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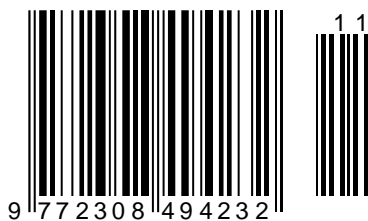
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Article



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FORMATION OF MACRO MODELS OF THE FINAL SUPPLY OF UZBEKISTAN AND SEGMENTS OF ITS COMPONENTS

Abstract: In this article constructed an econometric macromodel of final supply of goods and services. Also, econometric models of supply were tested for the statistical significance of indicators estimated on the statistical data of Uzbekistan, and an economic interpretation of the equations included in the macro model of supply was given.

Key words: econometric modeling, macroeconomic equilibrium, supply of goods and services, gross value added of sectors, assessment, economic interpretation, model testing.

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Introduction

One of the issues of adopting effective administrative, legal, foreign policy and economic measures of state policy to ensure macroeconomic equilibrium is directly related to the breadth (amount of data) and depth (time series) of statistical data in national statistics, as well as the presence of methodological approaches to analysis and forecasting in scientific research and higher education institutions in the country.

It is worth noting that statistical modeling and forecasting of supply and demand are important tools for determining macroeconomic equilibrium and developing effective government regulation measures.

Therefore, the structure of macro models and forecasting supply and demand at any period of economic development becomes important for determining the factors of sustainable development and the level of macroeconomic equilibrium of the country.

It should be emphasized that in the conditions of unstable development of the world economy, in order to determine the level of balance of the national

economy, it is necessary to develop new approaches to constructing macro models of macroeconomic equilibrium and improve forecasting tools taking into account new external and internal challenges, as well as political risks.

Moreover, this requires improvement of existing methodological recommendations for the structure of macro models and the development of new alternative approaches to modeling and forecasting indicators of macroeconomic equilibrium.

Without detracting from the practical significance of other approaches, it should be noted that improving the modeling and forecasting of the country's macroeconomic equilibrium based on macro proportions and SNA indicators is relevant and becomes important due to the need to introduce mathematical and econometric tools in the practical activities of national statistics, which is indicated in the National Development Strategy statistics of the Republic of Uzbekistan for 2020 – 2025 [11], as well as in the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 691 “On the implementation of a modern system of national

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accounts in the Republic of Uzbekistan” dated August 19, 2019 [12].

In this regard, this article explores the issue of econometric modeling of the final supply and its component segments, as a macro model of the production capabilities of the national economy and the main macro indicator of the macroeconomic equilibrium of Uzbekistan.

Analysis of literature.

The study of applied econometric models for analyzing supply and demand in the CIS countries, chosen by us as the closest in terms of development level and economic structure, showed that there are enough studies covered by forecasting the supply of goods and services.

Uzbek scientist S.V. Chepel, predicting the volume of supply “in the range of input indicators of the model on the supply side,” included “indicators of industry output and investment (supply from domestic producers), as well as imports (supply from the world economy)” [20].

Russian scientists led by S.M. Drobyshevsky [3], S.G. Sinelnikov-Murylev [13] and I.V. Filimonenko [18] formed econometric models for forecasting GDP by supply factors.

A group of scientists led by S.M. Drobyshevsky, when forecasting the index of physical volume of GDP, as variable supply factors included the share of the public sector in GDP, the economically active population, the number of employed, the share of those employed in the public sector in the total number of employed population, the unemployment rate, the average monthly nominal wage, the index of physical volume and the share of public sector in terms of fixed assets.

Also, a number of scientists have built applied econometric models for analyzing and forecasting segments of supply components, in particular, gross added value of industry (V.V. Matveev [10], E. Astafieva (2015) [1], N.N. Shinkevich [23]), GVA of agriculture (A.S. Truba, A.K. Markov, E.E. Mozhaev [16], L.M. Osinevich [9]) GVA of construction (A.B. Zhadigerova [4]), GVA transport (I.A. Toymentseva [14]) GVA of trade (P.I. Kuzmin, V.V. Mishchenko, Yu.A. Sultanyan, S.Yu. Baeva [7], A.G. Zinoviev, P.I. Kuzmin, O.V. Isaeva [6], the volume of the service sector (D.M. Dalgatova [3]) and others.

Generalized applied econometric models for analyzing and forecasting supply and segments of its components (GVA and industrial output) by scientists from the CIS countries are presented in Table 1.

Table 1. Applied econometric models for analysis and forecasting of supply and segments of its components

Resulting indicator	Factor	Research
Supply volume	- industrial products; - Agriculture; - investments; - import; - production of consumer goods; - paid services to the population.	Chepel S.V. (2019), [20]
GDP physical volume index	- share of the public sector in GDP; - economically active population; - number of employees; - the share of people employed in the public sector in the total employed population; - unemployment rate; - average monthly nominal wage; - index of physical volume of fixed assets; - share of the public sector in the volume of public funds.	Drobyshevsky S.M., Idrisov G.I., Kaukin A.S., Miller E.M., Pavlov P.N., Sinelnikov-Murylev S.G. (2019) [3]
GDP volume	- investments in fixed capital; - government spending on applied scientific research; - internal expenditures on research and development; - number of people employed in the economy with higher professional education; - number of people employed in the economy with secondary vocational education; - number of people employed in the economy with primary vocational education; - the number of working-age population without vocational education.	Filimonenko I.V. (2011) [18]
GDP volume	- labor; - capital; - aggregate productivity factors.	Sinelnikov-Murylev S., Drobyshevsky S., Kazakova M., Alekseev M. (2015), [13]
GVA industry	- employment; - hours worked; - material reserves; - fixed assets; - intensity of capacity utilization; - age of capital; - quality of capital.	Matveev V.V. (2011) [8]
GVA industry	- labor; - capital; - aggregate productivity factors.	E. Astafieva (2015) [1]

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GVA industry	- cost of fixed assets in the industry; - consumption of fuel and energy resources in the republic; - number of employees in the industry;	Shinkevich N.N. (2010) [19]
GVA of agriculture	- investments in fixed capital for the type of activity "Agriculture, forestry, hunting, fishing and fish farming"; - sown areas; - average annual number of employees.	Truba A.S., Markov A.K., Mozhaev E.E. (2020) [16]
GVA of agriculture	- investments; - population.	Osinevich L.M. (2013) [9]
Gross Agricultural Production	Production potential: - number of employees; - feed consumption; - cost of fixed capital; - area of land; - number of computers for agricultural organizations; - conditional livestock.	Cheremukhin A.D. (2020) [21]
Gross Agricultural Production	- level of production intensification, use of fertilizers, new technology and other factors; - increasing subsidies from the budget, weakening the disparity in prices for industrial and agricultural products; - reduction of costs for material resources.	Trutneva N.Yu. (2003) [17]
Gross Agricultural Production	- state support; - land resources; - natural and climatic conditions; - state of science and technology; - healthy competitive environment.	Panin A.V. (2016) [10]
Gross Agricultural Production	- level of development of social infrastructure.	Evdokhina O.S., Falaleeva E.V., Pogrebtsova E.A., Leushkina V.V. (2016) [5]
Profit of an agricultural organization	- subsidies for 100 hectares of agricultural land; - working capital per 100 hectares of agricultural land; - fixed assets in the form of depreciation per 100 hectares of agricultural land; - wages per 100 hectares of agricultural land.	Cherdantseva E.A. (2011) [22]
GVA of construction	- fixed assets; - number of employees.	Zhadigerova A.B.) [4]
The volume of housing commissioning depending on changes in supply factors	XS1 - investments in fixed capital, million rubles; XS2 - cost of fixed assets, million rubles; XS3 - investments in fixed capital by types of activities related to housing and communal services and consumer services, million rubles; XS4 - research and development of new products, services and methods of their production (transfer), new production processes, million rubles. XS5 - acquisition of machinery and equipment related to technological innovation, million rubles. XS6 - marketing research, million rubles.	https://bstudy.net/905072/ekonomika/regionalnyy_zhiliщno_stroitelnyy_kompleks_infrastrukturnyy_element_sotsialno_ekonomicheskoy_sistemy?vsclid=lgc679yr3x720314355 [24]
GVA of transport	- volume of passenger transport services; - cost of transporting passengers; - natural volume of services; - passenger mobility; - number of passengers; - level of motorization; - population size.	Toymentseva I.A. (2011) [14]
Freight turnover	- volume of work performed by type of economic activity "Construction"; - retail trade turnover; - agricultural products; - rate of growth (decrease) of investments in vehicles, machinery and equipment;-tariff index for freight transportation.	https://infopedia.su/13xe1a1.html [25]
Passenger turnover	- number of public buses per 100,000 population; - number of own passenger cars per 1000 people; - rate of growth (decrease) of investments in vehicles, machinery and equipment; - growth rate of average monthly nominal accrued wages of employees; - population below working age; - population size at working age; - population over working age.	https://infopedia.su/13xe1a1.html [25]
Volume of services in the cellular communications market	External factors: - financial policy of the state; - prices for resources; - stability and perfection of the banking system; - investment attractiveness of the industry. Internal factors: - information transmission technology; - capacity of data transmission channels; - availability of qualified workers; - software.	Tregub I.V. (2009) [15]

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GVA of trade	- growth rate of change in the physical volume of fixed production assets; - investments in fixed assets; - average monthly nominal wages of workers.	Kuzmin P.I., Mishchenko V.V., Sultanyan Yu.A., Baeva S.Yu.(2017) [7]
GVA of trade	- availability of fixed production assets; - volume of investments in fixed capital; - number of industry employees; - volume of retail trade turnover in food products, including drinks, and tobacco products.	Zinoviev A.G. Kuzmin P.I., Isaeva O.V., (2022) [6]
Volume of service sector	- population size and density; - state regulation of the normal functioning of all economic entities; - level of innovative development, individuality and creativity of the entrepreneur; - the pace of development of the national economy; - solvency of the enterprise; - real income per capita; - pricing policy in the services market; - competitiveness and quality of services provided.	Dalgatova D.M. (2010) [2]
Volume of gross turnover of the service sector	- change in labor productivity of one employee due to labor intensification; - change in labor productivity of one employee due to changes in prices for goods; - change in the average number of employees; - change in labor productivity of one employee; - changes in prices for goods.	Chikin S.N., Vostrikov N.I., Kozlov A.N. (2012) [23]
Source: compiled by the authors.		

Research methodology.

In the methodological aspect of constructing an econometric macromodel for analyzing and forecasting the final supply of Uzbekistan, it is necessary to develop them sequentially and separately in the following order:

- modeling of individual factors (segments influencing it) of the final offer;
- formation of a macromodel of the final proposal;
- assessment of econometric models of the final supply and its constituent segments using statistical data from Uzbekistan.

We use the SNA equation as the basis for the macromodel of final supply, according to which GDP (on the supply side) is calculated by the production method (as a set of newly created added values in sectors of the national economy).

Thus, the entire forecast value of the growth rate of final supply will be determined by adding the multiplied growth rates of industries (industry, agriculture, construction, transport and communications, trade and public catering and procurement, as well as other service sectors) and their shares in the country's GDP and will take the following form of a mathematical formula:

$$AS_gr(GDPs) = IND_VA_gr * Ind_va_d + (AGR_VA_gr * Agr_va_d) + (CONST_VA_gr * Const_VA_d) + (TRANS \& COM_VA_gr * Trans \& Com_va_d) + (TRADE_VA_gr * Trade_VA_d) + (SERV_VA_gr * Serv_va_d)$$

Where,

- AS_gr(GDPs) - growth rate of final supply;
- IND_VA_gr - growth rate of industry GVA;
- Ind_va_d - the share of industry in the final supply in GDP (calculated by the production method);
- AGR_GR - growth rate of GVA in agriculture;
- Agr_va_d - share of agriculture in GDP;
- CONST_VA_gr - growth rate of construction GVA;
- Const_VA_d - share of construction GVA;
- TRANS&COM_VA_gr – growth rate of GVA of transport and communications;
- Trans&Com_va_d - share of GVA of transport and communications;
- TRADE_VA_gr - growth rate of GVA of trade and public catering and procurement;
- Trade_VA_d) - share of GVA of trade and public catering and procurement;
- SERV_VA_gr - growth rate of GVA other service sectors;
- Serv_va_d) - share of GVA in other service sectors.

Results of simulation.

When constructing an econometric model of final supply based on theoretical and applied approaches, the growth rate of industry GVA (IND_VAgr) (growth rate of employment in industry (Empl IND), growth rate of labor productivity in industry (Empl_prod IND), investment in industry, from two annual lag (INV_2YM), growth rate of producer price index of industrial goods (PPI), export of goods and services (EXP), import of goods and services (IMP), total income per capita (GREV_PC)), growth rate of GVA of agriculture (AGR_GR) (consumer price index (CPI_FP), agricultural productivity (Prod_AGR), changes in world prices for agricultural products (FAO_Pindex), population growth rate (Pop_gr)), construction GVA growth rate (Const_GVAg) (gross output growth rate (OUTPUT), growth rate of investment in fixed capital (INV_grFC), growth rate of GVA of industry (IND_VAgr), household expenses (HCONS_2), growth rate of population (Pop_gr)), growth rate of GVA of transport and communications

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(Trans&Com_gr) (growth rate of gross output (OUTPUT), import of goods and services (IMP), growth rate of passenger transportation (Pass_traffic_gr), growth rate of cargo transportation (Trans_goods_gr), rate of change in tariffs for communication services (ComServ_tariffs), rate of change in tariffs for transportation services (TransServ_tariffs)), rate growth of GVA of trade and public catering and procurement (GVA_trade) (growth rate of GDP per capita (GDP_PC_gr), import of goods and services (IMP), household expenditure (HCONS_2), growth rate of investment in fixed capital (INV_grFC), growth rate of total income per capita (GREV_PC)), GVA growth rate other service sectors (Serv_gr) (gross output growth rate (OUTPUT), consumer price index (CPI), GVA growth rate of transport and communications (Trans&Com_gr), population growth rate (Pop_gr)) a wide range of indicators were taken into account.

However, not all of the above factors of econometric supply models showed a close relationship with the resulting indicators.

Econometric supply models analyzed on statistical data of Uzbekistan and assessed as satisfactory, in particular, the growth rate of GVA of industry (Annex 1.), the growth rate of GVA of agriculture (Annex 2.), the growth rate of GVA of construction (Annex 3.), the growth rate of GVA of transport and communications (Annex 4.), the growth rate of GVA of trade and public catering and procurement (Annex 5.), the growth rate of GVA of the service sector (Annex 6.) had statistically significant indicators p-values of t-statistics (within 0.1, presented in parentheses under the coefficients of the equations).

The system of econometric supply models assessed using statistical data from Uzbekistan is presented in Table 2.

Table 2. A system of econometric supply models assessed using statistical data from Uzbekistan

Econometric models	Variables indicators
Темп роста ВЛС промышленности Industry GVA growth rate	
$\text{IND_VAg} = -1,093 + 1,047 * \text{Empl IND} + 0,999 * \text{empl_prod IND} + 0,047 * \text{INV_2YM}$ <p style="text-align: center;">(0,000) (0,000) (0,000) (0,1215)</p>	IND_VAg - Growth rate of industry GVA; Empl IND - Growth rate of employed in industry; Empl_prod IND - Productivity growth rate labor in industry; INV_2YM - Investments in industry, smoothing two annual values.
Growth rate of GVA in agriculture	
$\text{AGR_VA_gr} = 0,120 + 0,339 * \text{Prod_AGR} + 0,572 * \text{GDP PC_gr} + 0,057 * \text{DEF_GDP} - 0,076 * \text{PPI}$ <p style="text-align: center;">(0,0019) (0,0159) (0,0517) (0,0595)</p>	AGR_GR - growth rate of GVA in agriculture; Prod_AGR - productivity in agriculture; GDP_PC_gr - GDP growth rate per capita; DEF_GDP - inflation growth rate (GDP deflator); PPI - producer price index for industrial goods.
Construction GVA growth rate	
$\text{Const_VA_gr} = (-0,307) + 2,191 * \text{OUTPUT} + 0,362 * \text{SAV_2YM} - 0,154 * \text{IMP} - 0,084 * \text{PPI_1YL}$ <p style="text-align: center;">(0,0280) (0,0193) (0,022)</p>	Const_VAg - growth rate of construction GVA; OUTPUT - growth rate of gross output; SAV_2YM - GFCF growth rate, smoothing two annual values; IMP - import of goods and services; PPI - producer price index for industrial goods.
Growth rate of GVA of transport and communications	
$\text{Trans\&Com VA_gr} = (-0,270) - (0,080 * \text{CPI}) + 0,117 * \text{Imp} + 1,264 * \text{GDP PC_gr}$ <p style="text-align: center;">(0,0999) (0,0145) (0,0082)</p>	Trans&Com_gr - growth rate of GVA of transport and communications; CPI - consumer price index (CPI); IMP - import of goods and services% GDP_PC_gr - GDP growth rate per capita (annual).
Growth rate of GVA of trade and public catering and procurement	
$\text{Trade_VA_gr} = -1,032 + 1,432 * \text{GDP_PC_gr} + 0,128 * \text{IMP} + 0,480 * \text{HCONS}$ <p style="text-align: center;">(0,0000) (0,0599) (0,0016)</p>	Trade_VA_gr - growth rate of GVA of trade and public catering and procurement; GDP_PC_gr - GDP growth rate per capita; IMP - import of goods and services; HCONS - household expenditures.
Growth rate of GVA in the service sector	
$\text{Serv_VA_gr} = (-0,505) + 1,390 * \text{OUTPUT} + 0,011 * \text{EXCH_R} + 0,106 * \text{CPI} - 0,031 * \text{PPI}$ <p style="text-align: center;">(0,0000) (0,0647) (0,0021) (0,0156)</p>	Serv_VA_gr - growth rate of GVA other service sectors; OUTPUT - growth rate of gross output; EXCH_R - rate of change of the national exchange rate. currencies (US dollars per sum); CPI - consumer price index (CPI); PPI - producer price index for industrial goods.
Source: compiled by the authors.	

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The economic interpretation of the equations included in the macro model of supply is as follows:

- The growth rate of employment in industry (Empl IND), the growth rate of labor productivity in industry (Empl_prod IND), the growth rate of investment in industry, with a two-year lag (INV_2YM) by 1% leads to an increase in GVA of industry (IND_VA_{gr}) by 1.047%, 0.999% and 0.047% respectively.

- Growth in agricultural productivity (Prod_AGR), growth rate of GDP per capita (GDP PC_{gr}) and GDP deflator (DEF_GDP) by 1% leads to an increase in agricultural GVA (AGR_GR) by 0.339%, 0.572% and 0.057%, respectively, in while an increase in the industrial goods producer price index (PPI) leads to a decrease in the growth rate of added value in the agricultural sector by 0.076%.

- The growth rate of construction GVA (Const_GVA_{gr}) is mainly determined by the volume of gross output (OUTPUT), which is reflected in the elasticity coefficient, which in the equation is equal to 2.191. The growth rate of gross fixed capital formation (SAV) is less decisive for the growth of construction GVA (Const_GVA_{gr}) than the volume of gross output (OUTPUT), which is confirmed by the elasticity coefficient (0.362) in the model. The growth of imports of goods and services (IMP) and the producer price index of industrial goods (PPI) negatively affect the growth rate of construction GVA (Const_GVA_{gr}).

- The growth rate of GDP per capita (GDP PC_{gr}) and import of goods and services (IMP) have a positive impact on the volume of added value in the transport and communications sectors (Trans&Com_{gr}). An increase in GDP per capita

(GDP PC_{gr}) and imports of goods and services (IMP) by 1% leads to an increase in the GVA of transport and communications (Trans&Com_{gr}) by 1.264% and 0.128%, respectively, while an increase in the consumer price index (CPI) - to a decrease in the growth rate of added value of the industry by 0.080%.

- The growth rate of GDP per capita (GDP PC_{gr}), import of goods and services (IMP) and household expenditure (HCONS_2) by 1% leads to an increase in GVA of trade and catering and procurement (GVA_{trade}) by 1.432% 0.128% and 0.480% respectively.

- The greatest impact on the growth rate of GVA of other service sectors (Serv_{gr}) is exerted by the growth of gross output (OUTPUT), which is confirmed by the relatively high elasticity coefficient, which in the equation is equal to 1.390. Less influential factors in the growth rate of GVA of other service sectors (Serv_{gr}) are the growth of consumer prices (CPI) and the rate of change in the exchange rate of the national currency to foreign currency (EXCH_R). Their growth by 1% causes an increase in the growth rate of GVA of other service sectors (Serv_{gr}) by 0.106% and 0.011%, respectively.

Conclusion.

Summarizing the results of the above presented research, we can conclude that the constructed econometric macro model of the final supply is scientifically sound from the point of view of economic theory and applied econometrics, and can be used to predict the values of macroeconomic equilibrium and in drawing up programs for the socio-economic development of the Republic of Uzbekistan.

Annex 1. Regression statistical characteristics of an econometric model of industry

CONCLUSION OF RESULTS

Regression statistics	
Multiple R	0,952
R-squared	0,906
Normalized R-squared	0,894
Standard error	0,014
Observations	29

Analysis of variance

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	Significance F
Regression	3	0,048	0,016	79,989	0,000
Balance	25	0,005	0,000		
Total	28	0,053			

	Coefficients	Standard Error	t-statistic	P-Value	Lower 95%	Upper 95%
Y - IND_VA _{gr}	-1,093	0,154	-7,108	0,000	-1,410	-0,776
X1 - Empl IND	1,047	0,116	9,031	0,000	0,808	1,286
X2 - IND emp _{prod}	0,999	0,086	11,576	0,000	0,821	1,177

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X3 - INV_2YM	0,047	0,029	1,603	0,121	-0,013	0,107
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Annex 2. Regression statistical characteristics of an econometric model of agriculture

CONCLUSION OF RESULTS

Regression statistics

Multiple R	0,804
R-squared	0,647
Normalized R-squared	0,586
Standard error	0,018
Observations	28

Analysis of variance

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	Significance F
Regression	4	0,014	0,003	10,543	0,000
Balance	23	0,007	0,000		
Total	27	0,021			

	Coefficients	Standard Error	t-statistic	P-Value	Lower 95%	Upper 95%
<i>Y-AGR_GR</i>	0,120	0,228	0,528	0,603	-0,351	0,591
<i>X 1 -Prod_AGR</i>	0,339	0,097	3,510	0,002	0,139	0,538
<i>X 2 -GDP_PC_gr</i>	0,572	0,220	2,603	0,016	0,117	1,027
<i>X 3-DEF_GDP</i>	0,057	0,028	2,053	0,052	0,000	0,115
<i>X 4-PPI</i>	-0,076	0,038	-1,983	0,059	-0,155	0,003

Annex 3. Regression statistical characteristics of the econometric model of construction

CONCLUSION OF RESULTS

Regression statistics

Multiple R	0,884
R-squared	0,782
Normalized R-squared	0,744
Standard error	0,050
Observations	28

Analysis of variance

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	Significance F
Regression	4	0,206	0,052	20,626	0,000
Balance	23	0,057	0,002		
Total	27	0,263			

	Coefficients	Standard Error	t-statistic	P-Value	Lower 95%	Upper 95%
<i>Y-Const_VA_gr</i>	-0,307	0,606	-0,507	0,617	-1,561	0,946
<i>X 1-OUTPUT</i>	1,215	0,518	2,345	0,028	0,143	2,287
<i>X 2-SAV_2YM</i>	0,362	0,105	3,451	0,002	0,145	0,578
<i>X 3-IMP</i>	-0,154	0,062	-2,482	0,021	-0,281	-0,026
<i>X 4-PPI_1YL</i>	-0,084	0,034	-2,516	0,019	-0,154	-0,015

Annex 4. Regression statistical characteristics of the econometric model of transport and communications

CONCLUSION OF RESULTS

Regression statistics

Multiple R	0,817
R-squared	0,667

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Normalized R-squared	0,626
Standard error	0,033
Observations	28

Analysis of variance

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	Significance F
Regression	3	0,052	0,017	16,045	0,000
Balance	24	0,026	0,001		
Total	27	0,078			

	Coefficients	Standard Error	t-statistic	P-Value	Lower 95%	Upper 95%
Y-Trans&Com VA_gr	-0,270	0,492	-0,548	0,589	-1,285	0,745
X 1- CPI	-0,080	0,047	-1,711	0,100	-0,177	0,016
X 2-Imp	0,117	0,045	2,636	0,014	0,025	0,209
X 3-GDP PC_gr	1,264	0,439	2,879	0,008	0,358	2,169

Annex 5. Regression statistical characteristics of the econometric model of trade, public catering and procurement

CONCLUSION OF RESULTS

Regression statistics

Multiple R	0,845
R-squared	0,713
Normalized R-squared	0,679
Standard error	0,046
Observations	29

Analysis of variance

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	Significance F
Regression	3	0,131	0,044	20,748	0,000
Balance	25	0,053	0,002		
Total	28	0,184			

	Coefficients	Standard Error	t-statistic	P-Value	Lower 95%	Upper 95%
Y-Trade_VA_gr	-1,032	0,278	-3,711	0,001	-1,604	-0,459
X 1-GDP PC_gr	1,432	0,291	4,922	0,000	0,833	2,031
X 2-Imp	0,128	0,065	1,970	0,060	-0,006	0,261
X 3-HCONS	0,480	0,135	3,545	0,002	0,201	0,759

Annex 6. Regression statistical characteristics of the econometric model of other service industries

CONCLUSION OF RESULTS

Regression statistics

Multiple R	0,928
R-squared	0,861
Normalized R-squared	0,837
Standard error	0,010
Observations	28

Analysis of variance

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	Significance F
Regression	4	0,016	0,004	35,703	0,000
Balance	23	0,003	0,000		
Total	27	0,018			

	Coefficients	Standard Error	t-statistic	P-Value	Lower 95%	Upper 95%
Y-Serv_VA_gr	-0,505	0,174	-2,901	0,0080	-0,866	-0,145

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X 1-OUTPUT	1,390	0,148	9,383	0,0000	1,084	1,697
X 2-EXCH_R	0,011	0,006	1,940	0,0647	-0,001	0,023
X 3-CPI	0,106	0,030	3,468	0,0021	0,043	0,168
X 4-PPI	-0,031	0,012	-2,613	0,0156	-0,056	-0,007

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Article



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RESEARCH AND PLANNING THE DEVELOPMENT OF AN AUTOMATED SYSTEM FOR BUILDING RELATIONAL DATABASE MODELS BASED ON PROVIDED TASK TEXT IN NATURAL LANGUAGE

Abstract: In this paper authors research the possibility of developing an automated system for building relational database models based on provided task text in natural language. Authors describe the root cause of the problem they're solving, proof the actuality of such development, and explain the most essential problems. Also, different approaches in natural language processing and classification are researched as well. Authors propose an initial algorithm and architecture for developing such system.

Key words: Natural language processing, relational databases, model building, text analysis, SQL, text classification.

Language: Russian

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ИССЛЕДОВАНИЕ И ПЛАНИРОВАНИЕ РАЗРАБОТКИ АВТОМАТИЧЕСКОЙ СИСТЕМЫ ДЛЯ ФОРМИРОВАНИЯ МОДЕЛЕЙ РЕЛЯЦИОННЫХ БАЗ ДАННЫХ НА ОСНОВЕ ТЕКСТА ЗАДАНИЯ НА ЕСТЕСТВЕННОМ ЯЗЫКЕ

Аннотация: В данной статье рассматривается возможность создания автоматической системы для построения моделей реляционных баз данных на основе текста задания на естественном языке. Описывается суть проблематики, обосновывается актуальность подобной разработки, а также объясняются основополагающие проблемные моменты. Также рассматриваются различные подходы к анализу текстов на естественном языке, их классификации. Предлагается первичный алгоритм для реализации такой системы, а также ее первичная архитектура.

Ключевые слова: Обработка естественного языка, реляционные базы данных, построение моделей, анализ текста, SQL, классификация текста.

Введение

Ни одна информационная система на сегодняшний день не обходится без хранилища

данных и способов оперирования ими, которые предоставляются механизмами таких инструментов как базы данных. При разработке

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современных информационных систем этап проектирования является одним из наиболее важных, если не самым важным, и проектирование баз данных в нем играет одну из ключевых ролей.

Множество информационных систем для интеграции в повседневную жизнь общества, или же бизнес-процессы, разрабатываются крупными компаниями, как, к примеру, Сбер, Яндекс, ВТБ, VK и т. п. Подобные представители IT-индустрии могут позволить себе найти профессиональных специалистов в разработке и администрировании баз данных.

Но стоит учесть, что регулярно появляется огромное количество стартапов, академических проектов, или же просто небольших проектов. Объединяет эти категории наличие зачастую достаточно скромного бюджета. Есть также учебные проекты, которые и вовсе лишены любого финансирования (речь идет не о проектах на гранты и т. п., а именно о проектах в рамках учебной деятельности). При этом средняя зарплата специалистов в области разработки баз данных на 2023 год составляет 150.000 рублей [1]. Это может оказаться значительной позицией для небольшого бюджета. В то же время высокая стоимость оплаты труда профессионального специалиста может стать не основной проблемой в формировании команды, в отличие от того факта, что многим специалистам просто не выгодна подобная временная проектная деятельность, если к тому же они не смогут заработать больше, чем на постоянной позиции.

Таким образом все сводится к тому, что, скорее всего, вместо найма профессионального специалиста в разработке/администрировании БД необходимо будет искать альтернативы. Чаще всего заниматься планированием и разработкой БД в проекте придется либо другим разработчикам, с отличным основным профилем, либо же, как нередко бывает, и вовсе человеку, не имеющему даже смежной специализации. В этом случае не только страдает качество итоговой информационной системы, в силу некачественной реализации работы с данными, но и существенно возрастают временные затраты и когнитивная нагрузка, так как ответственному работнику приходится усваивать большое количество новой информации, включая непростую теоретическую составляющую, а затем учиться применять эти знания на практике.

Однако, даже если оценивать процесс проектирования БД специалистом, он все равно потребует значительных временных затрат и приведет к высокой когнитивной нагрузке, так как во многих случаях необходимо придумать, каким образом правильно и оптимально формализовать спецификацию требуемой базы в виде описания технического задания. В результате встает вопрос

– есть ли способ упростить и ускорить хотя бы часть процесса проектирования баз данных? И на этот вопрос можно найти ответ.

В рамках данной статьи рассматривается возможность создания системы, которая позволила бы автоматически генерировать модель базы данных (к примеру, в формате DDL скрипта) на основе некоторого текстового описания на естественном языке. Использование такой системы в будущем могло бы позволить снизить требования к специалистам для некоторых проектов, а также снизить когнитивную нагрузку на этом этапе проектирования и уменьшить затрачиваемое на него время.

