircraft equipment idle time. Costs on maintaining a large number of reserve spare parts and repair materials don't increase much due to detection of latent failures and false rejection. Ensuring the efficiency of aircraft equipment, and hence its technical parameters allows to provide the quality of recovery. Economic effect of providing stable, timely transportation will be created in addition to an economic effect from operating costs on aircraft equipment. Then it is possible to determine the economic impact of quality of transportation by vehicles, and so the chain of economic effects may be extended.

Depending on the purpose and functions of air transportation one can identify aircrafts for cargo transportation, passenger transportation, military and special aircrafts.

As aircraft equipment has multipurpose use, the economic effect of ensuring the quality of its recovery will have a different composition and will be determined differently. Providing a fixed level of aircraft equipment efficiency due to the quality of recovery, involved in the transportation of raw materials, spare parts and other industrial goods, can promote continuity of implementation of technological processes.

Bad providing of technical condition indicators, and therefore efficiency of aircraft equipment causes inadequate change of operating costs and process in which it participates. That is why the differentiated research of technical indicators impact on determining the economic effect by ensuring the quality of the recovery and maintenance of aircraft equipment is needed. Moreover, character of this impact for different conditions can vary depending on which indicator of technical condition should be provided first. Thus, for the aircraft equipment in difficult weather conditions the accuracy of navigation devices is very important as well as an increased margin of safety of aircraft elements. For commercial cargo aircrafts such indicators as capacity and efficiency are very important. During express transportation speed indicators of aircraft equipment become also important.

Calculation of economic effect requires distinguishing between savings and avoided losses. The aim of our development is to improve the general provisions of economic effect evaluation in case of determining the quality of aircraft recovery.

The economic effect in the form of savings can be reached by reducing the cost of repairs and maintenance of aircraft equipment and the cost of providing the quality of its recovery. The economic effect can also be created by assuring the quality of aircraft equipment recovery, being repaired or maintained. Defect in the construction of aircraft equipment belongs to the avoided loss no matter when it appears: during manufacture or at the stage of its operation and who fixes it (repair company or operating organization).

Due to the difference of objects of economic analysis we should classify the sources of effects. The effects that arise in repair service, call it conditionally manufacturer, effects that arise during the operation of the repaired aircraft equipment (call conditionally consumer). Differentiation of orders of economic effects caused by the difference of their display areas and the need of strict accounting is also needed. For economic analysis we will mention the effects of 1st and 2nd order.

The economic effect of the 1st order in manufacturer - this effect (shows savings of resources) appears when performing work to assure the quality of repair and maintenance of aircraft equipment. This effect may occur due to the improvement of the organization process of repair and maintenance of aircraft equipment, the organization of the recovery process, means of support, increase of employees' level of skills, improvement of recovery process, reducing complexity of work in testing the aircraft equipment, control and reducing costs through occasional defect of renewed details, newly produced components in the repair process of aircraft, reducing the cost for correction of defects and second control of repaired aircraft equipment.

The effect of the second and third orders of consumer is created by changing of the operating costs

of aircraft equipment, as well as by reducing the cost of operation of aircraft equipment.

The proposed economic model for evaluating the quality of repair and maintenance admits determining of the total economic effect. The annual economic effect from assuring quality recovery and maintenance of aircraft equipment, resulting in operation of aircraft equipment (the effect of the second-order), occurs in the form of savings and avoided losses for two reasons. First, eliminate losses due to non-compliance of technical parameters of aircraft equipment to normative and technical values. Second, due to changes in the operating costs connected with the elimination of aircraft equipment idle time due to technical reasons. This allows to get additional income through extra services like people and cargo transportation and consequently to increase total revenue.

CONCLUSIONS

1. In determining the level of aircraft efficiency one should consider not only the technical capabilities of aviation equipment and its service systems, but also economically reasonable limits of providing the parameter of aircraft equipment recovery quality.

2. The research of economic peculiarities of aircrafts reduces to determining costs, economic effects, cost-effectiveness and development of recommendations to improve the quality parameter of aircraft equipment recovery on economic criteria.

3. It was established that in the result of providing optimal level of quality of aircraft equipment recovery appear effects of different order. Effects of the first order include works to assure the working condition of aircraft equipment. Economic effect is achieved by saving directly in the recovery process within aircraft repair plant. Effects of the second order are created by providing working condition of aircraft equipment, elimination of aircrafts idle time and thereby avoiding potential losses, including losses from possible disasters. Third-order effects arise due to the possibility to increase the volume of transportation by increasing of aircraft efficiency.

4. Costs on assuring the quality of recovery and maintenance of aircraft equipment belong to preventive costs on providing working condition of aircraft equipment. They are characterized by the value of work on recovery and maintenance. An important economic effect from assuring the quality of aircraft equipment recovery and maintenance is the effect of avoided loss regardless of the stage at which it appeared: recovery or operation.

5. Application of method of total economic effect for determining the cost-effectiveness of quality assurance of recovery and maintenance of aircraft equipment makes it possible to optimize this process by determining the maximum cumulative economic effect. The annual economic effect from assuring the quality of recovery and maintenance of aircraft equipment, obtained as a result of elimination of reasons of aircrafts idle time caused by their technical state. Revenue generated from the additional services like people and cargo transportation will increase the general profitability of operating organizations.

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Investigation of mathematical models for vibrations of one dimensional environments with considering nonlinear resistance forces

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Abstract. In this paper we consider important classes of one dimensional environments, bending stiffness of which can be neglected. It is impossible to apply approximate analytical method of solution of mathematical models of dynamic processes. So justification of existence and uniqueness of solutions, carried out a qualitative their evaluation, based on numerical analysis are considering in this paper. Also the features of dynamic processes of some of examined class of systems are analyzed. Methods of qualitative study of oscillations for restricted and unrestricted bodies under the influence of the resistance forces, described in this paper are based on the general principles of the theory of nonlinear boundary value problems – Galerkin method and the method of monotonicity. Scientific novelty consists in generalization these methods of studying for nonlinear problems at new classes of oscillating systems, justification of solution correctness for specified mathematical models that have practical application in real engineering vibration systems.

Key words: mathematical model, nonlinear vibrations, nonlinear boundary value problem, Galerkin method, nonlinear elastic properties.

INTRODUCTION

The development of new technology and the transition to high-speed machinery requires the formulation and solution of new problems, mathematical models of which can not be investigated by the asymptotic methods of nonlinear mechanics: the problem of vibrations of flexible elements belt or chain gears tape systems for recording and reproducing information, conveyor lines, different kind of cable lifts, equipment for rolling paper, metal strip, wire, thread, equipment for drilling oil and gas wells, pipelines and others.

In the case of nonlinear elasticity law, significantly nonlinear dependence of oscillation amplitude from the resistance force and so the problem is related with fundamental mathematical difficulties (even in the case when model fluctuations in limited areas are researching), because there is no general analytical methods for solving this class of problems. This problem is generally solved only for a very narrow class of problems. Therefore, there is no general methods for determining the amplitude– frequency characteristics of oscillatory process.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

On the other hand, qualitative methods of the theory of nonlinear boundary value problems allow for a broad class of oscillatory systems mentioned above to get the results for correct solution of the problem (ie, the existence, uniqueness and continuous dependence on initial data). The above method allows to prove the correctness of the solution of a problem in the model and allows with further research of solution to use various approximate (numerical) methods. Thus, the problem of qualitative research methods for nonlinear systems is relevant.

The work is devoted to the research solutions of problem for nonlinear wave equations and systems, which in the model case [1] have the form:

$$\frac{\partial^2 u}{\partial x^2} - a\frac{\partial^2 u}{\partial x^2} + g\left(x,t,\frac{\partial u}{\partial t}\right) = f(x,t), \quad (1)$$

where: a – some function (constant), which characterizes the physical – mechanical parameters of oscillation system, g – nonlinear function, which describes the nonlinear dependence of the oscillation amplitude from the resistance. Problems for hyperbolic equations like (1) and in a form:

$$\frac{\partial^2 u}{\partial x^2} - a\frac{\partial^2 u}{\partial x^2} + g_1(x,t,u) = f(x,t), \quad (2)$$

were: g_1 – nonlinear function in restricted and unrestricted areas were considered in [3–13]. Some results of solution correctness interpretation in these works obtained under the assumption of a qualitative behavior of the solution, the initial data and the right-hand side of equation (system) on infinity, another results – without such assumptions. The work [12] is devoted to research of first mixed problem for second-order weakly nonlinear hyperbolic equation of the form (1). The conditions of existence and uniqueness of a generalized solution in spaces of locally integrable functions received in this paper. In [14] have been studied mixed problem for weakly nonlinear hyperbolic systems of equations of the first order with two independent variables. A similar question for a mathematical model that describes the problem for equation (2) was considered in [15].

Note that the issue of substantiation of well-posedness of certain weakly and strongly nonlinear mathematical models of nonlinear oscillating systems has been considered in the works [7–22]. In particular, in those works there have been developed a methodology of investigating the well-posedness (existence and uniqueness of solutions) of mixed problems for quasi-linear and strongly nonlinear evolutional equations of beam vibration type (in the case of presence of dissipative forces in the system) in bounded and unbounded domains.

OBJECTIVES

Lets discuss a method of qualitative research of mathematical model for nonlinear oscillations of semi-stricted inhomogeneous environment under condition Vincler nonlinear force action:

$$\frac{\partial^2 u(x,t)}{\partial t^2} - a\frac{\partial^2 u(x,t)}{\partial x^2} + g\left|\frac{\partial u(x,t)}{\partial t}\right|^{p-2}\frac{\partial u(x,t)}{\partial t} = f(x,t),\ p>2, \quad (3)$$

with initial conditions:

$$u(x,0) = u_0(x), \quad (4)$$

$$\frac{\partial u(x,0)}{\partial t} = u_1(x), \quad (5)$$

and boundary condition:

$$u(0,t) = 0. \quad (6)$$

In relations (3)-(6):

– $u(x,t)$ – the longitudinal (transverse) movement of environment with coordinate x at an arbitrary point of time t,

– a – constant, which characterizes cross-sectional area of environment, running mass, elastic properties of the environment , etc.,

– $g > 0$ – constant, which takes into account given above characteristics and describes nonlinear resistance forces,

– $f(x,t)$ – the function that describes the distribution of forces along the environment,

– $u_0(x)$ and describing the initial state of the environment (initial rejection – form and initial velocity).

Environment is semi-stricted, therefore $x \in (0,+\infty)$ and the dynamic process we will consider an arbitrarily long time period, so $0 \le t < +\infty$. Everywhere further in this paper use the following notation for arbitrary $R > 0$, $t \in (0,T]$:

$Q_{R,t} = (0,R)\times(0,t)$ – rectangle with base $(0,R)$ on the axis Ox and height t,

$Q_t = (0,+\infty)\times(0,t)$ – halfstrips with base $(0,+\infty)$ on the axis Ox and height t.

For description of qualitative properties of the input data and solution we will use some spaces of generalized functions.

$H_0^1(0,R)$ – space of functions which squares with their derivatives are Lebesgue integrable on the interval $(0,R)$, and at the end of the interval homogeneous boundary conditions fulfilled $u|_{x=0} = u|_{x=R} = 0$. Norm in this space defines as:

$$\|u\|^2_{H_0^1(0,R)} = \int_0^R \left(\frac{\partial u}{\partial x}\right)^2 dx,$$

were: $H^1_{0,loc}(0,+\infty)$ – space of functions belonging to $H_0^1(0,R)$ for arbitrary $R > 0$, where $u(0,t) = 0$,

$L^r_{loc}(\overline{Q})$ – space of functions Lebesgue integral with degree p at the interval $(0,R)$ for arbitrary $R > 0$, and $r \in (1,+\infty)$.

The aim of this work is, in particular, research of the solution for problem (3) – (6) for second order nonlinear wave equation, namely obtaining of correct solution conditions in mathematical model – sufficient conditions for the existence and uniqueness of the solution in the class of locally integrated functions. The specified equation, in particular, describes the forced oscillation of rod or rope in the environment with resistance [2, p. 234].

THE MAIN RESULTS OF THE RESEARCH

Generalized solution of problem (3) – (6) we will call function u, that satisfies the condition (4) and integral identity:

$$\int_{Q_t}\left[-\frac{\partial u}{\partial t}\frac{\partial v}{\partial t}+a\frac{\partial u}{\partial x}\frac{\partial v}{\partial x}\right]dxdt+\int_{Q_t}\left[\left|\frac{\partial u}{\partial t}\right|^{p-2}\frac{\partial u}{\partial t}v-fv\right]dxdt+$$

$$+\int_0^{+\infty}\frac{\partial u}{\partial t}(x,t)v(x,t)dx-\int_0^{+\infty}u_1(x)v(x,0)dx=0, \quad (7)$$

where: arbitrary $t\in(0,T]$ and arbitrary function v with limited carrier are such, that the identity (7) makes sense. Concerning coefficients of right side for equation (3) and initial data lets assume fulfillment of following conditions.

1. Function $f\in L^q_{loc}(\overline{Q})$, and q is the conjugate number for p: $\frac{1}{p}+\frac{1}{q}=1$.

2. The initial deviation $u_0(x)$ belong to $H^1_0(0,R)$ for arbitrary $R>0$, and $u_0(0)=0$; primary velocity $u_1(x)$ is a function that belongs to $L^2(0;R)$ for the arbitrary $R>0$.

The main result of qualitative research: if the mathematical model of an oscillatory process described problem (4) – (6) for the equation (3) under conditions that (1)-(2) exist unique generalized solution $u(x,t)$ of problem (3) – (6), moreover: function u – continuous by variable t on the interval $[0,T]$, and by variable x refers to the space $H^1_{0,loc}(0,+\infty)$; derivative $\frac{\partial u}{\partial t}$ – continuous and locally integrable with degree p by variable t at the interval $[0,T]$, and by the variable x – locally integrable with degree p.

Application of methods of the theory of nonlinear boundary problems for proving existence and uniqueness of solution. Let u^1,u^2 – generalized solution of problem (3) – (6) and problem, which differs from (3) – (6) by the fact, that in the right side of (3) compelled force f is replaced by $\overline{f}$ respectively. Then for arbitrary t,R,R_0 such that $0<R_0<R$, $t\in(0,T]$ one can obtain following estimation:

$$\int_0^{R_0}\left(\frac{\partial u^1(x,t)}{\partial t}-\frac{\partial u^2(x,t)}{\partial t}\right)^2dx+$$

$$+C_1\int_0^{R_0}\left(\frac{\partial u^1(x,t)}{\partial x}-\frac{\partial u^2(x,t)}{\partial x}\right)^2dx+$$

$$+C_2\int_{Q_{R_0,t}}\left|\frac{\partial u^1}{\partial t}-\frac{\partial u^2}{\partial t}\right|^p dxdt\le\left(\frac{R}{R-R_0}\right)^b\times$$

$$\le\left(C_3R^{1+(a-1)\frac{2p}{p-2}}+C_4\int_{Q_{R,t}}\left|f-\overline{f}\right|^q dxdt\right), \quad (8)$$

where: $b>\frac{2p}{p-2}$ are arbitrary number; C_1-C_4 are positive numbers, which depends only from p, b.

Lets justify inequality (8). Put $R>R_0>0$, $t\in(0,T]$ are arbitrary numbers. Let function $j(x)$ is defined as follows: $j(x)=\begin{cases}\frac{R^2-x^2}{R}, & x\le R,\\ 0, & x>R\end{cases}$. Directly easy to see that for the function j following estimation is correct $R-x\le j(x)\le 2(R-x)$.

Let $u^1(x,t),u^2(x,t)$ – generalized solution of problem (3) – (6) and problem, which differs from (3)–(6) by the fact, that in the right side of (3) compelled force f is replaced by $\overline{f}\in L^q_{loc}(\overline{Q})$. Suppose further $w=u^1-u^2$ and make the regularization procedure described in [2, pp. 238–239]. Fix $s_0,s_1\in[0,T]$, $s_0<s_1$. Let q_m – неперервна continuous piecewise linear function on $[0,T]$, $q_m=1$, if $s_0+\frac{2}{m}<t<s_1-\frac{2}{m}$, $q_m=0$ for $t>s_1-\frac{1}{m}$ and for $t<s_0+\frac{1}{m}$, $m=1,2,...$ Let r_n $(n=1,2,...)$ – regulative sequence in the space of infinitely differentiable in $\mathbf{R}$ functions with a compact support $r_n(t)=r_n(-t)$, $\int_{-\infty}^{+\infty}r_n(t)dt=1$, $\operatorname{supp} r_n(t)\subset\left[-\frac{1}{n},\frac{1}{n}\right]$ for arbitrary $n\in\mathbf{N}$. Suppose now $v=((q_m(\frac{\partial w}{\partial t}))*r_n*r_n)q_m j^b$, $b>0$. Symbol $*$ indicated on the last equality means convolution operation. Subtract from equation (3), generalized solution of which is function u^1 similar equation for u^2 with right-hand side $\overline{f}$. Lets multiply both sides of the resulting difference for v and integrate results from 0 to t, $0<t\le T$. As a result, after calculations and transformations similar to those made in [2, p. 238-239], and in limiting transition $n\to\infty$, $m\to\infty$ we will obtain:

$$\frac{1}{2}\int_0^R\left[\left(\frac{\partial w(x,t)}{\partial t}\right)^2+a\left(\frac{\partial w(x,t)}{\partial x}\right)^2\right]j^b dx+$$

$$+\int_{Q_{R,t}}a\frac{\partial w}{\partial x}\frac{\partial w}{\partial t}\frac{\partial j^b}{\partial x}dxdt+$$

$$+\int_{Q_{R,t}} g\left(\left|\frac{\partial u^1(x,t)}{\partial t}\right|^{p-2}\frac{\partial u^1(x,t)}{\partial t}-\right.$$

$$\left.-\int_{Q_{R,\tau}} -\left|\frac{\partial u^2(x,t)}{\partial t}\right|^{p-2}\frac{\partial u^2(x,t)}{\partial t}\right)\times$$

$$\times\left(\frac{\partial u^1(x,t)}{\partial t}-\frac{\partial u^2(x,t)}{\partial t}\right)j^{\,b}\,dxdt=$$

$$=\int_{Q_{R,t}}\left(f-\overline{f}\right)\frac{\partial w}{\partial t}j^{\,b}\,dxdt. \qquad (9)$$

Let's estimate integrals in equality (9) for $\frac{1}{2}+\frac{1}{p}+\frac{1}{p_1}=1$ just as is done in [10]. Considering there evaluations obtained there and using properties of function $j(x)$, we have:

$$(R-R_0)^b\left(\int_0^{R_0}\left(\frac{\partial w(x,t)}{\partial t}\right)^2 j^{\,b}\,dx+\right.$$

$$+C_5\int_0^{R_0}\left(\frac{\partial w(x,t)}{\partial t}\right)^2 j^{\,b}\,dx+$$

$$\left.+C_6\int_{Q_{R_0,t}}\left|\frac{\partial w}{\partial t}\right|^p dxdt\right)\le C_7 R^{\,b+1+(a-1)\frac{2p}{p-2}}+$$

$$+C_8R^b\int_{Q_{R,t}}\left|f-\overline{f}\right|^q dxdt,$$

where: C_5-C_8 are positive constants. From the last inequality is easy to obtain the inequality (8).