Recent works on automated NLP systems

Для лучшего представления о поставленной задаче и возможных методах ее решения рациональным окажется рассмотреть некоторые последние работы схожей тематики. Варианты различных задуманных архитектур систем, а также подходов к их реализации для достижения схожих, однако отличающихся друг от друга в силу специфики каждого конкретного случая, результатов позволят заложить основу для реализации задуманной системы.

В работе [2] освещается подход к реализации когнитивной системы автоматизированной службы поддержки, которая могла бы «понимать» содержимое запросов от пользователей, верно их классифицировать, распределяя по категориям, анализировать и предлагать подходящее решение.

Приводится следующую модель жизненного цикла обработки запроса с проблемой системой (рис. 1) [2]. На первом этапе (Problem Diagnostics) извлекается логическая структура текста проблемы, происходит идентификация разделения на основе контекста, а также классификация проблемы. При этом используется анализ на основе паттернов (см. раздел 5) с предварительным разделением возможных компонент текста на большое количество групп, как контекстно-зависимых, так и инвариантных к контексту. После этого выполняется анализ первопричин (Root Cause Analysis – RCA), для чего используются собранные данные по прошлым запросам и их решениям, а также производится предобработка естественного языка для вычленения конкретных смысловых фраз (здесь и токенизация, и определение частей речи и прочее). На последнем этапе выполняется анализ семантического совпадения извлеченной информации с накопленной, в том числе с применением одного из достаточно простых, но вполне эффективных методов машинного анализа – Support Vector Machine (SVM) (см. раздел 5), по которой имеются рекомендации, которые и формируются в итоге и отправляются пользователю в качестве разрешения проблемы

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(это могут быть советы по необходимым действиям, скрипты и т. п.)

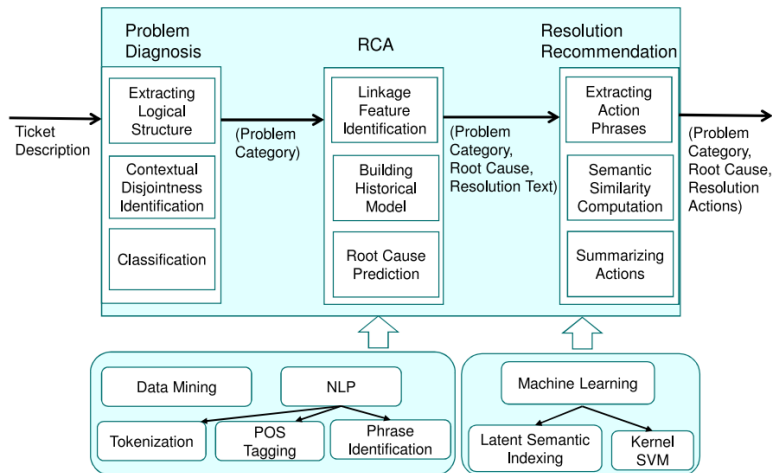


Рисунок 1 – Модель жизненного цикла обработки запроса в работе [2]

В работе [3] освещается подход к обработке запросов к реляционной базе данных, составленных на естественном языке, и перевод их в SQL запросы для непосредственного извлечения информации.

Авторами предлагается следующая модель системы (рис. 2) [3]. На вход подается запрос на естественном английском языке. В модуле обработки естественного языка сперва производится токенизация для формирования из входного запроса списка слов. Далее

производится лемматизация этого списка. После этого слова разделяются на группы по частям речи (POS-tagging). Затем происходит анализ предложений при помощи регулярных выражений для выделения различных свойств для SQL запросов. После того, как все ключевые слова выделены происходит их соотнесение с языко-специфичными терминами SQL для формирования конечного запроса.

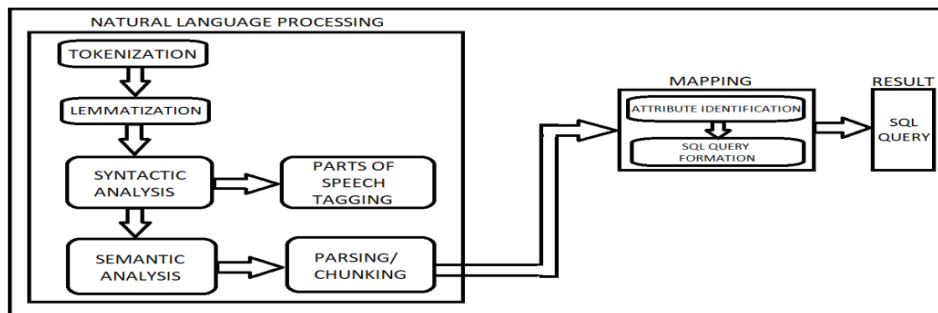


Рисунок 2 - Модель предлагаемой системы в работе [3]

В данной работе автор не использует методы машинного обучения, а применяет лишь подход, основанный на паттернах, выделяя атрибуты из предобработанного текста с использованием регулярных выражений (по сути паттерны).

В еще одной работе [4] также рассматривается алгоритм для автоматического транслирования запросов на естественном языке в SQL запросы. При описании этого алгоритма автор больше внимания уделил вопросу о разделении SQL запросов на группы по функциональности, а также моменту соотнесения выделенных атрибутов из запроса реальным атрибутам и таблицам схемы. Для этого требуется

составлять «карту» схемы базы данных, чтобы получить представления обо всех таблицах, их атрибутах и соединениях. Для решения этой задачи автор предлагает использовать машинные методы, чтобы не составлять «карту» схемы каждый раз вручную, тем самым сэкономив время и автоматизировав процесс.

System Architecture

Основываясь на приведенный в прошлом разделе краткий обзор некоторых работ о современных системах и алгоритмах, схожих с задуманной системой, упомянутой во введении к данной статье, можно обозначить первичную

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архитектуру такой системы, а также выделить некоторые этапы ее реализации и возможные инструменты.

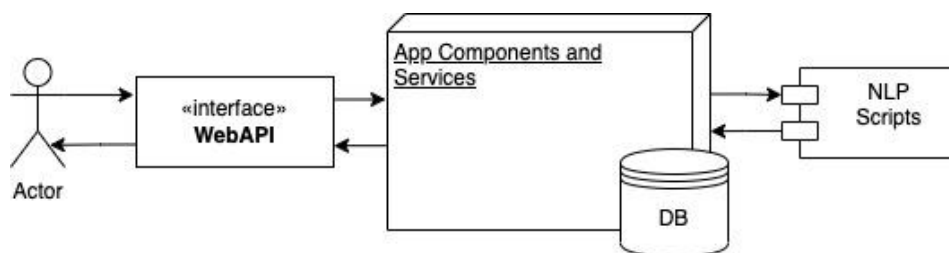


Рисунок 3 – Первичная архитектура задуманной системы

На рисунке 3 изображена первичная схема возможной архитектуры задуманной системы. Пользователь будет взаимодействовать с некоторым интерфейсом, например, с веб-API – это повысит доступность за счет мультиплатформенности. Через этот интерфейс будет происходить сообщение с основными компонентами и сервисами приложения (включая доступ к БД приложения через сервисный слой). Также отдельно выделен модуль для непосредственной работы с NLP, так как, скорее всего, приложение и скрипты будут реализовываться на разных языках программирования (наиболее популярным и часто используемым языком для NLP является Python).

При этом, учитывая специфику решаемой проблемы, потребуется, чтобы сформированная системой модель БД была максимально полезна пользователю, а это значит, что простого описания или визуального представления такой модели будет недостаточно, - потребуется практический результат, который можно будет сразу использовать. Наиболее актуальным в таком случае оказывается представление модели в виде

набора DDL скриптов для создания всех компонентов модели и связывания их между собой возможными ограничениями. Такой скрипт возможно будет сразу загрузить в IDE для СУБД и получить практический результат – готовую к использованию БД.

Таким образом, можно представить более подробно процессы, происходящие в модуле «NLP Scripts» на рисунке 3. На рисунке 4 приведен первичный алгоритм обработки исходного текста на естественном языке для получения результирующей модели БД. Исходный текст будет предобработан (приведение к инфинитиву, удаление предлогов и т. д.), затем при помощи алгоритмов машинного обучения будут выделены основные компоненты и связи, после чего будет выполнено соотнесение найденных компонент с требуемыми для построения модели БД элементами. После этого будет сформирована модель сперва в сущностях выбранного языка программирования, а затем будет построен DDL скрипт.

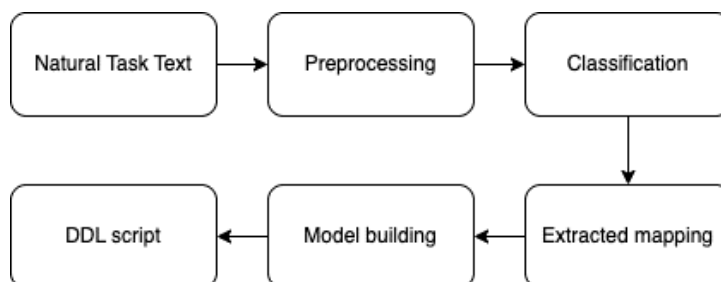


Рисунок 4 – Первичный алгоритм обработки исходного текста и формирования модели

Для классификации и сопоставления извлеченной информации возможно будет воспользоваться как анализом на основе паттернов (см. раздел 5), так и методами машинного обучения (см. раздел 5). Сама задача классификации ставится здесь для того, чтобы выделить основные сущности, для последующего сопоставления со спецификацией реляционных

БД (т. е. таблицы, их атрибуты, ограничения, типы данных и т. д.).

Построение модели в рамках сущностей выбранного языка программирования и формирование DDL скрипта на основе этих сущностей является не самой тривиальной, но уже решенной задачей в рамках бакалаврской работы автора данной статьи [5].

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Предполагается разрабатывать систему для работы сперва только с текстами на английском языке, так как это позволит воспользоваться более обширным набором инструментов (библиотеки, словари и т. д.), а также избавит от необходимости соотнесения русскоязычных и англоязычных терминов, что упростит работу. Однако в будущем, при успешной реализации системы для работы с английским языком, возможно будет расширение функциональности для работы и с русским.

Problem of semantics

Основная проблема, которая появляется при попытке транслировать любые выражения,

концепции или понятия с естественного языка в понятную компьютеру форму – это неоднозначность [6]. Причем неоднозначность как в отсылках к определенным объектам, что проиллюстрировано на рисунке 5, так и в концепциях. К примеру, «Джон лежит на диване» и «на Джоне лежит большая ответственность». В этом случае необходимо, чтобы было хотя бы минимальное понимание области (домена), в которой используется концепция в конкретном случае.

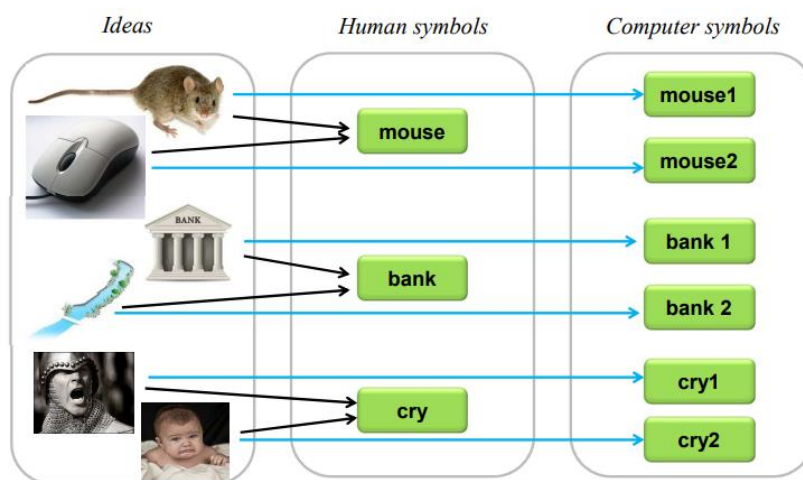


Рисунок 5 - Пример неоднозначности обозначений

Пример на рисунке 5 показывает, что в нашем естественном языке много понятий, для обозначения которых используется один и тот же термин, одно и то же слово. Однако есть и обратная ситуация – у многих понятий очень часто встречается несколько различных обозначений (рис. 6). При этом некоторые обозначения могут пересекаться для разных понятий, как в первом

примере, замыкая этот круг. Человек способен понять различия основываясь на собственном жизненном опыте и множестве накопленных в сознании контекстных ассоциаций. Компьютер же не обладает подобными возможностями изначально, и необходимо каким-то образом позволить ему четко дифференцировать понятия и концепции.

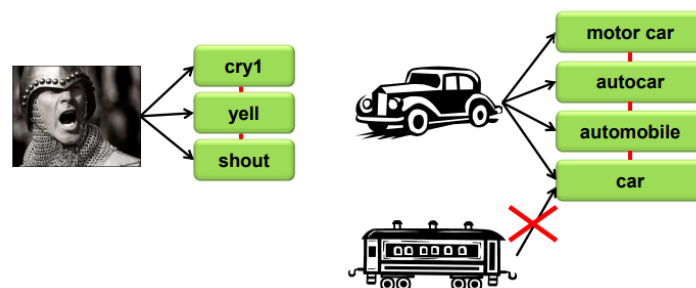


Рисунок 6 - Пример множественности обозначений

Обычно, когда речь идет о проблемах семантики, затрагивают также вопрос о принципе открытости реального мира [6]. Суть заключается в том, что окружающий нас мир не является

бинарным. В математике и классической логике мы привыкли использовать закон исключенного третьего, смысл которого сводится к тому, что любое высказывание однозначно является либо

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истинным, либо ложным. В основе компьютеров лежит именно классическая логика, позволяющая обосновывать все операции в машинном коде, состоящим из единиц (истина) и нулей (ложь). Так как с любого верхнего уровня всегда все сводится к исполнению инструкций машинного кода на

платах, физически реализованных на принципах классической логики, это четко дает понять, что компьютеры не могут оперировать информацией в условиях открытого мира напрямую, когда классическая логика не применима.

Таблица 1. Различия открытого и закрытого миров

	Открытый мир	Закрытый мир
Входные данные	Tuscany and Calabria are regions of Italy. Champagne is not a region of Italy.	
Вопрос 1	Is Tuscany an Italy region?	
Ответ 1	Yes	Yes
Вопрос 2	Is Champagne an Italy region?	
Ответ 2	No	No
Вопрос 3	Is Catalonia an Italy region?	
Ответ 3	Unknown	No

В 1908 году Л. Э. Я. Брауэр выступил с критикой классической логики, отметив, что закон исключенного третьего применим лишь к конечным областям [7]. Наш окружающий мир справедливо можно считать областью не конечной. Таким образом, при рассмотрении проблем семантики в общем виде можно говорить о том, что принцип открытости мира, по сути, не удастся реализовать в машинном виде, так как третье, неизвестное состояние утверждения, помимо «истина» и «ложь» (табл. 1) нереализуемо в классической логике.

Однако стоит отметить, что при решении обозначенной во введении проблемы для реализации системы автоматической генерации модели БД на основе текста на естественном языке нет необходимости строить модель мира, в случае чего проблема открытости мира играла бы роль, так как у системы нет цели отвечать на вопросы, а ее основной задачей, по сути, должна являться классификация и определение некоторых отношений между компонентами текста, причем тексты эти реализуют некоторую абстракцию конечной области приложения реляционной алгебры.

На сегодняшний день проблему понимания семантики компьютерами решают двумя основными способами: построение семантических сетей и онтологий, в которых описываются классы сущностей, отношения между ними, и которые реализуют пояснение семантических связей между объектами классов для машин [8]. Однако такой подход является не гибким, а также достаточно сложным в реализации, так как требует, по сути, ручной формализации большого количества понятий и концепций. Вторым вариантом, который сейчас в различных формах активно применяется в индустрии информационных технологий, а также и за ее

пределами, являются методы анализа естественного языка [9, 10].

Natural language analysis methods

1 Pattern-matching

Анализ на основе паттернов (правил), или же rule-based анализ, производится с использованием заранее подготовленных лингвистических правил, по которым будет классифицироваться текст. Причем правила эти составляются вручную. Такие правила могут, к примеру, состоять лишь из слов-маркеров, наличие которых отнесет фрагмент текста или же весь текст к определенному классу [10, 11].

Такой подход использовался еще до появления традиционных статистических методов классификации, и во многом считается несколько устаревшим, а также проигрывающим в точности и стабильности статистическим методам на сегодняшний день [12]. Однако в определенных ситуациях этот подход все еще может быть актуален. К примеру, если рассматриваемая предметная область является достаточно узкой и специфической, для нее возможно построить четкие правила, при этом их количество будет вполне адекватно.

Тем не менее в любом случае такой метод потребует достаточно глубокого понимания предметной области и большого объема предварительной работы по подготовке наборов правил [13]. Таким образом данный метод отличается высокой трудозатратностью.

2 Statistical methods

Наивный Байесовский Классификатор (NB) реализует теорему Байеса и широко применяется для решения проблем классификации текста ввиду своей простоты [12]. Байесовский классификатор является статистически оптимальным классификатором, учитывая не только

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вероятность того, что образ будет относиться к некоторому классу, но также и вероятность появления образа из этого класса [14]. Существуют также различные модификации стандартного NB, которые могут показывать лучшие результаты в зависимости от конкретного набора данных.

Метод k-ближайших соседей (K-Nearest Neighbors, KNN) относит неопознанный фрагмент к какому-либо классу основываясь на известных фрагментах-соседах. Для использования этого алгоритма не требуется составлять модель. Можно взять k тренировочных текстов и оценивать требуемый на основе близости соседей. Существует положительная корреляция между объемом данных и временем работы, так что при обработке больших наборов данных алгоритм будет работать ощутимо долго [12].

Support Vector Machine (SVM) – популярный метод классификации, в котором любой текст представляется вектором [12]. В данном случае решается проблема бинарного разделения образов на две категории. Строится плоскость, которая должна находиться между двумя категориями и на максимальном расстоянии от каждой. Таким образом каждый вектор либо однозначно находится с одной стороны от плоскости, либо его большая часть.

Decision Trees (DT) – принцип работы алгоритма похож на принцип работы нейронных сетей, но вместо системы весов используется концепция соответствия определенным логическим правилам [15]. Дерево строится на стадии роста, распределяя тренировочный набор данных на части, а затем на фазе сокращения изначальные данные обобщаются до построенных категорий. Однако такой метод показывает плохие результаты по скорости при увеличении объема данных [15], а также лучшие результаты могут достигаться лишь при переобучении модели под каждый новый набор данных [12].

Стоит отметить, что на сегодняшний день стандартный DT алгоритм почти не используется, вместо него обычно применяется Random Forest (RF), смысл которого в использовании множества DT-деревьев, которые обучаются на случайных фрагментах набора данных, а итоговое решение принимается на основе нескольких результатов по DT. Таким образом RF оказывается точнее, а также избавляет от проблем переполнения деревьев. К тому же он оказывается еще более устойчивым к шумам и неточностям в данных, чем стандартный DT алгоритм [16].

3 Deep learning

Методы глубокого обучения завязаны на использование нейронных сетей, симулирующих работу человеческого мозга при принятии решений. Такой подход позволяет извлекать даже

свойства высокого уровня из наборов данных и показывают лучшие результаты, нежели традиционные статистические методы в решении задач распознавания речи, обработки изображений или понимания текста [12].

Convolutional Neural Network (CNN) – сверточные нейронные сети, обычно используются для классификации изображений, так как их работа основана на отклике фильтров (свертке с фильтрами) с различными ядрами (kernel) [17]. Однако, возможно использовать CNN и для решения задач NLP (Natural Language Processing). Если представить элементы текст в векторном виде, и объединить векторы в матрицу, чтобы общее представление текста соответствовало формату представления изображения, то будет возможно применение фильтров и получение их отклика аналогичным образом с тем, как этот процесс происходит для изображений.

Recurrent Neural Network (RNN) – рекуррентные нейронные сети. Такие сети способны хорошо справляться с задачами прогнозирования. В RNN используется три типа слоев: входной, скрытый и выходной. За каждый временной период на вход подаются векторы токенов фиксированного размера, которые затем последовательно передаются в рекуррентную единицу [17]. Таким образом организуется некоторая «память» сети, которая как раз и представлена этим скрытым слоем, и каждый следующий временной этап использует в том числе эту накопленную информацию для лучшего принятия решений.

Существуют также некоторые другие вариации алгоритмов нейронных сетей, вроде ReNN (Recursive Neural Network) методов, Attention-based методов и др. Также существуют методы, основанные на предобучении, примерами которых являются OpenAI ChatGPT и Google BERT. Такие нейронные сети сейчас часто называют «языковыми моделями». Суть их в том, что они способны подготавливать «обучающий материал» для понимания машиной семантики естественного языка [12]. Реализуется это за счет анализа большого количества необработанной информации на естественном языке, за счет чего накапливается и постоянно передается между слоями множество контекстуальных знаний, что, в соответствии с особенностями семантики, описанными в предыдущем разделе, позволяет приблизиться к новому качественному уровню в понимании текстов на естественном языке.

4 Hybrid analysis

Гибридный подход предполагает совместное использование метода анализа, основанного на паттернах (правилах), и методов машинного обучения [10]. В некоторых случаях это может

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оказаться хорошей практикой. К примеру, если алгоритмы машинного обучения, используемые в системе анализа естественного языка, были обучены на конкретных классах текста, разделенных, допустим, по смыслу. В этом случае можно сперва разделять входной набор данных на эти классы основываясь на заданных правилах соответствия.

Subject area knowledge systematization

Большинство современных подходы к обработке естественного языка предполагают наличие определенного набора знаний о предметной области, в соответствии с которыми будут создаваться лингвистические правила (паттерны), задаваться классы образов,

составляться модель для обучения машинных алгоритмов. Исходя из этого и для решения обозначенной во введении проблемы потребуется некоторое формальное систематизированное описание рассматриваемой предметной области, а именно – домена знаний о моделировании реляционных баз данных.

Обычно, когда речь идет о реляционных базах данных, основной рассматриваемый элемент, – отношение, представляется следующим образом (рис. 7). Отношение состоит из множества атрибутов и ассоциированных с ними множеств значений, которые в результате выражаются конкретными наборами значений, так называемыми строками, или tuple'ами [18].

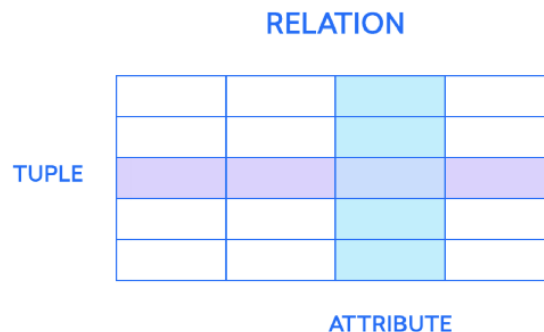


Рисунок 7 – Как представляется отношение в теории реляционных баз данных

Это представление соотносится с тем, что известно из теории реляционной алгебры. А именно – что примитивная реляционная схема представляет триплет вида:

$$PRS = (\Omega, \Delta, dom), \quad (1)$$

где Ω – конечный набор атрибутов, Δ – конечный набор множеств возможных значений, $dom - \Delta \rightarrow \Omega$ функция, которая ассоциирует с каждым атрибутом некоторое множество значений, соответствующее ему [19]. Также известно, что полная реляционная схема также представляет из собой триплет, состоящий из примитивной реляционной схемы PRS , неформального описания реляционной схемы на естественном языке M и набора условий (ограничений) SC на отношения схемы, представляющих собой булевы функции соответствия условию (2).

$$RS = (PRS, M, SC), \quad (2)$$

Опираясь на формулы 1 и 2 можно выделить следующие основные компоненты:

- 1) Сущности – то есть непосредственно классы объектов реального мира, которые необходимо формализовать в рамках теории реляционных баз данных, организуя таблицу;
- 2) Атрибуты сущностей – некоторые свойства и признаки классов объектов реального мира, которые могут принимать различные значения из свойственных им множеств;
- 3) Отношения между классами объектов реального мира и/или между атрибутами одного класса объектов; некоторые правила, ограничения, связи между сущностями/атрибутами.

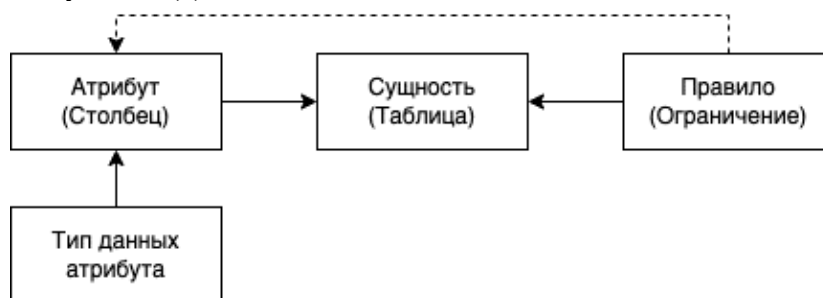


Рисунок 8 – Схема отношений выделенных компонент

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На рисунке 8 изображено схематическое представление отношений между выделенными основными компонентами предметной области. Так как теория реляционной алгебры описывает отношения, то главной компонентой можно справедливо считать сущность (в последствии таблицу). Для сущности определяются атрибуты (в последствии столбцы таблицы), ее свойства, для каждого из которых также важно определить тип данных, отражающий домен присущих атрибуту значений. Также на схеме отражены правила (условия/ограничения) для реляционной схемы, которые могут определять отношений между сущностями, о чем свидетельствует непрерывная стрелка от компоненты Правило, но также правила возможно применять и к атрибутам, о чем свидетельствует вторая стрелка.

Однако, если мы обратимся к спецификациям реализаций реляционной теории на практике, а именно – к различным реляционным системам управления базами данных (СУБД) (к примеру, СУБД Oracle [20]), мы увидим, что правила, или ограничения, применяются все также к таблице (сущности), только описывают не внешние отношения, а внутренние. Таким образом, нет необходимости напрямую связывать правила с атрибутами, ведь это может быть сделано через правила для сущности, о чем и свидетельствует пунктирная стрелка от компоненты Rule. Формально связь есть, но на практике она реализуется через сущность, которой атрибуты принадлежат.

Conclusion and future plans

Можно однозначно сказать, что с использованием современных подходов к

обработке естественного языка задуманную систему, описанную во введении, реализовать возможно. При обработке текста на естественном языке лучше будет использовать более современные подходы, основанные на методах машинного обучения, так как они более автоматизированы и дают лучшие результаты по сравнению с онтологическим моделированием и анализом на основе правил. Однако допустимо использование гибридного подхода с целью улучшения или упрощения классификации, если это будет актуально. Выбор конкретного метода машинного обучения будет зависеть от эффективности одного в конкретном случае, что возможно будет определить в будущем на тестовой выборке, оценив результаты, полученные разными методами.

В последующих работах планируется составить модель для использования алгоритмов машинного обучения, подобрать инструменты для предобработки текста, а также подготовить некоторый набор данных для обучения и тестирования эффективности алгоритмов машинного обучения. Когда этот этап будет пройден, планируется начать разработку конечного приложения, которое будет реализовывать обмен данными с пользователем, обработку текстов заданий на генерацию модели на естественном языке, а также непосредственно генерацию модели реляционной базы данных на основе выделенной из текста информации.

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Issue

Article



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THE INFLUENCE OF LEARNING, BUSINESS COMMITMENT, ENTREPRENEURIAL MOTIVES, AND ENTREPRENEURIAL SPIRIT ON THE PERFORMANCE OF TOFU AND TEMPEH INDUSTRIAL BUSINESSES IN PEKANBARU CITY

Abstract: This research examines the influence of learning, commitment of business actors, entrepreneurial motives, and entrepreneurial spirit on the performance of business actors in the Tofu & Tempeh industry in Pekanbaru City. Data collection was carried out using a questionnaire method which contained a list of statements regarding each variable studied. The respondents of this research were business people in the tofu and tempe industry in the city of Pekanbaru, and the sample used was 50 respondents. Data analysis in this research used the SmartPLS 7.0 program. Hypothesis testing using the PLS approach is carried out in two stages, namely testing the outer model and inner model. The outer model test was carried out to prove the validity and reliability of all indicators for each variable. The inner model test was carried out to test the influence between variables according to the previously established hypothesis. The research results show: 1) The results of hypothesis 1 testing prove that learning has an effect on the performance of business actors. 2) The results of hypothesis 2 testing prove that the commitment of business actors has no effect on the performance of business actors. 3) The results of hypothesis 3 testing prove that entrepreneurial motives influence the performance of business actors. 4) The results of hypothesis 4 prove that the entrepreneurial spirit influences the performance of business actors.

Key words: Learning, Commitment of Business Actors, Entrepreneurial Motives, Entrepreneurial Spirit, Performance of Business Actors.

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Introduction

Background

The development of an industry requires a long

process until it can finally realize its planned goals. The success of industry in realizing its goals is not easy, competition is one of the things that must be

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faced and strategic steps are needed in responding to it. Every business actor always wants to be superior to his competitors. There are many ways that business actors can win the competition in business. Competitive Advantage can be obtained by offering consumers greater value, such as offering lower prices

or by providing more benefits in consumer services at higher prices. According to the Department of Cooperatives and Small and Medium Enterprises of the Republic of Indonesia, there are 50 tofu and tempeh industries that have developed from 2009 to 2022.