Consider the sequence of domains $Q^k=(0,k)\times(0,T)$, $k=1,2,...$ and in each domain Q^k respectively problem:

$$\frac{\partial^2 u^k(x,t)}{\partial t^2}-a\frac{\partial^2 u^k(x,t)}{\partial x^2}+g\left|\frac{\partial u^k(x,t)}{\partial t}\right|^{p-2}\times$$

$$\times\frac{\partial u^k(x,t)}{\partial t}=f^k(x,t), \qquad (10)$$

$$u^k(x,0)=u_0^k(x), \qquad (11)$$

$$\frac{\partial u^k(x,0)}{\partial t}=u_1^k(x), \qquad (12)$$

$$u^k(0,t)=u^k(k,t)=0. \qquad (13)$$

Note that in equation (10) functions $f^k(x,t)=\begin{cases}f(x,t), x\le k,\\ 0, x>k.\end{cases}$ Besides this, instead of function u_0 considered u_0^k, where

$$u_0^k(x)=u_0(x)\cdot x^k(x),\quad x^k\in C^1(\mathrm{R}),$$

$$x^k(x)==\begin{cases}1, x\le k-1,\\ 0, x>k,\end{cases}\ 0\le x^k(x)\le 1.$$

It is clear that functions $u_0^k\in H_0^1(0,k)$ and $\lim\limits_{k\to+\infty}\left\|u_0^k-u_0\right\|_{H_0^1(0,k)}=0$. Instead initial function u_1 were reviewed u_1^k – constriction of function u_1 at $(0,k)$, $u_1^k\in L^2(0,k)$, $\lim\limits_{k\to+\infty}\left\|u_1^k-u_1\right\|_{L^2(0,k)}=0$. Under a generalized solution of problem (10)-(13) we understand the function u^k, which satisfy (10), (11), (13) and the integral identity similar to the identity (7), which is consider in the area Q^k, and function v is chosen integrable with her derivative by time variable, and by spatial variable is locally integrable with degree p.

Note that in the above conditions exist unique generalized solution of the problem (10) – (13) in Q^k [2, p. 234]. Consider now sequence of problems of the form (10) – (13) for $k=1, k=2,...,$ redefinding u^k by zero at $Q\setminus Q^k$. We obtain a sequence of solutions of problem (3) – (6) in Q, which for convenience we again denote as $\{u^k\}$. Similarly as is done in [10] we show that the sequence $\{u^k\}$ and $\left\{\frac{\partial u^k}{\partial t}\right\}$ are fundamental in appropriate functional spaces. It is obviously that for function u, conditions (4)–(6) is true. Consequently, the function $u(x,t)$ is a generalized solution of problem (3)–(6) in sense of the integral identity (7).

The uniqueness of the obtained solution follows from inequality (8) for $R\to+\infty$, if we consider two arbitrary solutions u^1 and u^2 of problem (3)–(6) and consider that

$$u^1(x,0)=u^2(x,0),\ \frac{\partial u^1(x,0)}{\partial t}=\frac{\partial u^2(x,0)}{\partial t}.$$

Note, that for problem (3) – (6) is easy to obtain sufficient conditions for the existence and uniqueness of periodic by linear variable generalized solution.

The results of numerical integration in the model case. Consider the special case of equation (3), namely the case of natural oscillations of a continuous environment, provide by constant along its length physical and mechanical properties, ie

$$\frac{\partial^2 u}{\partial t^2}(x,t)=a\frac{\partial^2 u}{\partial x^2}(x,t)-g_0\left|\frac{\partial u}{\partial t}(x,t)\right|^{p-2}\frac{\partial u}{\partial t}(x,t).$$

In the latter relation a and g_0 are constants and boundary conditions take the form $u(0,t)=u(l,t)=0.$ Due to original form, it is described as:

$$u_0(x)=\begin{cases}\dfrac{2hx}{l}, & 0\le x\le\dfrac{l}{2}\\ 2h-\dfrac{2hx}{l}, & \dfrac{l}{2}<x\le l\end{cases}.$$

We feel that the initial velocity of continuous environment points is zero, i.e., $\frac{\partial u}{\partial t}(x,0)=0$. The problem describes transversal oscillations of threads (rope) that at the initial time loaded by concentrated force at the point with coordinate $x=\frac{l}{2}$. The above problem is of the form (10) – (13). As shown above, there is unique generalized solution of this problem. Therefore, for the numerical integration of the equations of motion is the choice of method is principal only in computer needs. Examined equation we will reduce to a system of two equations like:

$$\begin{cases}\frac{\partial u}{\partial t}(x,t)=v(x,t),\\ \frac{\partial v}{\partial t}(x,t)=a\frac{\partial^2 u}{\partial x^2}(x,t)-g_0|v(x,t)|^{p-2}v(x,t).\end{cases}$$

We divide the interval $[0;l]$ by discretization points $[0;l]$ by discretization points $x_i=i\frac{l}{n}$ at n parts with length $\Delta=\frac{l}{n}$. We approximate the derivative by spatial variable with finite difference:

$$\frac{\partial^2 u}{\partial x^2}(x,t)=\frac{u(x_{i-1},t)-2u(x_i,t)+u(x_{i+1},t)}{\Delta^2}.$$

Numerical solution of system of ordinary differential equations:

$$\begin{cases}u'(t)=v(t),\\ v'(t)=L(t,v),\end{cases}$$

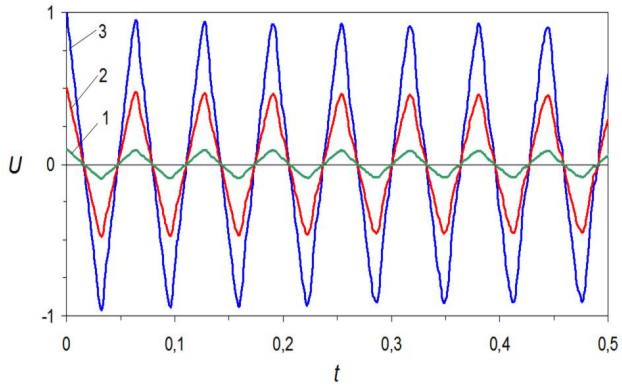
where: $L(t,v)=a\frac{\partial^2 u}{\partial x^2}(x,t)-g_0|v(x,t)|^{p-2}v(x,t)$,

implemented by the Runge-Kutta fourth order method:

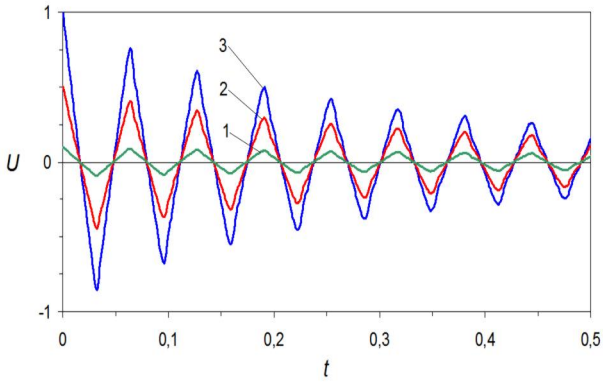
$$\begin{cases}u_{k+1}=u_k+v_k\Delta t+\frac{\Delta t}{6}(k_1+k_2+k_3),\\ v_{k+1}=v_k+\frac{1}{6}(k_1+2k_2+2k_3+k_4),\end{cases}$$

moreover:

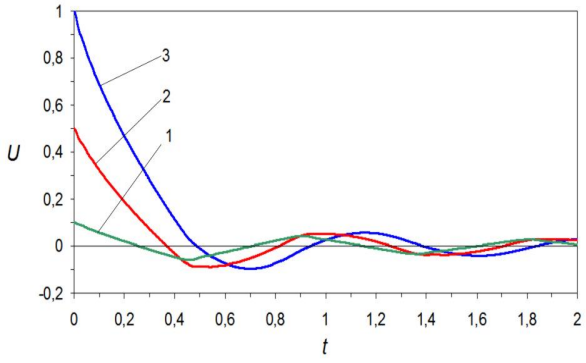
$$t_k=k\Delta t,\ u_k=u(t_k),\ v_k=v(t_k),$$



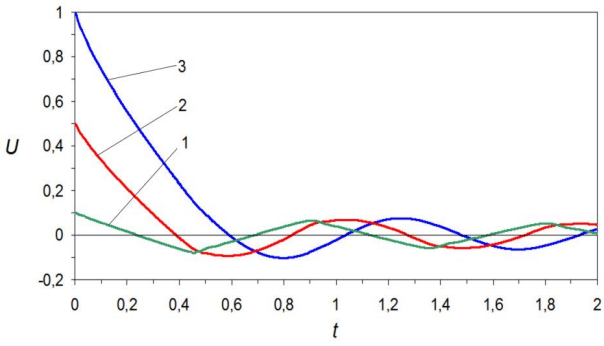
a) $a=1000$, $g_0=1$, $p=2{,}1$.



b) $a=1000$, $g_0=1$, $p=3$.



c) $a=5$, $g_0=6$, $p=3$.



d) $a=5$, $g_0=6$, $p=4$.

Fig. 1. Laws change of environment mid-point deviation with the different parameters a, g_0, p

$$\begin{cases} k_1 = L(t_k, u_k, v_k)\Delta t, \\ k_2 = L\left(t_k + \dfrac{\Delta t}{2}, u_k + v_k \dfrac{\Delta t}{2}, v_k + \dfrac{k_1}{2}\right)\Delta t, \\ k_3 = L\left(t_k + \dfrac{\Delta t}{2}, u_k + v_k \dfrac{\Delta t}{2} + \dfrac{k_1}{4}\Delta t, v_k + \dfrac{k_2}{2}\right)\Delta t, \\ k_4 = L\left(t_k + \Delta t, u_k + v_k \Delta t + \dfrac{k_2}{2}\Delta t, v_k + k_3\right)\Delta t. \end{cases}$$

Fig. 1a – 1d presents the graphic changes over time of deviation in time from the equilibrium position of the environment mid-point under different initial deviation from equilibrium (curve 1- $h = 0{,}1$; curve 2 - $h = 0{,}5$; curve 3- $h = 1$) taking into account the different models of the resistance force and for other values of dimensionless parameters of the system.

CONCLUSIONS

Obtained in proposed work qualitative results and graphical depending show:

1) the presence of the resistance force leads to damping of environment oscillations;

2) the rate of damping depends largely on the degree of nonlinearity of the resistance force;

3) by a considerable nonlinearity resistance force ($p = 3$) dynamic process is aperiodic;

4) the impact of the resistance force at the period of oscillation for small values of parameters *g*, *p* and *h* is insignificant. The latter also confirmed by asymptotic integration of specified differential equations.

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The method of automatic summarization from different sources

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Abstract. In this article is analyzed technology of automatic text abstracting and annotation. The role of annotation in automatic search and classification for different scientific articles is described. The algorithm of summarization of natural language documents using the concept of importance coefficients is developed. Such concept allows considering the peculiarity of subject areas and topics that could be found in different kinds of documents.

Method for generating abstracts of single document based on frequency analysis is developed. The recognition elements for unstructured text analysis are given. The method of pre-processing analysis of several documents is developed. This technique simultaneously considers both statistical approaches to abstracting and the importance of terms in a particular subject domain. The quality of generated abstract is evaluated. For the developed system there was conducted experts evaluation. It was held only for texts in Ukrainian. The developed system concluding essay has higher aggregate score on all criteria.

The summarization system architecture is building. To build an information system model there is used CASE-tool AllFusion ERwin Data Modeler. The database scheme for information saving was built.

The system is designed to work primarily with Ukrainian texts, which gives a significant advantage, since most modern systems still oriented to English texts.

Key words: annotation, abstracting, national system of abstracting, heterogeneous data, analysis.

INTRODUCTION

Automatic abstracting (came from *Automatic Text Summarization*) is a creation of summaries of materials, summaries or digests, that is getting of the most important data, from one or from several documents and generation on their basis laconic and informal sated reports. There are two directions of automatic summarization – quasi summarization and a maintenance summary.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

As a branch of practical activities summarization was generated in depths of library-bibliographic and journalistic practice. In the beginning of XX century the basic task of summarization is full reflection of the maintenance of the primary source on what the attention of experts – experts has been concentrated. Activation of development of theoretical questions of annotation was promoted by introduction of system of the annotated printing card in 1925. During this period appears a lot of works where the concept of "summary" was considered, classification of summaries and general provisions concerning their drawing up was directed. Very fruitful was a worked out the scheme of the summary offered by O.G. Fomin [1]. He opened about 30 information elements which are used in texts of summaries, having allocated among them the main things homogeneous behind a design and the form.

With formation and development of computer science a new stages in development summarization were based, on the agenda the attention to the question of algorithmization and automation of this process was brought. Problems of summarization which gets an interdisciplinary character are studied by bibliographers, linguists, philosophers, experts in branch of computer science, computer facilities and cybernetics. In

researches of 1970th years the attention was concentrated on principles of manual summarization and possibilities of formalization of the given process with computer facilities use. The great value is got by problems of automation of semantic processes which developed behind three basic directions. The first – has been connected with introduction of inquiries to system. This process requires the previous semantic transformation of inquiry that is construction on demand of the search instruction which is already entered to the information retrieval system. The second direction covered the search processes connected with comparison behind certain rules of search images of inquiries which have arrived to system, and to a documents which remain there. The third direction pursued the aim of automation to input documents to the information retrieval system. Among its processes the central place is occupied with questions of automation of indexing, annotation and summarization. More details about problem automatic summarization you can see on VINITI analytical review [1].

Statistical methods are based on the American scientific G. Lun's [7] workings out which the first in 1958 has received the machine abstract. He has suggested to carry out selection of offers on the basis of frequency of the use of words in the offer (this is more often, there is a word in it, the above its semantic weight), and also in view of the location of significant words in the offer. In selection of offers to the abstract for each of them “the semantic weight” is defined. Than more words which often meet, appear nearly, the more especially essential information is contained by the offer, as should join in the abstract.

G. Lun's ideas stimulated the subsequent workings out from automation summarization, based on the statistical analysis of texts. Techniques of Russians V. Agraev, B. Borodin [7] and V. Purto [11] became the most known. First two have offered a technique; agree with which offers chosen from the text appear connected among themselves. The most connected that is why such which are subject to inclusion to the abstract, offers which contain the greatest quantity of identical significant words are considered.

V. Purto, V. Gorkov [11] has developed a method of an estimation and selection of offers behind quantity of the information which they contain [7]. In this case texts are subject to the statistical analysis for revealing of frequency of the use of words. Words which are used in the scientific and technical literature more often, terms are. The researcher confirms: the more important term, the more often it meets in the text, and offers will contain a maximum quantity of these terms are selected. The volume of the abstract received in such a way makes, as a rule, no more than three offers, irrespective of volume of the primary document.

In case of use of a statistical method of summarization the volume and quality of abstracts completely depend on statistical characteristics of the text, therefore offers, which contain the major information (for example, conclusions in scientific articles, patent formulas in descriptions of inventions), can be not allocated absolutely not and not enter to the abstract. However, lacks are defined, to a certain extent, are compensated thanks to simplicity of the analysis and uniformity of abstracts which were prepared by means of the computer. It stimulates works in such direction in many countries.

Item methods are based on the direction of better work the most significant offers aimed at perfection in texts with attraction of a difficult mathematical apparatus. Selection is carried out on principles of four interconnection methods: a hint, keywords, the title, localization.

The essence of a method of a hint consists in use during selection of offers of the list of words in which words with positive, negative semantic weight and “zero” (neutral) are preliminary allocated. At selection words which transfer a positive and negative estimation are considered only. In case of use of a method of keywords the words selected by a frequency principle and to this sign defined key, there are considered in similar to the offered G. Lun [7] to the approach. In a method of the title the leading role is taken away to the dictionary of the terms selected from the title and subtitle which have big “weight”, than words from other offers of the text. To the abstract offers where there are terms which are in the dictionary are selected. The localization method is based on the assumption, that the most essential information concentrates in the beginning or in the end of a certain fragment or the text paragraph. Comparison of all has shown four methods, that the method of keywords provides completeness of reflection of the maintenance of the primary document on 15–40 %, a title method – on 30–40 %, and general use of methods of a hint, the title and localization – on 30–60 %.

This approach has got the subsequent development during working out of indicative methods of summarization compared with which statistical and item methods play an auxiliary role. Indicative methods give the chance to formalize on the basis of parse a statement of the basic maintenance of the primary document in the abstract of cable style. To parse can be subject both all text, and its separate fragments which contain typical markers.

In the early eighties science officers of Moscow and Leningrad had been offered a technique formalized summarization with use of markers for texts from electronics. According to with this technique process automatic summarization is shown to two procedures:

own extracting (that is recognition in the text of the primary document of the marked offers and their deliveries on the printer); post editing (during it there is an elimination of logic and semantic repetitions, superfluous turns and also inclusions of necessary semantic sheaves between phrases). In this technique that post editing is carried out is positive is formalized and can be carried out not only experts in certain branch of knowledge, but also librarians, bibliographers who own bases of summarization. In the long term authors intended to realize the given technique so that the user independently defined a priority and made a choice of the aspects of the maintenance necessary to it (individual summarization) and, at necessity, a smog receive the corresponding abstract review of a file of primary sources [4].

The question of automation of semantic processes is considered and on pages of the Ukrainian professional editions. As a whole generalization of domestic and foreign experience testifies that the main aspects of research of problems of summarization are the history, the theory and a technique, and also the organization of processes of analytic-synthetic processing of the information.

SJ (summarization journal) were one of the very first forms scientifically information publications and within last century have gained the greatest distribution among the given kind of editions. And the abstract and the summary is one of the major means of scientific communications who function independently in separate systems (the scientific and technical information, libraries, publishing houses) and simultaneously carry out function of communication during an information transfer from one system to another. Theoretical and methodical aspects of analytic-synthetic processing of documents always were and remain in the centre of attention of experts in library business and scientifically to an information work [19, 20, 21].

Recently release of scientific and other editions not only in printing, but also the electronic form quickly extends [2, 8, 9]. Possibilities of carrying out of contextual search directly behind texts of publications have appeared and develop, that, apparently, does SJ superfluous. But such conclusion is erroneous. Information search behind abstracts which are collected in one file and in which in the compact form the basic maintenance of publications is stated, provides high revelation the received results while navigation behind full texts of publications in which there are almost all words of a natural language, causes considerable search noise. Therefore the subsequent development of computer technologies will lead not to dying off of the abstract information in the printing or electronic form, and to growth of its role, including as to navigation means in electronic libraries. Almost for 170 years of the existence the abstract information was well entered in system of scientific communications which has developed and for which for today there is no adequate replacement.

In view of continuous and fast growth of quantity of the printing and neo published information in the modern world and increases of the prices for a subscription, one of the most real and its valid means full coverage in the course of formation of an information DB are close cooperation of libraries and information centers from creation of the distributed information resources for mutual use. To solve these questions probably by creation of the big information systems for the purpose of fuller coverage subjects and a timely information transfer, elimination of unjustified duplication, the account of economic advantages from cooperation of libraries and information centers – participants of systems for analytic-synthetic processing and indexing of documents and so forth are created. Integration of information systems promotes increase of efficiency of an information work, its faster development and perfection [5, 6].

OBJECTIVES

Purpose of this paper is to improve the efficiency and quality of summarization method in text by the use of the combined algorithm and create own measure. This measure we can use for the sentence ordering method. This is the problem of taking several sentences, such as those deemed to be important by an extractive summarizer, and presenting them in the most coherent order. After that we will use text revision method. Sentence revision involves re-using text collected from the input to the summarizer, but parts of the final summary are automatically modified by substituting some expressions with other more appropriate expressions, given the context of the new summary. And the last method is sentence fusion. Sentence fusion is the task of taking two sentences that contain some overlapping information, but that also have fragments that are different. The goal is to produce a sentence that conveys the information that is common between the two sentences, or a single sentence that contains all information in the two sentences, but without redundancy.

THE MAIN RESULTS OF THE RESEARCH

We will analyze the document *D:*

$$D = \{T, K, A, M, L\}, \quad (1)$$

where: T is name, K is the set of keywords, A is the set of authors, M is main part, L is literature [3].

Defining elements of the document is based on the allocation of such text features [17-18]:

– location in the document;
– location of a paragraph (left, right, centered);
– type of writing (bold, italic, underline, normal);
– character recognition.

Based on these characteristics formed the basis of the rules of recognition elements of the document (Table 1).

Table 1. The rules of recognition elements of the document

id	type	place	paragraph	alpha	symbols
1	title	BEGIN	{Center;Right}	{Bold}	
2	author	BEGIN	{Center; Left}		{By;©: (C) }
3	keyword	BEGIN			{Keyword; Keywords; Ключові слова; Ключевые слова}
4	main	CENTER			
5	literature	END		{Typical, Italic}	

To form essay there is stand out from the main part of the sentence.

Bulk, in turn, is divided into fragments by divisions and sections, introduced by the authors. It is believed that the sentences that appear in the introduction and conclusion, with higher informative value than a sentence with the middle of text.

The sentence ordering method

First of all, we introduce the concept of weight sentence.

The coefficient is defined as the location:

$$Location = \frac{1}{n \cdot m}, \quad (2)$$

where: $n = \overline{1..3}, m = \overline{1..3}$ – the place calls to the main part and paragraph respectively. Begin and end of text or paragraph estimated value of 1, the middle is as 3.Coefficient key phrase is determined by entering the sentence *U* of elements of a set of significant sentences from *A* membership function:

$$Cuephrase = m_A(U), \quad (3)$$

where: *A*={"Conclusion", "In the end", "By the way"…}.

Index of statistical significance is formed on the basis of visiting sentence keywords specified by the author of the article:

$$Statterm = m_K(U). \quad (4)$$

The value added is defined as the presence of terms related words sentences that appear in the article's headline to the total number of words in a sentence (words) except for words whose length is less than 3 characters:

$$Addterm = \frac{word}{words}. \quad (5)$$

The weight of text block *U* is:

$$Weight(U) = Location(U) + Cuephrase(U) + Statterm(U) + Addterm(U). \quad (6)$$

The text revision method

So after studding all the documents it is necessary to accomplish the following: to exclude a statement with hit the consolidated data repository and to perform the final sorting sentences. For the bringing task of the final ranking factor "information novelty" there is used the following method:

1. Let we have two sets of sentences $B = \varnothing$ i $A = \{A_i | i = 1,2,...,N\}$, N is count of sentences in text. For every sentence A_i the usefulness $P(i)_i$ set q_i: $P(i)_i = q_i, i = 1,2,...,N$.
2. The sentences from set A sort Descending $P(i)_i$.
3. If A_i has the biggest $P(i)_i$, we take it in *B*. The usefulness for sentences in A set s $P(i) = P(i)/kq_i$, where: $k > 0$ – factor clipping similar sentences.
4. Is *A* empty? If NOT, go to 1.

The sentence fusion method

The next problem is information estimating from different sources [15- 16]. For semi-structured data type text file with a known format – dictionary data types defined formatting released the text of the formatting, copying its contents:

$$object \rightarrow Find(p_{firmattype}(s_{object}(Dic))),$$

```
for each object:
Selection
  ParagraphFormat.Alignment = Left (1, formattype),
  Font.type = Mid (formattype, 3, 1),
  Font.Caps = Right (formattype, 1),
  InStr (1,. Text, Right (formattype, 2),
Copy.Selection.
```

Sentence fusion is the method fro semantic network building. The algorithm of semantic network building consists of such steps:

- Find subject constants in dictionary $par \rightarrow Find(s_{par}(K))$,
- Text selection: par.Selection,
- Words selections situated behind subject constants: S=Right (.Text, Find(' ∨ ',' ∨ '.')),
- $Create(par, Cg')$,
- $Insert(Cg', S)$,

The information system building

To build an information system model there is used CASE-tool AllFusion ERwin Data Modeler, which enables model based infological model of information system build its datalogical model and create a database in any database management system. The development of the summarization system provides in the notation IDEF1X. The projected information system contains the following information objects (entities, IE) [10] (Fig. 1).

Sentence contains information about all the sentences in the text. The given entity has the following attributes:

- SentenceID serial number sentence;
- WordsWeight (Weight of words) is value of the sum of weights of all the words that make up sentences,
- Format is the sentence weight based on its format,
- Place is the sentence weight based on its location in the text,
- Sum is the sum of weights of the previous attribute that determines the total weight of the sentence.

Keywords contain information about all the key words in the text. The given entity has the following attributes:

- WordID contains the serial number of words,
- Word contains the word,
- Frequency is the weight of words, depending on the frequency of its appearance in the text,
- Place is the weight words depending on its location in the text,
- SentenceID is the order number sentence.Format is the weight words depending on its format,
- UserWeight is the weight of words defined by the user,
- Sum is the sum of the weights of previous attributes so that the total weight of the word.

Words-Sentence contains information about the relationship between words and sentences in the text. The given entity has the following attributes:

- ID is the serial number of communication,
- WordID is the serial number of words.

The main process in projected system "The abstract forming" divided into 5 subprocesses "Decode information from external format", "Wrapping text Structural branches", "Formation keywords", "Assigning weights", "Conclusions." These subprocesses performed in the system sequentially, one after the other. To perform "Decoding information from external format" subprocess on the entrance to it submitted data, which can change in the course of work. Such data are publication, the results of scientific research, scientific article. They enter the system as a result of user actions. The result of this execution and the input data according to "Wrapping text Structural branches" subprocess is a text information, ie data that entered the system after "Decoding information from external format" subprocess implementation are converted to the corresponding data format for the system in which they is ready for further processing. Due to performance "Wrapping text Structural branches" subprocess text information is divided into parts of a sentence. This subprocess occurs following the developed method. The result of this is a set of subprocess proposals submitted for subprocess entrance "Formation keywords" for further processing and for entrance "Assigning weights" subprocess. These subprocess are governed by rules of evaluation of proposals, and it uses a knowledge base. The result of "Assigning weights" subprocess is evaluated sentence. They arrive at the entrance to "Conclusions" subprocess given the results obtained as a result of the implementation of all previous subprocesses forms the abstract as the final result.

For the developed system there was conducted experts evaluation. It was held only for texts in Ukrainian. Method of estimation was as follows. Five experts were presented document the source and received on the basis of his essay. Experts answered the following questions by selecting the response under such scale evaluation [12-13]:

- To what extent abstract reflects the content of the documents? (1 – does not reflect, 2 – not quite complete, 3 – satisfactory).
- Is there redundancy in the abstract? (1-way too much, 2 – so not too much, 3 – no).
- Satisfies the abstract properties of connectivity text? (1 – or 2 – there are no related sentences 3 – true).
- Estimate the length of the essay (1 – very long, 2 – very short, 3 – the best).

The results of expert assessments are shown in Table 2.

- Most part of experts lowered estimates because there are sentences which violate the connectivity pattern of the text. The developed system concluding essay has higher aggregate score on all criteria. Highest rated experts put in the assessment of completeness, which means that the system is fairly accurate translation of the original document.

Developed automated system concluding essay can significantly reduce the time spent on drafting an essay in comparison with other systems summarization. Its algorithm is simple enough, but it has several advantages:

1. The use of weighting coefficients significantly improves the quality of the essay;
2. The user can determine the weight of certain terms, depending on what topic focused essay he wants to;
3. The system is designed to work primarily with Ukrainian texts, which gives a significant advantage, since most modern systems still oriented to English texts.

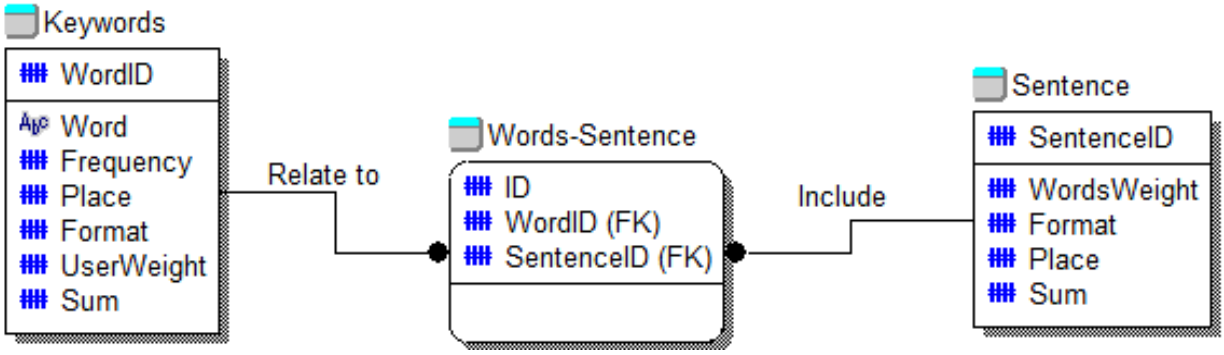

Fig. 1. Entity-relation diagram. The attribute level.

Table 2.Expert marks of essay quality

The method	Expert number	Completeness	Redundancy	Connectivity Evaluation	Length Evaluation
Projected system	1	2	2	2	3
	2	3	2	1	1
	3	3	3	3	2
	4	2	1	2	3
	5	2	3	2	3
	AVG	2,35	2,05	1,89	2,22
Autosummarize in Microsoft Office	1	2	1	2	1
	2	3	3	1	2
	3	3	2	3	1
	4	1	1	1	1
	5	2	1	2	3
	AVG	2,05	1,43	1,64	1,43

CONCLUSIONS

1. The method of generating abstracts based on the developed models and methods of frequency analysis of terms in sentences and determining the weight of sentences was invented.

2. Summarizing of documents is an urgent and important task, which is very difficult for modern system of abstracting. Resources for referencing could have varied nature, so traditionally they required different pre-processing but using weights theory increases the quality of the resulting abstract. Methods of abstracting which are considered in this thesis can be successfully applied in modern information systems.

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Analysis of business processes in electronic content-commerce systems

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Abstract. Practical factor of information resources processing in electronic content commerce systems (ECCS) is related to solving problems with increase in content amount on Internet, active development of e-business, rapidly spreading Internet accessibility, information products and services extension set, increasing demand for content. The aim was to develop methods and software of information resources processing to improve the efficiency of ECCS due to increased sales of content. Article is devoted to the standardized methods and software development of information resources processing in ECCS. In this paper an actual scientific problem of development and research in methods and means of information resources processing ECCS was solved with use of designed classification, mathematical providing and software and generalized ECCS architecture. ECCS classification was researched and improved on the basis of analyzing and evaluating of such systems. It made possible to determine, detail and justify choice of their functional possibilities for content lifecycle designing. The task of developing methods and software formation, management and support of information products resolved with a theoretically grounded concept by automating information resources processing in ECCS to increase content selling for constant user, by involvement of potential users and expanding the boundaries of the target audience.

Key words: information resources, content, content lifecycle, electronic content commerce system.

INTRODUCTION

Rapid development of the Internet contributes to increasing needs in receiving operative data of productive and strategic nature and implementation of new forms of information service. Documented information prepared in accordance with user needs is an information product or commercial content and main object of e-commerce processes. The issue of design, development, implementation and maintenance of e-commerce content is relevant in view of factors such as lack of theoretical foundation of standardized methods and the need for unification of software processing of information resources. Principles and technologies of electronic content commerce are used in creating online stores, systems for on-line and offline sale of content, cloud storage and cloud computing. The world's leading manufacturers of informational resources processing tools such as Apple, Google, Intel, Microsoft, Amazon are working in this direction.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

Term content or filling has few interpretations according to the direction of application [1-2]. For the computer science branch – it's informatively meaningful filling (for example: graphics, multimedia) of the information resource [2]; variety of all values, operated by information system [2]; certain generalized notion of data without pre-defined structure [2, 9]. Respectively, information resource – is a totality of structured/non structured content arrays in information system, for example: libraries, archives/repositories, funds, portals, directories/vocabularies, data banks/bases/warehouses, electronic commerce systems etc. [1-2]. Commerce content notion is determined as information resources

contents in electronic content commerce system (ECCS); ECCS business process object (for example: article, software, book etc.); structured variety, logically completed information, which is an object of relations between user and ECCS; data set without pre-defined structure, that exist only in electronic form; information of commercial appointment, indivisible in time; main factor of activity area formation, ECCS functioning and appointment [1-2, 33-38].

OBJECTIVES

This article describes the features, lifecycle phases and commerce content services management. The detailed analysis of content management systems and prospects of electronic content commerce systems implementation is made. A detailed classification of content commerce systems and electronic content commerce systems is made. Business processes, content flows, tools, content management systems models are analyzed. Methods and tools of content management, their advantages and disadvantages are described. Modern Internet progress causes increasing needs as in productive factor information so strategic resource information, and realization of new information service forms [1-38]. Documented information prepared in accordance with users needs and appointed to satisfy them is an information product or commercial content [2]. Actions for providing users with commercial content are information service. The Internet market is a totality of economic, law, organizational and program relations for sale/purchase of information products and services between developers/providers and users [2, 6-9].

THE MAIN RESULTS OF THE RESEARCH

Content distribution market provides technological progress of operational content preparing, which is available through information resources and depends on perception, image, and preservation of his values. For processing and solving certain tasks information system moderators are formalizing, analyzing, formatting and structuring content. Structuring process is content unit determination, methods and orders of their combination amongst themselves and bigger from smaller content elements formation [2]. Formed content arrives to data base/warehouse, where his directions/subjects are defined, for example: electronic publications with bigger demand coefficient from information resource visitors/users
(Fig. 1). Structured content is concentrated, for example, in ERP/CRM, and non structured – in e-mail's, freeform working papers and collective work provision tools and stored, for example, in ECMS [2].

Content lifecycle is complicated process, which content passes while being managed through different stages/phases of publication with such set of properties, as collaboration, inventory management, digital assets and versions that are supported by various technologies [2]. Existing e-commerce tools give system administrator/ moderator various content management possibilities (form, formalize, structure, add, edit, delete), but does not solve automating information resource processing problem. So content lifecycle realization is requires tools that realize forming processes, content management and support. Content is characterized by renewability/ modification time and has a set of specific properties (Fig. 2). Content volume is measured in information quantity units (bit/byte). Quantity/quality of content characterizes user's degree of interest to information resource, where it is located [2]. Web-content – text, visual, sound content or part of information resource user's experience. Business process management is an important phase of commercial content lifecycle. Determining commercial content parameter *topicality/accuracy* (latest information about defined question) requires clear business process management on the basis of workflow.

Economic content is an element of e-business subject economic activity (Fig. 3).