Table 1. Data on Tofu and Tempeh Industry Players in Pekanbaru City

No	Name of MSME	Address	Subdistrict	MSME ID
1	SELLING TEMPE TOfu <NASWIN>	JL. H. AGUSSALIM	Tampan	1.47101E+14
2	<IWAN>'S TEMPE TOfu BUSINESS	PASAR KAGET JL. MELATI GANG ESEMKA	Tampan	1.47101E+14
3	SELLING TEMPE TOfu <SUKRI>	JL. UKA	Tampan	1.47101E+14
4	TEMPE TOFU <YATI>	PASAR KAGET JL. UKA	Tampan	1.47101E+14
5	TEMPE KNOWN TRADERS <AGUN>	JL. ROWOBENING PRUM ASABRI	Tampan	1.47101E+14
6	SELLING TEMPE TOfu <ADLI>	JL. CIPTA KARYA PASAR KAGET	Tampan	1.47101E+14
7	SELLING TEMPE TOfu <SUWAR>	JL. CIPTA KARYA	Tampan	1.47101E+14
8	TEMPE KNOWN TRADERS	PASAR BARU PANAM	Tampan	1.47101E+14
9	TEMPE KNOWN TRADERS	PASAR BARU PANAM	Tampan	1.47101E+14
10	SELLING TEMPE TOfu <SOBIRAN>	PASAR KAGET AIR DINGIN	Bukit Raya	1.47102E+14
11	SELLING TEMPE TOfu <WASNITA>	JL. SULTAN SYARIF QASYIM	Lima Puluh	1.47103E+14
12	SELLING TEMPE TOFU	JL. HANG JEBAT I	Sail	1.47104E+14
13	SELLING TEMPE TOfu <ERNI>	JL. KESUMA	Sukajadi	1.47106E+14
14	TRADING TEMPE KNOWN<DONA>	JL. TUANKU TAMBUSAI PASAR CIK PUAN PEKANBARU	Sukajadi	1.47106E+14
15	TEMPE TOFU TRADING <YATI>	JL. TUANKU TAMBUSAI PASAR CIK PUAN PEKANBARU	Sukajadi	1.47106E+14
16	SELLING TEMPE TOfu <TUMIRAH>	JL. SEROJA	Senapelan	1.47107E+14
17	K5 TEMPE KNOWLEDGE <ISWAHYUNI>	JL. TERATAI GANG ANGGREK	Senapelan	1.47107E+14
18	Tahu TEMPE SHOP <MUKHITUN>	PADANG BULAN	Senapelan	1.47107E+14
19	TEMPE TOfu SHOP <NUR HAYATI>	JL. TERATAI	Senapelan	1.47107E+14
20	TEMPE TOfu <JUFRIANDI> K5	JL. TERATAI	Senapelan	1.47107E+14
21	TEMPE TOfu TRADER <ARDIANSYAH>	JL. CEMPAKA GG ISTIQOMAH	Senapelan	1.47107E+14
22	TEMPE KNOWN TRADERS <HALIMAH>	JL. TERATAI	Senapelan	1.47107E+14
23	TEMPE KNOWN TRADERS	JL. AHMAD YANI GG. ISTIQOMAH	Senapelan	1.47107E+14
24	SELLING TEMPE TOfu <FENDI>	JL. KARTIKA SARI	Rumbai	1.47108E+14
25	SELLING <ASMI> TEMPE TOFU	JL. KARTIKA SARI	Rumbai	1.47108E+14
26	SELLING TEMPE TOfu <ANTONI PURNOMO>	JL. TENGGU KASIM PERKASA	Rumbai	1.47108E+14

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27	SELLING TEMPE TOFU <DIDI>	JL. KARTIKA SARI	Rumbai	1.47108E+14
28	SELLING TEMPE TOFU <SUMARWI>	JL. KARTIKA SARI	Rumbai	1.47108E+14
29	SALES OF TEMPE TOFU <SEFRIANDI>	JL. GOTONG ROYONG	Rumbai	1.47108E+14
30	TEMPE TOUGH FACTORY BUSINESS	JL. SOEKARNO HATTA GG ANSOR	Marpoyan Damai	1.47109E+14
31	TEMPE KNOWN TRADERS <EKA SANDI>	JL. HANDAYANI	Marpoyan Damai	1.47109E+14
32	TEMPE Tofu <ANGGUN WIBOWO>	JL. SOEKARNO HATTA <PASAR ARENGKA>	Marpoyan Damai	1.47109E+14
33	SELLING TEMPE TOFU <ATUN>	JALAN SIMPATI	Marpoyan Damai	1.47109E+14
34	SELLING TEMPE TOFU <YUSNITA>	JL. CENDRAWASIH	Marpoyan Damai	1.47109E+14
35	MAKING TEMPE TOFU <ARIANTO>	JL. INDRAPURI	Tenayan Raya	1.4711E+14
36	MAKING TEMPE TOFU <TAMBAS>	JL. INDRAPURI	Tenayan Raya	1.4711E+14
37	SELLING NELI TEMPE TOFU	TANGKERANG TIMUR	Tenayan Raya	1.4711E+14
38	SELLING TEMPE TOFU	TANGKERANG TIMUR	Tenayan Raya	1.4711E+14
39	KNOW TEMPE AROUND <NGADIRAN>	JL. GARUDA GG. PRIBADI	Payung Sekaki	1.47111E+14
40	LOS TAU TEMPE TOGE <TUGIRA>	PASAR PAGI PALAPA	Payung Sekaki	1.47111E+14
41	LOS Tahu TEMPE, BEAUT <TANTI>	PASAR PAGI PALAPA	Payung Sekaki	1.47111E+14
42	SALE OF TEMPE TOFU<RUS>	JL. DARMA BAKTI	Payung Sekaki	1.47111E+14
43	TEMPE TOFU FACTORY <AGUS>	JL. HARAPAN JAYA	Payung Sekaki	1.47111E+14
44	SELLING AN TEMPE TOFU	JL. SIDORUKUN GANG MUSHOLA	Payung Sekaki	1.47111E+14
45	SALE OF TEMPE TOFU<WAHYUDI>	JL. HANDAYANI	Payung Sekaki	1.47111E+14
46	SELLING TEMPE TOFU <DILLA>	JL. JAMBU	Payung Sekaki	1.47111E+14
47	TEMPE TOFU BUSINESS <SRI>	JL. KHAYANGAN PASAR RUMBAI	Rumbai Pesisir	1.47112E+14
48	TEMPE TOFU BUSINESS <HASANAH>	JL. KHAYANGAN PASAR RUMBAI	Rumbai Pesisir	1.47112E+14
49	TEMPE TOFU BUSINESS <LENA>	JL. KHAYANGAN PASAR RUMBAI	Rumbai Pesisir	1.47112E+14
50	TEMPE TOFU BUSINESS <ART>	JL. KHAYANGAN PASAR RUMBAI	Rumbai Pesisir	1.47112E+14

Source: <http://umkm.depkop.go.id/>

In the food sector, soybeans are one of the commodities produced by the IKM (Small and Medium Industry) sector which operates in the food industry. Soybeans are a staple commodity with high nutritional value and are good for health because they contain high protein equivalent to meat, milk and eggs (Bolla, 2015). According to the Directorate General of Small and Medium Industries, Ministry of Industry, in 2013, SMEs specifically for soybeans numbered ±139,842 business units and were dominated by tofu

and tempeh SMEs. (Styawan, et al., 2016).

Several factors that must be considered in terms of improving the performance of tofu and tempeh industry business actors in Pekanbaru City are learning, commitment of business actors, entrepreneurial motives and entrepreneurial spirit. These factors are thought to influence the performance of business actors based on the pre-survey conducted. This allegation needs to be proven by conducting this research. The low performance of

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business actors reflects the inability of business actors to manage their business. Business actors need to learn knowledge in managing a business.

Based on the results of previous research on small and medium industries in Pekanbaru City, it was concluded that many factors cause the low performance of business actors, such as training, entrepreneurial motives and entrepreneurial spirit (Hendriani et al., 2020). One way to improve human resource skills and knowledge apart from formal education is learning which can be done in various ways. Learning activities are one strategy that can be carried out through learning communities to improve the entrepreneurial spirit. Learning strategies must be able to encourage the growth of an entrepreneurial spirit for business people, especially in tofu and tempeh.

A high entrepreneurial motive can encourage entrepreneurs to study harder, accept input as improvement, be long-term oriented and want to achieve competitive advantage. Competitive advantage can only be created through creativity and innovation in creating superior value that customers need. For example, micro businesses that develop in society, the success of the business is determined by the performance of the business owner who also plays the role of worker, owner and leader of the business organization. A business owner must influence business performance so that it remains able to compete with sustainable excellence.

A business actor must have an entrepreneurial spirit and commitment to running a business with the determination to devote all his attention to the business he is running. In running this business, a successful entrepreneur must have determination (a strong spirit) in developing the business, not be half-hearted in trying, dare to take risks, work hard, and not be afraid to face the opportunities that exist. Without serious effort towards work, no matter how great an entrepreneur is, he or she will definitely fail in managing the business. Therefore, an entrepreneur must have a commitment to the business and work he is doing. Success in making quality products in a different way, more effectively and efficiently and having higher value in the eyes of customers, is a step towards success in managing a business.

Based on the description above, the author conducted research with the title The Influence of Learning, Commitment of Business Actors, Entrepreneurial Motives, and Entrepreneurial Spirit on the Performance of Business Actors in the Tofu & Tempe Industry in Pekanbaru City.

Formulation of the problem

Based on the background above, the author formulates the problem as follows:

1. Does learning influence the performance of tofu & tempeh industry business actors in Pekanbaru City?

2. Does the Commitment of Business Actors influence the Performance of Tofu & Tempeh Industry Business Actors in Pekanbaru City?

3. Does the Entrepreneurial Motive influence the Performance of Tofu & Tempeh Industry Business Actors in Pekanbaru City?

4. Does the Entrepreneurial Spirit influence the Performance of Tofu & Tempeh Industry Business Actors in Pekanbaru City?

Research Aims and Objectives

Based on the problem formulation above, the author formulates the objectives as follows:

1. To determine the effect of learning on the performance of tofu & tempeh industry business actors in Pekanbaru City.

2. To determine the influence of Business Actors' Commitment on the Performance of Tofu & Tempeh Industry Business Actors in Pekanbaru City.

3. To determine the influence of entrepreneurial motives on the performance of tofu & tempeh industry business actors in Pekanbaru City.

4. To determine the influence of the Entrepreneurial Spirit on the Performance of Tofu & Tempeh Industry Business Actors in Pekanbaru City.

LITERATURE REVIEW

Business Performance

Understanding Business Performance

According to Robbins and Dessler in Prahartanto (2014: 11), states: "Performance is work achievement, namely the comparison between work results and established standards."

Business Performance Indicators

To measure business performance, Rahayu (2018) explains using 3 indicators, namely increased sales, increased profits and satisfactory growth. Here's the explanation:

1. Increase in sales Increase in sales can be measured according to the assessment of business actors by the average level of sales over the last three years.

2. Increase in profit. Profit or profit measurement is assessed from the average level of company profits over the last 3 years.

3. Satisfactory growth assessing how satisfied the entrepreneur is with business growth during business growth over a period of 3 years.

Learning

Understanding Learning

According to Mathis and Jackson (2003), training is a process where people gain capabilities to help achieve organizational goals.

Indicators that Influence Learning.

There are several measurements that organizational learning must have according to Mangkunegara (2007), namely:

1. Training Objectives

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2. Material
3. Method used
4. Training Participants
5. Trainer (instructor) Qualifications

Commitment of Business Actors
Understanding the Commitment of Business

Actors

Currie & Brian (2006) suggest that Entrepreneurial commitment is a concept that explains consistency based on attitudes, beliefs and behavior based on the choice to accept or refuse to carry out a goal.

Indicators of Commitment of Business Actors

According to (Hendro 2011), the measurement indicators of business actors' commitment are:

1. Skills and skills
2. Courage is related to emotions
3. Determination and self-motivation
4. Creativity and inspiration.

Entrepreneurial Motives

Understanding Entrepreneurial Motivation

Sarosa in (Rosmiati et al., 2015). Baum, Frese, and Baron (2007) in (Rosmiati et al., 2015) explain that motives in entrepreneurship include motivation aimed at achieving entrepreneurial goals, such as goals that include the implementation and use of business opportunities.

Entrepreneurial Motivation Indicators

According to (Sardiman, 2007: 73) it is an indicator Entrepreneurial Motivation Is

- 1) Persevere in facing tasks

- 2) Resilient in facing difficulties (not giving up easily)
- 3) Shows interest in a variety of issues
- 4) Prefer to work in groups
- 5) Don't get bored quickly with routine tasks (things that are mechanical, repetitive, so less creative)
- 6) Can defend his opinion (if he is sure about something)
- 7) It's not easy to let go of what you believe in. Enjoys finding and solving problems.

Entrepreneurial Spirit

Understanding the Entrepreneurial Spirit

The entrepreneurial spirit is the lifeblood of entrepreneurship, which in principle is an entrepreneurial attitude and behavior demonstrated through the nature, character and disposition of a person who has the will to creatively realize innovative ideas into the real world (Hartanti 2008).

The Entrepreneurial Spirit Indicators according to (Hartanti 2008). (Nasution 2007: 42-44; Suryana 2006: 3).

- 1) Confident Optimism
- 2) Discipline,
- 3) Commitment,
- 4) Initiative,
- 5) Have a leadership spirit,
- 6) Have responsibility

Research Framework

In this research the author puts forward the research variables that will be studied as follows:

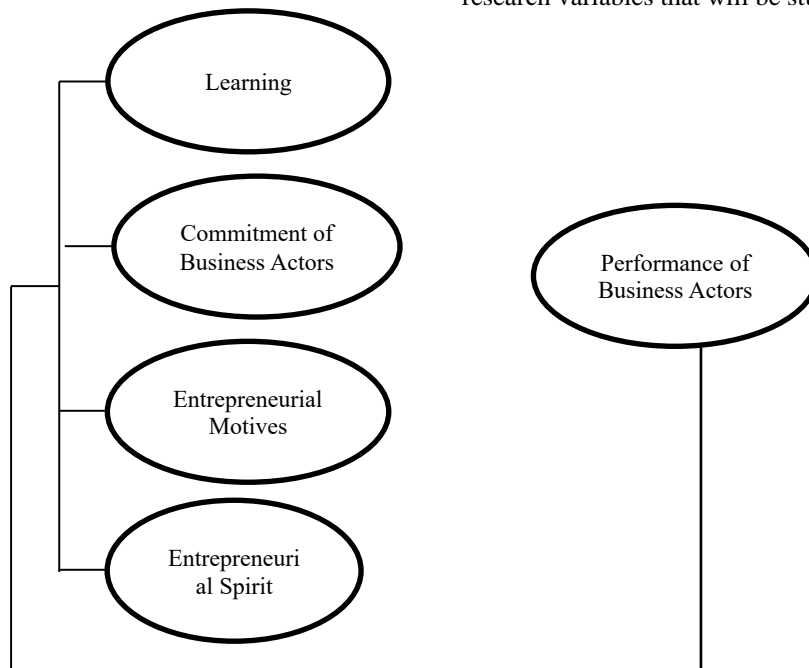


Figure 1. Research Framework

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Hypothesis

Based on the framework above, the author formulates the problem as follows:

1. Learning influences the performance of tofu & tempeh industry business actors in Pekanbaru City.
2. The Commitment of Business Actors influences the Performance of Tofu & Tempeh Industry Business Actors in Pekanbaru City?
3. Entrepreneurial Motives influence the Performance of Tofu & Tempe Industry Business Actors in Pekanbaru City?
4. Entrepreneurial Spirit influences the Performance of Tofu & Tempeh Industry Business Actors in Pekanbaru City?

RESEARCH METHODS

Research sites

This research was conducted at the Tofu & Tempe Industry in Pekanbaru City, totaling 50 business actors.

Data Types and Sources

According to Umar (2009:42), there are two types of data used in this research, namely:

a Primary data, namely data obtained directly from the first source, either from individuals or individuals, such as the results of filling out questionnaires carried out by researchers and interviewing related parties, as well as other data that is related to the research.

b Secondary Data, namely data that has been processed and presented and documented. Where the data is in the form of other relevant data. (Robbins, 2012).

Population and Sample

The population in this study were 50 Tofu and Tempeh Industry Entrepreneurs in Pekanbaru City.

Data testing

Testing research instruments

1. Validity

Validity is evidence that the instrument, technique, or process used to measure a concept actually measures the intended concept. The validity test aims to measure whether a statement system is valid or not.

- a. If $r_{count} > r_{table}$, it means the question item is valid
- b. If $r_{count} < r_{table}$, it means the question item is invalid

2. Reliability test

Reliability is an index that shows the extent to which a measuring instrument can be trusted or relied upon. If a measuring instrument is used twice or more to measure the same phenomenon and the results

obtained are relatively consistent, then the measuring instrument is reliable. The reliability test aims to measure the consistency of a person's answers to the statement items in the questionnaire. Now (2006:248).

Data Analysis Methods

Descriptive Statistical Analysis

This research was carried out using an approach Structural Equation Model (SEM) using Partial Least Square (PLS) software, namely WarpPLS software version 7.0. PLS is often called soft modeling because it eliminates OLS (Ordinary Least Square) regression assumptions such as data must be multicollinearity between independent (exogenous) variables. PLS is a linear technique that is used as a predictive technique, not as an interpretative (explanation) (Latan and Ghozali; 2014: 5).

Inferential Statistics

Inferential statistics is a data analysis technique used to determine the extent of similarity between the results obtained from a sample and the results that would be obtained in the population as a whole. So, inferential statistics helps researchers to find out whether the results obtained from a sample can be generalized to the population (Abdillah & Jogiyanto, 2015: 91).

Evaluation of Model or Outer Model Measurements

Evaluation of the measurement model (*outer model*) was carried out to assess the reliability and validity of the indicators forming the latent construct (Ghozali & Latan, 2014: 91).

1. Convergent Validity

Validity testing is intended to test whether the items/indicators that represent latent constructs are valid or not in the sense that they can explain the latent construct to be measured.

2. Discriminant Validity

Discriminant validity (discriminant) aims to test items/indicators of two constructs that should not be highly correlated (Ghozali & Latan, 2014: 91) where if the correlation of the construct with the measurement item is greater than the size of the other construct

3. Reability Test

There are 2 (two) criteria for measuring or evaluating reliability, namely indicator reliability and internal consistency reliability. Indicator reliability is the amount of variance of the indicator/item to explain the latent construct. The parameter used to test the reliability of the reliability indicator criteria is Cronbach's alpha.

Evaluation of the Structural Model or Inner Model

The structural model (inner model) is a structural model to predict causal relationships between latent variables (Ghozali & Latan, 2012: 77). PLS-SEM is

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only able to estimate recursive models, namely structural equation models that only have one causal relationship, while for non-recursive models you must use a covariance-based SEM program (Ghozali & Latan, 2012: 151).

Coefficient of Determination

The coefficient of determination uses R-squared or adjusted R² which shows what percentage of variation in the endogenous construct/criterion can be explained by the construct that is hypothesized to influence it (exogenous/predictor). R-squared only exists for endogenous variables (Sholihin & Ratmono, 2013:62).

Model Fit and Quality Indexes

To evaluate model fit, several fit indicators can be determined, namely:

- Average Path Coefficient (APC), Average R-squared (ARS), Average Adjusted R-squared (AARS), namely measuring the average path coefficient, R-square and adjusted R-square values produced in the model.
- Average Variance Inflation Factor (AVIF) and Average Full Collinearity Variance Inflation Factor (AFVIF) are two model fit measures used to test collinearity problems in the PLS fit model.
- For overall fit index or quality indices, you can use the Goodness Of Fit criteria which can be seen from the Tenenhaus GoF value which was introduced by Tenenhaus, et al (2004) as the GoF index.
- Symson's Paradox Ratio (SPR) is an index measure that indicates causality problems, so it

is recommended to reverse the hypothesis (Pearl, 2009:174 in Ghozali & Latan, 2014:104).

- R-squared Contribution Ratio (RSCR) is an index to measure expansion where a model is free from negative R-squared contributions.
- Statistical Suppression Ratio (SSR) is an index that measures the extent to which a model is free from the problem of statistical suppression effects.

Nonlinear Bivariate Causality Direction Ratio (NLBCDR) is an index to measure the extent of the bivariate non-linear coefficient of the relationship supported for the hypothesis of the causal relationship in the model.

Hypothesis test

Hypothesis testing is used to explain the direction of the relationship between the independent variable and the dependent variable. This test was carried out using SEM technique analysis. The SEM technique can simultaneously test complex structural models, so that the path analysis results can be seen in one regression analysis. The correlation results between constructs are measured by looking at the path coefficients and their level of significance which are then compared with the research hypothesis.

ANALYSIS AND DISCUSSION RESULTS

SEM-PLS Analysis Test Results

Evaluation Results of the Measurement Model (Outer Model)
Convergent Validity

Table 2. Construct Convergent Validity Test Results (Indicator Loading and Cross Loading)

Indicator	Loading and Cross Loading Indicators					Information	P value
	X1	X2	X3	X4	Y		
X1.1	0.893	0.097	0.238	-0.335	-0.104	Valid	<0.001
X1.2	0.901	0.058	0.034	0.002	-0.361	Valid	<0.001
X1.3	0.720	-0.254	-0.424	0.162	0.613	Valid	<0.001
X1.4	0.852	0.052	0.073	0.211	-0.028	Valid	<0.001
X2.1	-0.031	0.841	-0.027	0.123	-0.137	Valid	<0.001
X2.2	0.250	0.814	-0.295	0.054	0.134	Valid	<0.001
X2.3	-0.136	0.910	0.198	-0.027	-0.131	Valid	<0.001
X2.4	-0.060	0.889	0.092	-0.139	0.141	Valid	<0.001
X3.1_	0.001	0.040	0.912	-0.240	-0.065	Valid	<0.001
X3.2	-0.227	0.053	0.872	0.291	0.175	Valid	<0.001
X3.3	0.029	0.036	0.909	-0.015	0.027	Valid	<0.001
X3.4	0.205	-0.139	0.833	-0.025	-0.142	Valid	<0.001
X4.1	0.120	-0.003	0.012	0.851	0.019	Valid	<0.001
X4.2	0.060	-0.021	0.178	0.876	-0.067	Valid	<0.001

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Indicator	Loading and Cross Loading Indicators					Information	P value
	X1	X2	X3	X4	Y		
X4.3	0.083	-0.080	0.043	0.824	-0.085	Valid	<0.001
X4.4	-0.091	-0.058	-0.006	0.876	-0.218	Valid	<0.001
X4.5	-0.167	0.160	-0.230	0.855	0.355	Valid	<0.001
Y.1	0.515	-0.180	0.496	-0.203	0.721	Valid	<0.001
Y.2	-0.077	-0.012	-0.087	0.106	0.856	Valid	<0.001
Y.3	-0.118	-0.072	0.064	-0.165	0.816	Valid	<0.001
Y.4	-0.630	0.091	-0.203	0.125	0.692	Valid	<0.001
Y.5	0.276	0.165	-0.237	0.126	0.821	Valid	<0.001

Source: Processed Data, 2023

In accordance with the SEM-PLS testing procedure, evaluating the convergent validity of the construct using indicators in the form of loading factors in Table 2 shows that the variable learning has a loading factor of 0.720 - 0.901 which is greater than the critical limit of 0.50, the business actor commitment variable has a loading factor of 0.814 - 0.910 which is greater than the critical limit of 0.50, the Entrepreneurial Motive variable has a loading factor of 0.833 - 0.912 which is greater than the

critical limit of 0.50, the entrepreneurial spirit variable has a loading factor of 0.824 - 0.876 which is greater than the critical limit of 0.50 and the business actor performance variable has a loading factor of 0.692 - 0.856 which is greater than the critical limit of 0.50. So it can be concluded that statistically each indicator statement for all variables is valid and suitable for use as research data. Whereas for *average variance extracted* (AVE) as shown in the latent variable coefficients table which shows the following:

Table 3. Latent Variable Coefficients

Latent Variable Coefficients	Variables				
	Y	X1	X2	X3	X4
R-Square	0.665				
Adj. R-Square	0.636				
Avg. Var. Extract	0.614	0.713	0.747	0.778	0.734
Full Collin. VIF	2,984	3,413	1,628	2,650	3,769
Q-Square	0.704				

Source: Processed Data, 2023

Based on Table 3, it can be analyzed that the AVE value of the business actor performance variable (Y) is 0.614, the learning variable (X1) 0.713, the business actor commitment variable (X2) 0.747, the Entrepreneurial Motive variable (X3) 0.778, and the entrepreneurial spirit variable (X4) 0.734, so it can be concluded that the AVE value of all variables is > 0.50, thus meeting the convergent validity criteria.

Discriminant Validity

The criteria used are square roots, average variance extracted (AVE), namely diagonal columns and given bold letters, the value must be higher than the correlation between latent variables in the same column (above or below). Discriminant validity result each variable can be seen in the table below:

Table 4. Discriminant Validity Test Results

	X1	X2	X3	X4	Y
X1	0.844	0.516	0.680	0.813	0.739
X2	0.516	0.864	0.556	0.504	0.584
X3	0.680	0.556	0.882	0.736	0.711
X4	0.813	0.504	0.736	0.856	0.738

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Y	0.739	0.584	0.711	0.738	0.784
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Source: Processed Data, 2023

Based on Table 4, it can be seen that each of the constructs such as business actor performance variable (Y), learning variable (X1), business actor commitment variable (X2), Entrepreneurial Motive

variable (X3), and entrepreneurial spirit variable (X4) in the measurement of the item/indicator itself it is greater than other indicators.

Reliability Test

Table 5. Reliability Test Results

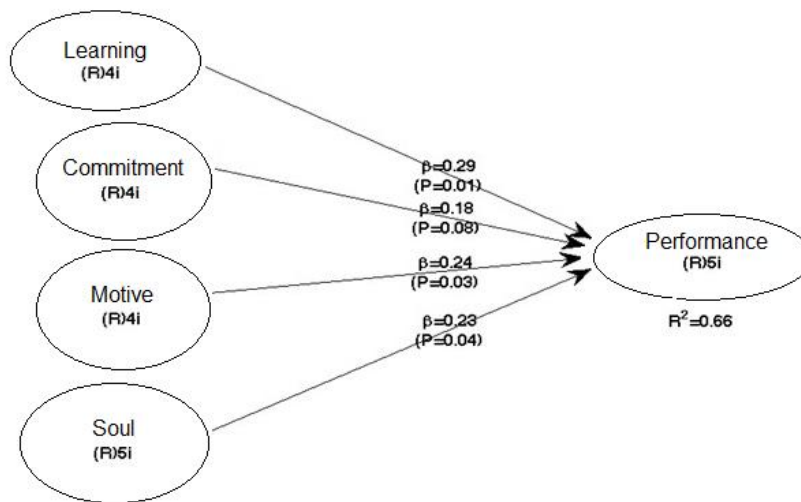
Variable	Composite Reliability	Cronbach's Alpha
Business Actor Performance (Y)	0.888	0.841
Learning (X1)	0.908	0.863
Commitment of Business Actors (X2)	0.922	0.886
Motive Entrepreneurship (X3)	0.933	0.904
Entrepreneurial Spirit (X4)	0.932	0.909

Source: Processed Data, 2023

Composite Reliability tests the reliability value of indicators on a variable. A variable is said to meet the rule of thumb composite reliability if it has a composite reliability value > 0.70 and a Cronbach's

alpha value > 0.60. The table proves that the measurements in this research meet the reliability requirements.

Structural Model Evaluation Test (Inner Model)



Model Fit and Quality Indexes

To evaluate model fit, several fit indicators can be determined, the results of which can be seen in Table 6.

Table 6. Model Fit Test Results and Quality Indexes

Fit Models	Index	p-values	Criteria	Information
Average Path Coefficient (APC)	0.237	0.017	p < 0.05	Accepted
Average R-squared (ARS)	0.665	0.001	p < 0.05	Accepted
Average Adjusted R-squared (AARS)	0.636	0.001	p < 0.05	Accepted

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	JIF = 1.500	SJIF (Morocco) = 7.184	OAJI (USA) = 0.350

Average Block Variance Inflation Factor (AVIF)	2.693, acceptable if ≤ 5 and ideally ≤ 3.3	AVIF < 5	Accepted
Average Full Collinearity VIF (AFVIF)	2.889, acceptable if ≤ 5 and ideally ≤ 3.3	AFVIF < 5	Accepted
Tenenhaus GoF (GoF)	0.691 Small ≥ 0.1 ; Medium ≥ 0.25 ; Large ≥ 0.36	Gof ≥ 0.36	Large

Source: Processed Data, 2023

Rule of thumb the average path coefficient (APC), average R-squared (ARS), average adjusted R-squared (AARS) value is $P < 0.05$. From Table 4.11 it is known that the average path coefficient (APC) value is 0.237 with p -value < 0.017 , average R-squared (ARS) is 0.665 with p -value < 0.001 , average adjusted R-squared (AARS) is 0.636 with p -value < 0.001 , this means that this research model has good fit.

Furthermore, the rule of thumb for the Average Variance Inflation Factor (AVIF) and Average Full Collinearity Variance Inflation Factor (AFVIF) values is ≤ 5 and ideally ≤ 3.3 . The Average Variance Inflation Factor (AVIF) value is 2.693 and the Average Full Collinearity Variance Inflation Factor (AFVIF) is $2.889 < 5$, this can be interpreted as meaning that there is no multicollinearity problem between indicators and between exogenous variables.

Tenenhaus goodness of fit values have a rule of thumb of ≥ 1.00 (small effect size), ≥ 0.25 (medium

effect size), and ≥ 0.36 (large effect size) (Ghozali, 2014: 101-102). The Tenenhaus goodness of fit value is $0.691 > 0.36$, this shows that the predictive power of the model is large or the fit is very good, which means the model used in this research matches the data obtained. (Ghozali, 2014: 101-102).

Path Coefficients and P Value Test Results

Changes in the R-square value can be used to assess the influence of certain independent latent variables on the dependent latent variable which has a substantive influence. In hypothesis testing, to test the proposed hypothesis, in the SEM PLS program WarpPLS 7.0 the results can be found by assessing the output of the Path coefficient table (mean, STDEV, P-values). Based on the output results of WarpPLS 7.0 it is found that the results of the Path Coefficients table and the P Value table as follows:

Table 7. Path Coefficients Test Results

	X1	X2	X3	X4
Y	0.295	0.184	0.238	0.231

Source: Processed Data, 2023

Table 8. P Value Test Results

	X1	X2	X3	X4
Y	0.011	0.081	0.033	0.037

Source: Processed Data, 2023

From the test results above it can be concluded that:

1. The learning variable influences the performance of business actors with a beta value of 0.295 with a significance of $P = 0.011 < \alpha = 0.05$.
2. The commitment variable of business actors has no effect on the performance of business actors with a beta value of 0.184 with a significance of $P = 0.081 < \alpha = 0.05$,
3. Variable Entrepreneurial motives influence the performance of business actors with a beta value of 0.238 with a significance of $P = 0.033 < \alpha = 0.05$,
4. The entrepreneurial spirit variable influences the performance of business actors with a beta value of 0.231 with a significance of $P = 0.037 < \alpha = 0.05$,

Results and Discussion

Learning variables on the performance of business actors.

The results of statistical tests explain that learning has an effect on the performance of business actors with a beta value of 0.295 with a significance of $P = 0.011 < \alpha = 0.05$. This is in line with research conducted by Scelin Karolin R. Sowang and Nur Hidayah (2023) who conducted research on the Effect of Learning. Organization and Entrepreneurial Orientation on the Performance of Culinary MSMEs.