Content market based on Internet with information technologies knowledge management is a tool, that helps e-business functioning with commercial content spreading and his profitability growth for e-commerce subjects [1-2, 9, 17-20]. *Commercial content* is and

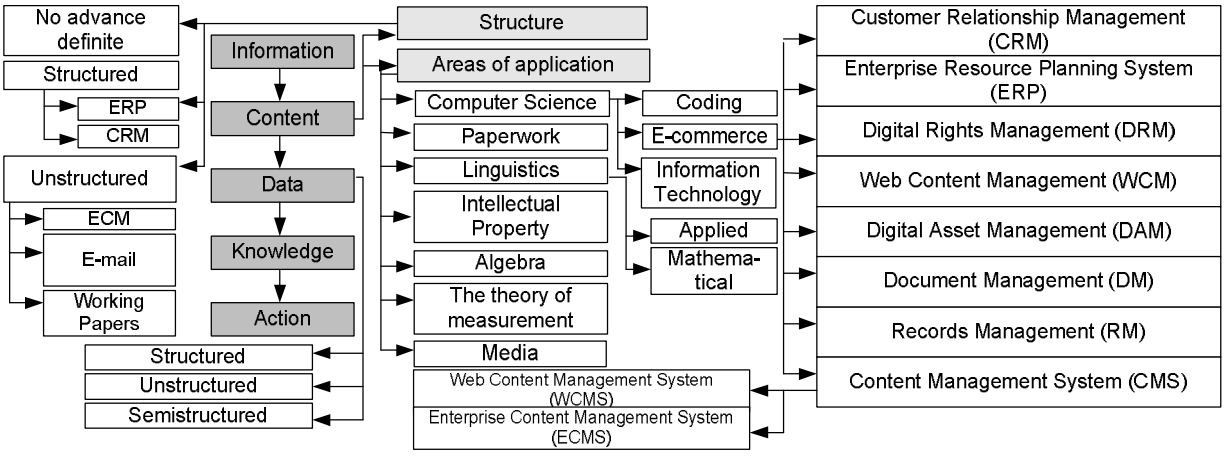

Fig. 1. Structure and directions classification of content use

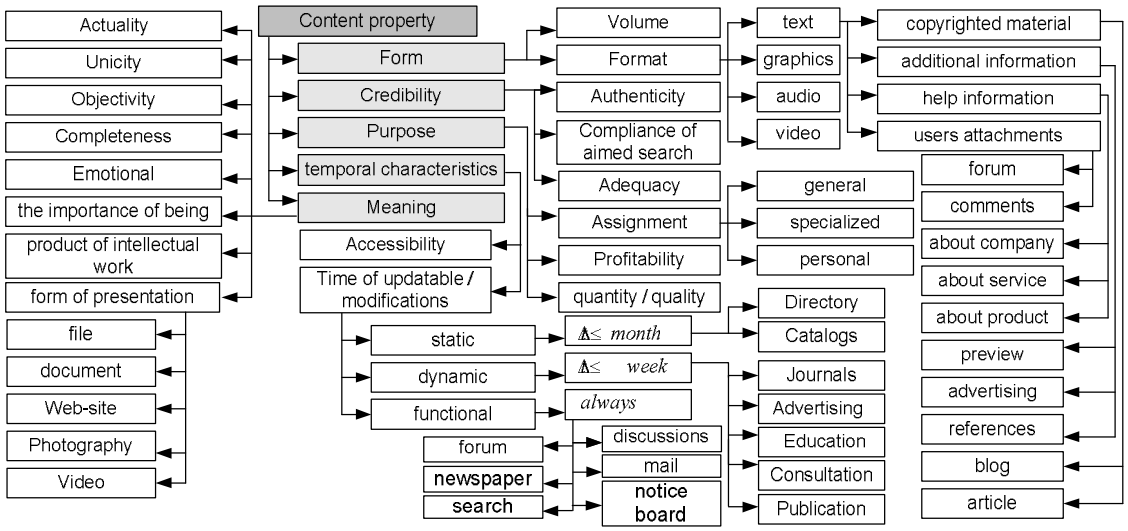

Fig. 2. Main content properties

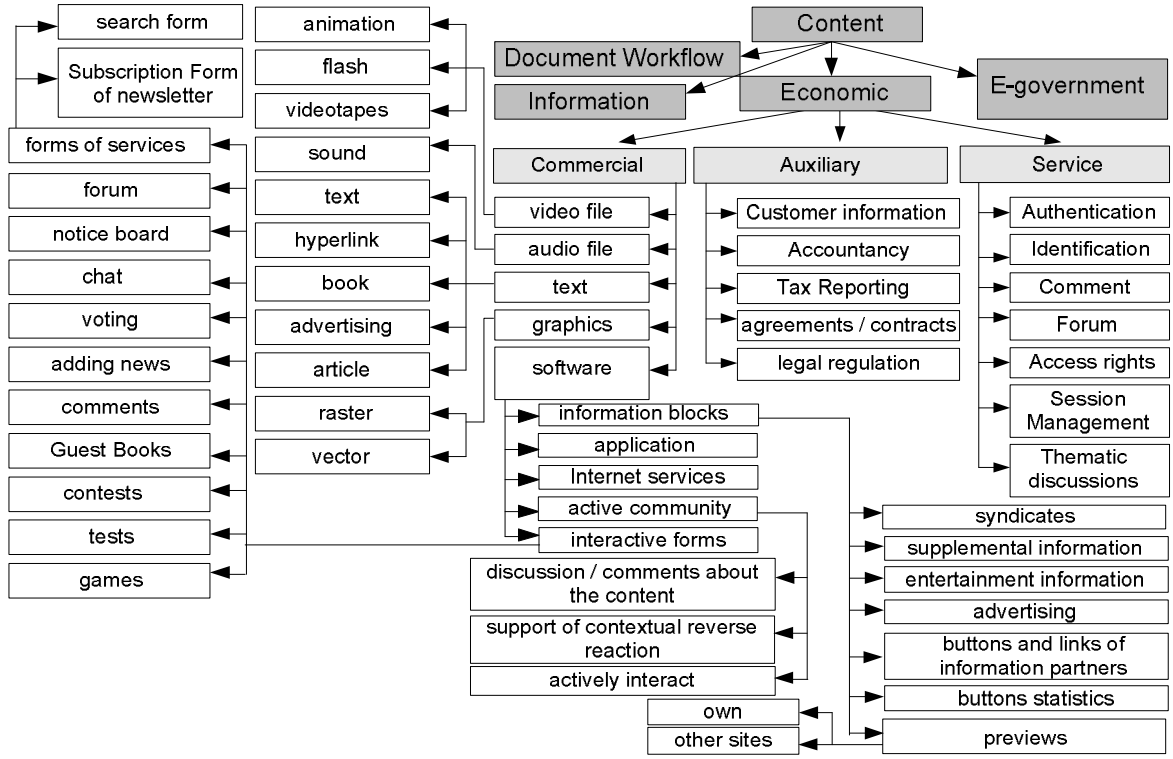

Fig. 3. Economical content classification

object of purchase and sale between e-commerce members [2], for example: information block that is divided into blocks (exchange rates, weather block), other sections/resources materials announcements (with links), referential information (holiday dates, event announcements, and train timetable) entertaining information (anecdote of the day), advertisement, buttons and information partners links, statistic buttons. EMC, IBM, Microsoft Alfresco, Open Text, Oracle and SAP corporations developed content management Interoperability Services (CMIS) specifications on Web-services interface for content management systems interaction (Table. 1). CMIS does not specify single system and security parameters configuration and does not solve integration problems [2, 9, 17-20]. Interoperable Content Application tools interact with content from different repositories via service interface and special module CMIS Implementation that is developing by each CMIS member [2, 17-20].

Electronic commerce is an e-business separate case (table. 2), for which commerce content is valuable asset [1-2, 9]. For fast business growth effective e-commerce policy is taken into account: protection of intellectual property; interactive confidence (content protection/privacy); free/open trading; active investments in infrastructure [1-2].

Table 1. Content Management Interoperability Services standard characteristics [17-20]

Name	Characteristic	Explanation
Standard goals	Single service	Allows application to determine operation variety that is performing in current context by specific user above specific object.
	Data integration	Providing new applications work with available repositories (archive data warehouses) and accumulated content in them.
	Authenti-cation	remains on repository, protocols and applications
	Language independence	Independent different repositories content management through Web-services.
	Web 2.0 support	Providing Web-services and interfaces Web 2.0 (IT, which simplifies application development, that changes user perception of Internet)
	Openness	Platform creation and support, independent from content language.
	Content formation	Composite applications and collages development support from several content sources, that looks like single unit
	Actions permissions	Determination of the allowed actions based on the internal authorization module.
Standard conceptions	Repository abstraction	Is independent from main data storage mechanisms. Standard determines interfaces for abstraction storage maintenance.
	Object typing	*Base object types* in repository –documents, folders, relations and politics.
	Types detalisation	Repository determines additional *object types* for any of the base types.
	Object properties	*An object type determines properties* schemes, that are allowed/required for object.
	Protocol Indepen-dance	*Data model and services* are independent of the protocol (supports protocols based on SOAP/REST), that is used for service launch.
	Services	Content management services availability
	Documents versions support	Objects *document* can be *versions* (objects folder, relations and politics are not versions). All methods for sending/receiving *documents* point if they are related to certain document *version* or always must receive latest version
	Multi-registration	Repository ability to support several document servings to zero/one/few folders simultaneously: Not allowed to serve folders few times.
Object types	Documents	Individual objects in repository that comprise/omit one content flow.
	Folders	Organizational containers, which store documents/folders.
	Relations	Free bonds only between two objects (documents, objects) in repository.
	Politics	Sets of an administrative rules, which are applied to objects.
Content management services	Type identification	Find *object type* and other repository data, including data about additional possibilities that are provided by specific repository.
	Modification	Create, edit and delete *objects*.
	Distribution	Distribute documents to multiple folders.
	Navigation	Repository navigation and search by hierarchy of folders.
	Versifi-cation	Create object versions (documents) and provide access to version history.
	Search criteria	Samples in any objects repository, that satisfy criteria of user determined search order.

Table 2. Main determinations of e-commerce notion

№	Definition
1	All goods/services trading forms through electronic means use, including Internet, which gives possibilities to develop new markets, but rises a question about safety of information and intellectual property [1-2], that the digital legal management is solving.
2	Wide interactive methods set of activity conducting of providing/selling goods/services to customers.
3	Any forms of business transactions, where sides interact via IT, but not in the exchange/contact process. For example: Electronic data interchange, EDI systems – totality of content creation, processing, management, passing, receiving, storage, use and destruction processes, that are performed with integrity check and confirmation of receiving if necessary [1-2].
4	Use of electronic communications and electronic data processing technologies for relations installation and editing, creating value between organizations and individuals.
5	Business transaction on-line in the following areas: direct products and services sales; banking and billing (payment systems); safe content placement; corporative purchases.

E-commerce system, ECS is information system with set of functions for electronic commerce processes automatic support (Fig. 4) [1-2, 9].

Electronic commerce systems are classified by e-commerce member's relationship type and main business process flow kind (Table. 3; Fig. 5) [2].

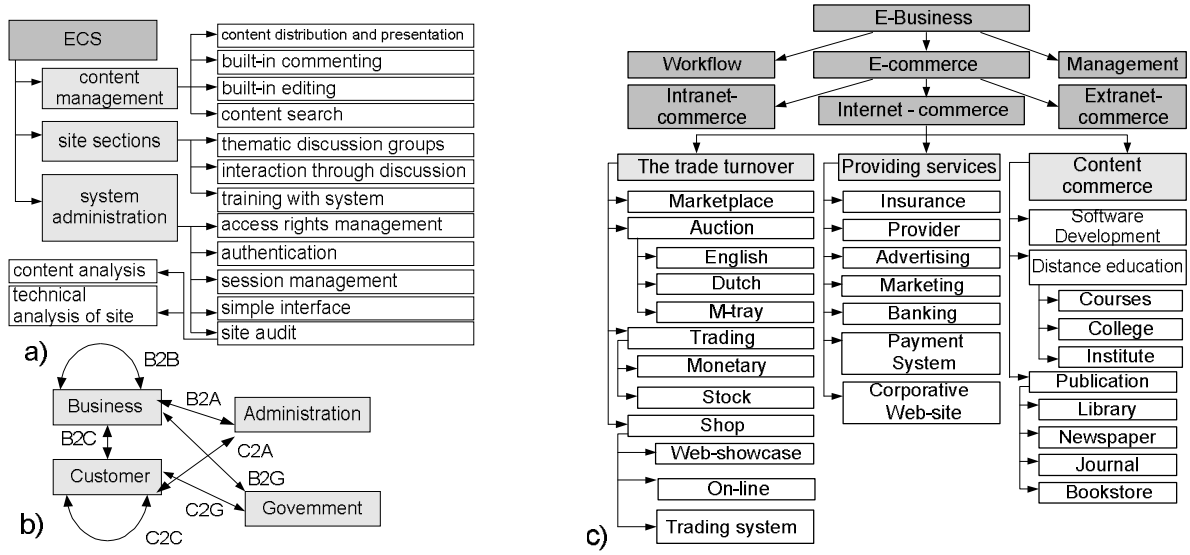

Fig. 4. a) Functions, b) relationships and c) e-com...e systems typology

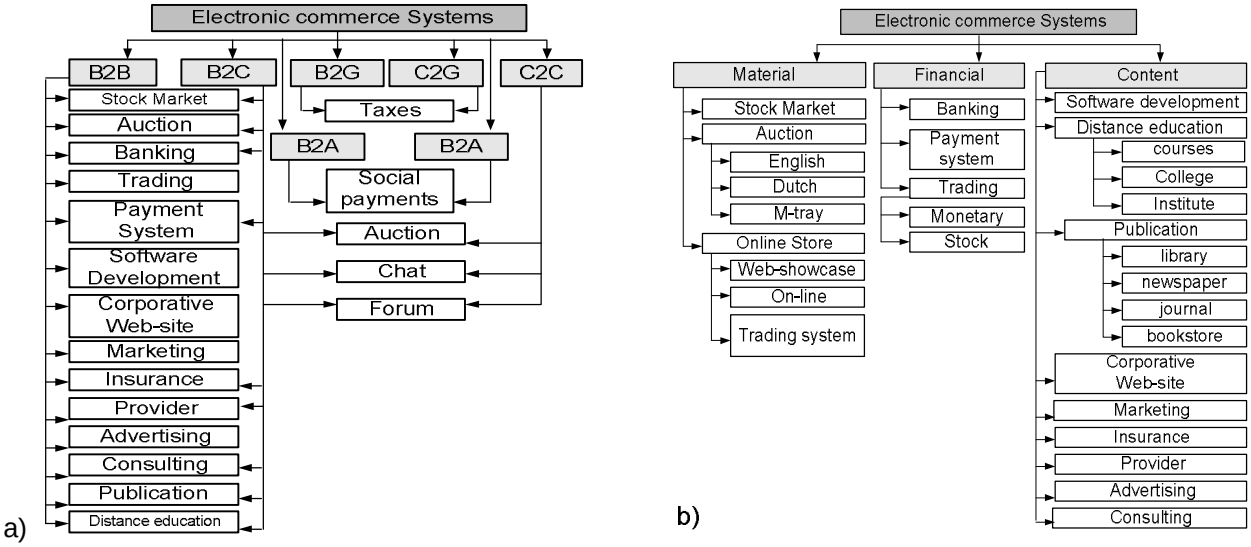

Fig. 5. a) Categories and b) Electronic content business processes

Table 3. Electronic commerce systems categories

Type	Category	Definition
B2B	Business-to-Business	Business operations between companies;
B2C	Business-to-Customer	Electronic retails;
B2A	Business-to-Administration	Administrative workflow;
B2G	Business-to-Government	Operations between companies and government departments;
C2A	Customer-to-Administration	Interaction with administration (social payments);
C2G	Customer-to-Government	Interaction with government departments (taxes);
C2C	Customer-to-Customer	Commercial activity between individuals

ECS is classified by activity: global electronic marketing; Media interactivity, that changes the paradigm of advertising business and market research; active development of e-commerce direction; operative services provided at a distance (counseling, law/accounting support, etc.); work on distance (distributed offices organization for collaboration from different world parts). Communication overhead are slight, and, as consequence: global markets opening for small/medium business; increase in competitiveness and offers amount; development of new ECS modeling and design approaches; implementation of new product as a commercial content [1-2]. ECS implementation is hard through such problems as costs, value, safety, interoperability [1-2, 9]. The Internet provides an additional alternative way of doing business, but ECS must be integrated with existing ones

for avoiding duplicating functionality and their applicability, current work and reliability support. With the ECS ability to automatically share content business reaches cost reductions, work improving and increase in additional cost lances creation.

Electronic content commerce system, ECCS is information system of automatic e-commerce information resources processing processes support and commercial content promoting on global markets (Fig. 6, a).

ECCS prospects of development caused by totality of economical, social, electro-technology, law-organizational factors, among which significant is Internet multifunctional; liberalization of economic activity and economic globalization; organizational and technical accessibility and financial-economic effectiveness of e-commerce for market subjects. Depending on the range of content, level of information technologies, status, creation manner ECCS is divided into universal/specialized/ independent/highly specialized; components of traditional publishing; corporate, personal, leased. Content is an important factor in e-business transaction (Fig. 6, b) with such features: a significant increase in demand for content; introduction of fundamentally new technology based on rapid development of e-commerce; rapid expansion of software for creating ECCS. The main areas of marketing services are products/services markets research and business partners search (Fig. 7, a).

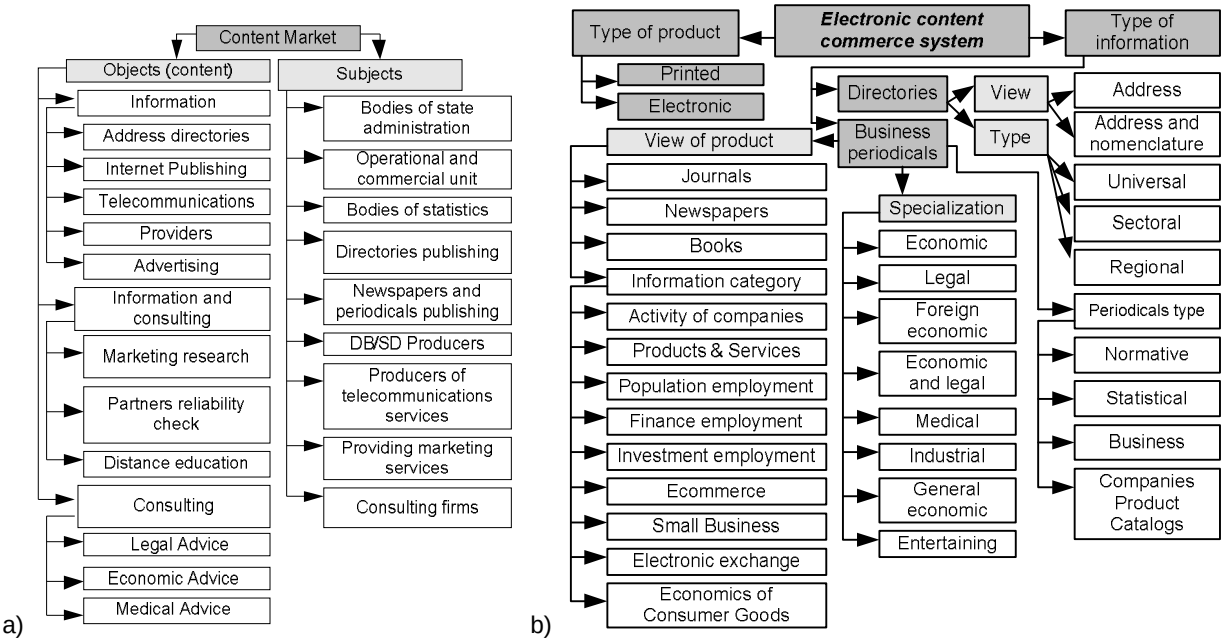

Fig. 6. Classification of e-commerce content by type a) commercial activity and b) commercial content

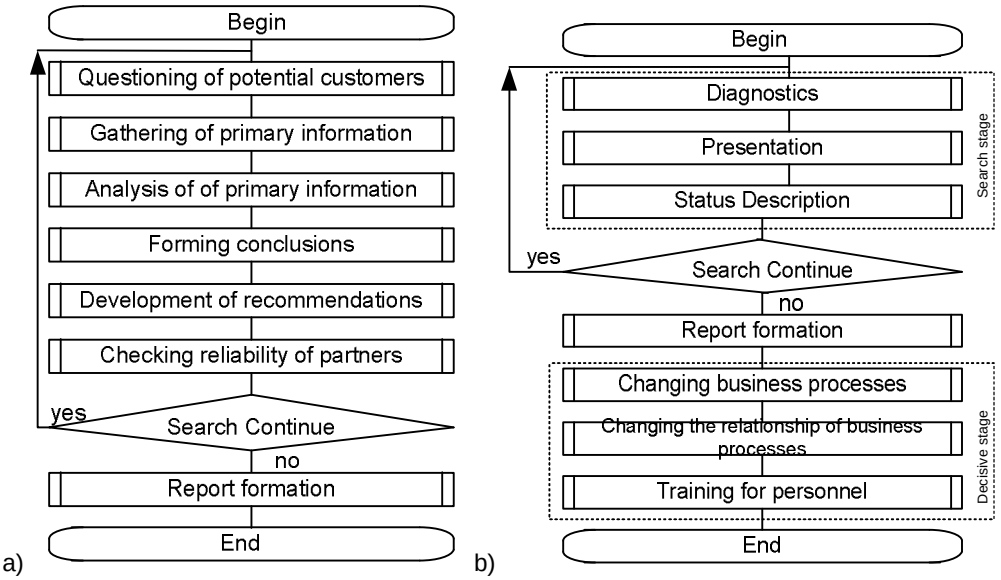

Fig. 7. Stages of granting a) marketing and b) consulting services

Content consumers meet the information needs in such ways: visiting information resources or data bases/warehouses; periodically receiving content via e-mail; connecting to specialized information systems/ networks. Main consulting content granting problems (Fig. 7, b) are: debtor defaults, increase in prime cost, tax payments minimization, production realization on market. Main perspective research directions are improving/ researching methods of e-business strategic planning and improvement; implementation of quality management systems, personnel and content streams management systems and e-commerce technologies. Number of content flows is significantly greater, than ways of products displacement in industrial plants (Fig. 8).

Big part of the content flows consists of easily formalized and automated procedures (Fig. 9). ECCS is a core of content exchange process. Information resource processing in ECCS is a powerful and effective way to make e-business.

Main e-commerce tool – electronic content commerce system, whose Web-site is a relation between users and system (Tabl. 4).

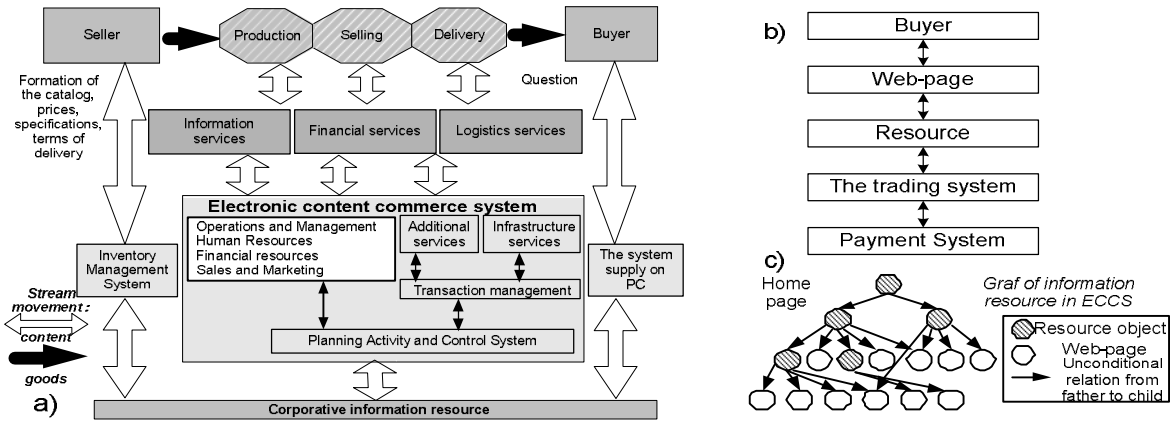

Fig. 8. Content flow scheme in e-commerce systems

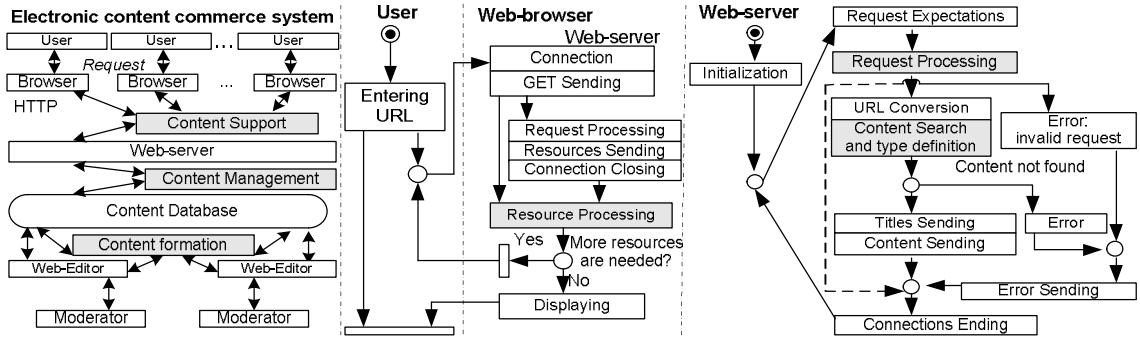

Fig. 9. Electronic commerce system functioning scheme, developed by [1]

Table 4. Electronic content commerce tools classification

Name	Definition
Corporative Web-site	Information page/resource with information about company, project, content, activity type, proposals for cooperation. Information resource with content about company, project, commercial content, activity type, proposals for cooperation etc., which has hierarchical structure and optimal scheme of functioning.
Internet – publishing house	Variety of Internet store, where product is thematic content topical during certain time classified and submitted to information resources.
Provider	Access to the Internet and information services.
Internet advertisement	Commercial promotion of consumer product qualities in order to increase demand.
Distance education	Profile courses or distance education (where content – knowledge variety) with further specialty or document about learning specialty receiving.
Content portal	Complicated system of company business processes and content flows management is established on the basis of corporative information resource and integrated with ECCS.
Internet marketing	Production/sales activities management system of companies / firms, based on complex market analysis, demand, prices, advertisement studying/forecasting, funding and planning coordination, new content sorts creating etc.
Software development	Software designing, development and support on-line via Internet.

Content management system, CMS is information system for information resources organization on the Internet, Intranet or Extranet [1-2]. CMS process functioning output information is data about purpose and conditions of the system that determines main goal of modeling and allows formulating requirements to formal model of S system and content management models. Content management system formal model – set of values $S = \langle X, Q, C, V, H, Function, T, Z, Y \rangle$, which describe system functioning process and create subsets, (Table 5 and Fig. 10) [2, 9]. Values x_i, c_r, v_l, h_k, y_j are disjoint subsets elements and contain deterministic and stochastic components [2, 10]. Incoming effects x_i, effects of the commercial content flow c_r, the external environment effects E and internal system parameters are *independent* *variables* and output characteristics of the system are dependant. CMS S work process described $y_j(t_p + \Delta t) = Function(x_i, q_d, c_r, v_l, h_k, t_p, z_w)$, where x_i is visitors/users requests to the content management system. According to Google Analytics [5] $y_j = \{a_1, a_2, ..., a_m\}$, where: a_1 – number of visits over time Δt; a_2 – average time on information resource (min, s); a_3 – fault indicator (%); a_4 – reached aim; dynamics (%); a_5 – total number of page views; a_6 – page views per visit; a_7 – new visitors (%); a_8 – absolute unique visitors; a_9 – traffic sources % (search engines, direct traffic or other information resources) etc. [2]. Values effects c_r, v_l, h_k, on z_w and y_j as a CMS work result are unknown and unexplored [1-2, 10].

Table 5. Content management system components

Name	Marking	Range	Plural
Input system effects	$x_i \in X$	$i = \overline{1, n_X}$	$X = \{x_1, x_2 \mathbf{K}, x_{n_X}\}$
Users effects on system	$q_d \in Q$	$d = \overline{1, n_Q}$	$Q = \{q_1, q_2 \mathbf{K}, q_{n_Q}\}$
Content flow effects on system	$c_r \in C$	$r = \overline{1, n_C}$	$C = \{c_1, c_2 \mathbf{K}, c_{n_C}\}$
External environment effects on system	$v_l \in V$	$l = \overline{1, n_V}$	$V = \{v_1, v_2, \mathbf{K}, v_{n_V}\}$
Internal system parameters	$h_k \in H$	$k = \overline{1, n_H}$	$H = \{h_1, h_2, \mathbf{K}, h_{n_H}\}$
System information resource components	$z_w \in Z$	$z = \overline{1, n_Z}$	$Z = \{z_1, z_2 \mathbf{K}, z_{n_Z}\}$
Content management transaction time	$t_p \in T$	$p = \overline{1, n_T}$	$T = \{t_1, t_2 \mathbf{K}, t_{n_T}\}$
Output system characteristics	$y_j \in Y$	$j = \overline{1, n_Y}$	$Y = \{y_1, y_2 \mathbf{K} y_{n_Y}\}$

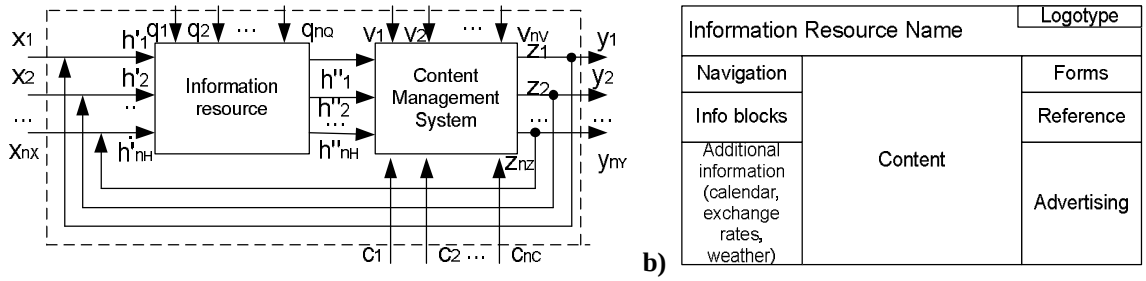

Fig. 10. Structure a) content management system and b) resource layout, developed by [10]

Formal CMS model does not reveal relations between input information, content, output information and content processing processes in system. Content commerce dynamics flow studying and information resources processing model building in CMS are important and topical [2]. For effective commerce content management process realization divide content plurality c_r to relevant/irrelevant and published/ unpublished subsets (Tabl. 6), where content plurals quantity is equal to: $a + b + d + g$ [1-2, 6, 9].

Table 6. Commercial content plural amount

Content subset	Published	Not published
Relevant	*a*	*g*
Irrelevant	*b*	*d*

In Table 7 are formulas which calculate effectiveness indicators of commercial content search [1-2, 6, 9]. One hundred percent quality search is impossible because of software tool power limit. Attempts are improved one of the parameters (accuracy/completeness) causes deterioration of another [6].

Table 7. Content search effectiveness indicators

Coefficient	Characterizes a content part	Around content array	Formula
Completeness	Published relevant	Relevant	$p = a/(a+g)\cdot$
Accuracy	Published relevant	published	$n = a/(a+b)\cdot$
Noise	Published irrelevant	Published	$e = b/(a+b) = 1-n$
Sediment	Published irrelevant	Irrelevant	$q = b/(d+b)\cdot$
specificity	Unseen irrelevant	Irrelevant	$k = d/(d+b)\cdot$

Table 8. Commercial content lifecycle models classification, developed by [1-2, 16-32]

№	Author	Information resources processing		
		Formation	Management	Support
1	McKeever S.	+/–	–	+/–
2	Bob Boiko	+/–	+/–	+/–
3	McGovern G.	+/–	–	+/–
4	JoAnn Hackos	+/–	–	+/–
5	Ann Rockley	+/–	+/–	+/–
6	Russell Nakano	+/–	–	+/–
7	The State Victoria	+/–	–	+/–
8	AIIM	+/–	+/–	+/–
9	CMP organization	+/–	+/–	–
10	Bob Doyle	+/–	+/–	+/–
11	Woods Randy	+/–	+	+
12	Halverson	+	+/–	+/–

Table 9. Electronic commerce systems and electronic content commerce systems features comparison

System characteristic name	E-commerce	Electronic content commerce
Product immateriality	–	+
Stable product quantity	–	+
Product variety growth	+/–	+
Storehouse absences	–	+
Keeping product in databases	–	+
Efficiency of product promotion by keywords	+/–	+
Efficiency of product search by keywords	+/–	+
Automatic detection and liquidation of product duplication	–	+
Automatic product aging determination by content	–	+
Automatic product topicality determination	+/–	+
Automatic audience analysis	+/–	+
Automatic digest formation	–	+
Automatic distribution of products between members	+/–	+
Automatic distribution of digests between workers	–	+
Automatic product formation	–	+
Automatic product formatting	–	+
User's experience effect on sales amount increase	+/–	+

Dynamic flows of commercial thematic content are leads to limited models, opening way to further researches [1-11]. Content management models are assigned for content flow aging/topicality processes determination. They do not solve formation, content support problems. Commercial content lifecycle models authors suggest and describe several stages with set of properties that are supported by various technologies and processes (Table 8). In certain content lifecycle models project/content/ resource management concepts, information architecture, content strategies, semantic printing is foreseen. Different authors suggest various content lifecycle phases [1-4, 6-9]. Main phases (content creation, development, view, spreading and activation) are present almost in all offered models [2]. Content management processes, actions, status and role lifecycles vary in models depending on organizational strategies, needs, requirements and possibilities of models [2, 9, 16-32].

Considered content lifecycle models do not solve his formation and support problems and solve not all management problem: presentation set content to user according to his request, stories and information portfolio; automatic digest and information profile formation; thematic story detection and content meaning duplication; building relationship tables and content rating calculation; gathering data from various sources and their formatting; keywords and content notions detections; rubricating and content selective spreading. Existing e-commerce systems don't support all commercial content lifecycle and don't solve main information resources processing problems – content formation and support (Table 9). Lack of general and detailed classification of e-commerce content systems is leaded to the problem of defining and shaping general methods of design/development functioning architecture/ algorithms of these systems. This justifies

the purpose, relevance, feasibility and research directions. Known technology of content management is Internet marketing with Internet-integration, information management, public relation, service work with customers and sales in different areas [1-2].

Internet Marketing uses all aspects and the basic elements of traditional marketing, combined with new research methods and data analysis using modern technology (Fig. 11) [2]. Staying in constant contact with users is effective because of automatically tracking statistics. For its analysis return on investment, rate of return and conversion rate coefficients are used.

Conversion or information resource visiting efficiency – relation of information resource visitors quantity, that complete targeted actions on it (hidden/direct advertisers instructions, sellers, commercial content authors, i.e. purchase, registration, subscription, information resource certain page visiting, ad-link transition), to total information resource visitors amount [2]. Successful conversion is differently interpretation by authors (customer buy operation, who got interested in product by clicking on the ad), advertisers or content providers (doings, expected from visitors, for example: information resource visitors registration, mail subscription, software downloading). Internet marketing involves the use of strategies and trends of traditional direct response marketing and specialized areas of research that are applied to e-business Internet space. Internet marketing is not only content trading, but information space, software, business models etc. [1-2]. Google, Yahoo and MSN raised Internet-advertisement market on new level and segmented Internet-advertisement market, suggesting local advertising services to e-business. Through automation of audience research ROI increases and costs are reduced. The main advantages of online marketing: interactivity, the ability to make the most accurate targeting, the ability post click analysis to maximize performance information resource conversion and ROI / ROR online advertising [1-2]. The purpose of the use of online marketing technology - getting the maximum effect of the potential information resource audience with the ability to instantly obtain sales statistics, visits, demand, etc. (Table 10) [1-2].

Search Engine Marketing (Table 11) has the following features [1-2]: work on the specific requests (keywords); relation with search (search engines, information resource search); information resource content findability increasing; context analysis (content subject, information resource subject, etc.). Usability – overall comfort rate of object using; software user interfaces development concept, oriented for maximum psychological/visual user friendliness; efficiency coefficient of menu design and information resource navigation system performance; ease of use, friendly interface and usability of the software.