In the tofu and tempeh industry, learning seen from the recapitulation of respondents' answers is still low on average. Only two business actors who responded had learned how to run this business. In order for a business to progress and develop, learning

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is an important thing that must be done. Learning in business is not just knowing how to produce (learning about processes only). Input-Process-Output are three things that must be studied seriously. Business actors must learn about the raw materials that are the main input for the products they will produce. The goal is to ensure product quality is as planned. In terms of processes, even though we can carry out them as usual, it is still possible to continue learning how to process more effectively and efficiently. Evaluate the usual production process. If errors or discrepancies are found in the calculation of how long the soybeans must be boiled, how long they must be fermented, how much yeast is used to make tempeh. Business actors need to learn for better results. Output is the result of the production process. Regarding output, business actors are still required to learn. Currently they only sell to small traders and traditional markets. They have to learn how to penetrate the modern market, how to expand market share through online business which is currently in great demand by business people. How to convince consumers that the products we offer are durable and safe to consume within a certain period of time, this all needs to be studied by business actors.

Variable commitment to the performance of business actors

The statistical test results explain that the commitment variable of business actors has no effect on the performance of business actors with a beta value of 0.184 and a significance of $P = 0.081 < \alpha = 0.05$. These results are in contrast to research conducted by Utami Tunjung Sari, Bhenu Artha, Sinta Manggal (2022) who said that this research aims to analyze internal factors in the form of entrepreneurial characteristics and entrepreneurial commitment as the key to successful MSME performance. The sample in this research was MSME business actors in Yogyakarta. The difference between the results of previous research and the results of this research shows that the commitment of business actors is still low in running their business. As a businessman, even though this is a small business, you must still maintain your commitment to running the business. Continuous production, improving the quality of production results, business development efforts, expanding market share need to always be thought about and implemented. The statistical results which explain that the commitment of business actors has no effect on the performance of business actors, can also be seen from the respondents' answers, where not all respondents responded very well to all the indicators asked. Even though more than 50% responded that they were committed to running this business, this was not demonstrated by actual committed behavior in terms of increasing expertise and skills, readiness to take risks and seriousness in managing the business.

Entrepreneurial Motive Variables on the performance of business actors

The statistical test results explain that the entrepreneurial motive variable influences the performance of business actors with a beta value of 0.238 with a significance of $P = 0.033 < \alpha = 0.05$. This is different from research conducted by the author, namely Hendriani Susi, et al (2021) which shows that Entrepreneurial Motives do not have a significant effect on Business Performance where the sig value is > 0.05 ($0.890 > 0.05$) meaning that H_0 is accepted and H_a is rejected. So it can be concluded that the hypothesis is not proven. The results of hypothesis testing 2, entrepreneurial motives influence business performance but are not significant, meaning that entrepreneurial motives are not strong enough to encourage increased business performance. It appears that there are differences in the results of the two studies that the author conducted. In 2020, research conducted on creative industries made from rattan raw materials turned out that entrepreneurial motives did not have a significant effect on business performance. In fact, rattan industry entrepreneurs still have a side business in the form of a daily stall to meet their living needs. This is different from business actors in the tofu and tempeh industry, who really depend only on the proceeds from sales of tofu and tempeh products. Thus, the higher the entrepreneurial motive, the greater the ability to improve the performance of business actors.

Entrepreneurial spirit variable on the performance of business actors

The statistical test results explain that the entrepreneurial spirit variable influences the performance of business actors with a beta value of 0.231 with a significance of $P = 0.037 < \alpha = 0.05$. This is in accordance with research conducted by Dedeng Abdul Gani Amrulloh (2012) who said that the research results show that business characteristics and entrepreneurial spirit influence simultaneously (simultaneously) on business performance. Partially, each variable also contributes to business performance. This research was only conducted on Plered Purwakarta ceramic micro and small businesses (UMK) with factors that can influence business performance only from within (internally) limited to two variables, while other variables include factors that can influence business performance from outside the business such as government policy, economic conditions, industrial environment and others. In the tofu and tempeh industry, the entrepreneurial spirit influences the performance of business actors. Based on the recapitulation of respondents' answers, it turns out that not all business people in the tofu and tempeh industry in Pekanbaru city have a high entrepreneurial spirit. The lowest response from respondents was on the innovation indicator, this indicates that as a business actor he is unable to create products that are much better and

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tastier than his competitors. Innovation can also be carried out in business management and product marketing. If innovation is not carried out due to a low entrepreneurial spirit, it is feared that the business will run in a place where ultimately the business actor will experience losses and the business may close.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

1. The results of hypothesis 1 testing prove that learning influences the performance of business actors. The assumption is that if learning has been carried out correctly it will lead to increased performance of business actors. Based on the recapitulation of respondents' answers regarding learning whose indicators consist of training, materials, methods, the quality of trainers is still low on average. Business people need to be educated about the various learning they need in this business.

2. The results of hypothesis 2 testing prove that the commitment of business actors has no effect on the performance of business actors. This means that even if the commitment of business actors is increased, it will not improve the performance of business actors. This statistical decision is contrary to theory, where commitment actually influences the performance of business actors. Of course, this difference can be assumed to mean that tofu and tempe business actors do not have a high commitment to the business they run, which is indicated by their lack of commitment to production, attention to quality, business development efforts and expansion of market share. However, as a businessman you must have a high level of commitment and be oriented towards customer satisfaction.

3. The results of hypothesis 3 testing prove that entrepreneurial motives influence the performance of business actors. The assumption is that high entrepreneurial motives will have an impact on increasing the performance of business actors. Business actors 66 with high entrepreneurial motives can be seen from their perseverance, tenacity, consistent cooperation and solutions to business management. From the respondents' answers to these 5 indicators, on average, they are still below the high criteria.

4. The results of hypothesis 4 prove that the entrepreneurial spirit influences the performance of

business actors. The assumption is that the higher the entrepreneurial spirit, the greater the impact on the performance of business actors. A person with a high entrepreneurial spirit will be more confident, disciplined, creative, innovative and responsible. Of the 5 indicators asked to respondents, the innovation indicator was the lowest. Only a small portion of respondents responded that they had innovated the products they were selling.

Suggestion

1. To improve the performance of business actors, it is necessary to carry out learning, increase commitment, entrepreneurial motives and entrepreneurial spirit in accordance with the results of identifying the needs of each tofu and tempe industry business actor in Pekanbaru City.

2. Learning is a description of the achievement of three aspects of competence, namely knowledge, skills and attitudes. These three competencies must be possessed by business actors. The learning that can be done includes: carrying out Benchmarks, taking part in training, learning on your own through books, learning through YouTube channels according to the needs of business actors regarding what is needed to be learned. And what is no less important is learning from the business actor's own experience by no longer making mistakes at work.

3. Business actors must have high commitment. With high commitment, business actors will have a good name and will continue to gain consumer trust. High commitment can be demonstrated by being disciplined in production, optimistic by always trying to improve quality and business development, creative in thinking about expanding market share. High commitment can be realized with confidence, patience and hard work in running a business.

4. Entrepreneurial motives can be improved in various ways, such as: Seeing and learning from the success of other business people, being active in similar or non-similar business communities, doing inspirational things, always trying to appreciate your own achievements, always maintaining business financial management.

5. An entrepreneurial spirit or entrepreneurial spirit can be created in several ways, such as: High ambition to succeed, Focus, Consistency, Enjoying the process, and Willing to try new things.

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Article



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CHEMICAL STRUCTURE OF TREE OILCROP INDUSTRY *Litseaindica* *Pers.*

Abstract: *Litsea (Litseaindica Pers.)* oil that was distilled from the leaves and barks of the plant using either the water and steam method or the direct steam method had essentially identical physical and chemical qualities, but the composition of the oil was fundamentally different. According to the results of the gas chromatography examination, the primary component of this oil was cineole, which accounted for 48.5% of the total (using the water and steam method) and 40.7% using the direct steam method. Both of these numbers are derived from samples of bark. On the other hand, cineole may be extracted from leaves at a rate of 57.5% through the water and steaming procedure and 4.57 percent using the direct steam technique.

Key words: *Litseaindica*, distillation method, essential oil, cineole.

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Introduction

The plant that produces Litsea oil in Indonesia is *Litseaindica*. In West Java this oil is called trawas oil and in Central Java it is called krangan but in Riau it is called kilemo oil. This type of oil contains relatively the same chemical components but different levels (Rusli et al., 2022). So far, *Litseaindica* oil has been used for the pharmaceutical industry, fragrances, food and beverage additives, soap ingredients, and ingredients for mixing fat-soluble vitamins, including vitamins A and K (Lehninger, 2022).

Litsea is a plant belonging to the Lauraceae family and grows widely on the island of Java on mountain slopes (Anggraeni et al., 2022). This plant can produce relatively a lot of essential oil because all parts of the tree such as roots, bark, leaves, flowers and fruit contain essential oil, but in this study only the leaves and bark were taken because they have

more potential than other parts (Mayuni, 2022).

Apart from being influenced by climate, soil type, material handling, distillation and storage methods, the quality of essential oils is also influenced by the type and variety of plants. Oil quality is determined in the form of physicochemical and organoleptic properties. The physical constants are specific gravity, refractive index, optical rotation and solubility in ethanol. The observed specification chemical constants depend on the type of oil. Generally, essential oil specifications include acid number, ester number, saponification number and the main components of the oil. The main component that is nutritious in the body of this plant, both the leaves and the bark, is cineol. This component is the main medicinal constituent of *Litsea* oil. So far, it is usually used as a stain and color remover, besides cineol there is also relatively large portions of citronellal,

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especially in the stem bark. Litsea oil is known to be antiseptic and inhibits the action of staphylococcus sp. (Leider, 2022 and Schreiber, 2022) which explains the cholikinetic action due to the presence of camphene compounds in the leaves.

Research on the main components of Litsea essential oil has been carried out by several experts including Dieterle and Emperor (2013) and Guenther (2013) who analyzed the oil components using thin layer chromatography and gas chromatography.

Winkler (2020), Malingre (2020), and Purseglove et al. (2013) have also identified chemical components in Litsea oil. Each of these studies shows different results in terms of the type and amount of the main components contained in the oil.

In relation to this problem, this research aims to describe the physicochemical properties of Litsea oil, identify the main components, and apply their benefits in order to explore the possibility of substituting imported ingredients and developing types of essential oils that can be exported by Indonesia.

Plant determinations were carried out at the Biology Department Laboratory, Andalas University, Padang and at the Bogoriensis Laboratory at LIPI Bogor. The laboratory results of this plant include division: Spermatophyta, subdivision: Angiospermae, class: Dicotyledone, order: Ebenales, family: Lauraceae, genus: Litsea, species: Litsea indica. Isolation of Litsea oil samples was carried out at the Research Institute for Spices and Medicinal Plants, Cimanggu, Bogor.

Gas chromatography (Hitachi 263-70) with the following conditions: flame ionization detector, graph paper speed 0.5 cm/min; capillary column 25 m X 0.25 mm(L x diameter) carbowax 20 M; nitrogen carrier gas with air pressures of 40, 30, and 300 ml/min, respectively; injector temperature 220°C program column temperature 60-180°C. The tool is programmed with a temperature increase speed of 30°C/minute: volume up to 0.2 micron liter; identification of chemical components; components of Litsea oil by adding 20% standard components to the oil sample.

METHODOLOGY STUDY

Steam and water distillation (steamed)

The principle of distillation using this method is to use low steam pressure. This method causes the distilled material to not be in direct contact with water. The ingredients are placed on a plate. The plate is made from a stainless steel plate with holes (like a sieve), and is located several cm above the water surface in the kettle. After the water boils, water vapor comes out through the disc holes and continues to flow between the ingredients. Together with this water vapor, the Litsea oil contained in the ingredients will also be distilled. The water vapor that arises is channeled through the pipe and then enters the cooling device (condenser). In a cooling device, water vapor condenses into water and oil. The mixture of oil and water is collected in an oil separator vessel. Due to the difference in specific gravity, the water will be separated from the oil and then collected in a special vessel.

Direct steam distillation

Distillation with a steam system basically involves flowing high pressure steam. The water steam boiler is separated from the distillation boiler, namely the boiler containing the material. The water vapor produced in the steam boiler flows through a pipe into the distilling boiler. The distilled material is placed on a perforated disc in the boiler. There can be more than one plate and can be used in stages. To facilitate the movement of water vapor to a higher level, empty space is provided between the material located on the disk below it and the disk above it. Between the plate located at the bottom and the base of the boiler there is an empty space as a reservoir for steam from the boiler. The clear steam produced at a pressure of approximately 1 atm is channeled into the distilling kettle. Together with the water vapor, the Litsea oil will also be distilled, which is channeled through the condenser. After undergoing a condensation process, oil and water can separate due to differences in specific gravity.

RESULTS AND DISCUSSION

PHYSICAL PROPERTIES

The physical properties observed in this research include specific gravity, refractive index, and optical rotation. The physical properties of Litsea oil can be seen in Table 1.

Table 1. Physical Properties of Litsea Bark and Leaf Oil

Physical Properties	STEAM				STEAM			
	Leaf		Bark		Leaf		Bark	
	X	elementary school	X	elementary school	X	elementary school	X	elementary school
Specific Gravity	0.8786	0.0029	0.8786	0.0012	0.8785	0.0002	0.8785	0.00014
Refractive Index	1,458	0.0003	1.4582	0.0002	1.4579	0.0002	1.4583	0.0003
Optical Rotation (α)	(-)6.70	0.008	(-) 6.70	0.0141	(-)6.75	0.0216	(-)6.72	0.0216

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Information: X = Average of three replications
SD = Standard Deviation

Specific Gravity

Based on the research results, the specific gravity of Litsea oil treated with two steam and steam distillation methods from the bark and leaves is almost the same, namely an average of 0.878 (Table 1), thus it can be said that Litsea from the stem bark and leaves distilled in this study has the same level of purity. Furthermore, Gunther (2022) explained that the specific gravity value of essential oils for plants from the Lauraceae family is generally 0.696-1.0888. This is said to be included in the specific gravity group of relatively good quality essential oils.

According to national and international quality standards (EOA No. 24). The specific gravity of essential oils from the Litsea genus, including the Lauraceae family, ranges from 0.696-0.993. The results of this research mean that the specific gravity of Litsea is 0.878, which means it meets these quality requirements. The size of the steam pressure used in the distillation process can affect the specific gravity of the Litsea produced in addition to environmental factors also influencing it.

Refractive Index

The index determines the purity of the oil essential. Deviations in the refractive index of the oil obtained from distillation are an indication that the oil is getting dirtier or of lower quality. The refractive index results from research on Litsea oil from stem bark and leaves using two distillation methods (steam and steam) are almost the same, namely an average of 1.458 (Table 1).

The refractive index for Litsea oil from stem bark and leaves is almost the same because the purity level is almost the same. This is in accordance with the opinion of previous researchers, Jhun (2022), who explained that the purity level of essential oils is almost the same, meaning that all their physical properties are relatively almost the same, especially in parts of trees of the same species.

The refractive index in the quality standard provisions of the Indonesian Ministry of Trade is

1.454-1.473 from the Essential Oil Association of USA (EOA No. 24) is 1.456-1.478. This means that the refractive index of Litsea oil from leaves and stem bark as a result of the research meets the quality requirements.

Optical Rotation

The research results showed that the Litsea optical rotation was (-) 6.70 (Table 1). Both from the bark and leaves. The quality standard provisions from the Indonesian Ministry of Trade are (00)-(-60) and from the Essential Oil Association of USA (EOA No. 24) are (00)-(-6.90) thus meaning that the optical rotation of Litsea oil is a research result slightly different from the national quality standard provisions, however, this is compared with the optical rotation of Litsea from ordinary distillation which is generally carried out on the flower parts, the result will be the same, namely positive, meaning that the Litsea oil from the flower does have the ability to rotate light polymerization to the right (dextro-rotation) (Endah, 2014).

In general, the greater the steam pressure used in the distillation process, the smaller the optical rotation of the Litsea oil produced. This means that with high steam pressure, the oil components which have the ability to rotate light polymerization to the right will change or decompose a lot so that as a result the rotation of Litsea oil resulting from distillation using high steam will be smaller than the optical rotation of oil resulting from distillation. by using low steam pressure (Gunther, 2022). The results of research on Litsea oil from stem bark and leaves show that the size of the steam pressure used in the distillation process will affect the quality of the oil produced. So deviations from quality standards that occur during optical rotation mean that the oil can be said to be relatively low quality (Yulia, 2022).

CHEMICAL COMPONENTS

The differences in the chemical components of the essential oils of the two parts of the tree can be seen in Table 2.

Table 2. Chemical Properties of Litsea Bark and Leaf Oil

Component (%)	Steam		Steam	
	Leaf	Bark	Leaf	Bark
Citral	1.43	3.20	1.43	5.20
Cineole	57.50	48.50	45.70	40.70
Citronelal	0.90	25.50	0.76	21.40
Linalol	-	5.58	-	2.36
Geraniol	10.60	6.70	15.60	4.20

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α – Pinene	1.50	1.04	5,10	1.90
β – Pinene	3.61	1.12	3.67	1.54
Camphene	4.90	-	4.96	-

Description: - Not detected

The results of gas chromatography analysis can be seen that the highest component is cineol, both from stem bark and leaves. This may be caused by species, where the plant grows and other factors such as soil type, age, variety and treatment during the distillation process (distillation method and time).

Napis (2022) explains that the essential oil compounds of Litsea plants that grow in the highlands generally tend to contain more cineol compounds than other compounds. In the world of trade, things that are similar to Litsea oil are kranglean oil, trawas oil and May Chang oil. These three types of oil predominantly contain 40-70% cineol compounds known as cineol oil (Rusli, 2022). Cineol is soluble in alcohol, ether, benzyl benzoate, diethyl phalate, and slightly soluble in mineral oil and insoluble in glycerin.

The results of this research, apart from cineol, Litsea oil still contains other compounds, namely citronellal (C₁₀H₁₈O), citral (C₁₀H₁₆O), linaloon (C₁₀H₁₈) in the bark, camphene (C₁₀H₁₆) in the leaves, graneol, α and β Pinene. All of these compounds are relatively low except for citronellal and graniol in the leaves which is quite high, namely more than 10%. This is in accordance with the opinion of Lumberg (2022) who explains if the essential oil content is less than 10%, it can be said to be relatively low and does not have a pleasant smell because the main things that cause it to smell are citronellal and

graniol.

Quality standard provisions from the Department Indonesian Trade and the Essential Oil Association of USA (EOA No. 24) is a citronellal and graniol content of at least 3.5% of Litsea oil which is equated to May Chang oil, meaning that the oil from the results of this research almost all of its components meet the requirements for cineol oil.

In all the descriptions of the physicochemical properties, it can be said that the research oil from the Litsea plant meets the requirements of national and international quality standards.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Data from research on Litsea oil from leaves and stem bark shows that the oil has almost the same physical and chemical properties, only the percentage levels are different. The main components of Litsea oil besides cineol in other aromatic series found include citronellal stem bark (21.4-25.5%), graniol (4.2-10.6%), citral (1.43-5.2) quite has the potential to be isolated and used as an ingredient in perfume, cosmetics and medicines.

Suggestion

Data on the yield of Litsea oil is relatively high, its chemical properties are quite potential, so the Litsea plant needs to be developed as an essential oil commodity with good prospects.

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Article



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ELIMINATION OF WASTES BY SIX SIGMA IN SEWING PRODUCTION

Abstract: The article presents the main stages of the "six sigma" method for improving the processes of sewing production. An example of the use "six sigma" method during laboratory work in the discipline of the master's degree "Innovations in the preparation of production" in the study of the process "Manufacture of a slot pocket with two threads and a valve" was considered. The effectiveness of this method is shown.

Key words: lean production, six sigma, sewing production.

Language: Russian

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УСТРАНЕНИЕ ПОТЕРЬ МЕТОДОМ «ШЕСТЬ СИГМ» ПРИ ПРОИЗВОДСТВЕ ШВЕЙНЫХ ИЗДЕЛИЙ

Аннотация: В статье представлены основные этапы метода «шесть сигм» для совершенствования процессов производства швейных изделий. Рассмотрен пример использования метода «шесть сигм» при проведении лабораторных работ по дисциплине магистратуры «Инновации в подготовке производства» при изучении процесса «Изготовление прорезного кармана с двумя обтачками и клапаном». Показана эффективность применения данного метода.

Ключевые слова: бережливое производство, шесть сигм, швейное производство.

Введение

Перед российскими швейными предприятиями в настоящее время стоит сложная задача удовлетворения потребностей населения в качественной одежде разнообразного ассортимента. Для ее решения предприятию в современных условиях нужно научиться быть эффективным, понимать свой производственный потенциал [1], непрерывно искать и устранять потери. Вопрос повышения качества продукции является одним из важнейших для обеспечения конкурентоспособности. При этом необходимо руководствоваться требованиями нормативных документов [2-4], использовать современные концепции для организации производственного процесса, в том числе бережливое производство одежды [5], а также использовать скрытые возможности предприятия за счет настройки

процессов на выпуск качественной продукции с использованием системы, т.е. использование метода «шесть сигм» [6].

Основная идея системы «шесть сигм» – если существующий производственный процесс может производить некоторое количество качественной продукции, то его можно настроить на регулярное и стабильное производство большего количества качественной продукции [6].

Если в существующем процессе есть определенные проблемы, приводящие к снижению качества продукции, то можно настроить процесс на изготовление более качественной продукции.

Для швейного предприятия, использующего инструменты бережливого производства при изготовлении швейных изделий, использование метода «шесть сигм» является логичным и легко

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встраиваемым в систему управления производственными процессами. Это соответствует системе непрерывного совершенствования процессов «кайдзен» и способствует повышению производительности предприятий и качества продукции.

В основу метода «шесть сигм» положена система настройки регулярных бизнес-процессов на снижение всех типов дефектов и потерь с помощью последовательного выполнения проектов по устранению корневых причин дефектов на основе количественных исследований процессов [6]. В названии метода используется значение среднеквадратичного отклонения σ (сигма), которое показывает степень вариабельности процесса, то есть является мерой разброса параметров на выходе процесса. В

идеальном случае от среднего значения измерения до границы допуска укладывается 6 σ . В этом случае вероятность произвести дефектную продукцию стремится к нулю и составляет всего 3,4 дефекта на миллион возможностей – рис. 1. Для оценки вариабельности процесса на действующем предприятии используется методика расчета количества сигм по ГОСТ Р ИСО 13053–1 [7]. При внедрении на предприятии системы «шесть сигм» в первую очередь оценивается начальная ситуация путем расчета данного показателя, и в дальнейшем, рассчитывая количество сигм после внедрения определенных мероприятий по улучшению качества продукции, можно оценивать их эффективность.

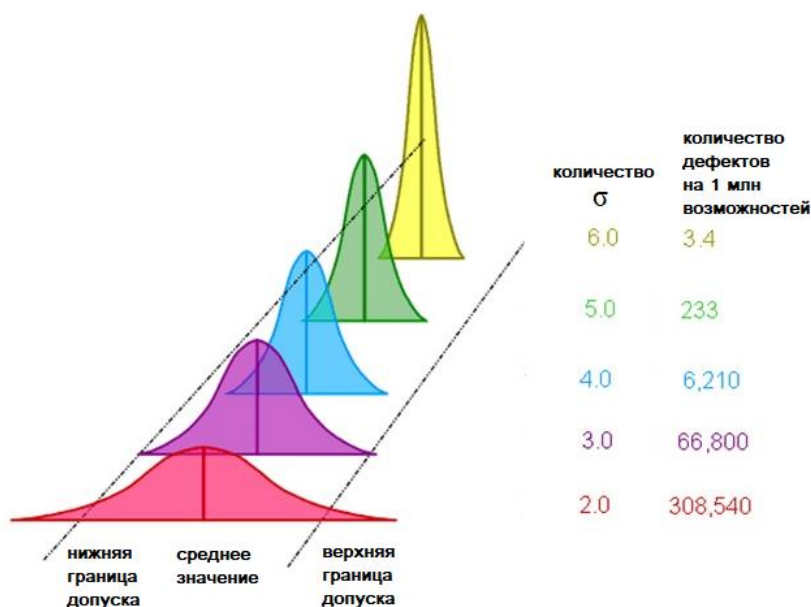


Рисунок 1 – Вариабельность процесса

Чем выше вариабельность процесса, тем больше возникает потеря:

- дефекты швейных изделий: могут возникать на разных этапах производственного процесса, проявляться как в изменениях значений параметров, так и в динамическом изменении количества дефектов;

- издержки производства швейных изделий: могут проявляться в колебаниях объемов затрат, в нарушении норм и статей бюджета и т.д.;

- потери ресурсов: из-за снижения неэффективной организации труда рабочих при подготовке и раскрое материалов при изготовлении швейных изделий в потоке, из-за снижения производительности оборудования; неэффективного использования материалов;

- потери времени: нарушение сроков поставки материалов на производство, отсутствие

обоснованных норм времени на технологические операции, аварийные и технологические простои.

Метод «шесть сигм» позволяет применить количественные статистические исследования для совершенствования производственного процесса. Процесс должен обеспечивать производство такой продукции, результатом которого являются такие показатели качества, которые во-первых всегда находятся в рамках допуска (отсутствует брак), во-вторых, их средние значения находятся в середине допуска и разброс характеристик так мал, что существует уверенность в стабильности процесса даже при существенном внешнем воздействии на него.

Метод «шесть сигм» предполагает создание эффективных систем сбора достоверных данных о процессе, анализ этих данных с помощью статистических инструментов, проведение

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экспертных исследований, разработку решений по модернизации процесса [6].

На швейном предприятии, как и на любом другом производстве, основными факторами, которые могут повлиять на выход процесса, являются люди, оборудование, среда, технология и сырье. Поэтому для внедрения метода «шесть сигм» необходимо учесть именно эти составляющие производственной системы. В частности, необходимо описать все возможные типы потерь, дефектов издержек (чтобы контролировать выход процесса). Нужно обеспечить статистический контроль процессов, в том числе с использованием системы менеджмента качества на предприятии. Следует

подготовить почву для внедрения метода путем новых подходов к обучению, созданию новой корпоративной и технологической культуры. Очень важно проработать и апробировать технологию внедрения метода «шесть сигм» на швейном предприятии.

В соответствии с ГОСТ Р ИСО 13053-1 [7] основу метода «шесть сигм» составляет реализация следующих этапов: определение, измерение, анализ, совершенствование, контроль – методология DMAIC (английская аббревиатура DMAIC - define, measure, analyse, improve and control) – рис 2.

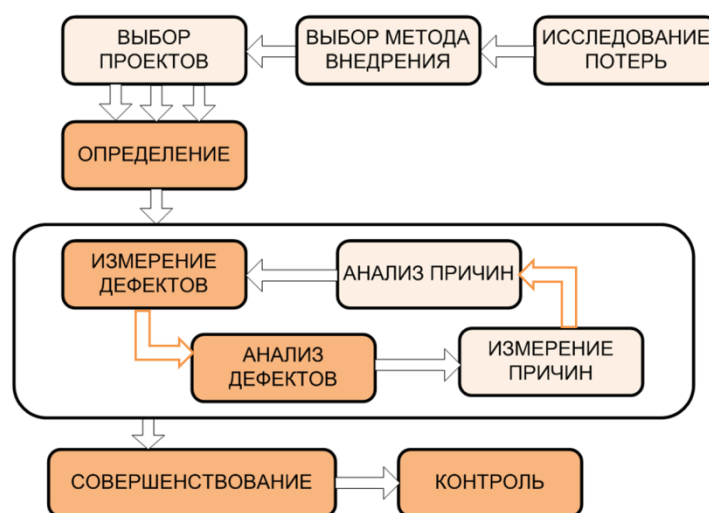


Рисунок 2 - Этапы методологии DMAIC

Исследование возможности использования метода «шесть сигм» на швейном предприятии было проведено в лабораторных условиях в рамках дисциплины магистратуры «Инновации в подготовке производства» при изучении процесса «Изготовление прорезного кармана с двумя обтачками и клапаном». В качестве исходных данных были использованы: эскиз метода обработки; технологическая последовательность; 24 единицы продукции (узлы, изготовленные студентами бакалавриата в ходе изучения дисциплины «Технология швейных изделий»).

Предпроектные исследования начинаются с исследования потерь. Этот этап является очень важным, здесь необходимо выявить наиболее

значимые потери. Устранение этих потерь приведет к видимому экономическому эффекту и обеспечит успешное внедрение метода «шесть сигм». Внедрением метода «шесть сигм» на предприятии должна заниматься рабочая группа, функции которой определены стандартом ГОСТ Р ИСО 13053-1 [7].

Для реализации процессного подхода и эффективного поиска потерь первостепенной важности нужно построить карту бизнеса, а на ее основе карту потерь. Для исследуемого процесса «Изготовление кармана с двумя обтачками и клапаном» построена карта потерь, представленная на рис. 3.

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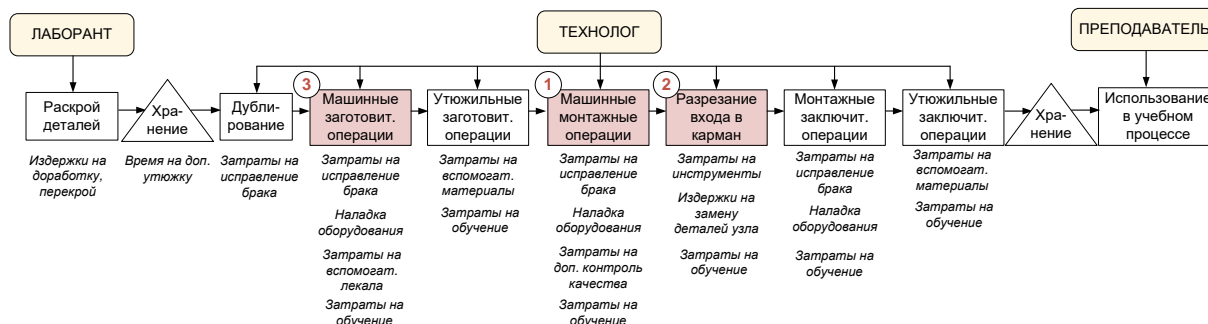


Рисунок 3 - Карта потерь процесса «Изготовление кармана с двумя обтачками и клапаном»

Чтобы составить карту потерь, необходимо проанализировать этапы производственного процесса, выявить возможные дефекты на каждом из этих этапов, понять, какие издержки возникают вследствие устранения дефектов, какие потери несет предприятие. Структура дефектов, издержек и потерь определяется особенностями процесса. В данном примере рассматривается процесс раскроя деталей узла лаборантом, хранение кроя, изготовление узла под руководством технолога (преподаватель дисциплины «Технология швейных изделий»), а также дальнейшее использование полученной продукции при обучении других студентов другими преподавателями. Для выявления источников потерь рабочая группа осуществляет коллективное обсуждение и индивидуальные предложения. В итоге из карты бизнеса формируется карта потерь с указанием источников потерь. В реальном бизнесе далее обязательно осуществляются экономические расчеты для оценки и прогноза потерь.

На этапе выбора метода внедрения «шесть сигм» оценивается уровень готовности предприятия. Вариантами внедрения метода «шесть сигм» на российских предприятиях являются «Корпоративная культура», «Проектная система» и «Партизанская война» [6]. Для исследуемого процесса наиболее подходящим вариантом стала «Проектная система», рекомендуемая для среднего уровня готовности предприятия.

Для оценки значимости этапов исследуемого процесса, на которых возникает наибольшее количество дефектов, применен метод экспертных оценок. Наиболее значимыми этапами являются этапы выполнения машинных заготовительных и

монтажных операций, а также этап разрезания переда по линии входа в карман. Именно этот участок процесса будет в дальнейшем настроен с использованием метода «шесть сигм».

После выполнения предпроектных этапов выполняется этап «Определение», на котором выполняется сбор и анализ существующей информации, определяется начальный уровень качества продукции в производственной системе [6, 7].

В первую очередь на данном этапе устанавливается точный перечень дефектов продукции и границы их допусков. При этом нужно использовать нормативные документы данной предметной области (для швейных изделий это ГОСТы, устанавливающие терминологию изделий и деталей [8, 9], ГОСТы, регламентирующие качество швейных изделий [3, 4], а также нормативные документы в области системы менеджмента качества [2]). Кроме нормативных документов также очень важно услышать так называемые «голос клиента» и «голос процесса». «Голос клиента» – это целенаправленный сбор информации о требованиях потребителя к качеству готовой продукции, а «голос процесса» – требования каждого следующего участка процесса к предыдущему процессу. Так формируется перечень КДК – критических для качества характеристик продукта [6]. На основе КДК составляются операционные определения дефектов, т.е. их точные формулировки, позволяющие однозначно идентифицировать дефект в производстве. Для исследуемого процесса перечень операционных дефектов представлен в табл. 1.

Таблица 1. Перечень операционных дефектов узла «карман с двумя обтачками и клапаном»

Номер	Наименование дефекта
1	Неравномерная ширина верхней обтачки
2	Неравномерная ширина нижней обтачки
3	Искривленный край клапана
4	Разноширинность верхней и нижней обтачек

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5	Неровная рамка кармана
6	Нестыковка и перекрывание верхней и нижней обтачек
7	Некачественное закрепление углов кармана
8	Искривление швов стачивания/притачивания подкладки или отсутствие строчки
9	Неправильное соединение подзора с подкладкой
10	Слабая или стянутая строчка
11	Отсутствие строчки стачивания подкладки кармана /нарушение целостности строчки
12	Незахватывание припуска шва

Далее составляется карта процесса для выявления факторов, влияющих на качество продукции. Наиболее подходящей является карта ПВПРК (SIPOC). Для ее построения необходимо выбрать участок процесса (не более 15 этапов). Для каждого этапа определить «вход», а также «поставщика», т.е. источник сырья/полуфабрикатов, а также управляющих воздействий. Далее для каждого этапа определить «результат», то есть конечный продукт, а также «клиента», т.е. потребителя производимой данным участком продукции. Если тщательно составить и изучить карту, можно увидеть все

наиболее существенные факторы управления процессом [6].

Для исследуемого процесса ограничились этапами, которые были выделены на стадии анализа карты потерь, и где возникают выявленные операционные дефекты.

Карту ПВПРК обычно дополняют описанием процесса, которое необходимо для расшифровки некоторых кратких формулировок и фиксации количественной информации по каждому этапу

Фрагмент карты ПВПРК исследуемого процесса представлен на рис. 4.

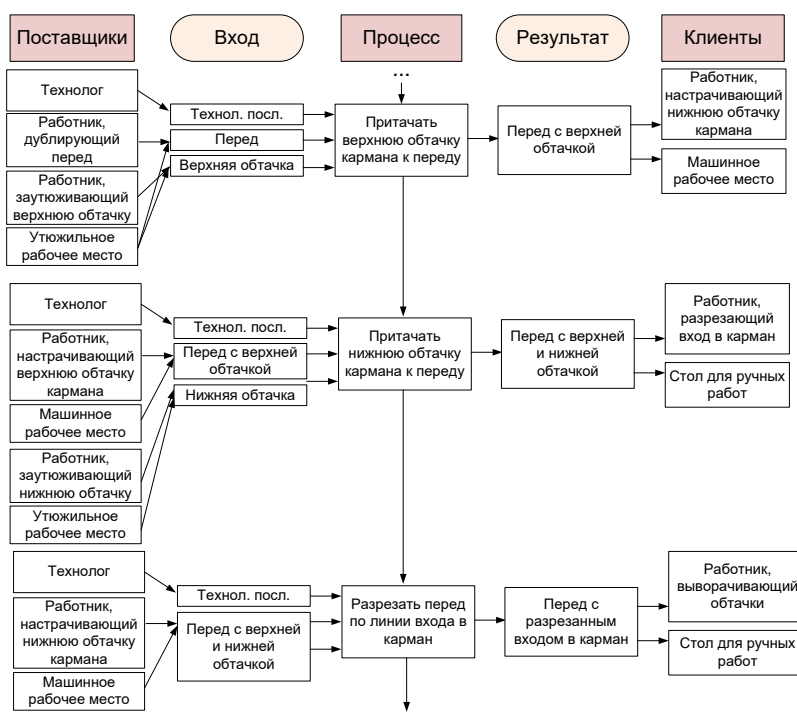


Рисунок 4 - Фрагмент карты ПВПРК процесса «Изготовление кармана с двумя обтачками и клапаном»

На стадии «Определение» также устанавливается начальный уровень количества сигм. Для исследуемого процесса начальный уровень сигм составил 1,57 σ , что соответствует значительному количеству дефектной продукции.

Внедрить систему «шесть сигм» для устранения всех выявленных дефектов сразу нецелесообразно, так как это связано со значительным объемом работ. Для выбора

наиболее значимых дефектов можно использовать различные методы, в том числе экспертный анализ, но наиболее простым и эффективным количественным методом является диаграмма Парето. Для исследуемой группы дефектов анализ Парето показал, что в первую очередь нужно устранять группу из 7 наиболее значимых дефектов. Именно для этой группы в дальнейшем

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выполняются следующие шаги исследования –
 рис. 5.

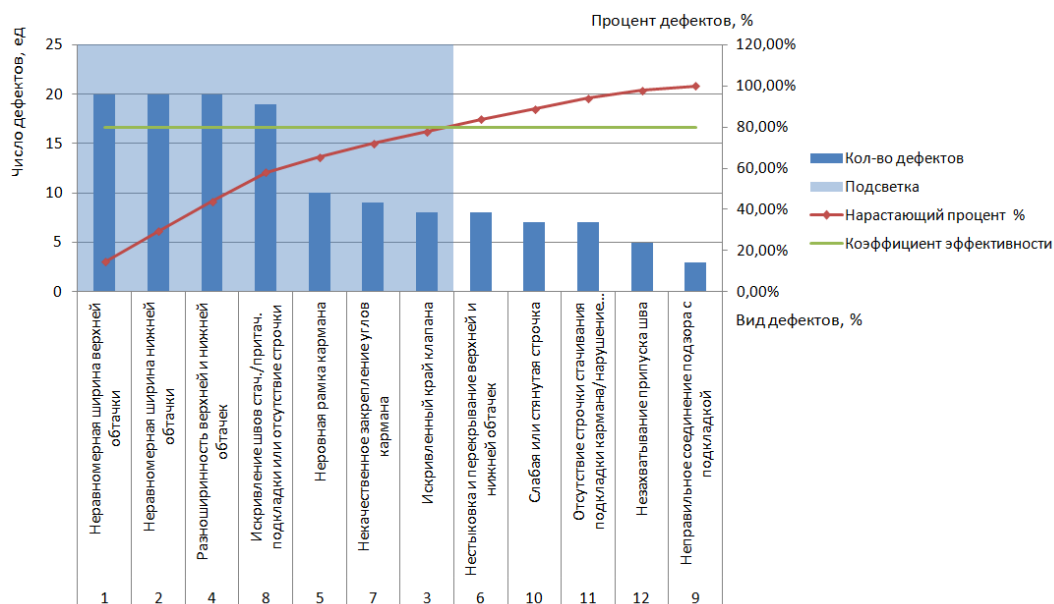


Рисунок 5 - Диаграмма Парето

Целью этапа «Измерение» является получение оперативной и достоверной информации о количестве дефектов и их динамике. На этом этапе разрабатывается система измерения каждого конкретного дефекта в динамике. При этом широко используются статистические методы контроля качества, в частности контрольная карта [10, 11]. Для измерения каждого из наиболее значимых дефектов разработана методика, в которой указываются: наименование дефекта; тип данных (непрерывные или дискретные); возможный размах; устанавливается требуемая точность измерения (обычно от 2 до 5%); определяются инструменты для измерения, а также детально прописывается процедура измерения и требования к контролеру. Целесообразно составить инструкцию по процедуре измерения. Далее выполняется расчет объема выборки по методике, изложенной в ГОСТ Р ИСО 13053-2 [10]. Для исследуемого процесса не

представляется возможности исследовать процесс в динамике и менять объем выборки, но для реального производства обязательно производится этот мониторинг для оценки стабильности процесса.

На этапе «Анализ» необходимо определить причины возникновения дефектов. Для этого используются разнообразные методы, в том числе визуальный, корреляционный и регрессионный анализ данных, статистические методы анализа данных, планирование эксперимента. Часто используются экспертные методы, наиболее интересными из которых являются диаграмма Исикавы (причинно-следственная диаграмма) и метод «5 Почему?». Суть этих методов изложена в ГОСТ Р ИСО 13053-2 [10], а также в литературных источниках по статистическим методам контроля качества [11]. На рис. 6 представлена диаграмма Исикавы для поиска причин возникновения дефекта «Неравномерная ширина верхней обтачки».

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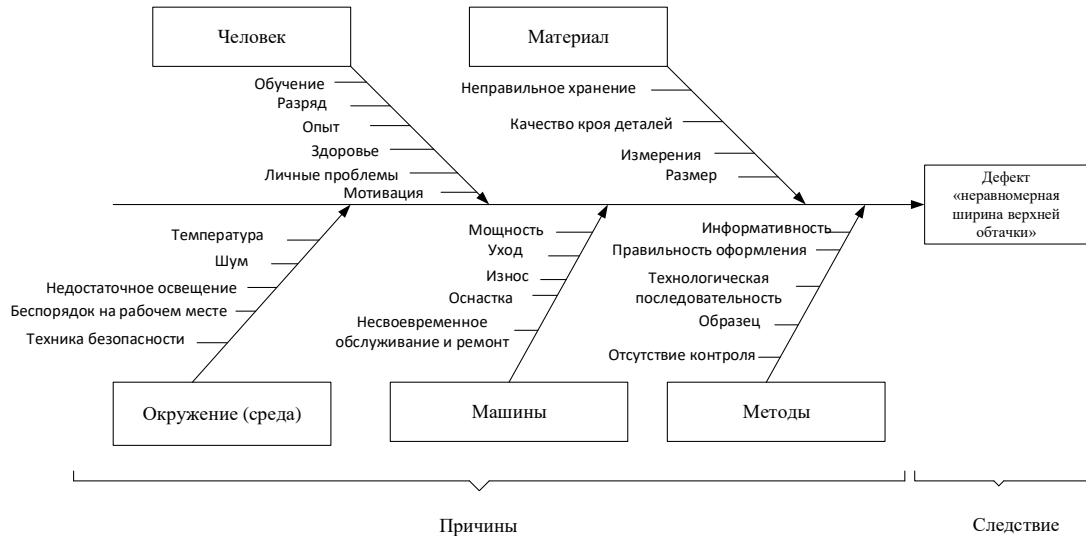


Рисунок 6 - Диаграмма Исикавы для дефекта «Неравномерная ширина верхней обтачки»

Результатом этапа «Анализ» является перечень мероприятий для устранения выявленных причин возникновения дефектов. Эту гипотезу можно и нужно проверять в лабораторных условиях, но самым главным действием является внедрение разработанных мероприятий. Это выполняется в ходе этапа «Совершенствование». Целью этого этапа является реализация решений и задач совершенствования производственного процесса. Внедрение предложенных изменений возможно тремя способами: настройка процессов, локальная модернизация и реинжиниринг процессов [6]. Наиболее мягким и требующим минимальных затрат является метод настройки процессов. Для исследуемого процесса он является наиболее подходящим. Очень важно спланировать

организацию работ по внедрению метода «шесть сигм», свести к минимуму риски возможных негативных последствий, осуществлять постоянное информирование участников процесса, довести до сведения всех работающих (в нашем случае преподавателя и обучающихся) предлагаемый план изменений. Очень полезным является составление и внедрение инструкционных документов. Так для исследуемого процесса предложен ряд мероприятий по совершенствованию процесса изготовления узла для устранения дефекта «Неравномерная ширина верхней обтачки». Составлена инструкционная карта для технологической операции «Притачать верхнюю обтачку кармана к переду», представленная на рис. 7.

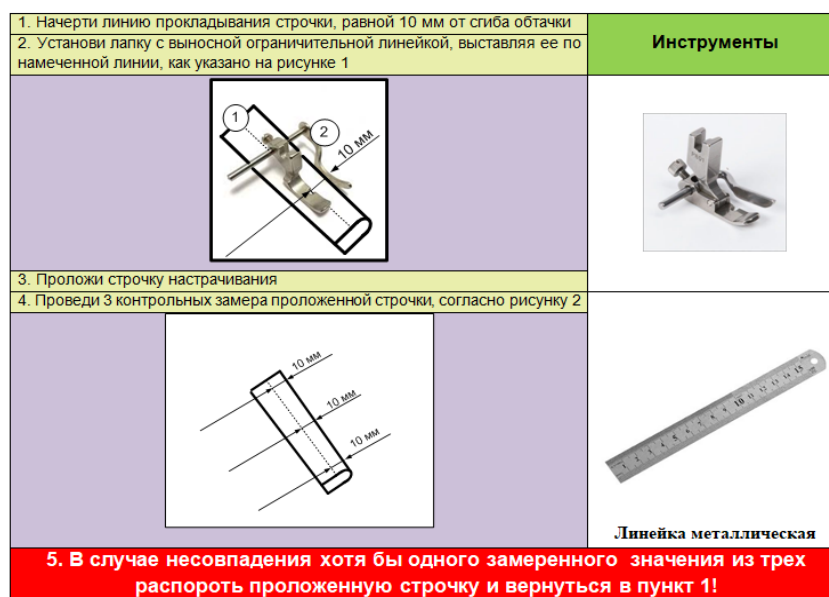


Рисунок 7 – Инструкционная карта выполнения технологической операции «Притачать верхнюю обтачку кармана к переду»

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Основным результатом этапа «Совершенствование» является практическое устранение причин возникновения дефектов, повышение качества производимой продукции. Полученный эффект необходимо закрепить. Это выполняется на стадии «Контроль». Целью данного этапа является закрепление преимуществ от совершенствования процесса на долгий срок. После внедрения мероприятий по совершенствованию процесса ожидается уменьшение количества дефектной продукции. Следовательно, целесообразно оценить уровень сигм на этой стадии в соответствии с ГОСТ 13053-1 [7].

Для исследуемого процесса определено количество сигм после внедрения изменений, итогом которого является устранение или значительное снижение наиболее значимых

дефектов. Итоговый уровень сигм составил 2,76σ, что показывает значительное улучшение процесса. Однако до уровня 6σ данный процесс не настроен, следовательно, цикл DMAIC необходимо повторять, снова выявляя наиболее значимые дефекты, измеряя, анализируя, совершенствуя и контролируя их в соответствии с методом «шесть сигм».

Таким образом, использование метода «шесть сигм» при изготовлении швейных изделий является действующим инструментом для настройки производственного процесса на выпуск качественной продукции. Этот инструмент может быть использован при проектировании и реконструкции действующих швейных предприятий (средних и малых) наряду с другими инструментами бережливого производства [5].

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Article



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MODELING AND NUMERICAL RESULTS OF INVESTIGATION OF THE INFLUENCE OF THE IRREGULARITY OF WAKE JETS ON MIXING IN FLAT CHANNELS

Abstract: In this work, based on the complete Navier-Stokes equations, numerical simulation of a compressible gas in flat channels of constant cross section is performed. For the convenience of solving the system of equations, the procedure of "dimensionless" coordinates and physical parameters was carried out, and the coordinate transformation transforming the rectangular computational domain into a square one, as well as the coordinate transformations that ensure the finite-difference grid thickening in areas with the sharpest change in the flow parameters, both in the inlet part and at the channel wall.

On the basis of the developed calculation algorithm, the influence of the non-design of coaxial jets on mixing and propagation in a limited flat channel was numerically studied.

Numerically identified and analyzed, what are the ratios of the height of the inlet slots, and the initial data on the temperature, velocity and pressure of the wake jets, which in the initial sections of the channel are observed (not observed) the recirculation zone.

Key words: internal flows, simulation, flow, numerical solution, pressure, jet, Navies-Stokes, coaxial, mixing, off-design.

Language: English

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Introduction

The advent of modern high-speed computing tools make it possible to consider the numerical simulation of complex jet flows by solving exact equations expressing conservation laws.

Of great practical interest is the study of the influence of the initial data and the geometry of coaxial jets on mixing and propagation in a limited flat channel, since such flows are used in the creation of mixing and furnace devices, internal combustion engines, chemical and oil-gas industries.

Field experimental studies of the mixing of coaxial gas jets with different pressures, temperatures,

velocities and geometries, as well as other parameters in channels of constant and variable cross-sections, are in many cases difficult and analytical solutions are not always possible, therefore, to solve such problems, mathematical modeling methods using numerical methods.

Such flows in the channels can be accompanied by separations, motion of waves in the jet contact zone, recirculation zones and other complex processes that cannot be solved by the parabolized Navier-Stokes equations, although the solution of which is much simpler than integrating the original Navier-Stokes equations. Numerical modeling of viscous gas flows

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based on the complete Navier-Stokes equations is difficult, however, it gives exact solutions to the above flow cases [1-3].

The purpose of the work is to investigate the effects of the non-design of cocurrent flows on their mixing and propagation in flat channels on the basis of an effective computational algorithm for solving the complete Navier-Stokes equations for a viscous gas, and the little-studied region of parameters is of particular interest, when a recirculation flow zone is formed as a result of the interaction of jets. Few experimental studies of turbulent mixing of gas jets with different densities were studied in [4–8], concurrent flows in a channel of constant cross section in the presence of recirculation zones and the conditions for the formation of recirculation zones were studied in a number of works [9–12], but the relations areas (heights) of the cross section and pressure of flows at the inlet to the channel.

Numerous works are devoted to modeling and numerical studies of internal flows and mixing of flows in channels based on approximate and complete Navier-Stokes equations [1,2,13-17]. It is known that a complete picture of the flow can be obtained with complex internal flows, the numerical solution of the complete Navier-Stokes equations when modeling two-dimensional flows of a viscous compressible fluid. A more detailed review of methods and schemes for solving the Navier-Stokes equations is given in [18-21], and for calculating internal flows, an excellent systematic review is given in [1, 17].

Below, we describe the results of a numerical study of the influence of the non-design of coaxial flows on the mixing and propagation parameters of flows in a channel of constant cross section based on the full Navier-Stokes equations, with the cross-sectional areas of the flows at the inlet having different finite ratios.

Problem statements. Given a flat channel of length L height $2f_0$. The flow diagram is shown in fig. 1. Suppose the channel and the flow are symmetrical about the OX axis, the OY axis coincides with the inlet section of the channel, and the origin of coordinates is located on the axis of symmetry. At the entrance to the channel there are two jets I - near-wall and II - central (main), respectively, with their physical and geometric characteristics.

It was said above that the main goal of this work is the numerical study of the mixing and flow of turbulent gas jets in a channel of constant cross section, in the presence of specific factors, such as the occurrence of recirculation zones and shock waves in particular. In these cases, it is necessary to use the full уравнений Навье – Стокса.

To describe the flow, two-dimensional complete non-stationary Navier-Stokes equations are used, in a vector-conservative form [22-23]

$$\frac{\partial U}{\partial t} + \frac{\partial F(U)}{\partial x} + \frac{\partial G(U)}{\partial y} = \frac{\partial v_1(U, U_y)}{\partial x} +$$

$$+ \frac{\partial v_2(U, U_y)}{\partial x} + \frac{\partial W_1(U, U_x)}{\partial y} + \frac{\partial W_2(U, U_y)}{\partial y} \quad (1)$$

Relationship of total specific energy with internal and kinetic energy:

$$E = \rho C_\theta T + \frac{1}{2} \rho (u^2 + \vartheta^2). \quad (2)$$

State equation:

$$p = \rho T. \quad (3)$$

Expression for effective viscosity:

$$\mu = \mu_l + \mu_t, \quad (4)$$

where μ_l -laminar, μ_t -turbulent viscosity, U -vector of conservative variables; F, G, V_1, V_2, W_1, W_2 are flow vectors that look like:

$$U = \begin{bmatrix} \varphi_x & F_y & \rho & u \\ \varphi_x & F_y & \rho & \vartheta \\ \varphi_x & F_y & \rho & \vartheta \\ \varphi_x & F_y & E & \end{bmatrix} = \begin{bmatrix} \bar{\rho} \\ \bar{\rho} u \\ \bar{\rho} \vartheta \\ \bar{E} \end{bmatrix} = \begin{bmatrix} \rho \\ m \\ n \\ E \end{bmatrix};$$

$$F = \frac{1}{L \varphi_x} \begin{bmatrix} m \\ \frac{m^2}{\rho} + p \\ mn \\ \frac{mE}{\rho} \end{bmatrix}; \quad G = \begin{bmatrix} n \\ \Omega_1 m \\ \Omega_1 n + p \\ \Omega_1 (E + p) \end{bmatrix}.$$

$$W_1(U, U_x) = \frac{1}{ReL} \begin{bmatrix} 0 \\ N_x \\ -\frac{2}{3} M_x \\ \frac{(mN_x - \frac{2}{3} nM_x)}{\rho} \end{bmatrix},$$

$$W_2(U, U_y) = \frac{\varphi_x}{ReF_y} \begin{bmatrix} 0 \\ M_y \\ \frac{4}{3} N_y \\ \frac{\frac{4}{3} nN_y + (m+n)M_y}{\rho} + P_T T_y \end{bmatrix}$$

$$V_1(U, U_x) = \frac{F_y}{ReL^2 \varphi_x} \begin{bmatrix} 0 \\ \frac{4}{3} M_x \\ N_x \\ \frac{nN_x}{\rho} + \frac{4}{3} \frac{mM_x}{\rho} + P_T T_x \end{bmatrix},$$

$$V_2(U, U_y) = \frac{1}{ReL} \begin{bmatrix} 0 \\ -\frac{2}{3} N_y \\ M_y \\ \Omega_1 M_y + \left(-\frac{2}{3} m\right) \frac{N_y}{\rho} \end{bmatrix},$$

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$$W_2(U, U_y) = \frac{\varphi_x}{ReF_y} \left[\begin{array}{c} 0 \\ M_y \\ \frac{4}{3}N_y \\ \frac{4}{3}nN_y + (m+n)M_y \\ \rho \end{array} \right] + P_T T_y$$

$$\text{where } M_x = \frac{\mu(m_x\rho - \rho_x m)}{\rho^2}, M_y = \frac{\mu(m_y\rho - \rho_y m)}{\rho^2},$$

$$N_x = \frac{\mu(n_x\rho - \rho_x n)}{\rho^2}, N_y = \frac{\mu(n_y\rho - \rho_y n)}{\rho^2},$$

$$P_T = \frac{C_p\mu}{Pr_T}, \Omega_1 = \frac{n}{\rho}, Re = \frac{\rho_2 u_2 f_0}{\mu_2}$$

The system of equations (1-4), for the convenience of the numerical solution, is written in a dimensionless form for the channel in a reduced square form, and by introducing the function $F(y)$ it allows to condense the design points near the wall in the physical plane while maintaining a constant step in the design plane and the function $\varphi(x)$ crowding calculated points in the inlet part of the channel [22].

Dimensionless quantities are associated with dimensional relationships in the form

$$\bar{x} = \frac{x}{f_0}; \bar{y} = \frac{y}{f_0}; \bar{u} = \frac{u}{u_2}; \bar{\vartheta} = \frac{\vartheta}{u_2}; \bar{E} = \frac{E}{\rho_2 u_2^2};$$

$$\bar{p} = \frac{p}{\rho_2 u_2^2};$$

$$\bar{\mu} = \frac{\mu}{\rho_2 f_0 u_2}; \bar{t} = \frac{t}{\frac{f_0}{u_2}}; \bar{\rho} = \frac{\rho}{\rho_2}; \bar{T} = \frac{T}{\frac{u_2^2}{R_m}}; \bar{C}_p = \frac{C_p}{R_m};$$

$$\bar{C}_\vartheta = \frac{C_\vartheta}{R_m}; \bar{L} = \frac{L}{f_0}; Re = \rho_2 f_0 u_2 / \mu_2. \quad (5)$$

Index 2 denotes the values of the parameters of the central jet at the channel inlet. The transition from a rectangular channel to a square one was carried out by transforming the coordinates: $\xi = \bar{x}/\bar{L}$, $\eta = \bar{y}$.

Boundary and initial conditions. The solution of the problem posed is found for stationary boundary conditions and, starting from the problem statement, can have the following form:

$$t = t_0;$$

$$x = 0:$$

$$u = u_2, \vartheta = 0, E = E_2, \mu = \mu_2, \rho = \rho_2, p = p_2,$$

when $0 \leq y \leq R_2$,

$$u = u_1, \vartheta = 0, E = E_1, \mu = \mu_1, \rho = \rho_1, p = p_1,$$

when $R_2 < y < 1$,

$$u = 0, \vartheta = 0, E = E_w, \mu = \mu_w, \rho = \rho_w, p = p_w,$$

when $y = 1$.

$$0 < x \leq 1:$$

$$u = 0, \vartheta = 0, E = E_0, \mu = \mu_0, \rho = \rho_0, p = p_0,$$

when $0 < y < 1$,

$$u = 0, \vartheta = 0, E = E_w, \mu = \mu_w, \rho = \rho_w, p = p_w,$$

when $y = 1$.

$t > t_0:$

$$x = 0:$$

$$u = u_2, \vartheta = 0, E = E_2, \mu = \mu_2, \rho = \rho_2, p = p_2,$$

when $0 \leq y \leq R_2$, (6)

$$u = u_1, \vartheta = 0, E = E_1, \mu = \mu_1, \rho = \rho_1, p = p_1,$$

when $R_2 < y < 1$, (7)

$$u = 0, \vartheta = 0, E = E_w, \mu = \mu_w, \rho = \rho_w, p = p_w,$$

when $y = 1$. (8)

$0 < x \leq 1:$

$$\left\{ \begin{array}{l} u = 0, \vartheta = 0, E = \tilde{E}_w \\ \rho = \tilde{\rho}_w, \frac{\partial P}{\partial y} = 0, \mu = \tilde{\mu}_w, T = \tilde{T}_w \end{array} \right\} \text{ when } y = 1 \quad (9)$$

$$\left\{ \begin{array}{l} \frac{\partial u}{\partial y} = \vartheta = \frac{\partial E}{\partial y} = 0 \end{array} \right\} \text{ when } y = 0. \quad (10)$$

$x = 1:$

$$\left\{ \frac{\partial u}{\partial x} = \frac{\partial \vartheta}{\partial x} = \frac{\partial E}{\partial x} = 0 \left(\text{or } \frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 \vartheta}{\partial x^2} = \frac{\partial^2 E}{\partial x^2} \right), \right.$$

when $0 < y < 1$. (11)

Conditions (5-11) subscripts 1, 2, w -respectively refers to the parameters of the near-wall, central jet and on the wall, ρ_1, E_1, μ_1 and ρ_2, E_2, μ_2 , respectively, are calculated for a given temperature T_1, T_2 and pressure p_1, p_2 of the wall and central jet. The numerical values $\rho_w, E_w, \tilde{\rho}_w, \tilde{E}_w, \tilde{\mu}_w$ are calculated by setting the boundary conditions on the wall in terms of u, ϑ, T, P , and $u_0, E_0, \rho_0, \mu_0, T_0$ are some initial values of the required parameters. All of the above notation is generally accepted [3,22], and as usual, the x, y coordinates, as well as dimensionless variables, are written without an overline.

The given boundary conditions at the inlet ($x = 0$) correspond to the stepwise assignment of homogeneous gas flows in the inlet section of the channel. The flow is symmetrical with respect to the x axis, therefore, for the values $y = 0$ and $0 < x \leq 1$ the flow symmetry conditions are set. As the boundary conditions at the channel output at $x = 1$ relations are used that correspond to linear extrapolation of the desired u, ϑ, E variables over the internal nodes of the computational grid. The boundary conditions on the wall at $t = t_0$ and $t > t_0$ in terms of velocities were set to stationary conditions of sticking $u = 0$ and impermeability $\vartheta = 0$, and at $t = t_0$ in the case of setting T_w of the wall temperature, p_w are found from the equation of state.

Solution method. For the numerical solution of the system of equations (1-4) with boundary conditions (5-11), an effective implicit Beam-Warming finite-difference scheme was used for the numerical integration of the Navier-Stokes equations in the form of conservation laws for a compressible gas [23]. This scheme and algorithm is non-interactive and retains a conservative form, which is important for studying internal flows with a recirculation zone. In addition, the results of calculations [22, 23] show that the scheme has sufficient computational stability and accuracy for

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Courant numbers greater than one. When solving equation (1), a one-step finite-difference scheme was used in the form [23]

$$\Delta U^n = \frac{\theta \Delta t}{1 + \theta_2} \frac{\partial}{\partial t} \Delta U^n + \frac{\Delta t}{1 + \theta_2} \frac{\partial}{\partial t} U_n + \frac{\theta_2}{1 + \theta_2} \Delta U^{n-1} + 0 \left[\left(\theta - \frac{1}{2} - \theta_2 \right) \Delta t^2 + \Delta t^3 \right], \quad (12)$$

where $\Delta U^n = U^{n+1} - U^n$ and $U^n = U(n \Delta t)$ are solutions of the partial differential equation (1). The calculations were carried out at $\theta=1$ and $\theta_2=0.5$, which means that scheme (12) will be three-layer of the second order of accuracy. In addition, the delta form retains the advantageous property of a stationary state, if it exists, to be independent of the time step size [23].