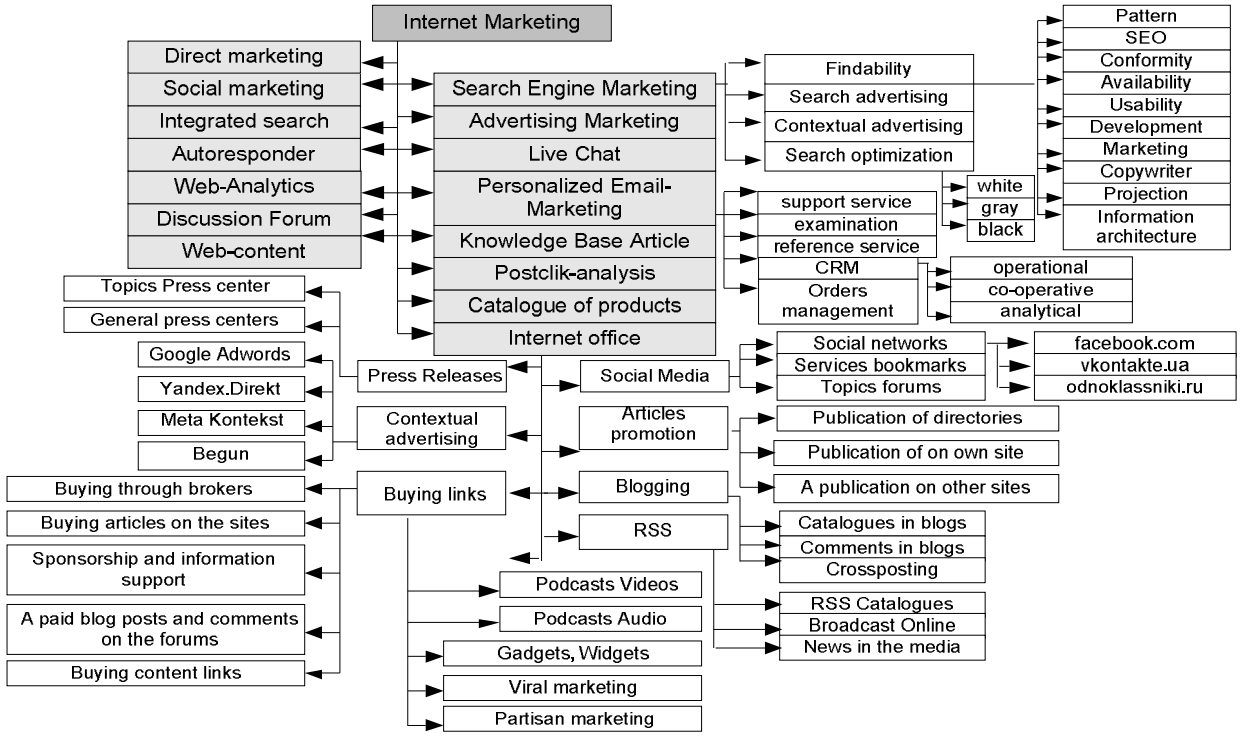

Fig. 11. Internet marketing directions

Table 10. Main Internet marketing benefits

Name	Definition
Interaction	System organization principle, when aim is reached by content exchange between system elements and environment.
Search engine marketing, SEM	The process of increasing traffic from search engines, the lists of search results and advertisements.
Targeted advertising	Advertising mechanism that allows to select target audience that meets criteria to show it advertisement.
Post-click analysis	Method of Post-click marketing that maximizes efficiency and information resource conversion and ROI of online advertising.

Table 11. Main search marketing technologies

Technology	Search marketing technology appointment
Search advertising	Dissemination of information in search engines by placing ads with keywords [1-2].
Search engine optimization, SEO	The set of actions to change the state of information resource (promotion) and elements of external environment in order to obtain high positions in search results for queries [1-2].
Context advertising	Placing advertisement on thematic information resources. [1-2].

Search Engine Marketing is not reaching advertising purposes due to factors such as [2]: advertised product is not always directly reported; selling service/product is not always a purpose; difficult to increase brand awareness; impossible to bring a new product/service to market.

Result of the search engine marketing use is [1-2]: users attraction to the information resource, where for each individual case is different audience, therefore attracting wide (increasing the overall rate of information resource attendance) or interested audience; spread the content about the information resource in search engines.

The criterion for successful search engine marketing strategy chosen is the number of visitors to the information resource and conformity of resulting audience quality is predicted. A simple criterion of information resource popularity verification is external links quantity dynamics on information resource and increasing product/service or trade mark names mentioned on the Internet. The limiting case of search and contextual advertising is the placement of advertisements in information resource search results thematic. The development of the Internet contributed to the emergence of new technologies of social marketing optimization and video search marketing. Separation of search engine marketing as a separate independent strategy associated with [1-2]: continued growth of the Internet market; growth of the market for contextual and search advertising; the use of search engine optimization [1-2]; the need in content area optimal navigation and browsing, containing text, visual, animated and/or audio content and/or users experience of the system; content complex lifecycle process support that it is passing during management through various stages of publication. The process of designing and creation of e-commerce content via Internet marketing is an iterative and proceeds from analysis, design, and plan development to prototype creation and experimental tests, starting with the formation of the specifications, layout, template creation, content formation and its position according to the structure of information resource (Fig. 12). Concentrating solutions are for business purposes and the needs of end-users. In the initial stages before determining functional requirements and development start users are joined to the process using questionnaires, alternative design and prototypes of varying degrees of readiness, i.e. collecting valuable information, causing users to feel them as a part of the design gaining their trust.

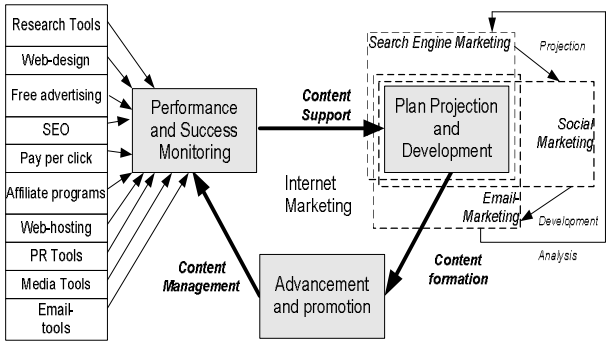

Fig. 12. Internet marketing for electronic content commerce systems

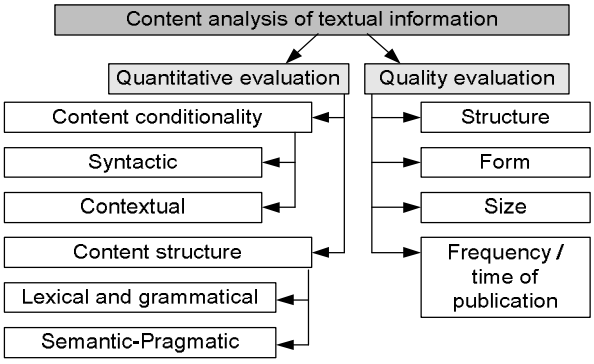

Fig. 13. Text content analysis mechanism

A well-known analysis method of textual information is content analysis – standard research method in the social sciences (Fig. 13), the object of which is to analyze the content of text arrays and communication correspondence (comments, forums, emails, articles, etc.). The concept of content analysis has no unambiguous definition [2. 9, 11], so systems that are based on different approaches are incompatible. The use of content analysis of the text in the electronic commerce content systems has several advantages for simplifying business and solving a number of problems faced by participants in business processes, namely: user content filtering on information resource; the ability to automatically create a "portrait" of permanent user by analyzing his comments; the ability to automatically create a "portrait" of the target audience by analyzing the "portraits" of regular users; reduce the number of information resource moderators in ECCS; reducing the time for posting content to information resources through its automatic processing, not moderators; elimination of the language barrier through automatic creation of dictionaries and regular user automatic translation.

Most definitions of content analysis are constructive, i.e. procedural. Due to different initial approaches they generate different algorithms, which sometimes contradict each other. Existing various approaches to content analysis understanding are criticized [11]. The biggest doubt is ignoring the role of context, but the practical value of the method avoids many contradictions. Combining tools and methods and natural selection by repeated evaluation of the results make it possible to select or confirm knowledge and actual power/usefulness of the tools. Thus, content analysis – a quantitative and qualitative analysis of numerous texts for further meaningful interpretation of the quantitative and qualitative patterns. *Content analysis* used in the study of sources invariant in structure / content and existing as no systematic randomly organized text [2, 9, 11]. *The method of content analysis* is to build on the diversity of the text content of an abstract model of content. There are two methods of content analysis: quantitative and qualitative. In the study of the mechanisms of generating text in [9] found that the choice of models describing the content depends on the construction of probabilistic-linguistic testing and selection of some of its units. Simulation of the text and its components is the first step to describe the features of its linguistic units. Analysis of the language via probabilistic text modeling based on methods of quantitative linguistics, probability theory, mathematical statistics, information theory and combinatory. In linguistic studies, such as content search [9], there are challenges, associated with the prediction of the emergence of a segment of a given length of a number of relevant classes' word forms/phrases. Modeling text, compositions, phrases, and grammar classes determines sample size that is required to provide with a certain probability of appearance at least once relevant linguistic unit [9]. Quantitative assessment of meaningful information in the text, words and phrases are based on the value of syntactic information and contextual conditioning [9]. Hypotheses about the most probabilistic extension text built on the basis of two types of combinatorial restrictions: combinatory figures (letters and syllables) and combinatory signs (morphemes, words, phrases) [9]. At the fifth text symbol step combinatory of letters and syllables are suppressed by restrictions that related to the compatibility of morphemes and words. When deploying text on word combinatorics restrictions are pilling with combination of phrases and sentences, limitations associated with combinatorics paragraphs, sections of the content. When guessing letters far enough from the beginning of the content is located, basing not on static letters and syllables combinatorics, but on meaningful (lexical and grammatical) text building. If the text removed from the initial portion of content serves as a quantitative assessment of the distribution and statistics of letters, the syntactic information from remote sites from the beginning of content serves as a reflection of the content (semantic-pragmatic) information. These considerations make it possible to offer content analysis method for quantitative evaluation of the content and information content segments.

Content tone determination based on text analysis is harder then spam detection. Finding spam considers two hypotheses (spam, not spam), determining tone requires emotional tone check (positive, negative, neutral) and their combinations. In Bayesian method for spam detection base assessments are used - two buildings content, one of which is made up of spam, and the other - no [7-8]. For each content count frequency of each word and weighted score is from 0 to 1, i.e. the conditional probability that the content of this word is spam [7-8]. Weights value close to ½, not taken into account while integrated calculating, so words with such weights are ignored and deleted. On detecting new events from the stream of content, which series to the input ECCS from scanning tools or content router and choused by thematic query, new events are revealed, described in content [7-8]. Plot strings of similar content are formed for them. Content, which represents new event, is interdependent content cluster base (Table 12) [7-8].

Main ECCS management tools is *content management system* [1-2]. CMS has to match certain set of requirements (Fig. 13). Usually such systems are used for saving and publishing huge content amount (documents, pictures, music, video etc.). Similar CMS allow managing textual and graphic filling, giving to user convenient information saving and publishing tools.

CMS do not support all content flow lifecycle and do not solve main information resource processing problem – content support and formation [1-2]. Main CMS disadvantage is connection absence between incoming information, content and output information. CMS are often used to builds ECS and ECCS (Table 14) [1-2].

Table 12. New event detection processes

Author	Stages of new process detection
G. Salton	1. First reviewed content is associated with first cluster. Each class shown as terms vector (keywords), which are included in clusters content. Normalized or approximated by certain criterion terms vector is centroid. 2. Each next content is compared with available clusters centroids via measure of proximity. 3.If content is close enough to certain cluster, than it is credited to this cluster, where after appropriate centroid is recalculated. 4. if content is not close to available clusters, then new cluster is formed, and new content is credited to it. 5. Content time range is an observation window. Cluster, all content of which goes outside observation window, is not considered. New event corresponds to each new cluster, shown is this cluster content.
R. Papka	1. Requests by themes formation (Text Mining is used to detect and choose notions from content). 2. New incoming content is compared with available requests. 3. If content doesn't match requests, he is associated with new event. 4. New request is added into system, which matches such content (optional).

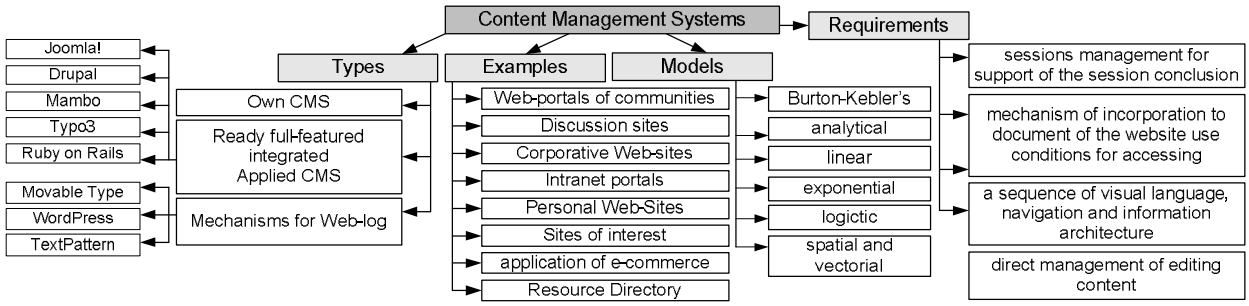

Fig. 13. Content management systems features

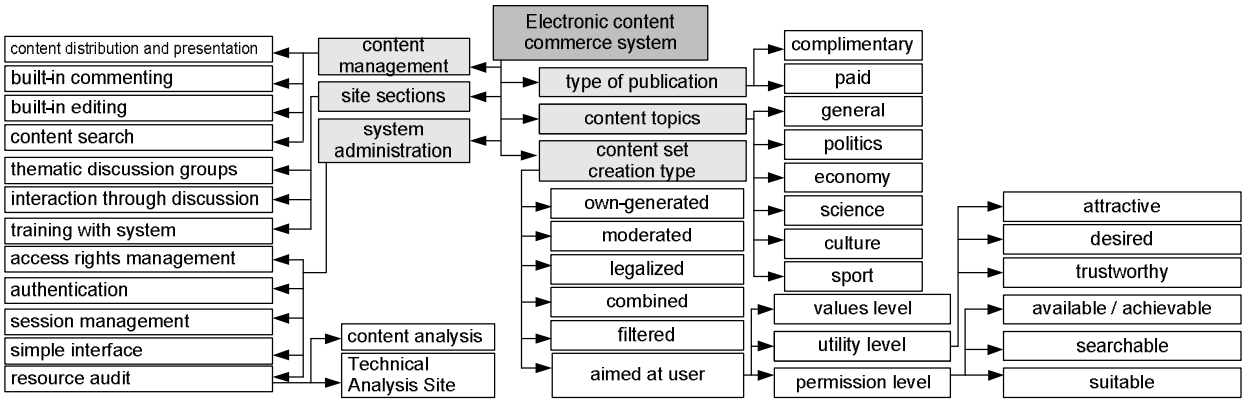

Fig. 14. Main components of ECCS

Table 13. Main content management systems characteristic ECCS, developed by [1-2]

CMS name	Software requirements			Installation simplicity	Learning curve	Session management	Users management	Extensibility	Scalability	Themes using	xHTML/CSS
	Web-server	Database	Language								
Ruby on Rails	Apache, FastCGI	MySQL, PostgreSQL, SQLite,Oracle, SQL Serer, DB2, Firebird	Ruby	+/–	+/–	+/–	+/–	+	+	+/–	+
Drupal	Apache IIS	MySQL, PostgreSQL	PHP	+/–	+/–	+	+	+	+	+	+
Mambo	Apache IIS	Apache IIS	PHP	+	+/–	+/–	+	+/–	+	+/–	+
Typo3	Apache IIS	Apache IIS	PHP	–	–	+	+	+	+	+/–	
Movable Type	Apache IIS, Jetty, Tomcat	Apache IIS, Jetty, Tomcat	Perl	+	+/–	–	+/–	+/–	+	+/–	–
Word Press	Apache, mod_rewrite	Apache	PHP	+	–	–	+/–	+/–	–	+/–	+
Text Pattern	Apache	Apache	PHP	+	–	–	+/–	–	–	+/–	+
Joomla!	Apache	MySQL	PHP	+	+	+	+	+	+	+	+

Table 14. Main content management components, developed by [1-2]

Name	Content management system characteristics
Menu items	Addition, editing, information resource of any level menu items management.
Articles	Addition, editing, planning and articles publication (information resource pages).
News	Addition, editing and news publication.
Photo gallery	Possibility of galleries with under galleries work, automatic photo zooms.
Notice board	Adverts with photo, description and contact details addition.
Settings	All settings of information resource and his management system storage.
Users	Rights management of registered users.
Catalogue of companies	Addition, editing, publishing in under groups of any inset.
Survey	Addition/editing of surveys, results as graphs.

Web Content management system, WCMS is a tool (Table 13) for modeling information resource branched structures in ECCS and managing their content [1-2] without having special technical programming skills or html-layout. WCMS is developed for content generation in applications with such problems as dynamic gathering, content caching, safety etc. [1-2]. CMS provides control on access information resource and alteration and designed to simplify as much as possible information resource management process while keeping setting and control flexibility. Main information resource components in CMS showed in Table 14.

Content value determines his appeal for user. Content integration makes information resource attractive and application integration – useful. CMS using do not require software installation. Browser is used for editing and administrating. Intuitive system interface i and work simplicity facilitates information resource management and lowers further spending on his support. CMS includes such possibilities: fast update and content search in information resource; data collection about clients and potential clients; surveys formation and editing; information resource visiting analysis.

CONCLUSIONS

Made an analysis of commercial content formation methods, popular content lifecycle models were researched and content management services standardized, which gives possibility to determine requirements for creating optimal commercial content lifecycle. Researched Internet technologies for construction of service oriented electronic commerce system, what gave possibility to classify electronic commerce systems and electronic content commerce systems. In detail information resources and production processes of electronic commerce systems, what gives possibility to develop optimal content lifecycle and typical electronic content commerce system architecture is reviewed. Analyzed content management technology in electronic commerce, what gives possibility to develop formal models, unified methods and software information resources processing in electronic content commerce systems. From system approach position made an analysis of modern methods and tools of electronic content commerce systems designing, modeling and realization, also justified necessity and feasibility of unified methods and information resources processing software creation.

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ECONTECHMOD. AN INTERNATIONAL QUARTERLY JOURNAL – 2016. Vol. 5. No. 1. 127–132

Environmental insurance system in Ukraine

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Abstract. This article examined methodological, theoretical and scientific principles of environmental insurance system. Nowadays, are growing a number of man-caused environmental accidents and disasters, objects and types of activities that are sources of danger for the environment, for people life and health, increases negative impacts of economic activities on the state of the ecosystem, exacerbated the problem of storing and disposal of hazardous waste. To solve these problems, we need effective economic tool in environmental protection, which provides emergency prevention of environmental pollution. This tool is environmental insurance.