To obtain a numerical solution, it is necessary to set the initial time $t = t_0$ of the gas-dynamic quantities, for example, as from condition (5). At the beginning of the calculation, at the boundaries and in all internal nodes, the viscosity was set depending on temperature in the form $\mu = \text{const} \cdot T^{0.6472}$. On the wall at pressure $t > t_0$, a much less stringent condition $\frac{\partial P}{\partial y} = 0$ is set, since the constancy of P is assumed only across the sublayer adjacent to the wall with a thickness equal to Δy .

As a method for numerically solving the problem, we used the algorithm described in [22], where the spatial derivatives were approximated by the second order of accuracy $O(\Delta x^2, \Delta y^2)$.

The effective turbulent viscosity is calculated using an algebraic model in the form

$$\mu = \text{const} T^{0.6472} + \chi \rho b^2(x) \left| \frac{\partial u}{\partial y} \right|, \quad (13)$$

here χ is the empirical turbulence constant, $b(x)$ is the conditional width of the mixing region;

Steady-state solutions are considered obtained if the conditions are met at all grid points

$$m \alpha x \left| \frac{\Delta U_{i,j}^n}{U_{i,j}^n \Delta t} \right| < \varepsilon \quad (14)$$

where ε is a small number, taken as options, equal to 0.0001.

Results of a numerical study. To study the patterns of propagation of cocurrent flows with different pressures in a channel of constant cross section, a channel was chosen, as in [11], with geometric data: $D=188$ mm ($f_0=0.94$ mm - half-height), $L=1.4$ m. Calculations assumed that both air flows, heat capacity at constant pressure and heat capacity at constant volume are constant, $Pr_T=Pr=0.7$. The main calculations were carried out under the condition on the wall along T in the form $\partial T / \partial y = 0$

The calculations performed for various initial data and their variants are shown in the table. The main

calculation results are presented in the form of graphs in Figs. 2.

The results of options № 1 and № 2, i.e. at the same temperatures of the jet and cocurrent $T_1=T_2=300$ K ($\varphi_4=1$) as well as at $T_1=300$ K and $T_2=700$ K ($\varphi_4=2.333$) with the rest constant parameters, shows that in the second variant there are recirculation zones (reverse currents) in the initial sections of the channel. At the same temperatures of the jet and concurrent, this is not observed. Increasing the temperature of the jet promotes the development of the flow. In both cases, in the initial sections of the channel, the axial value of the longitudinal velocity first increases, and decreases with distance from the channel exit. This can be explained by the fact that an increase in temperature leads to an acceleration of the flow and a decrease in pressure in the initial sections.

Options № 3 and № 4 differ from the previous ones by the pressure of the jet and daily flow, which are respectively equal to 4 atm and 1 atm. In these options, similar flow patterns are also observed, an increase in the initial values of temperature and pressure to a jet of 4 atm leads to a sharp increase in the axial values of the longitudinal velocity in the initial sections of the channel, and when moving away from the channel exit, to its rapid drop. Such patterns were not observed in [11, 12].

On fig. 2 shows the transverse distributions of temperature and pressure at various distances from the channel exit (———— - option № 3, - - - - - option № 4). It can be noted here that, as the temperature and pressure move away from the inlet section of the channel, they equalize along the cross section and tend to a uniform value. The axial value of temperature and pressure is also given here. It can be seen from the graph that the axial value near the mouth of the slot first falls, in the recirculation zone it increases, and as the distance from the nozzle exit, the temperature decreases and tends to a constant value.

On fig. 3-6 show the results of the calculation for the case when the flow velocity is set to essentially subsonic along the central slot, and along the peripheral slot - sonic and supersonic. On fig. Figures 3-4 show the transverse and axial distributions of the longitudinal velocity and pressure, respectively, for options № 5 and № 6. Figure 3 shows the transverse distributions of the longitudinal velocity at different distances of the channel, as well as the axial change in the longitudinal velocity at $R_2/f_0=0.5$ (solid line), $R_2/f_0=0.26$ (dotted line). As follows from the graphs, as we move away from the channel exit, the velocity profile gradually smoothest out, the maximum velocity value tends to the jet axis, while taking on a parabolic form, the axial velocity value in the initial sections increases, and decreases as we move away from the beginning of the section.

On fig. 4 shows the transverse distribution and axial pressure change at slot ratios $R_2/f_0=0.5$ and $R_2/f_0=0.26$ (solid and dotted lines, respectively). As

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can be seen from the graphs, with a small slot ratio, the transverse pressure distribution equalizes faster, and the axial value drops rapidly. This is obvious, since the flow flowing out of the smaller slot loses its momentum faster and equalizes with the flow flowing out of the larger slot. On fig. 5 and fig. Figure 6 shows the transverse distributions of the longitudinal velocity, pressure, as well as the axial change in velocity, temperature and pressure at the slot ratio $R_2/f_0 = 0,26$, while the more heated gas is supplied through the central slot (option №. 7).

Here it can be noted that the transverse distributions of the velocity and pressure profiles are similar to other cases, when the axial change in velocity in the initial sections increases rapidly, and with distance from the beginning it gradually decreases and tends to a constant value. This is explained by the fact that when mixing two viscous flows, where the speed of the larger one involves a flow with a lower speed, it thereby leads to an acceleration of the flow with a lower speed at the initial sections of the channel. The axial value of pressure increases in the initial sections, while the temperature decreases. This is due to the fact that, at the mixing boundary, the deceleration of the flow at a high speed leads to an increase in the pressure value, and the temperature drops, transferring heat from a more to a less heated flow.

Variants №. 8 and №. 9, at a heated temperature of the central jet and low pressure ratios of the jet and cocurrent flow ($P_2/P_1 = 1$), as well as two values of φ_2 in the mixing region, abrupt changes in the velocity and temperature profiles are not observed, and also in both cases the core and high temperature are maintained until the end of the channel.

The results of variant №. 10 showed that noticeable flow recirculation zones are traced in the initial sections, and when moving away, the transverse distribution of the longitudinal velocity passes to a parabolic profile. At $\bar{x} = 0.03, 0.07, 0.2, 0.4$, the height of the recirculation zone occupies, respectively, $0.64f_0, 0.48f_0, 0.35f_0, 0.10f_0$ of the channel section, and reaches half the channel length.

On fig. 7 shows the transverse distributions of the longitudinal velocity

(- · - option №11; ---- - option №.12; ——— - option №.13), as well as the axial value of the longitudinal velocity with different values of temperature and pressure. In all three variants, a recirculation zone is observed in the initial sections of the channels; reverse currents. At constant parameters $\varphi_1, \varphi_2, \varphi_3, \varphi_5$, an increase in the temperature of the main jet, respectively, leads to an expansion of the reverse flow region, and in these zones the transverse pressure change is harmonious. This phenomenon can

be explained by the fact that in the reverse flow zones, i.e. at the boundary of the mixing of two jets, the jet moving at a speed of about - and supersonic involves a jet moving at subsonic speed. In this case, a jet with a high speed loses part of its inertia due to deceleration, and a subsonic jet accelerates, naturally, in the mixing region, a decrease in the value of the jet velocity occurs, due to which a decrease in speed leads to an increase in pressure, and an increase in speed vice versa, which thereby leads to to a harmonious change in transverse pressure.

Numerical results showed that even at pressure ratio $P_2/P_1 = 1$, but at high temperature ratios ($T_2/T_1 = 2.3333$), a recirculation zone is also observed in the initial sections (option . 14, Fig. 8). On fig. Figure 8 shows the axial changes in the longitudinal velocity along the channel, as well as its transverse distributions in different sections of the channel. As follows from the graph, the axial value of the longitudinal velocity in the initial sections decreases, and as it moves away, it increases and tends to its constant value.

From the profiles of the transverse distributions of the longitudinal velocity, given in different sections of the channel, it follows that in the inlet sections near the channel wall, reverse current lines are traced, and as they move away, they extend and pass to a fully developed flow.

Conclusion.

The paper presents the results of a numerical study of the influence of the non-design of coaxial jets on mixing and propagation in a limited flat channel obtained by numerical solution of the non-stationary full Navier-Stokes equations by the method of implicit finite-spaced schemes. In particular, the following regularities were revealed:

- at different initial pressures and large ratios of jet velocities and temperatures, a recirculation zone is observed in the initial sections of the channel;
- at high ratios of initial pressure (4:1) and jet temperature, it leads to a sharp increase in the axial values of the longitudinal velocity in the initial sections of the channel;
- if the central jet is essentially subsonic and wall-mounted sonic or supersonic, in the initial sections there is no recirculation zone, and with a small ratio of slots, the pressure distribution levels out faster, and the axial value drops rapidly;
- at small ratios of velocity and heated temperature of the central jet and at small ratios of pressure of the jet and cocurrent ($P_2/P_1 = 1$), no sharp changes in the velocity and temperature profiles are observed, and the core and high temperature persist until the end of this channel.

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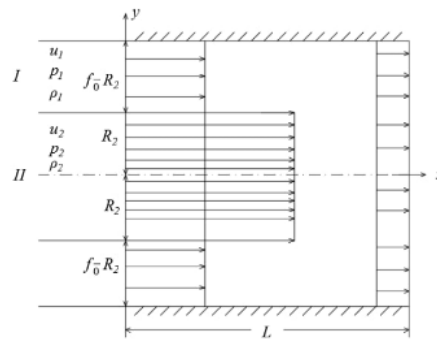


Fig 1. Scheme of the flow.

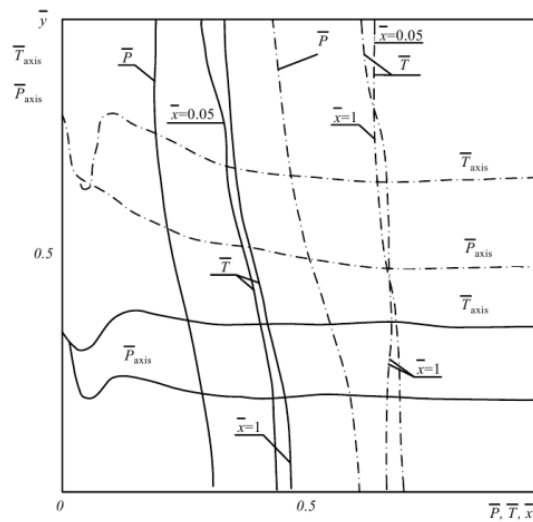


Fig. 2. Transverse changes in temperature and pressure at different distances from the inlet section of the channel, as well as their axial changes along the channel: — -option № 3; - · - option № 4.

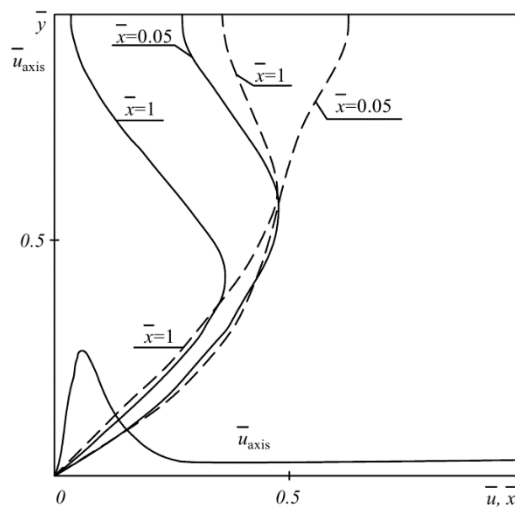


Fig 3. Transverse and axial distributions of longitudinal velocity: - - - option №. 5; ——— option №. 6.

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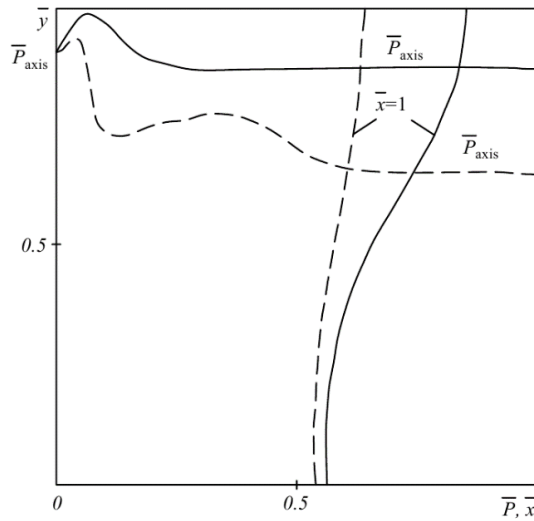


Fig 4. Transverse and axial pressure distributions:
 - - - option №. 5; ——— option №. 6.

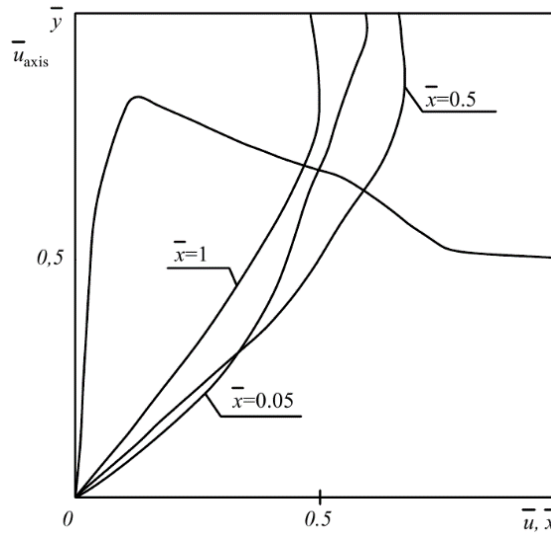


Fig 5. Transverse and axial distributions of longitudinal velocity: option №. 7.

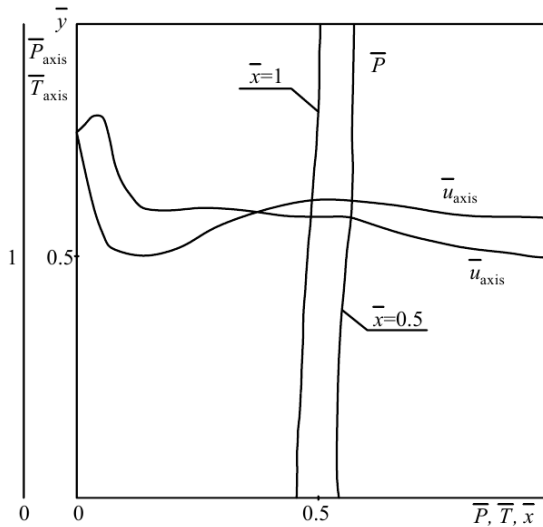


Fig 6. Transverse and axial change in temperature and pressure: option №. 7.

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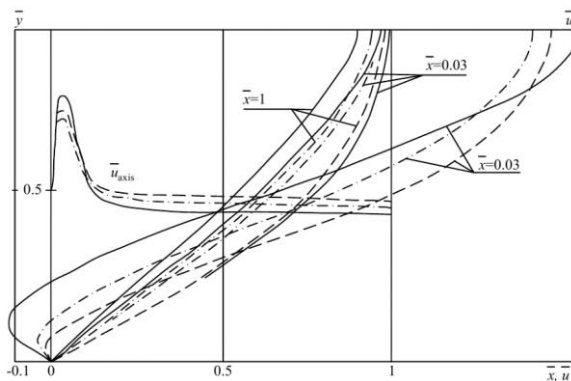


Fig 7. Transverse and axial change in longitudinal speed:
 - - - - option №. 11; - - - - option №. 12; ——— - option №. 13.

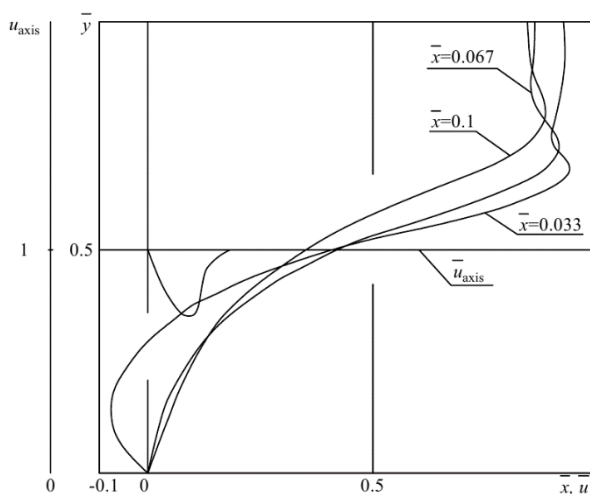


Fig 8. Transverse profiles of the longitudinal velocity in different sections of the channel, as well as its axial change along the channel: option №. 14.

Table 1.

N	$\varphi_1 = u_2/u_1$	$\varphi_2 = R_2/f_0$	$\varphi_3 = L/f_0$	$\varphi_4 = T_2/T_1$	$\varphi_5 = P_2/P_1$
1	72.4636	0,5	14.8936	1	2
2	72.4636	0,5	14.8936	2.3333	2
3	72.4636	0,5	14.8936	1	4
4	72.4636	0,5	14.8936	2.3333	4
5	0.02222	0,26	14.8936	1	2
6	0.02222	0,5	14.8936	1	2
7	0.02222	0,26	14.8936	1,6666	2
8	0.02222	0,26	14.8936	2,3333	1
9	0.02222	0,5	14.8936	2,3333	1
10	45,0725	0,26	14.8936	1	2
11	45,0725	0,5	14.8936	1	2
12	45,0725	0,5	14.8936	0.4286	2
13	45,0725	0,5	14.8936	1.6666	2
14	45,0725	0,5	14.8936	2.3333	1

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Article



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PROPAGANDA AND POLITICAL DEBATES IN THE NEWSPAPERS OF THE LEADING POLITICAL PARTIES DURING THE PRE-ELECTION PERIOD OF THE 1919 CONSTITUENT ASSEMBLY OF GEORGIA (Republic of Georgia; Unity; Public Affairs; Georgia; Labour)

Abstract: Our research explores the democratic processes during the First Republic of Georgia (1918-1921). In essence, this is a complex and intricate subject, therefore, our article is dedicated to a detailed examination of the publishing activities of the four prominent leader parties during that era, with a specific focus on one or two pivotal aspects.

This article delves into one of the most captivating and significant episodes within the three-year span of Georgia's independence: the 1919 Constituent Assembly elections and pre-election activities. We evaluate the political debates and the opposition between the leading political factions from a journalistic perspective, especially since these elections stand out as one of the most democratic in recent Georgian history. Furthermore, this subject holds intrigue in terms of Georgia's Western orientation.

The 1919 Constituent Assembly election serves as an exemplary instance of such distinction. It is characterized by meticulous preparatory work, the formulation of political party agendas, and a high level of political maturity, all of which persisted despite ideological conflicts. It represents a civil demonstration of the proper conduct of opposition.

Within the scope of our research, we aim to rekindle interest in these aspects and systematically catalog articles disseminated through the press as vehicles for party propaganda. This, in turn, facilitates a fresh evaluation of the media landscape from a century ago.

During our investigation, we have identified a set of pertinent questions:

1. What constituted the core themes in pre-election debates among the leading parties in the First Republic?
2. How did each party conduct propaganda through print media?

The materials we have scrutinized unequivocally attest to the relatively high quality of democracy within a nation freshly liberated from captivity.

This article promises to pique the interest of European scholars engaged in the study of democratic processes.

Key words: Constituent Assembly, political campaigning, election propaganda, political parties, agrarian reform.

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Introduction
Methodology

In exploring the research topic, **secondary data** from periodicals preserved in the state archives and the library of the Parliament of Georgia, as well as

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electronic media, were systematically searched, processed, and studied. **The qualitative research** method was employed, proven to be the most effective for delving into historical contexts, especially during critical periods. **Content** and **thematic analysis** of textual materials were utilized to interpret patterns and meanings. The materials underwent detailed analysis using **discourse analysis**, focusing on **propaganda and political debates found in the press pages of leading political parties during the pre-election period of the founding assembly of Georgia in 1919**. **Qualitative data**, such as the Republic of Georgia, unity, public affairs, Georgia, and work, formed the basis for processing and highlighting the propaganda and political debates. Publications were systematically grouped according to their content, genre, and type, yielding valuable insights into the attitudes toward political processes, the state, and the prevalence of narrow-party or populist approaches within the party press.

Introduction

The reshuffling of social and political forces in Georgia at the dawn of the 20th century, coupled with the emergence of distinct groups in the public sphere, laid the groundwork for the establishment of political parties. These parties, each with its unique ideologies and beliefs, engaged in fervent debates about the future development of Georgia.

While more than a dozen political parties existed, four emerged as leaders, attracting renowned political and public figures, active supporters, and wielding influential party print organs—newspapers. Our research centers on these political unions: Social-Democrats, Social-Federalists, National-Democrats, and Socialist-Revolutionaries.

Following liberation from the Russian Empire, the newly independent republic faced numerous challenges, focusing on the establishment of democratic governance and the European model of political arrangement. The National Council of Georgia and the Parliament worked on these key issues, directing efforts toward the creation of the Constituent Assembly, the highest legislative body of the Democratic Republic of Georgia.

The convocation of the Constituent Assembly, mandated by the Declaration of Independence on May 26, 1918, emphasized the importance of universal and equal elections. These elections were seen as a vital confirmation of the Georgian people's will.

Throughout the election campaign, party-printed editions played a crucial role. Newspapers such as "Government Moambe," "Ertoba," "Georgia," "People's Affairs," and "Shroma" served as the primary platforms for political expression and propaganda.

Despite ongoing controversies and verbal clashes between parties, the press became the battleground for political debates and struggles.

Parties sought to popularize their ideologies, gain public support, and discredit rival parties through the dissemination of programs and promises.

For our research, party periodicals serve as the primary source. We thoroughly examined publications from five newspapers dedicated to the formation of the Constituent Assembly in the pre-election period. Before delving into our presentation, we find it essential to outline the historical context and state environment that influenced the media climate, drawing upon contextual knowledge.

Proto-Experience of Research

Studies of the period of independence predominantly assume historiographical or political dimensions. However, delving into the press and media landscape poses a considerable challenge due to its multi-profile nature, each facet warranting an extensive examination. This article narrows its focus to explore propaganda methods, given their pivotal role in addressing various state-important issues. Collectively, these methods contribute to shaping a media environment grounded in independent and liberal values, an area largely unexplored at this stage.

The Constituent Assembly, convened through democratic elections, emerges as a paramount component for the political development of the country. Upon studying the materials, it becomes evident that the positioning of one's own opinion on this crucial event, coupled with discrediting opposing views on the press pages, stood out as one of the primary methods employed by participating parties during the elections. According to young researcher Sh. Kezherashvili, controversies and political debates during the pre-election period of the legislative body, the Constituent Assembly in the years of Georgia's independence, were indeed democratic. (Kezherashvili, 2019)

It was also intriguing for us to note that Georgia was embroiled in war conflicts during the mentioned period. However, this did not hinder the pre-election campaign from unfolding in a highly democratic setting. The question of how democratic and pluralistic the environment was becomes significant. Based on media texts, we assert that freedom of speech, election meetings, free movement, rallies, and the display of portraits of politicians, posters, and campaign slogans were unrestricted.

In the theoretical analysis of the conducted election campaign by T. Nikvashvili and Ts. Jananashvili, authors express the opinion that Georgia, undergoing significant changes, exhibited a profound emotional backdrop to the elections, a characteristic that remains sharp even in modern times. Conversely, the global pre-election agitation adopted an aggressive and rather uncivilized appearance. Thus, we comprehend that the elections of the Constituent Assembly a century ago adhered to

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all principles of democracy. (Nikvashvili & Jananashvili, 2018)

The election campaign of the Constituent Assembly receives a high democratic index in nearly all studies dedicated to this issue. Iremadze directs attention to the diverse content within print media. Starting from mid-January, periodicals of the leading political parties have extensively featured articles on their programs, ideologies, highlighting the shortcomings of others, and showcasing their own superiority. (Iremadze, 2018)

Each party endeavored to showcase its merits in the attainment of Georgia's independence, outlining its distinctive role in various matters of state importance. Moreover, each party presented its program on newspaper pages. Historian Otar Janelidze, a researcher of the First Republic, views party promises as notably generous. The author's documentary materials are intriguing, referencing the content of pre-election campaign materials. He highlights an instance where the Social-Democrats, aiming to discredit their political opponents, issued a poster featuring a Georgian prince, urging voters to tarnish candidates from the National-Democratic Party as 'exploiters of the peasantry' and 'defenders of landlord interests.' 'I have become!' (Janelidze, 2018)

The mentioned parties and their programs garnered additional strength through public support.

Before delving into our main topic, we deemed it fitting to provide a brief overview of the ideologies embraced by the four political parties within our field of interest.

The Political Spectrum in the Pre-election Campaign of the Constituent Assembly

In November 1919, following several months of deliberation, the parliament ratified the law titled 'Regulations on Constituent Assembly Elections,' wherein every aspect governing the elections was meticulously formulated. The complete text of the regulation was published in the official newspaper 'Republic of Georgia,' which also provided detailed explanations regarding the election system.

In January, the party participating in the elections commenced its election campaign. The Central Election Commission ultimately approved the list of candidates from 15 political entities. (Iremadze, 'The Greatest Event in the Life of the Nation - Constituent Assembly Elections,' 2018)

№1 was awarded to the main leading party - the Social Democratic Party of Georgia. №2 is the National Democratic Party of Georgia, №3 is the Party of Socialist-Revolutionaries of Georgia, №5 is the Socialist-Federalist Party of Georgia. (Here, we have listed only the political unions chosen as the object of our research).

As we know from officially confirmed documents, the Social Democrats of Georgia had 130 candidates nominated because they represented the

majority in the temporary parliament and did not intend to give up their positions in the Constituent Assembly.

It is necessary to mention the leaders of the mentioned party who created and propagated the ideology of their party. These are famous writers and figures in Georgia: Egnate Ninoshvili, Noah Jordania, Silibistro Jibladze, Grigol Lortkifanidze, Irakli Tsereteli, Akaki Chkhenkeli, Viktor Nozadze.

The Social-Democrats had developed a rather interesting action program. They considered the economic revival of the country as their primary task. They intended to eliminate social and political contradictions between the classes, and they planned it by following democratic principles. The society was promised protection of the interests of the working masses.

The social democrats named the people as the main leaders of the central government: 'The central government has no way to be organized separately, and it gradually approaches the people, becoming a people's government.' (Bendianishvili, 2001)

One of the crucial aspects of economic progress for the Social Democrats was the land issue, i.e., agrarian reform. They also emphasized the necessity for reforms in the field of education. The foreign researcher Steven Jones, in his work 'Socialism in Georgian Colors,' highlights the international perspectives of this party alongside the national ones.

The second position on the list was occupied by the National Democratic Party of Georgia. It is essential to note that the origins of this party trace back to the associations of Ilia Chavchavadze and his allies. Consequently, it is not surprising that the party's primary political demand, its foremost concern, is the national freedom of Georgia. In the vision of the national democrats, a peaceful Georgia prioritized the citizens' free will as the most significant value.

In the pledges of the National Democratic Party, significant emphasis was placed on the blueprint for the advancement of entrepreneurship and trade. The land issue and the welfare of the working class were acknowledged as vital and challenging matters.

Although only 8 MPs from the party list secured a place in the Constituent Assembly, they made a substantial contribution to formulating numerous program laws, and the provisions they created were adopted by both the Parliament and the subsequent Constituent Assembly.

The sources indicate that the National Democratic Party was established as the right-wing opposition to the majority Social Democrats in the founding assembly.

We reviewed the programs of each party and observed that the National Democrats' program stood out for its diversity and a well-structured legislative system. The party impressively emphasized key areas such as citizens' rights, education, and economic growth through land reform regulation.

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It is a documented fact that the National Democratic Party viewed political freedom as integral to the creation of the nation's property, spiritual well-being, and physical strength. Upon reviewing the party's program and comparing it with those of other parties, it becomes evident that they held distinct perspectives on various issues. Notably, the party's leaders, in a departure from social paths, prioritized the development of private property, highlighting their differences with the Social Democrats on numerous fronts.

The third position was allocated to the party of Social Revolutionaries, commonly known as CP.

The CP organization that emerged in Georgia at the beginning of the 20th century had Russian roots, initially being part of the Russian CP party. The program was adapted from the Party of Social Revolutionaries of Russia. Although modifications were introduced to the program over time, the core remained unchanged, leading to clashes with opposing leading parties on multiple occasions.

We find it essential to highlight that the socialization of land was a pivotal issue in the program of the Socialist-Revolutionaries, as our article focuses on the primary object of the political media struggle being the aforementioned issue.

The Socialist-Federalist Party of Georgia was registered as number five. The primary objective of the Federalists was to liberate the working people and foster prosperity centered around them.

From the outset, the party opposed all bourgeois initiatives and viewed a socialist political arrangement as the correct form for the country. It was this party that resisted the agrarian bill devised by the sword-wielding Social-Democrats.

Having briefly explored the election programs of all four parties, it was evident that the most significant discord arose regarding agrarian reform. Each party held a distinct position in this regard, with some points of agreement, but the ruling power failed to reach a consensus with the opposition parties. Further details on this matter will be discussed below.

Agrarian Reform: The Central Topic of Political Debates and Intense Confrontations

Modern Perspectives on Agrarian Reform: Assessing a Progressive Move in the Democratic Republic of Georgia Despite a Century-Old Political Controversy. The complexity arises from the fact that this reform was developed and adopted during the constituent assembly elections, turning it into a frequent point of contention among the leading parties.

We must consider the plight of the Georgian peasantry and working class during that era. Over 80 percent of the population resided in rural areas, with 65 percent of peasants leasing land. The nobility possessed vast land holdings, and the initial stage of the reform—confiscation of land from owners,

initiated in 1918—was effectively executed and, by 1919, essentially concluded.

The peasantry, and society at large, expressed significant concern about the distribution of confiscated lands. The program presented by the Social Democrats to the Parliament proposed the municipalization of lands, transferring them to peasants who privately worked on the land. The state retained control over forests, waters, pastures, natural resources, and certain farms.

The legislation governed the transfer and redistribution of lands, sparking contentious debates among political factions. According to the Social Democrats' plan, the land would be allocated to the new owner at a discounted price rather than for free. However, the extent of affordability for everyone during that period was a subject of ongoing discussion among opposition parties throughout the pre-election campaign.

'Ertoba' newspaper extensively covers the agrarian reform in the majority of its issues, providing a detailed analysis to the public. The publication asserts that the legalization of land as private property is highly advantageous for both the peasants and the economic progress of the state.

At the start of January, Ertoba dedicated a series of articles to this issue. The article, initiated in No. 11 under the title 'Agrarian Project,' continues in subsequent issues of the newspaper. 'Agrarian reform is geared towards the peasant, addressing the matter of agriculture. A preferential price will be set to cover the necessary expenses involved in the implementation of the land reform.' (Ertoba, 1919)

In the following article, the Social Democrats elucidate why land cannot be distributed for free. Owing to the bank's debts and the state's financial constraints, they establish prices for the lands.

The newspaper 'Georgia' articulates the stance of the National Democratic Party, which opposes free land confiscation. This represents a distinct position: 'Our conscience cannot align with the idea of free land confiscation. Such confiscation without compensation is deemed as tyranny and robbery.' (Georgia, 1919) The National-Democratic Party asserts that it does not oppose compulsory land confiscation but condemns the social-democratic approach to this confiscation, deeming it primitive. In an article published just before the constituent assembly elections, it openly accuses the ruling power of disunity and questions the viability of its project: 'This is the state creation of our social democracy. There are many tears, much blood, and chaos in the national economy.' (Ertoba, 1919)

As observed, the leaders of the National Democratic Party found common ground with the ruling party on several matters. However, the Social-Federalist Party engaged in a radical conflict over the agrarian issue.

The newspaper 'People's Affairs' extensively and sharply addressed this matter, advocating for the free

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distribution of land to farmers with the slogan 'Land to the tiller, free of charge and free of charge!' Public Affairs overtly pledges to its supporters that it will eliminate private land ownership, transforming it into public property.

Samson Firtskhalava eloquently addresses the land issue with his customary intelligence and a composed, healthy tone. In the January 23 edition, he dedicates a special article to this problem. Firtskhalava delicately articulates his own position and chastises the Social-Democrats for hasty decision-making.

Unlike Firtskhalava, the publicist of 'People's Affairs' and advocate for the social-federalists, Tedo Ghloni, publishes sharply critical articles. He directly accuses the ruling party of impoverishing the working class and establishing a bourgeois state.

On January 14, 'People's Affairs' fully presented the draft agrarian law, scrutinizing it article by article. For example, it pointed out inconsistencies and flagged flaws.

Concerning the agrarian project, we did not encounter insulting or obscene words directed at opponents. However, during our review of relevant literature on the issue, we unfortunately came across such instances, reflecting a flaw in the political ethics of the period.

The 'Shroma' newspaper aligns with the social-federalists on the agrarian issue. Its pages feature the program of the social revolutionaries (ESRs). The ESRs urge the ruling party to postpone the adoption of such a crucial project until the Constituent Assembly elections. According to the SRs, the land issue should be addressed by the newly convened democratic Constituent Assembly, which enjoys the trust of the people.

In the January and February issues, the 'Shroma' newspaper publishes extensive articles whose authors contend that the Social-Democrats' project will once again favor the rich, leaving the working class and peasantry disillusioned. The Socialist-Revolutionaries advocate the slogan 'Land should not become an object of trade.'

Finally, we can confidently assert that before the election of the Constituent Assembly, there existed an 'agrarian issue front,' and each party engaged in this battle with its own ideology and methods, fully aligning with the pre-election propaganda struggle.

Conclusion

Before concluding our paper, it is essential to reiterate that the pre-election campaign unfolded under equal conditions among the parties. It stands as the epitome of democracy, with no restrictions on the expression of opinions, freedom of speech, organization of rallies, pre-election meetings, and, certainly, the articles we scrutinized published in the press pages serve as a clear confirmation of this.

With the materials we presented, we ascertained that opposition and criticism in the information domain were highly intense.

Our objective was to illustrate the characteristics of propaganda and debates during the pre-election period. Consequently, we selected the agitation surrounding the agrarian reform as a focal point, yet we could not sidestep other vital problematic issues where strategies of promoting one's activities and the mutual struggle of opponents were distinctly visible.

Within the framework of the research, we deemed it necessary to highlight one more detail. During the analysis of the materials we studied, it was found that the situation quite familiar today, involving the polarization of the media and, therefore, public opinion, was not unusual even a century ago. In one of the issues of "People's Affairs," a response was given to the article published in the 'Georgia' newspaper, which discussed the division of the Georgian political spectrum into two camps, socialist and non-socialist.

All middle groups are disappearing and should disappear. The Social-Federalists, as a middle group, will be wiped out, leaving two forces on the battlefield: the National-Democrats and the Social-Democracy. (People's Affairs, 1919)

While recounting the cases of discrediting, we came across an article by the Social-Federalists, in which the ruling power was directly exposed to violence and blackmail. The publication, authored by Sanganidze, describes the Social Democrats' violent and threatening intimidation and pressure on the public. 'If you don't have the label of Social Democrats, you won't be able to boldly go to the ballot box. Violence, threats, and injustice reign where there should be justice, non-violence, and directness.' (Sanganidze, 1919)

Of course, 'Ertoba' newspaper did not remain in debt, and on January 16, it published a rather hot and embarrassing publication. Federalists are referred to as gossips and slanderers in the mentioned article. 'We will not engage in polemics with them on this basis. It would be humiliating for our dignity. We don't think that posting such headlines and articles will add anything to the capital of Social-Federalists, except garbage.'

As we can see, the parties did not shy away from belittling each other in public, and we considered this to be a way of avoiding politics; however, there are not many such examples, and offensive and obscene words are not often found.

Finally, we should note that all four parties reviewed by us, through their printed organs, articulate their own ideological lines, focus on problematic points, and offer their own versions of solving the problems to the electorate.

Each newspaper actively opposes multiple rival parties, emphasizing key issues and prominent political figures. Employing a variety of means to

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discredit opponents, these actions are categorized within the realm of political agitation by our theoreticians.

Every newspaper typically features one or two leading publicists considered the primary agitators. Our study reveals a diverse range of article genres, including appeals, interviews, conversations, criticisms, and portraits.

Historians and political scientists assert that the 1919 Constituent Assembly elections were conducted with a high level of democratic quality and adherence to democratic principles. We concur, recognizing the outstanding significance of the debates and

propaganda during this election, establishing a foundation for a healthy tradition.

Despite occasional scathingly critical letters and offensive publications, the election campaign and debates contributed to the creation of a fairly intellectual media landscape. While the social democrats secured a significant majority in the constituent assembly, the ideas presented by individual parties were intriguing and thought-provoking for the public, influencing their decisions. In conclusion, each party genuinely engaged in democratic and patriotic discourse to fortify their positions and contribute to the building of a better state.

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Article



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SEMANTIC VARIABLES WITH NON-DOMINATED VARIANCES

Abstract: A cognitive model of financial debts of municipalities in 20 US cities has been developed. The model identified (discovered) new conceptual and quantitative manifestations of numerous subtypes for the known 2 types of debt. The model uses all components of all eigenvectors from the C_{66} eigenvector matrix. The initial semantic equality is a semantic matrix equality of the form: $\text{meaning}(Y_{m6}) = \text{meaning}(Z_{m6}C_{66})$. Found 6 semantic solutions to the semantic multidimensional equation $\text{meaning}(y_1) \oplus \dots \oplus \text{meaning}(y_6) = \text{meaning}(Z_{m6}c_1) \oplus \dots \oplus \text{meaning}(Z_{m6}c_6)$, $c_j = (c_{1j}, c_{2j}, \dots, c_{6j})^T$, $y_j = (y_{1j}, \dots, y_{mj})^T$, $Z_{m6} = \{z_i\}$, $z_i = (z_{1j}, z_{2j}, \dots, z_{mj})^T$, $j = 1, \dots, 6$. A system of 6 semantic equations with 6 unknown y -senses has been developed. 6 semantic solutions have been found: $\text{meaning}(y_1)$, $\text{meaning}(y_2)$, $\text{meaning}(y_3)$, ..., $\text{meaning}(y_6)$, which significantly complement the initial knowledge. Each solution is obtained from its own semantic equation. The model allows us to extract new knowledge about the structures of receivables and payables from multidimensional data on municipal debts of 20 US cities. The model cognitively models semantic variables and numerically models quantitative relationships between the manifestations of subtypes of debt. Their formulaic and phraseological types have been implemented, justified, and the descriptions of mutual relations of debts of 20 cities are visualized on graphs. Their formulaic and phraseological types have been implemented, justified, and the descriptions of mutual relations of debts of 20 cities are visualized on graphs.

Key words: semantic variables with non-dominant variances, matrix semantic equality, multi-semantic equation with known and unknown semantic variables, cognitive model of financial debts of municipalities of 20 US cities.

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СМЫСЛОВЫЕ ПЕРЕМЕННЫЕ С НЕДОМИНИРУЮЩИМИ ДИСПЕРСИЯМИ

Аннотация: Разработана Когнитивная модель финансовых задолженностей муниципалитетов 20 городов США. Модель выявила (обнаружила) новые смысловые и количественные проявления многочисленных подтипов для известных 2-х типов задолженностей. Модель использует все компоненты всех собственных векторов из матрицы собственных векторов C_{66} . Исходным смысловым равенством служит смысловое матричное равенство вида: $\text{смысл}(Y_{m6}) = \text{смысл}(Z_{m6}C_{66})$. Найдены 6 семантических решений смыслового многомерного уравнения $\text{смысл}(y_1) \oplus \dots \oplus \text{смысл}(y_6) = \text{смысл}(Z_{m6}c_1) \oplus \dots \oplus \text{смысл}(Z_{m6}c_6)$, $c_j = (c_{1j}, c_{2j}, \dots, c_{6j})^T$, $y_j = (y_{1j}, \dots, y_{mj})^T$, $Z_{m6} = \{z_i\}$, $z_i = (z_{1j}, z_{2j}, \dots, z_{mj})^T$, $j = 1, \dots, 6$.

Разработана система из 6 смысловых уравнений с 6 неизвестными y -смыслами. Найдены 6 семантических решений: $\text{смысл}(y_1)$, $\text{смысл}(y_2)$, $\text{смысл}(y_3)$, ..., $\text{смысл}(y_6)$, существенно дополняющие исходные знания. Каждое решение получено из своего смыслового уравнения. Модель позволяет извлечь новые знания по структурам дебиторской и кредиторской задолженностей из многомерных данных о муниципальных задолженностях 20 городов США. В модели когнитивно моделируются смысловые переменные, численно моделируются количественные связи проявлений подвидов задолженностей. Реализованы, обоснованы их

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формульные, фразеологические виды, визуализированы на графиках описания взаимных связей задолженностей 20 городов.

Ключевые слова: смысловые переменные с недоминирующими дисперсиями, матричное смысловое равенство, мимногосмысловое уравнение с известными и неизвестными семантическими переменными, когнитивная модель финансовых задолженностей муниципалитетов 20 городов США.

Введение

Малому количеству ℓ смысловых переменных с доминирующими дисперсиями исследователи уделяли большое внимание. В диссертации [1] приведены 13 примеров реальных данных из разных предметных областей, где выделены доминирующие дисперсии главных компонент и найдены их содержательные интерпретации - смыслы. К настоящему времени количество таких публикаций возросло в десятки раз. Главные компоненты с недоминирующими дисперсиями не рассматривались совсем, так как их доля ℓ/n была мала. Разработчик метода главных компонент [2] целью своей задачи ставил выделение главных компонент с наибольшими дисперсиями. Наибольшая и максимизированная 1-ая дисперсия математически выделялась из матрицы парных корреляций, но ее дисперсия не была достаточной для исчерпания 100-процентной изменчивости. Доля $(n-\ell)/n$ недоминирующих $n-\ell$ дисперсий мала, а количество $n-\ell$ неприменяемых собственных векторов намного превышает количество ℓ доминирующих дисперсий – $\ell=2,3$ или 4, оно зависит от количества n анализируемых переменных и от матрицы парных корреляций. Количество доминирующих дисперсий мало, а игнорирование недоминирующих дисперсий существенно уменьшает количество используемых компонент собственных векторов (индикаторов присутствия извлекаемых знаний [3]) – у исследователей происходят ситуации «упущенных возможностей». Близкое к нулю значение недоминирующей дисперсии указывает на практическое отсутствие изменчивости u -переменной (смысловой переменной), m значений ее (вычисленные по формулам) на графике не изменяются (меняются только цифры числа после запятой). Стабильная по изменчивости u -переменная содержит в своей формуле постоянные величины – заметные по абсолютной величине компоненты собственных векторов, соответствующих значению недоминирующей дисперсии. Количество $n-\ell$ таких собственных векторов больше, чем количество ℓ собственных векторов, имеющих доминирующие собственные числа. Наличие $n-k$ нулевых дисперсий при ранге корреляционной матрицы, равно k , $n>k>\ell>1$, точно указывает на наличие неизменяемых смысловых переменных. Теория многосмысловых уравнений позволяет использовать смысловые (семантические) переменные (главные компоненты Н. Хотеллинга)

с любыми дисперсиями. Но собственные векторы имеют компоненты, входящие в формулы смысловых переменных и должны использоваться, но не используются. Термин «компоненты» будем применять к компонентам собственных векторов (из матрицы C_{66}), смысловые главные переменные будем называть «смысловые u -переменные» (с значениями в столбцах матрицы Y_{mn}). Термин «семантические» применяем потому, что смысловые переменные являются семантическими решениями системы многосмысловых уравнений [4-9].

Разработаем модель, использующую все компоненты всех собственных векторов из матрицы C_{66} . Модель позволяет извлечь новые знания по структурам дебиторской и кредиторской задолженностей из многомерных данных о муниципальных задолженностях 20 городов США [10-11]. Кредиторская задолженность муниципалитета является обязательствами субъекта (фирмы) перед контрагентами за поставленные товарно-материальные ценности, выполненные работы и услуги, а также по налогам и другим начислениям. Обязательства подразделяются: по срокам, расчеты с персоналом по оплате труда, задолженность должностным лицам, проценты к оплате, начисленная задолженность по отпускам работников, прочая кредиторская задолженность. Дебиторская задолженность муниципалитета (требования к клиентам), образуемая в ходе хозяйственной деятельности субъекта (т.е. фирмы) подразделяется на нормальную и неоправданную. Оплата от покупателей и заказчиков поступает по счетам, вексялам и в других видах, в зависимости от условий по договору (контракту). Дебиторская (нам должны) и кредиторская (мы должны) задолженности фирмы делятся на составляющие. Новое разделение на подвиды задолженностей приведено ниже.

Исходные данные

Исходные данные о муниципальных задолженностях 20 городов США. Даны значения 6 показателей, отражающих структуры муниципальных задолженностей 20 городов США (Таблица 1). В модели переменными являются z -переменные, влияющие на структуры муниципальных задолженностей и 6 u -переменные, вычисляемые, исходя из значений 6 z -переменных и из матрицы собственных векторов C_{66} .

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- Имена-смыслы z-переменных:
 - стоимость земли под застройку (в числе 1000-долларовых акций, КЗ);
 - срок платежей по векселям (в сотнях месяцев, КЗ);
 - прирост населения(в 100000 чел., КЗ+ДЗ);
 - чистый общий долг (КЗ-ДЗ);
 - отношение числа учащихся колледжей ко всему населению;
 - величина задолженности (КЗ).

Когнитивная модель финансовых задолженностей муниципалитетов 20 городов США

Словесная модель финансовых задолженностей муниципалитетов 20 городов США изложена в [10-11]. Специфика управляющих параметров модели отлична от специфик моделей в других предметных областях [4-9]. Для излагаемой ниже Когнитивной модели финансовых задолженностей муниципалитетов 20 городов США входными переменными являются:

1. Известные числовые значения и смысловые переменные z-переменных: $\text{смысл}(z_1)$, $\text{смысл}(z_2)$, ..., $\text{смысл}(z_6)$.

2. Вычисленная с высокой точностью по корреляционной матрице R_{66} пара матриц (C_{66}, Λ_{66}) , матрица R_{66} вычисляется по реальным данным: ее матрица собственных чисел Λ_{66} и матрица собственных векторов C_{66} удовлетворяют условиям: $R_{66} = (1/m)Z_{m6}^T Z_{m6}$, $R_{66}C_{66} = C_{66}\Lambda_{66}$, $C_{66}C_{66}^T = I_{66}$, $C_{66}^T C_{66} = I_{66}$, $\Lambda_{66} = \text{diag}(2.2728, 1.9596, 0.9124, 0.4525, 0.3894)$, $\text{tr}(\Lambda_{66}) = \lambda_1 + \dots + \lambda_6 = 6$.

3. Смысловое матричное равенство вида: $\text{смысл}(Y_{m6}) = \text{смысл}(Z_{m6}C_{66})$ служит исходным условием. Ищется семантическое решение смыслового многомерного уравнения $\text{смысл}(y_1) \oplus \dots \oplus \text{смысл}(y_6) = \text{смысл}(Z_{m6}c_1) \oplus \dots \oplus \text{смысл}(Z_{m6}c_6)$, где $c_j^T = (c_{1j}, c_{2j}, c_{3j}, c_{6j})$, $y_j^T = (y_{1j}, \dots, y_{mj})$, $Z_{m6} = \{z_i\}$, $z_i^T = (z_{1j}, z_{2j}, z_{3j}, z_{mj})$, $j = 1, \dots, 6$.

4. Находятся 6 семантических решений: $\text{смысл}(y_1)$, $\text{смысл}(y_2)$, $\text{смысл}(y_3)$, $\text{смысл}(y_6)$, существенно дополняющие исходные смыслы. Решается система из 6 смысловых уравнений:

$$\text{смысл}(y_1) = (z_1) * (-0.5101) \oplus \text{смысл}(z_2) * (-0.2618) \oplus \text{смысл}(z_3) * 0.1066 \oplus \text{смысл}(z_4) * 0.3356 \oplus \text{смысл}(z_5) * (-0.7395) \oplus \text{смысл}(z_6) * 0.0193;$$

$$\text{смысл}(y_2) = (z_1) * 0.2655 \oplus \text{смысл}(z_2) * (-0.0520) \oplus \text{смысл}(z_3) * 0.9503 \oplus \text{смысл}(z_4) * 0.1491 \oplus \text{смысл}(z_5) * 0.0399 \oplus \text{смысл}(z_6) * (-0.0025);$$

$$\text{смысл}(y_3) = (z_1) * 0.3820 \oplus \text{смысл}(z_2) * (-0.5719) \oplus \text{смысл}(z_3) * (-0.1372) \oplus \text{смысл}(z_4) * 0.0088 + \text{смысл}(z_5) * (-0.0953) \oplus \text{смысл}(z_6) * (-0.7064);$$

$$\text{смысл}(y_4) = (z_1) * 0.3918 \oplus \text{смысл}(z_2) * (-0.5645) \oplus \text{смысл}(z_3) * (-0.1239) \oplus \text{смысл}(z_4) * (-0.0665) \oplus \text{смысл}(z_5) * (-0.1000) \oplus \text{смысл}(z_6) * 0.7057;$$

$$\text{смысл}(y_5) = (z_1) * (-0.4447) \oplus \text{смысл}(z_2) * (-0.3311) \oplus$$

$$\text{смысл}(z_3) * 0.2266 \oplus \text{смысл}(z_4) * (-0.7942) \oplus \text{смысл}(z_5) * 0.0951 \oplus \text{смысл}(z_6) * (-0.0392);$$
$$\text{смысл}(y_6) = (z_1) * 0.4149 \oplus \text{смысл}(z_2) * 0.204164 \oplus \text{смысл}(z_3) * 0.0093 \oplus \text{смысл}(z_4) * (-0.4795) \oplus \text{смысл}(z_5) * (-0.6507) \oplus \text{смысл}(z_6) * (-0.0328).$$

5. Этой системе смысловых уравнений с неизвестными правыми частями соответствует система числовых алгебраических уравнений с неизвестными числовыми переменными (y_1, \dots, y_6) , (z_1, z_2, \dots, z_6) :

$$y_1 = z_1(-0.5101) + z_2(-0.2618) + z_3 * 0.1066 + z_4 * 0.3356 + z_5(-0.7395) + z_6 * 0.0193;$$

$$y_2 = z_1 * 0.2655 + z_2(-0.0520) + z_3 * 0.9503 + z_4 * 0.1491 + z_5 * 0.0399 + z_6(-0.0025);$$

$$y_3 = z_1 * 0.3820 + z_2(-0.5719) + z_3 + z_4(-0.1372) + z_4 * 0.0088 + z_5(-0.0953) + z_6(-0.7064);$$

$$y_4 = z_1 * 0.3918 + z_2(-0.5645) + z_3(-0.1239) + z_4(-0.0665) + z_5(-0.1000) + z_6 * 0.7057;$$

$$y_5 = z_1(-0.4447) + z_2(-0.3311) + z_3 * 0.2266 + z_4(-0.7942) + z_5 * 0.0951 + z_6(-0.0392);$$

$$y_6 = z_1 * 0.4149 + z_2 * 0.4164 + z_3 * 0.0093 + z_4(-0.4795) + z_5(-0.6507) + z_6(-0.0328);$$

6. Для исходного смыслового равенства вычисляется (дополнительно к стандартизованной матрице Z_{m6}) центрированная матрица X_{m6} и матрица $Y_{m6} = X_{m6}C_{66}$ для добычи дополнительных знаний об взаимных динамиках x-отклонений финансовых задолженностей муниципалитетов 20 городов США.

7. Шесть y-переменных y_1, \dots, y_6 (получившие новые смыслы) и 6 z-переменных (имеющие прежние смыслы и типы задолженностей) из системы алгебраических уравнений (из пункта 5) меняют статус на «отклонение от средних» (именуются x-отклонение). Шесть видов y-отклонений также не коррелированы друг с другом: $\text{covar}(y_1, y_2) = \text{covar}(y_2, y_3) = \dots = \text{covar}(y_1, y_6) = \text{covar}(y_1, y_6) = 0$, и выполняются равенства $\lambda_{12} = \lambda_{23} = \dots = \lambda_{14} = 0$. Эти равенства – следствие исходной гипотезы из словесной модели: они не влияют по смыслам друг на друга.

В модели решена задача: разработать систему из 6 смысловых уравнений с $12 = 6 + 6$ семантическими переменными $\text{смысл}(y_1)$, $\text{смысл}(y_2)$, $\text{смысл}(y_3)$, $\text{смысл}(y_6)$, $\text{смысл}(z_1)$, ..., $\text{смысл}(z_6)$, удовлетворяющих матричному смысловому равенству вида $\text{смысл}(Y_{m6}) = \text{смысл}(Z_{m6}C_{66})$, где $\text{смысл}(Z_{m6}) = \text{смысл}(y_1) \oplus \dots \oplus \text{смысл}(y_6)$, $\text{смысл}(Z_{m6}C_{66}) = \text{смысл}(Z_{m6}c_1) \oplus \dots \oplus \text{смысл}(Z_{m6}c_6)$. j-ый столбец c_j матрицы C_{66} (j-ый собственный вектор) имеет вид: $c_j = (c_{1j}, c_{2j}, \dots, c_{6j})^T$, $i = 1, \dots, 6$. Матричному смысловому равенству соответствует математическое матричное равенство для числовых переменных вида: $Y_{m6} = Z_{m6}C_{66}$.

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Таблица 1. Данные о муни задолженностях 20 городов США

№	Город	x_1^0	x_2^0	x_3^0	x_4^0	x_5^0	x_6^0
1	Бирмингем	30	1.81	3.61	0.28	1.03	335.00
2	Окснард	10	1.93	0.29	0.01	0.00	365.00
3	Салинас	30	2.79	0.24	0.02	4.29	315.00
4	Данбери	15	1.81	0.40	0.04	2.38	325.00
5	Нью-Хейвен	15	1.87	1.65	0.19	6.54	283.00
6	Норуолк	40	2.17	0.59	0.15	0.15	300.00
7	Новый Орлеан	15	2.34	6.40	0.71	1.91	327.00
8	Балтимор	10	1.85	9.74	1.83	2.24	290.00
9	Детройт	10	2.09	19.25	1.70	1.81	317.00
10	Сент-Луис	55	2.03	8.73	0.53	3.09	273.00
11	Клифтон	5	2.37	0.81	0.09	0.00	356.00
12	Нью-Йорк	5	2.33	82.00	20.72	2.25	314.00
13	Норт-Хемпстед	35	1.93	2.05	0.08	2.10	345.00
14	Талса	25	2.53	2.54	0.19	2.57	315.00
15	Филадельфия	80	2.14	22.00	3.86	2.36	305.00
16	Мемфис	90	1.93	4.53	0.45	1.55	285.00
17	Хопуэлл	15	2.16	0.22	0.02	0.00	350.00
18	Норфолк	10	1.90	2.99	0.36	0.47	320.00
19	Мадисон	100	1.93	1.17	0.21	21.09	270.00
20	Южн.Милуоки	25	1.81	0.17	0.03	0.00	305.00

**Таблица 2. Вычисленная матрица C_{66} собственных векторов
 $\Lambda_{66}=\text{diag}(2.2728,1.9596,0.9124,0.4525,0.3894)$**

	c_1	c_2	c_3	c_4	c_5	c_6	
1	-0.5101	-0.2618	0.1066	0.3356	-0.7395	0.0193	1.0000
2	0.2655	-0.0520	0.9503	0.1491	0.0399	-0.0025	1.0001
3	0.3820	-0.5719	-0.1372	0.0088	-0.0953	-0.7064	1.0000
4	0.3918	-0.5645	-0.1239	-0.0665	-0.1000	0.7057	1.0000
5	-0.4447	-0.3311	0.2266	-0.7942	0.0951	-0.0392	1.0001
6	0.4149	0.4164	0.0093	-0.4795	-0.6507	-0.0328	1.0000
	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	

Таблица 3. Вычисленная матрица R_{66}

ROW 1	1.0000	-0.1775	-0.1343	-0.1579	0.5594	-0.5791
ROW 2	-0.1775	1.0000	0.1689	0.1805	-0.0902	0.1735
ROW 3	-0.1343	0.1689	1.0000	0.9853	-0.0498	-0.0851
ROW 4	-0.1579	0.1805	0.9853	1.0000	-0.0357	-0.0528
ROW 5	0.5594	-0.0902	-0.0498	-0.0357	1.0000	-0.5393
ROW 6	-0.5791	0.1735	-0.0851	-0.0528	-0.5393	1.0000

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Классификация смыслов z-показателей по типам финансовых задолженностей

В бухгалтерском учете все статьи задолженностей делятся на 2 типа: кредиторская задолженность (КЗ) и дебиторская задолженность (ДЗ). Поэтому переменная z_1, z_3, z_4, z_5, z_6 проинтерпретируем в терминах 2-х приведенных статей (БКЗ\БДЗ [11]). Тогда переменная z_1 (стоимость земли под застройку (в числе 1000-долларовых акций)) как составная часть «1000-долларовых акций» будет иметь тип КЗ. Почему? Имеются в виду 1000-долларовые акции, выпущенные муниципальными властями со сроком погашения X лет, для получения быстрых денег, с условием выкупа этих акций обратно у тех покупателей, которые их купили (ЮЛ или ФЛ, которым дали кредиты в бумажной форме, эти акции владельцы (ЮЛ или ФЛ) могут продать с выгодой и могут купить по частям или полные пакеты акций) с дисконтом, с условием вернуть их через X лет и получить номинальные цены муниципальные. Поэтому для муниципальных органов (балансов) стоимость земли под застройку (являющаяся частью 1000-долларовых акций) является кредиторской задолженностью (КЗ). Смыслы «срок платежей по вексялям» и «кредиторская задолженность по другим ценным бумагам» пропорциональны, поэтому $\text{смысл}(z_2)$ имеет тип КЗ. Теперь имеем для z-переменных иную смысловую модель. Переменная z_3 «прирост населения(в 100000 чел)» соответствует текущей кредиторской задолженности (КЗ), ибо инициирует выдачу денег населению в виде пособий на новорожденного, не облагаемых социальным налогом. Переменная z_4 «чистый общий долг» по определению равен разности долгосрочных (д\ср) и краткосрочных (кр\ср) кредитных задолженностей и суммы д\ср и кр\ср дебиторских задолженностей: КЗ-ДЗ. Переменная z_5 «отношение числа учащихся колледжей ко всему населению», доля учащихся колледжей порождает финансовые потоки в городах Бирмингем, Окснард, ... и т.д. в виде текущих кредиторских задолженностей стипендий местным студентам (КЗ физлицам). Переменная z_6 «величина задолженности» подразумевает кредиторскую задолженность (КЗ). Эти и другие смыслы ниже будут разбиты на подсмыслы у смыслов 6 u-переменных.

тип(z_1)=КЗ - стоимость земли под застройку (в числе 1000-долларовых акций);

тип(z_2)=срок платежей по вексялям (в сотнях месяцев);

тип(z_3)=КЗ+ДЗ - прирост населения(в 100000 чел);

тип(z_4)=КЗ-ДЗ - чистый общий долг;

тип(z_5)=КЗ- отношение числа учащихся колледжей ко всему населению;

тип(z_6)=КЗ - величина задолженности.

Конструирование смыслов 6 u-факторов финансовых задолженностей

Аналогичные смысловые матричные равенства имеют слагаемые, количество которых равно количеству z-переменных. Мы ниже рассматриваем этот случай когда исходным смысловым равенством служит матричное равенство вида: $\text{смысл}(Y_{m6}) = \text{смысл}(Z_{m6}C_{66})$.