Key words: insurance, environmental insurance, environmental risks insurance, signs of environmental insurance, environmental auditing, environmental and economic losses, environmental funds.

INTRODUCTION

Further socio-economic growths in Ukraine largely depends on achieving an acceptable level of technological-ecological safety and reproduce the natural environment in terms of enhanced anthropogenic impact on the elements of the environment, due to the constant growth of diverse human needs, the rapid development of science and technology. In recent years, according to official data, the proportion of relatively clean areas in Ukraine is only 7 % of the total area, relatively clean acknowledged about 8 % of the land, and have little pollution – 15 %. The remaining 70 % are areas with dangerous conditions for human life, while 1,7 % of the total area of the country classified as "ecological disaster area". This is especially true of the exclusion zone, which arose as a result of the Chernobyl accident, adjacent areas and certain regions of eastern and western Ukraine. Worsening problems of modern civilization is against the background of deteriorating environmental quality that needs further development of forms and methods to reduce the negative impact on the environment, as well as improvement and implementation of modern financial instruments of nature.

Through the unresolved mechanism of economic responsibility entities, especially companies with high risk – the perpetrators of accidents, the state assumes considerable budget allocations to overcome adverse environmental effects. In addressing these issues of particular relevance acquires the development and implementation of an effective system of environmental insurance. Lack of capacity use insurance as a powerful management tools and management of environmental risks, and lack of adequate insurance coverage of legal entities and citizens in environmental pollution determined the choice of the theme of scientific debate.

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

Analysis of scientific literature give reasons to believe that insurance nowadays is an independent economic category, which is characterized by specific functions and tasks. Common approaches to the interpretation of this term understand it as: a system of

economic relations [9]; closed set of special relations [14]; set of financial and economic relations [11].

OBJECTIVES

Due to intense environmental situation, which composed in the national economy in recent years, and necessity to minimize the risks associated with these processes, especially theoretical and methodological importance becomes interpretation essence of notion "ecological insurance". Enough thorough, in our opinion, is the understanding of environmental insurance as insurance companies responsibility – sources of increased environmental hazards for emergency (sudden, unintentional) contamination of the environment, which enables compensation of damages caused recipients pollution, creating additional sources of financing environmental measures [6, 281]. In a broad sense, environmental insurance is a mechanism of protection of property and social interests of businesses and individuals aimed at preventing, overcoming or reducing the negative impact of environmental risks [7].

THE MAIN RESULTS OF THE RESEARCH

As a form of economic relations environmental insurance include:

– mandatory and voluntary environmental insurance to cover unforeseen costs arising from accidents,

– system of disaster environmental insurance,

– environmental insurance funds and support to independent insurance companies [7].

Since insurance is a specific sector of the national economy, it is more reasonable interpretation environmental insurance as an institutional form of economic relations with the redistribution of national income from paid financial compensation system natural and legal persons in situations associated with ecological and economic losses that are both effective tool to implement social policy.

In general theoretical environmental insurance against internal instability associated with any manufacturing process, and the premiums paid by the insured, are a necessary part of current production costs, ultimately aimed at reducing its total costs. The apparent savings in insurance payments in practice revolves increase total costs. Technological accidents resulting in cost increases to the amount of damage caused as the very source of the accident and the other recipients. Insurance in such cases takes the form of reimbursement of market gross expenditures [5]. So, environmental insurance is essential way to ensure environmental sustainability of production processes in enterprises and reduce the risks of business.

Necessity of the introduction of environmental insurance companies in business practices lead to the following factors (Fig. 1).

Analysis of these factors gives rise to formulate the basic function of environmental insurance as accumulation of financial resources for granting "immediate environmental emergency aid to victims (owners or users of elements of the environment – public authorities, businesses and individuals)" as a result of accidental pollution in the form of damages and elimination of negative consequences. In addition to the functions of funds accumulation for environmental protection and compensation the damage, important functions of environmental insurance are environmental auditing and environmental risk compensation of gross expenses of the insured.

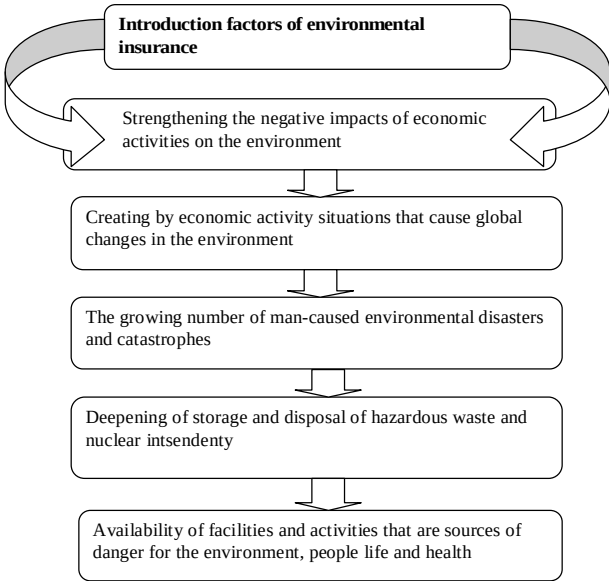

Fig. 1. Objective factors of implementation environmental insurance in business practice [13]

The study found that environmental insurance issues remain problematic for Ukraine, still unidentified mechanisms of risk insurance ecological character and there is no law about environmental insurance. Some difficulties in environmental insurance sphere associated with the timing of detection of ecological-economic damages. Characteristic features of ecological insurance in Ukraine displayed on (Fig. 2).

Analysis of foreign and domestic experience in the development and application of economic regulators reduce human pressure on the environment shows that environmental insurance among them has great importance. Actual question about the introduction of environmental insurance system is creation of institutional chain of command by the sphere of environmental usage. Existing system of environmental management and regulation has two levels. Higher levels (regulatory, control system) includes the structure of government – Ministry of Environment, public administration, local self-government. The lower level

consists of companies that pose a threat to the environment. The bases of the proposed insurance system are specialized institutions (companies) with mandatory and voluntary insurance. In total regional economic regulation system of environmental management similar functions rely on extra-budgetary environmental funds. They are organized in local government and are a multi-institutional structure. This is caused by the economic regulation mechanism of environmental management, which involves the creation of complex multi-level system of financial relations and related institutions (agencies, institutions, companies). Actually accumulations of funds, which are paid for pollution, are only a small part of what lies in these organs. This includes whole mechanism of redistribution of bank finance, partnership in the development and implementation of environmental programs, monitoring, storage and processing of information. Insurance company should also have a multifaceted focus in environmental insurance. Subordination of institutions, which engaged in insurance business, must correspond to the requirements, which imposed to them [3].

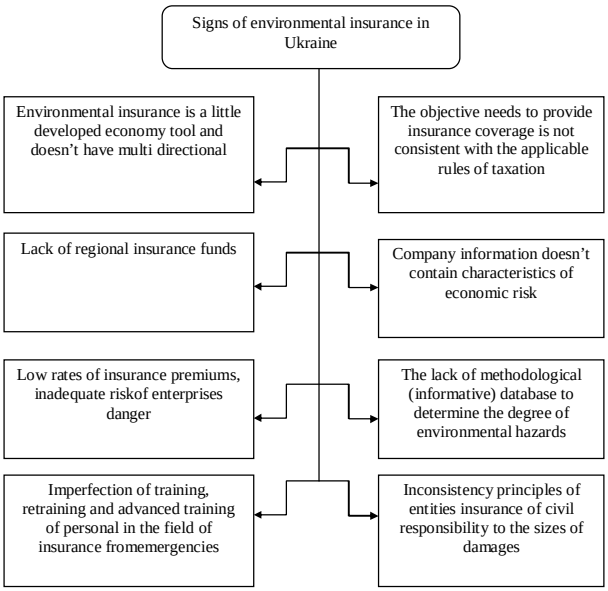

Fig. 2. Characteristic features of ecological insurance in Ukraine [9]

The responsibility of the situation in the field of environmental usage and impact on environmental in the region is carrying out by regional authorities. By this is justified legality of state institutions creation with compulsory environmental insurance [12]. However, along with the status of such institutions, in the current conditions should not be lost economic contract basis of relations between insured and insurer. Mandatory insurance will allow overcoming by primary care large and dangerous objects in environmental terms.

Accordingly, one of the key questions in establishing of environmental insurance system is to determine the degree of environmental hazard production. Working with objects allocation priority environmental insurance consist from the information collection about each object, which can be environmental hazard, identification of environmental hazards degree on each of them, grouping objects based on the probability of accidents and possible size of consequences and construction of series object priority by rank for consistent inclusion in the scope of environmental insurance. Information about the enterprise should be most objective, include environmental risk characteristics, as well as local regional characteristics of the environment.

Simultaneously during the implementation of environmental insurance should follow the general principle: for business that are the source of increased environmental hazard and risk are given the right of free choice of the reserve funds for the compensation of losses from environmental accidents. Herewith in compulsory insurance should be minimal financial guarantees for insurer loses compensation; scilicet not all responsibility should to pass on the insurer. According to experts, such action is necessary to do for enterprises partially located in directly dependent from their level of environmental hazard [10].

The mechanism of environmental insurance should be based also on the principle of mutual relations between the insurer and the insured. Except economic interest in the transfer of responsibility for possible consequences of accidental contamination of the insurer, the insured is interested in improving its environmental safety. Direct dependence reflected in the fact of increase the amount of premiums along with increasing accidents probability. The interest of the insurer to reduce the environmental risks, intensify its activities regarding conduct preventive measures, such as environmental audit of the insured. According to the expert's thoughts, environmental audit is an important institutional form of reducing environmental risks and security of entrepreneurship and living conditions of the population. Part of the difference between the insurance premium and insurance compensation insurer profitably to spend on environmental auditing, improving the quality of environmental monitoring and other environmental measures. Financial basis of environmental insurance is a system of environmental insurance funds, which includes insurance funds of companies, mutual insurance fund of enterprises and insurance fund environmental risk. This fund system makes the enterprise independently analyze the effectiveness of its activity, choose the optimal ratio of funds that go into the reserve and consumption, and most importantly, that during this is carrying out the realization of the free choice principle of the reserve funds method in case of accident.

The specified interactions between the suppliers and consumers show that in the modern global economy under certain conditions owners of natural resources and owners of financial resources began to shift places [18]. Functional institutional structure of insurer insured subject must include a set of specific elements (Fig. 3).

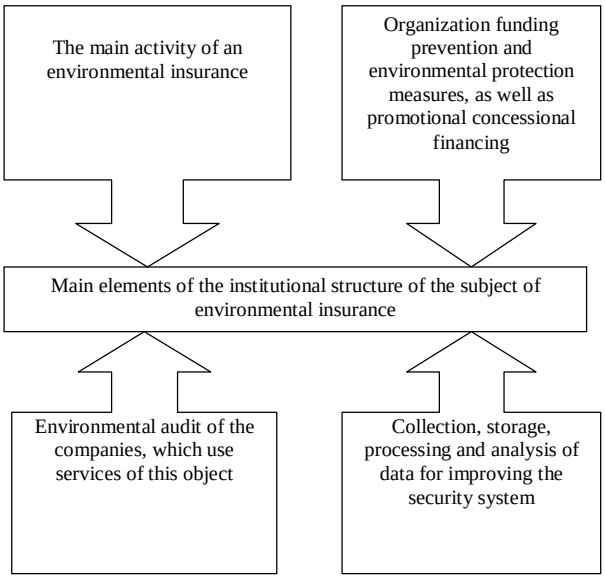

Fig. 3. Institutional structure of environmental insurance subject [3]

The main activity, which is based on the accumulation of insurance payments, paying of compensation due to the fact of accidental pollution and other work with insurers must fulfill special functional department of environmental insurance.

Responsibility for premiums operational funds movement assigned on the finance department of the insurer. Environmental Audit Service as a separate entity of insurer performs all works related with the assessment of the insured ecological state. Collection, storage, processing and analysis of data provide a dedicated team, on which relies forming of information bank for the company success.

Thus, the implementing environmental insurance mechanism should be based on the usage of institutional structure appropriate elements that plays an essential role in the choice of long-term strategic orientation relationship between the insurer and the insured, as depend on them the solution of many organizational issues**.**

Environmental insurance mechanism is based on the principles of mutually beneficial relations between insurers and insured. Except economic interest of transferring insurer responsibility for possible consequences of accidental pollution, the insured is interested in improving its environmental safety, because insured ability in the implementation of emergency measures in a company is limited due to lack of: resource potential for comprehensive study of its own security and environmental enough skilled specialists.

Depending on the insurance of certain environmental risks are setting sizes of the insurance rate [5].

Insurance rates are differentiated depending on:

– the degree of environmental risk,

– economic features of a particular insurer,

– technical condition of production assets,

– protection and water treatment companies,

– minimal and maximal amount of compensation.

Enterprises, that are a source of increased danger, become free from refund damages, caused to environment, only when they prove that the damage occurred due to natural calamities or willful misconduct victims. If the company does not belong to the owners of increased economic insecurity sources, they are exempt from coverage damage provided proof that the damage was not their fault. Persons, whom are damaged, are eligible for missed profits compensation during the time needed to restore health, environmental quality, and restoration of natural resources, suitable for usage due to the purpose.

Liability for damages, caused to the environment, carried on the following terms:

– compensation for the insured all sums, awarded by the law affected to the third parties in connection with the onset of insured event, including costs expenses,

– insurance is covered only accidental pollution,

– fines are not included in the coverage.

The insurance contract is concluded on year, followed by its sequel in the same insurer. Because of high insurance premiums, high administrative costs during the development of insurance terms and signing contracts or programs of preventive measures, providing control partnership is advantageous for insurer and insured during the period of at least 5-10 years. Territorial insurance boundaries are clearly stipulated, especially in the use of vehicles, such as during the transport of hazardous substances. Insurers limit the maximum amount of liability by the cash and time period, as well as environmental insurance is very complicated.

Insurers – entities, which have in its ownership increased risk objects, full economic management, operational control or who are using, owned by high risk objects, such as:

– chemical enterprises,

– enterprises producing, processing and storage of explosives and flammable substances,

– mining companies,

– woodworking enterprises,

– oil, gas and petrochemical enterprises,

– electricity Company (TPP, nuclear, hydro),

– other [7].

Insured event is considered as causing direct damage to third parties as a result of fire and / or accidents at high risk objects during the compulsory insurance contract, as a result rise the insurer's obligation to pay insurance claims. Insured sum and the amount of the insurance rate are determined by each individual high risk objects according to the risk category, and equals:

– Category 1of hazard – 200,000 citizen's income tax exemption at the time of calculation of the sum insured 1.5 %,

– Category 2 of hazards – 70,000 citizen's income tax exemption at the time of calculation of the sum insured 0.6 %,

– Category 3 of hazard – 45,000 citizen's income tax exemption at the time of calculation of the sum insured 0.4 %.

Insurance reimbursement is subject the direct damage caused by fire and / or accidents at high risk objects to life, health and property of third parties, which at the time of the insured event were in their possession or usage, including natural resources, territory and objects of nature reserve funds. Insurance payments are made in the following amounts:

1. on damage compensation inflicted to life and health of others as a result of the insured event – 50 % of the insured sum, including one person insurance payment:

– in the case of payment the insurance compensation to the third person heirs, who died (deceased) – 500 citizen's income tax exemption,

– in case of mounting to the third party I, II and III of disability – respectively 450, 375 and 250 citizen's income tax exemption,

– for each day of third person incapacity – one citizen's income tax exemption, but not more than 250 citizen's income tax exemption for all time of disability,

2. for compensation the damage caused to natural resources, territories and objects of natural reserve fund – 30 % of the insured sum,

3. to compensation the damage, caused to property of third parties – 20 % of the insured sum.

From the information above can be made following conclusions regarding to the development of environmental insurance market in Ukraine:

– real and effective mechanism of resources entanglement in the conservation activity of population ecological safety and territories could become catastrophic and environmental risks insurance,

– development of insurance of course will require the development of principally new types of insurance, covering the environmental and catastrophic risks,

– environmental and catastrophic risks insurance, because of their devastating impact and significant insurance claims, can be only with the adoption of national Concept and development of the insurance system as a whole, first of all adoption a package of laws of Ukraine "About Compulsory Environmental Insurance" (persons liability insurance – owners of sources of increased environmental hazards), "About mandatory flood insurance" (property insurance), "About compulsory insurance against meteorological hazards" (property insurance), etc.,

– development of insurance system requires improvement of methodological approaches for risk assessment probability, for evaluation of economic and insured losses, for calculation of tariff rates and amounts, that should be performed on each type of natural and anthropogenic catastrophic events, considered as insurance,

– necessity to develop and approve the Concept of ecological insurance in Ukraine,

– priority direction in the development of environmental insurance should be mandatory liability insurance for owners of increased environmental hazards sources in damage to third parties as a result of accidental pollution,

– necessity to establish a National Environmental Fund and the National Insurance Pool of environmental insurance,

– importance to develop and implement methodologies of risk assessment conduction due to the exploitation of hazardous objects, methods of insurance rates calculating in accordance with a certain level of risk,

– necessity to promote international cooperation in the field of environmental insurance, finance fund targeted programs and projects of such cooperation.

This analysis and experience make it possible to develop the corresponding anti-crisis strategies under conditions of competitive environment and European integration processes [17].

CONCLUSIONS

The current state of environmental insurance market in Ukraine is characterized by its specific fragmentation. Ukrainian insurance companies are not ready to engage fully in environmental insurance, as these policies in domestic realities of doing business can be unprofitable.

Learning experience of domestic insurers allows revealing several shortcomings of the system of environmental insurance that prevailing today in Ukraine.

First, there are virtually no insurance protection facilities environments. Such protection is implemented declaratively under the contract of property insurance protection, life and health. Said declarative insurance of environmental coverage objects predetermined competition claims, that when became occurrence of the insured event occurs between claims for compensation

for damage, caused to the environment, and claims for damages, caused to property, life and health of third parties. Considering the methodological complexity and ambiguity of determining the amount of damage inflicted to the environment, and the relatively small size of insurance sums, that are typically for contracts concluded by domestic insurers environmental insurance, all insurance amount is usually spent on insurance claims to third parties for damage, caused on their life, health and property.

Secondly, the list of risks covered by compulsory insurance types that can be considered as environmental, rather limited, and voluntary environmental insurance in Ukraine is not developed. It does not allow repairing the damage, caused to the environment in many cases.

Thirdly, there is a limited range of entities involved in the formation of insurance funds to cover the damage to the environment. To the insurance involved almost exclusively those businesses that operate with the increased risk objects.

Fourth, the usages of the legal forms of determine the amount of environment damage that is subject to compensation within the insurance relationships. This complicates the process damages the environment and leads to significant additional material costs and time-consuming.

Fifthly, there is no possibility of creating a system of funds targeted use for environmental protection provisions of precautionary measures, generated by insurance companies from insurance premiums, received within environmental insurance, because the premiums are paid by policyholders within the to date existing system environmental insurance, without distinguished from the total value of premiums, paid by policyholders for all contracts of compulsory insurance of their responsibility.

Nowadays segment of the global market for ecological technologies is around 1,000 billion euros a year, being already as an important development factor in the global economy [19].

One of the most effective mechanisms to encourage the development of environmental business and financing various environmental activities in Ukraine should be a system of environmental insurance funds. The main sources of their formation may include premiums of businesses associated with the risk of hazardous environmental situations and accidents; deductions from profits, other income not subject to tax[20].

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Quantitative assessment of investments: regional eco-efficiency

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Abstract. The article is dedicated to development of the methodological approach to determine the most effective ways and areas of investments use aimed at reducing the negative impacts of pollution. This takes into account the reality that the level of pollution is different for different areas (regions), and the degree of negative impact is due to two main factors-volume of gas emissions and the number of residents living in these territories. Taking into account the lack of quantitative laws regarding the impact of pollution on human lives the expediency to limit some qualitative considerations that significantly contribute to the solution of the problem are developed in the article. The paper develops analytic approach, which is based on establishing the parameters that characterize the essence of the developed phenomenon. The state of air pollution in particular is seen as the main factor that significantly affects the residents' life quality. At one and the same degree of negative pollution, its effect will depend on the number of residents living in the area. As our research continues with the assessment of air pollution reduction state, where two indicators were developed – harmful gas components in the air and population density in the area. Based on the hypothesis of parabolic type, the corresponding functional relation between the parameters proves, that the product of assumed parameters determines the priority of pollution reduction in some areas. The conducted proposed approach to interpretation of dust pollution on the example of regions of Poland is developed.

Key words: eco-investments, population's density, industrial gas pollutants.

INTRODUCTION

The sustainable economic growth and development is seen more and more in recent decades from the environmental point of view. It is impossible to achieve better life quality and sustainable growth without paying more attention to ecological component of human life. According to the report of the European Agency for the Environment and Air Quality2013, "there are more basic problems to human health caused by poor air quality. We are still far from our goal-to reach the level of air quality policy, which have generated significant negative impacts on human health and the environment" Janek Potochnyk, European commissioner for the environment [3].

Polish membership of the European Union entails a wide array of environmental-protection requirements. Some have been satisfied by Poland to a greater extent than required, for instance, as regards greenhouse gases emissions, the reduction of which in 2008-2012 in relation to the base year, i.e. 1988, should be 6 %. In 2011 Poland achieved a reduction of 29 % in the emission of greenhouse gases, expressed as a carbon dioxide equivalent, in relation to the base year. In particular, the emission of carbon dioxide dropped by 30 %, methane by 34 %, and nitrous oxide by 33 %.The reduction in greenhouse gases emissions achieved by Poland has therefore considerably exceeded the level required under the Kyoto Protocol [4, 5, 10, 20].

THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

The analysis of recent researches shows big interest in the field of investments and regional economic

development. Many authors, such as Paranchuk S., Korbutyak A., Ramadani V., Gergudi S., Kuzmin O. consider investments from the innovation-oriented point of view [8, 9, 15, 16, 17]. Other scientists develop factor approach towards the analysis of regional economic development, main publications here are developed by Alekseev I., Svyatokho N., Yachmeneva V. and others [17, 18, 19].

Thus, the importance of environmental security is stressed by The United Nations Resolution "The Future we want" [1], not mentioning, that it's stated in the Millennium Development Goals Framework, as goal number 7 "Ensure Environmental Sustainability" [2]. Among all 34 OECD countries, it was observed, that pollution decreases in last decade [11, 12, 15, 16].

However there is a small number of publications, that would link regional production potential and environmental factors, such as gas pollution.

OBJECTIVES

The main study task is the idea, that by means of having information on the contamination of certain areas is important to prioritize its reduction by implementing certain measures of ecological investment projects and programs. In turn, the definition of priorities involves the selection of the primary factors that characterize the contamination as well as to quantify the parameters of negative impacts on people. Further, called by identifying the relation between parameters, we aim to develop the problem by aiming to achieve the evaluation criteria for determining priorities, which would be scientifically proved, would have practical application, which is simple, logical and would not cause controversy.

THE MAIN RESULTS OF THE RESEARCH

The option of gas emissions that affects people is being considered as an important factor in favor concentration of harmful elements and the air. Equivalent to a certain extent characteristic of concentration is considered to be corresponding:

$$d = \frac{z}{S}, \tag{1}$$

where: Z – emissions into environment, S – emissions area.

With the increase of the negative component in the air, which is consumed in the process of human life, we should expect more significant damage to the human body at the same conditions. While analyzing the impact of pollution on humans there, the problem of identifying the quantitative relations between reasons and consequences arises. In general the definition of the relevant laws requires a special complex and long-term research with specialists in various industries. At the same time to solve a number of practical problems is sufficient to approximate approaches that allow to take real effective solutions, in particular, on the basis of logical reasoning.

From the standpoint of selecting analytical interrelationships between factors we offer to focus on the Powers features the following:

$$E = cd^2, \tag{2}$$

where: e – negative impact from the consequences of environmental pollution per capita, c – constant coefficient.

This dependence is characterized by the fact that, firstly, in the absence of pollution there will be no negative consequences, that is consistent with logical reasoning. Secondly, there is non-linearity effect of pollution. This means that one and the same absolute reduction of pollution for its various levels leads to unequal results of its influence. For higher limits overall pollution effect of the measures to reduce it to grow. General idea for the pollution reduction priority in areas with high gas emissions concentrations should be considered quite reasonable and this approach is often used in the practice of management.

Lets assume, that on the certain territory N people are living, then the dependence (2) can be modified as follows:

$$E = Ncd^2, \tag{3}$$

By using the derivative apparatus for elementary functions, that determine the quantitative relation between changes in pollution and its effect

$$DE = 2cduDZ, \tag{4}$$

where: u – population density in the area of contamination.

As can be seen from the dependence (4), the assumptions taken overall effect of the pollution is caused by changes in the product of two factors – pollution concentrations and density of the population living in the territory.

The priority towards pollution reduction require first of all areas with high degree of contamination and higher population density. The fundamental difference is the product of these two parameters.

Reducing pollution in general can be achieved in different ways – change in the sectoral structure of the economy, introduction of innovative technologies, the use of industrial waste, construction of treatment facilities, carrying out afforestation and so on.Typically, the implementation of such measures requires some investment costs. In terms of quantitative assessment of the effect of eco-investments requires identifying appropriate dependencies linking the size of investment with the value of the results obtained.

One way of such a dependence can be inear type functions such as:

$$DE = bK, \quad (5)$$

where: K – the volume of eco-investment, b – constant coefficient.

For typical projects the pollution reduction capital intensity is known and can be used for the purposes of economic analysis of investment options. In some cases, may also be involved and analyzed a combination of standard and custom project developments.

A typical example to be considered a renewal of vehicles resulting in reduced fuel consumption by one mile and accordingly reduces the amount of gas emissions.

Our studies revealed the quantitative regularities for the process of system update consistency of equipment in industrial plants, which can similarly be used to analyze the dynamics of pollution.

In particular, it should be considered a reasonable to use the following quantitative patterns:

$$\Delta Z = \frac{Z_0 - Z_n}{F_n} K, \quad (6)$$

where: Z_0 – pollution emissions in the operation of machines in the base period,

Z_n – amounts of pollution emissions during the operation of the new equipment that replaces existing equipment, K – cost imposed by the new equipment

The analysis of the dependence shows that investments' eco-efficiency is determined primarily by the size of the ratio of pollution to the cost of fixed assets in the base period of operation.

Also significant value has the innovative new technology that characterizes the "jump" to reduce pollution when replacing existing technology innovation. I should add that this factor is determined by the parameters of existing and new technology.

In accordance with presented dependence more investments correspond to a current number of vehicles, which in turn intensifies the reduction of pollution.

However, it should be noted, that this directly proportional dependence occurs in the form of approximately stable volumes of production. If the dynamics of these volumes occurs, the indicated dependence shall be slightly adjusted.

Of course, the environmental effectiveness of a new technology depends on its technological purpose, the rate of technological progress, industry conditions and so on.

The variety of vehicles and assets raises the problem of determining the best areas of the eco-investments, and those investments that tangentially affect the state of pollution. Lets analyze a number of parameters of air pollution on the example of Poland – Voivodships [4,12].

Overall, during the study period, pollution by dust has decreased by large size – about 2 times. At the same time gas pollution emissions decreased by 19 %. Significantly (by 45 %) were reduced the emissions of sulphur dioxide [4,12].

On the same level remained emissions of carbon dioxide and nitrogen oxides.

Taking into consideration the current trends, we can conclude that dust contamination is possible to reduce more rapidly, including through the use of appropriate technology filtering gas mixtures.

Using the raw data, we develop such quantities as population density, the ratio of its size to the size of the residence surface area and the average concentration of pollution – emissions related to the size of the territory they pollute.

Taking into consideration obtained data under the proposed approach we shall multiply the results and thus, that will determine the Voivodeship rating factor on the priority pollution reduction. For some types of equipment, there are three levels of performance: low, medium and high. Obviously, there is a difference in the cost of the equipment, which makes specific factory rational choice alternative treatment. In some cases, the improved treating achieved by means of multiple staging of this process. For example, two stages option purification takes place the following quantitative relation:

$$U = U_1 + (1 - U_1)\, U_2, \quad (7)$$

where: U – share of "hard" phase mixture shown cleaning system in relation to the amount of "hard" phase input, U_1 – share of "hard" phase, which remains after the first stage of filtration, U_2 – fraction of the solid phase, which remains after the second stage of filtration.

If we consider the value of entered indicators as filtration efficiency, the overall efficiency in some way connected with the relevant local efficiency. If for example we assume that $U_1 = U_2 = 0{,}8$, then the resulting efficiency is equal to U = 0,96. That is already a two stage filtration, that provides a significant effective performance compared with similar local efficiency.

The economic problem here is that by means of increasing stages of filtering significantly increases the cost of the equipment, while increasing efficiency to a lesser extent.

This is an important law, since there is a need to correlate the cost of the equipment with its performance.

Lets take a regional interpretation of equation (4) as an example the emission of dust pollution on the territory of Poland Voivodships. Relevant primary statistics are given below in Table. 1 [5, 10, 19, 20].

The statistical data are further used to determine for each of the Voivodeship concentration of gas

emissions and population density in the area. The result of these indicators can serve as a measure of efficiency (rate) of pollution reduction. It shall be noted, that a priori the volume of pollution emission and population in the territory the correlation is not expected. At the same time, the analysis shows a statistical relation, that illustrates a dependency of the correlation. In quanitative form, it has the following linear interpretation:

$$Z = -0{,}262 + 1{,}429N. \quad (8)$$

The graphic interpretation of given correlation can be observed in Fig. 1.

The coefficient of correlation is equal tor = 0,77. Thus, distress communication is significant.

By dividing the left and right side of the equation on the size of the surface S, we obtain the dependence of the concentration of impurities on the density of the population living in the territory:

$$\frac{Z}{S} = \frac{0{,}262}{S} + \frac{1{,}429N}{S}. \quad (9)$$

General conclusion is that in real business practices the pollution is closely linked to population density in the area. The reason for this phenomenon may be the concentration of production and consequently attract a large number of employees. Concentration in turn leads to an intensification of contamination. Selected primary statistics allow to access the problem of prioritization, that reduces pollution by individual region.

The results of the corresponding calculations are presented in Table 2 [4].

Table 1. The statistical data main parameters at Polish Voivodeships in 2012 [4]

Nr	Voivodeships	Population, mln., ppl.	Area, in thousand, km^2	Particulate dust pollutants emission, in th. ton.
1	Lower Silesian	2,9	19,9	4, 0
2	Kuyavian-Pomeranian	2,1	18,0	3,9
3	Lublin	2,2	25,1	2,1
4	Lubusz	1,0	14,0	1,2
5	Łódź	2,5	18,2	3,4
6	Lesser Poland	3,3	15,2	3,9
7	Masovian	5,3	35,5	4,6
8	Opole	1,0	9,4	1,2
9	Subcarpathian	2,1	17,8	1,7
10	Podlaskie	1,2	20,2	0,9
11	Pomeranian	2,3	18,3	2,8
12	Silesian	4,6	12,3	10,6
13	Świętokrzyskie	1,3	11,7	2,7
14	Warmian-Masurian	1,4	24,2	1,2
15	Greater Poland	3,5	29,8	4,0
16	West Pomeranian	1,7	22,9	2,6

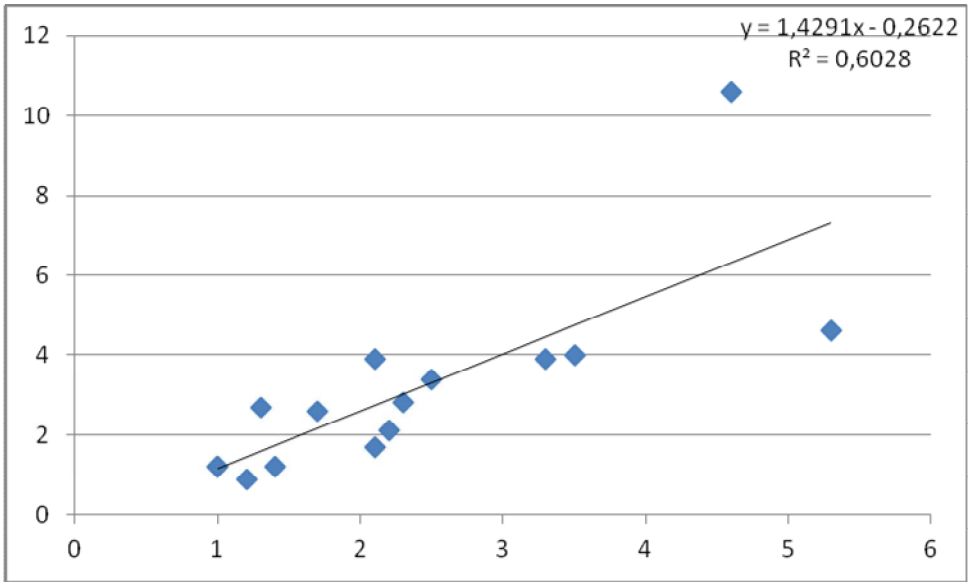

Fig. 1. The correlation between dust pollutants and population

Table 2. The definition of Voivodeship's rating for reducing dust pollution

Nr	Voivodships	Population density, mln., ppl./ th. km^2, v	Pollution concentration, th. ton/ th.km^2, v	100dv, indicator	Ranking of pollution influence
1	Lower Silesian	0,15	0,20	3,0	3
2	Kuyavian-Pomeranian	0,12	0,22	2,6	5
3	Lublin	0,09	0,08	0,7	13
4	Lubusz	0,07	0,09	0,6	14
5	Łódź	0,14	0,19	2,7	4
6	Lesser Poland	0,22	0,26	5,7	2
7	Masovian	0,15	0,13	2,0	7
8	Opole	0,11	0,13	1,4	10
9	Subcarpathian	0,12	0,10	1,2	11
10	Podlaskie	0,06	0,04	0,2	16
11	Pomeranian	0,13	0,15	1,9	8
12	Silesian	0,37	0,86	11,8	1
13	Świętokrzyskie	0,11	0,23	2,5	6
14	Warmian-Masurian	0,06	0,05	0,3	15
15	Greater Poland	0,12	0,13	1,6	9
16	West Pomeranian	0,07	0,11	0,8	12

If we compare the ratings we shall observe, that the top three priority on reducing pollution include the following Provinces: Silesian, Lesser Poland, Lower Silesian. The results are conditioned by the fact that in these Voivodships is the largest concentration of pollution and population density living in these areas.

The reason for it should be considered as the presence of large scale industrial production, which requires the involvement of a significant number of employees and activities which are based on industry specifics, that are related to pollution.

Priority means that first of all shall be implemented the environmental initiatives in these areas.But the choices of eco-investments significantly affects the readiness of technical and technological solutions. Also important factors include absolute and specific costs, including such factors as capital intensity reduction of pollution [7].

As was previously analyzed from the two areas of air quality improvement for dust pollution better results are achieved, which decreased more rapidly.

A priori, this can be explained by the fact that there are appropriate technical solutions that do not require for their implementation major capital expenditures. At the same time, the chemical nature of pollution may require more complex development projects and significant capital investment.Do not forget about the diversification aspects of environmental activities. In the majority of casses, the environmental measures of Voivodships are carried out independently at their own expense and opportunities. A compromise between the interests of the community as a whole and the community in some areas can be achieved through the introduction of appropriate criteria and constraints. Some approaches in this direction, were considered in [5, 8].

CONCLUSIONS

The performed work have shown, that the choice of parameters, that quantify environmental assessment should take into consideration the pollution's negative impact at first on the life quality of one man, and then summarize the number of residents living in a particular area.

Taking into consideration air pollution, the output parameters for the performed research should be considered a harmful gas in the air, the component that is correlated with the amount of gas emissions per unit of area. For residents of the entire territory the overall pollution impact is considered additive, which will be proportional to the population.

The statistical analysis of Polish Voivodeship illustrates, that these indicators and their product significantly differ for different areas – different regions of one country, on given example of Poland. Because of this, the latter figure may be used to identify priority areas for the implementation of measures in order to reduce air pollution. In order to select appropriate investment projects, we require further assessment of the eco-costs effectiveness, which is largely dependent on the innovation degree of new technology. The strategy to reduce pollution at the country level should consist in the eco-activities for individual Voivodeships considering the level of local pollution, their industrial specifics as well as general and local resource capacity allocation, formation and implementation of eco-investment projects.

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Table of contents

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