Рассмотрим смысловое равенство вида $\text{смысл}(y_1) \oplus \dots \oplus \text{смысл}(y_6) = \text{смысл}(Z_{m6}c_1) \oplus \dots \oplus \text{смысл}(Z_{m6}c_6)$, $c_j^T = (c_{1j}, c_{2j}, c_{3j}, c_{6j})$, $y_j^T = (y_{1j}, \dots, y_{mj})$, $Z_{m6} = \{z_i\}$, $z_i^T = (z_{1j}, z_{2j}, z_{3j}, z_{mj})$, $j=1, \dots, 6$. В нашем смысловом равенстве вычисляется стандартизованная матрица Z_{m6} , а не центрированная матрица X_{m6} с различными дисперсиями x-переменных. Смыслы фраз из правой части должны равняться смыслам фраз из левой части равенства. Так как в когнитивном компьютеринге смысловые равенства более значимы, чем числовые и функциональные равенства, то приоритетному смысловому равенству $\text{смысл}(Y_{m6}) = \text{смысл}(Z_{m6}C_{66})$ соответствует математическая модель вида: $Y_{m6} = Z_{m6}C_{66}$. Смысловое матричное равенство $\text{смысл}(Y_{m6}) = \text{смысл}(Z_{m6}C_{66})$ или $\text{смысл}(y_1) \oplus \dots \oplus \text{смысл}(y_6) = \text{смысл}(Z_{m6}c_1) \oplus \dots \oplus \text{смысл}(Z_{m6}c_6)$, $y_j = Z_{m6}c_j$, $y_j = (y_{1j}, \dots, y_{mj})^T$ - j-ый столбец матрицы $Y_{m6} = Z_{m6}C_{66}$, $c_j = (c_{1j}, \dots, c_{6j})^T$ - j-ый столбец матрицы собственных векторов C_{66} , позволяет (с учетом отсутствующих смысловых слагаемых из правой части) сконструировать 6 новые семантические переменные: $\text{смысл}(y_1) = \langle \dots \rangle, \dots, \text{смысл}(y_6) = \langle \dots \rangle$. Смысловые равенства обладают другими свойствами [2-7], чем числовые и функциональные равенства. Отличия обусловлены неравенством количеств u-переменных с количеством z-переменных [2-7]. Смысловое матричное равенство (например, из когнитивной модели [3]), действующее при применении ОМ АГК [12], имеет вид: $\text{смысл}(Z_{m8}) = \text{смысл}(Y_{m4}C_{84}^T)$, где [4]

$\text{смысл}(Z_{m8}) = \text{смысл}(z_1) \oplus \dots \oplus \text{смысл}(z_8)$,

$\text{смысл}(Y_{m4}C_{84}^T) = \text{смысл}(Y_{m4}c_1^T) \oplus \text{смысл}(Y_{m4}c_2^T) \oplus \dots \oplus \text{смысл}(Y_{m4}c_8^T)$. Здесь 4 - количество u-переменных, 8-количество z-переменных.

Аналогичные смысловые матричные равенства имеют слагаемые, количество которых равно количеству z-переменных [4]. Мы ниже рассматриваем иной случай когда исходным смысловым равенством служит матричное равенство вида: $\text{смысл}(Y_{m6}) = \text{смысл}(Z_{m6}C_{66})$.

Рассмотрим смысловое равенство $\text{смысл}(y_1) \oplus \dots \oplus \text{смысл}(y_6) = \text{смысл}(Z_{m6}c_1) \oplus \dots \oplus \text{смысл}(Z_{m6}c_6)$, $c_j^T = (c_{1j}, c_{2j}, c_{3j}, c_{6j})$, $y_j = (y_{1j}, \dots, y_{mj})$, $Z_{m6} = \{z_i\}$, $z_i = (z_{1j}, z_{2j}, z_{3j}, \dots, z_{mj})$, $j=1, \dots, 6$. В нашем смысловом равенстве (аналогично [13-15]) вычисляется стандартизованная матрица Z_{m6} , а соответствие смыслам столбцов центрированной

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матрицы X_{m6} с различными дисперсиями x -переменных будет показано ниже. Смыслы фраз из правой части должны равняться смыслам фраз из левой части равенства. Так как в когнитивном компьютеринге смысловые равенства более значимы, чем числовые и функциональные равенства, то приоритетному смысловому равенству $\text{смысл}(Y_{m6}) = \text{смысл}(Z_{m6}C_{66})$ соответствует математическая модель вида: $Y_{m6} = Z_{m6}C_{66}$. Матрица C_{66} (Таблица 1) является матрицей собственных векторов c_1, \dots, c_6 , вычисленной из матрицы $-$ корреляций $R_{66} = (1/m)Z_{m6}^T Z_{m6}$: $R_{66}C_{66} = C_{66}\Lambda_{66}$, $C_{66}^T C_{66} = I_{66}$, $C_{66}C_{66}^T = I_{66}$
 $\Lambda_{66} = \text{diag}(2.2728, 1.9596, 0.9124, 0.4525, 0.3894)$.
 Следуя результатам из работ [16-18] компоненты этих векторов называем коэффициентами комбинационной пропорциональности или индикаторами присутствия знаний.

Найдем присущие всем городским администрациям постоянно присутствующие типы финансовых задолженностей. Близкая к нулю дисперсия y -переменной укажет нам приблизительно одинаковость 20 значений y -переменной. Такими дисперсиями являются 0.9124, 0.4525, 0.3894. Мы называем их недоминирующими, ибо имеют значения, меньшие, чем 1 - дисперсия z -переменной. Начнем конструирование смыслов 6 y -факторов финансовых задолженностей с y -переменной y_6 .

Рассмотрим ее формулу $y_6 = x_3(-0.7064) + x_4(0.7057)$, содержащую только заметные «веса». Коэффициент корреляции $r_{34} = \text{corr}(z_3, z_4) = 0.9853$ показывает на тесную связь z -переменных z_3, z_4 , они сильно связаны друг с другом, но на y -переменную $y_6 = x_3c_{36} + x_4c_{46} = x_3(-0.7064) + x_4(0.7057)$ влияют с одинаковой силой ($c_{36}^2 = (-0.7064)^2 \neq x_4(0.7057)^2$) в противоположных направлениях (Рисунок 1). Суммы чистого общего долга (дебиторская задолженность, z_4) намного превышают прирост населения, это – признак оттока населения из городов, если учитывать $\text{смысл}(x_3) = \text{«прирост населения (в 100000 чел)»}$. Но наша формула $y_6 = x_3(-0.7064) + x_4(0.7057)$ должна соответствовать смысловому равенству $\text{смысл}(y_6) = \text{смысл}(z_3) \oplus \text{смысл}(z_4)$. Величины «прирост населения» и «прирост налогов для населения» пропорциональны, поэтому $\text{смысл}(z_3) = \text{«прирост населения (в 100000 чел)»}$ соответствует $\text{смысл}(x_3) = \text{«дебиторская задолженность по налогам с населения»}$. Пропорциональность 2-х величин и смысловое равенство $\text{смысл}(y_6) = \text{смысл}(z_3) \oplus \text{смысл}(z_4)$ помогает прояснить причины постоянно действующего (стабильного) фактора y_6 со смыслом $\text{смысл}(y_6) = \text{«ДЗ6»} = \text{«дебиторская задолженность по налогам с населения»} \oplus \text{«чистый общий долг»}$. Доля ДЗ6 равна 0,220%.

Рассмотрим ее формулу

$\text{смысл}(y_5) = \text{смысл}(z_1) * (-0.7395) + \text{смысл}(z_4) * (-0.1000) + \text{смысл}(z_6) * (-0.6507)$.
 $y_5 = x_1(-0.7395) + x_4(-0.1000) + x_6(-0.6507)$.

Переменные z_1 (тип задолженности К3), z_6 (тип задолженности К3) с разными силами ($c_{15}^2 = (-0.7395)^2 \neq c_{65}^2 = (-0.6507)^2$) в одном направлении влияют на y -переменную $y_5 = z_1(-0.7395) + z_4(-0.1000) + z_6(-0.6507)$ и имеют смысл типа «кредиторская задолженность». Динамика «величины задолженности муниципалитета» (Рисунок 2) сильно меняется относительно других 2-х показателей. Доля кредиторской задолженности муниципалитета равна 6,44% > 0,220%. Так как $\text{смысл}(z_1) * (-0.7395) = K315$, $\text{смысл}(z_6) * (-0.6507) = K365$, следовательно $\text{смысл}(y_5) = K31 \oplus K365 = K35$. К345-Д345.

Рассмотрим ее формулу $\text{смысл}(y_4) = \text{смысл}(z_1) * (0.3356) \oplus \text{смысл}(z_2) * (0.1491) \oplus \text{смысл}(z_5) * (-0.7942) \oplus \text{смысл}(z_6) * (-0.4795)$.

на y -переменную $y_4 = z_1(0.3356) + z_2(0.1491) + z_5(-0.7942) + z_6(-0.4795)$ влияют с разными силами ($c_{14}^2(0.3356)^2 \neq c_{54}^2 = (-0.7942)^2 \neq c_{64}^2 = (-0.4795)^2$) в противоположных направлениях. Величины: «доля учащихся колледжей» и «кредиторская задолженность по платежам учащимся» пропорциональны, поэтому $\text{смыслу}(z_5) = \text{«кредиторская задолженность по платежам учащимся»}$. $\text{смысл}(z_5) = \text{«кредиторская задолженность по платежам учащимся»} = K354$. Тогда $\text{смысл}(y_4) = \text{смысл}(z_1) * (0.3356) \oplus \text{смысл}(z_5) * (-0.7942) \oplus z_6(-0.4795)$ равен сумме 4-ч -смыслов. $\text{смысл}(z_1) = \text{«стоимость земли под застройку (в числе 1000-долларовых акций)»} = K314$, $\text{смысл}(z_2) = \text{«срок платежей по вексялям (в сотнях месяцев)»} = K324$, $\text{смысл}(x_5) = \text{«потоки платежей учащимся (от муниципалитета)»} = K354$, $\text{смысл}(z_6) = \text{«величина задолженности муниципалитета»} = K364$. Доля «кредиторских задолженностей 4-х видов» равна 7,5495%. (Рисунок 4) Динамика отклонений показателей x_1, x_6 сильно изменчива при медленном росте (Рисунок 3) отклонений «кредиторских задолженностей 4-х видов». $\text{смысл}(y_4) = K314 + K324 + K354 + K364 = \text{«кредиторские задолженности 4-х видов»}$. Динамика отклонений «кредиторские задолженности 4-х видов» (y_4) сильно изменчива при медленном росте (Рисунок 3) отклонений «срока платежей по вексялям». На y -переменную $y_4 = z_1c_{14} + z_4c_{54} + z_6c_{64} = z_1(0.3356) + z_2(0.1491) + z_5(-0.7942) + z_6(-0.4795)$ влияют с разными силами ($c_{14}^2(0.3356)^2 \neq c_{54}^2 = (-0.7942)^2 \neq c_{64}^2 = (-0.4795)^2$) в противоположном направлении. Величины: «доля учащихся колледжей» и «кредиторская задолженность по платежам учащимся» пропорциональны, поэтому

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смыслу(z_4)=«кредиторская задолженность по платежам учащимся». Смысл(z_5)= «кредиторская задолженность по платежам учащимся»=K354.

Рассмотрим ее формулу $\text{смысл}(y_3)=\text{смысл}(z_2) * (0.9503)+\text{смысл}(z_5)*0.2266$. Смысл(z_2)=«срок платежей по векселям (в сотнях месяцев)». Величины «доля учащимся колледжей» и «кредиторская задолженность по платежам учащимся» пропорциональны, поэтому $\text{смыслу}(z_5)$ =«кредиторская задолженность по платежам учащимся». Величины «срок платежей по векселям» и «кредиторская задолженность по другим ценным бумагам» пропорциональны, поэтому $\text{смысл}(z_2)$ =«кредиторская задолженность по ценным бумагам». Тогда $\text{смысл}(y_3)=\text{смысл}(z_2)\oplus\text{смыслу}(z_5)=K32\text{№}+K353$. Доля «кредиторских задолженностей по ценным бумагам равна 15,298%. Динамики отклонений показателей z_2, z_5 по разному изменчивы при сильном колебании (Рисунок 5) отклонений «кредиторские задолженности 4-х видов» (y_3).

Рассмотрим формулу $\text{смысл}(y_2)=\text{смысл}(z_1)*(-0.2618)\oplus\text{смысл}(z_3)*(-0.5719)\oplus\text{смысл}(z_4)*(-0.5645)\oplus\text{смысл}(z_5)*(-0.3311)\oplus\text{смысл}(z_6)*0.4164$. Ей соответствует числовая формула $y_2=z_3(-0.5719)+z_4(-0.5645)+z_5(-0.3311)+z_6*0.4164$. Величины «прирост населения» и «прирост налогов для населения» пропорциональны, поэтому $\text{смыслу}(z_3)$ =«прирост населения (в 100000 чел)» соответствует $\text{смыслу}(z_3)$ =«дебиторская задолженность по налогам с населения»=D332D332. Другие 2 величины «доля учащимся колледжей» и «кредиторская задолженность по платежам учащимся» пропорциональны, поэтому $\text{смыслу}(z_5)$ =«кредиторская задолженность по платежам учащимся»=K352. $\text{смысл}(z_4)$ =«чистый общий долг»=K342-D342. $\text{смысл}(z_6)$ = «величина задолженности муниципалитета»=K362. Теперь суммарный $\text{смысл}(y_2)=D332+(K342-D342)+K352+K362$.

Смысловое равенство $\text{смысл}(y_2)=D332+(K342-D342)+K352+K362$ генерирует сложный смысл задолженностей, которому соответствует y -переменная y_2 с небольшой дисперсией $\lambda_2=1,9645$. этот пакет задолженностей (с сложным смыслом) является стабильным для бюджетов городов. Доля пакета 2 равна $\lambda_2/6=1.9596/6=32,74\%$.

Первый нестабильный для бюджетов городов пакет задолженностей (также со сложным смыслом) выявляется, если соответствует y -переменная y_1 с большой дисперсией $\lambda_1=2.2728$ доля пакета 1 равна $\lambda_1/6=2.2728/6=37,75\%$.

Всего объем 2-х пакетов задолженностей, нестабильных для бюджетов городов, равен $37,75\%+32,74\%=70,49\%$. Суммарный объем 4-х

стабильных пакетов бюджетов 20 городов равен $100\%-70,49\%=29,51\%$, т.е. 1/3-я часть бюджета. Переменная y_1 зависит от тех же 6х-переменных, но с разными «весами», при этом дисперсия близка к нулю Динамики отклонений показателей $z_1, z_2, z_3, z_4, z_5, z_6$ по разному изменчивы при сильном колебании (Рисунки 8,9,10) отклонений пакета 1 (y_1). Смыслу(z_5)= «кредиторская задолженность по платежам учащимся» =K351. $\text{смысл}(z_4)$ =«чистый общий долг»=K341-D341. $\text{смысл}(z_6)$ =«величина задолженности муниципалитета»=K361. Тогда суммарный $\text{смысл}(y_1)=K311+K321+D331+(K341-D341)+K351+K361$ – пакет №1 из 6 видов задолженностей разных объемов, с разными «весами» вошедших в пакет. Как показано выше, $\text{смысл}(x_3)$ =«дебиторская задолженность по налогам с населения»= D331. Две величины «доля учащимся колледжей» и «кредиторская задолженность по платежам учащимся»=K351. Смысловое равенство $\text{смысл}(y_2)=D332+(K342-D342)+K352+K362$ генерирует сложный смысл задолженностей, которому соответствует y -переменная y_2 с большой дисперсией $\lambda_2=2.2649$. этот пакет задолженностей (с сложным смыслом) является нестабильным и опасным для бюджетов городов. Доля пакета 1 (y -переменная y_1 с большой дисперсией $\lambda_1=2.2649$) равна $\lambda_1/6=2,2649/6=37,75\%$. Всего объем пакетов задолженностей, нестабильных для бюджетов городов, равен 65,48%. Объем стабильного и полезного пакета бюджетов 20 городов равен 34.52%., т.е. 1/3 от бюджета. Динамики отклонений показателей x_1, x_2, x_3 по разному изменчивы при сильном колебании (Рисунок 6) отклонений пакета 1 (y_1).

Вычисленные по реальным данным числовые матрицы y - и x -отклонений

Вычисленные по реальным данным числовая матрица Z_{m6} z -отклонений менее понятна, чем матрица X_{m6} x -отклонений от средних. Для наших переменных верно смысловое равенство вида $\text{смысл}(z_{ij})=\text{смысл}(z_{ij}*s_j)=\text{смысл}(x_{ij})$. Вычисленные по реальным данным числовые матрицы Y_{m6}, Z_{m6}, X_{m6} y -, z - и x -отклонений [19-22] соответствуют 6 многосмысловым уравнениям:

$$\begin{aligned} \text{смысл}(y_1) &= (z_1)*(-0.5101)\oplus\text{смысл}(z_2)*(-0.2618)\oplus \\ & \text{смысл}(z_3)*0.1066\oplus\text{смысл}(z_4)*0.3356\oplus\text{смысл}(z_5)*(-0.7395) \oplus\text{смысл}(z_6)*0.0193; \\ \text{смысл}(y_2) &= z_1*0.2655\oplus\text{смысл}(z_2)*(-0.0520)\oplus \\ & \text{смысл}(z_3)*0.9503\oplus\text{смысл}(z_4)*0.1491\oplus\text{смысл}(z_5)* \\ & 0.0399\oplus\text{смысл}(z_6)*(-0.0025); \\ \text{смысл}(y_3) &= z_1*0.3820\oplus\text{смысл}(z_2)*(-0.5719)\oplus \\ & \text{смысл}(z_3)*(-0.1372)\oplus\text{смысл}(z_4)*0.0088+ \\ & \text{смысл}(z_5)*(-0.0953)\oplus \text{смысл}(z_6)*(-0.7064); \\ \text{смысл}(y_4) &= z_1*0.3918\oplus\text{смысл}(z_2)*(-0.5645)\oplus \\ & \text{смысл}(z_3)*(-0.1239)\oplus\text{смысл}(z_4)*(-0.0665)\oplus \\ & \text{смысл}(z_5)*(-0.100)\oplus\text{смысл}(z_6)*0.7057; \end{aligned}$$

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смысл(y_5)= $(z_1)*(-0.4447)\oplus$ смысл(z_2) $*(-0.3311)\oplus$
 смысл(z_3) $*0.2266\oplus$ смысл(z_4) $*(-0.7942)\oplus$
 смысл(z_5) $*0.0951\oplus$ смысл(z_6) $*(-0.0392)$;
 смысл(y_6)= $z_1*0.4149\oplus$ смысл(z_2) $*0.20.4164\oplus$
 смысл(z_3) $*0.0093\oplus$ смысл(z_4) $*(-0.4795)\oplus$
 смысл(z_5) $*(-0.6507)\oplus$ смысл(z_6) $*(-0.0328)$.

Так как смысл(z_{ij})=смысл($z_{ij}*s_j$), то система многосмысловых уравнений преобразуется в систему многосмысловых уравнений с семантическими переменными смысл(x_1),..., смысл(x_6). Новой системе 6-ти смысловым уравнений соответствует своя математическая модель вида $Y_{m6}=X_{m6}C_{66}$, где вновь полученная для визуализации взаимных динамик x - и зависящих от них новых y -переменных матрица $Y_{m6}=X_{m6}C_{66}$ отличается от матрицы $Y_{m6}=Z_{m6}C_{66}$ [19], применявшейся при когнитивном решении смыслового уравнения вида $\text{смысл}(Y_{m6})=\text{смысл}(Z_{m6}C_{66})$ с неизвестными семантическими переменными $\text{смысл}(y_1), \dots, \text{смысл}(y_6)$. Описание конструирования фраз для 6 переменных: $\text{смысл}(y_1), \text{смысл}(y_2), \text{смысл}(y_3), \dots, \text{смысл}(y_6)$ дано выше. Они существенно дополняют исходные смыслы z -переменных. Для визуализации x -отклонений нужна матрица $X_{m6}=Z_{m6}S_{66}$, где матрица $S_{66}=\text{diag}(27.8657, 0.2626, 17.9091, 4.4853, 4.4868, 26.2124)$ содержит значения стандартных отклонений x -переменных. Покажем: при переходе к матрице $X_{m6}=Z_{m6}S_{66}$ сохраняются как смысловое матричное равенство, так и матрица S_{66} собственных векторов.

Матрица C_{66} (Таблица 2) является матрицей собственных векторов c_1, \dots, c_6 , вычисленной из матрицы (z, z) -корреляций $R_{66}=(1/m)Z_{m6}^T Z_{m6}$: $R_{66}C_{66}=C_{66}\Lambda_{66}$, $C_{66}^T C_{66}=I_{66}$, $C_{66}C_{66}^T=I_{66}=\text{diag}(2.2728, 1.9596, 0.9124, 0.4525, 0.3894)$. Матрица X_{m6} имеет ковариационную матрицу $W_{66}=(1/m)X^T X$ и для нее назначим ту же матрицу собственных векторов C_{66} : $R_{66}=S_{66}^{-1}W_{66}S_{66}$, $C_{66}=S_{66}\Lambda_{66}$, тогда имеем $W_{66}S_{66}^{-1}C_{66}=S_{66}C_{66}\Lambda_{66}$. Формула $W_{66}S_{66}^{-1}$ из этого равенства означает: диагональные элементы матрицы $W_{66}=(1/m)X^T X$ равны 1, а ее внедиагональные элементы умножили значение коэффициента корреляции на разные числа. Переход от z -изменчивостей (матрицы Z_{m6}) к x -отклонениям (к матрице X_{m6}) без потери сконструированных новых смыслов y -переменных при назначенной матрице собственных векторов C_{66} для матрицы $W_{66}=(1/m)X^T X$, которая будет иметь матрицу собственных чисел, выделяемую из произведения матриц $S_{66}C_{66}\Lambda_{66}$. Вычислим матрицу $X_{m6}=Z_{m6}S_{66}$. На графиках взаимных динамик кривых новые y -

переменные с новыми дисперсиями $\text{disp}(y_1)=s_1\lambda_1$, $\text{disp}(y_2)=s_2\lambda_2, \dots, \text{disp}(y_6)=s_6\lambda_6$, их значения: $s_1=27.8657$, $s_2=0.2626$, $s_3=17.909$, $s_4=4.4853$, $s_5=4.4868$, $s_6=26.2124$. «Вес» из матрицы C_{66} при z -изменчивостях участвуют при вычислении значений 6 x -отклонений $x_1, x_2, x_3, \dots, x_6$, при этом x -отклонения $x_1, x_2, x_3, \dots, x_6$ имеют те же смыслы, что и z -изменчивости, т.е. смыслы x -отклонений являются преобразованным решением смыслового матричного уравнения вида $\text{смысл}(Y_{m6})=\text{смысл}(X_{m6}C_{66})$. Нахождение решения проводилось при анализе другого матричного уравнения вида $\text{смысл}(Y_{m6})=\text{смысл}(Z_{m6}C_{66})$ и конструируются фразы для семантических переменных $\text{смысл}(y_1)=\langle \dots \rangle, \dots, \text{смысл}(y_6)=\langle \dots \rangle$. После этого, так как $\text{смысл}(z_{ij})=\text{смысл}(z_{ij}*s_j)$, то система многосмысловых уравнений преобразуется в систему многосмысловых уравнений с семантическими переменными $\text{смысл}(x_1), \dots, \text{смысл}(x_6)$. А соответствующая числовая модель $Y_{m6}=X_{m6}C_{66}$ становится удобной для визуализации x -отклонений ($z_{ij}*s_j=x_{ij}^0-x^{me}$) от средних. Матрица Z_{m6} нужна для нахождения новых смыслов, матрица X_{m6} – для визуализации.

Визуализация знаний об x -, y -отклонениях факторов с «весами» в познающей модели о типах финансовых задолженностях 20 городов США

Выше мы получили s обновленные смыслы, генерирующие точки (y_{i1}, \dots, y_{i6}) , (x_{i1}, \dots, x_{i6}) , $i=1, \dots, m$. На Рисунках 1-11 показаны разные группы взаимных динамик x -, y -кривых, дающих дополнительные знания об x -, y -отклонениях факторов с «весами» в познающей модели о типах финансовых задолженностях 20 городов США. Количество z -шагов (длина одного шага равно s_j - одному стандартному отклонению), присущих фактору с номером j в i -ом городе, равно z_{ij} (Таблица 5), а абсолютная величина отклонения от среднего значения равно $x_{ij}^0-x^{me}_j=x_{ij}=z_{ij}s_j$ (Таблица 6). Сравнение z -шагов позволяет узнать сколько раз $(z_{ij}s_j)$ делают шаги факторы (в обе стороны от 0), если выделенный фактор делает 1 шаг длиной s_j . Количество z -шагов $z_{ij}=x_{ij}/s_j$ является одним из измерителей изменчивости. А величины отклонений от средних значений $(x_{ij}=z_{ij}s_j)$ показывают на сколько отличаются друг от друга объемы задолженностей, которые отличаются от своих средних значений.

Таблица 4. Матрица Z_{m6} z -изменчивостей (количества z -шагов)

№	Город	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6
1	Бирмингем	-0,035886	-1,05114068	-0,271314	-0,28816	-0,3926	0,77253649

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GIF (Australia) = 0.564	ESJI (KZ) = 8.771	IBI (India) = 4.260
JIF = 1.500	SJIF (Morocco) = 7.184	OAJI (USA) = 0.350

2	Окснард	-0,753613	-0,59412299	-0,456694	-0,34791	-0,62216	1,917035
3	Салинас	-0,035886	2,681170428	-0,459486	-0,34546	0,333982	0,00953749
4	Данбери	-0,574182	-1,05114068	-0,450552	-0,34256	-0,09171	0,39103699
5	Нью-Хейвен	-0,574182	-0,82263184	-0,380755	-0,30912	0,835456	-1,2112609
6	Норуолк	0,3229771	0,319912381	-0,439943	-0,31826	-0,58873	-0,5627118
7	Новый Орлеан	-0,574182	0,967354103	-0,115528	-0,19229	-0,19647	0,46733689
8	Балтимор	-0,753613	-0,89880145	0,070969	0,056747	-0,12292	-0,9442113
9	Детройт	-0,753613	0,015233923	0,601983	0,029101	-0,21875	0,08583739
10	Сент-Луис	0,8612724	-0,21327492	0,014574	-0,23175	0,066529	-1,5927604
11	Клифтон	-0,933045	1,081608525	-0,427659	-0,33097	-0,62216	1,57368545
12	Нью-Йорк	-0,933045	0,929269296	4,105781	4,268971	-0,12069	-0,0286125
13	Норт-Хемпстед	0,1435454	-0,59412299	-0,35842	-0,33386	-0,15412	1,154036
14	Талса	-0,215318	1,690965441	-0,33106	-0,30756	-0,04937	0,00953749
15	Филадельфия	1,7584311	0,205657959	0,755536	0,51023	-0,09617	-0,371962
16	Мемфис	2,1172946	-0,59412299	-0,219944	-0,25104	-0,2767	-1,134961
17	Хопуэлл	-0,574182	0,281827573	-0,460603	-0,34546	-0,62216	1,34478575
18	Норфолк	-0,753613	-0,70837741	-0,305933	-0,27122	-0,51741	0,20028724
19	Мадисон	2,476158	-0,59412299	-0,407557	-0,30488	4,078322	-1,7072103
20	Южн.Милуоки	-0,215318	-1,05114068	-0,463395	-0,34457	-0,62216	-0,371962
	mtans	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
	dispersions	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
	standart deviates	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000

Таблица 5. Матрица $Y_{m6} = Z_{m6}C_{66}$ у-изменчивостей (кол-во у-шагов отклонений)

№	Город	y1	y2	y3	y4	y5	y6
1	Бирмингем	0.017799	0.83355835	-1.01158	-0.21062	-0.50076	-0.0197119
2	Окснард	0.987963	1.69002047	-0.66232	-0.74748	-0.69468	0.025539
3	Салинас	0.274718	0.22115531	2.725703	0.13683	0.23741	0.0599909
4	Данбери	-0.089487	0.84921997	-0.97299	-0.44527	0.19669	0.058841
5	Нью-Хейвен	-1.066159	-0.1956405	-0.57437	-0.38086	1.3266	0.0487762
6	Норуолк	-0.344226	0.29068459	0.299595	0.91077	0.15784	0.13315
7	Новый Орлеан	0.711518	0.53428547	0.857571	-0.10475	0.17066	-0.0752177
8	Балтимор	-0.141962	-0.1810591	-0.98787	0.1603	1.11171	0.0134042
9	Детройт	0.762716	-0.0560255	-0.20083	-0.1147	0.42097	-0.4135276
10	Сент-Луис	-1.271615	-0.7771542	-0.08389	0.98367	0.4191	-0.1070522
11	Клифтон	1.399673	1.48071646	0.901725	-0.39408	-0.27617	0.0205955
12	Нью-Йорк	4.005457	-4.5339354	-0.33623	-0.31276	-0.08397	0.097628
13	Норт-Хемпстед	0.04866	0.9183309	-0.48294	-0.45232	-0.8279	-0.0099752
14	Талса	0.33773	0.35170568	1.656401	0.23204	0.2781	0.0100577
15	Филадельфия	-0.46541	-1.3142101	0.190757	0.84825	-1.18229	-0.1242473
16	Мемфис	-1.767993	-0.6368983	-0.35087	1.40071	-0.83118	0.0686332
17	Хопуэлл	0.891042	1.36006214	0.184134	-0.28246	-0.41993	0.0500737
18	Норфолк	0.286407	0.81690967	-0.79331	-0.0283	0.40578	0.025654
19	Мадисон	-4.217918	-2.2733913	0.701326	-1.66129	-0.28677	0.0181456
20	Южн.Милуоки	-0.358913	0.62166551	-1.06002	0.46233	0.37877	0.119243
	mtans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	dispersions	2.2649	1.9645	0.9179	0.4530	0.3866	0.0132
	standart deviates	1.5049	1.4016	0.9581	0.6730	0.6218	0.1150

Impact Factor:

ISRA (India) = 6.317	SIS (USA) = 0.912	ICV (Poland) = 6.630
ISI (Dubai, UAE) = 1.582	РИИЦ (Russia) = 3.939	PIF (India) = 1.940
GIF (Australia) = 0.564	ESJI (KZ) = 8.771	IBI (India) = 4.260
JIF = 1.500	SJIF (Morocco) = 7.184	OAJI (USA) = 0.350

Таблица 6. Матрица X_{m6} x-отклонений от средних

№	Город	X_1	X_2	X_3	X_4	X_5	X_6
1	Бирмингем	-1.0000	-0.2760	-4.8590	-1.2925	-1.7615	20.2500
2	Окснард	-21.0000	-0.1560	-8.1790	-1.5605	-2.7915	50.2500
3	Салинас	-1.0000	0.7040	-8.2290	-1.5495	1.4985	0.2500
4	Данбери	-16.0000	-0.2760	-8.0690	-1.5365	-0.4115	10.2500
5	Нью-Хейвен	-16.0000	-0.2160	-6.8190	-1.3865	3.7485	-31.7500
6	Норуолк	9.0000	0.0840	-7.8790	-1.4275	-2.6415	-14.7500
7	Новый Орлеан	-16.0000	0.2540	-2.0690	-0.8625	-0.8815	12.2500
8	Балтимор	-21.0000	-0.2360	1.2710	0.2545	-0.5515	-24.7500
9	Детройт	-21.0000	0.0040	10.7810	0.1305	-0.9815	2.2500
10	Сент-Луис	24.0000	-0.0560	0.2610	-1.0395	0.2985	-41.7500
11	Клифтон	-26.0000	0.2840	-7.6590	-1.4845	-2.7915	41.2500
12	Нью-Йорк	-26.0000	0.2440	73.5310	19.1475	-0.5415	-0.7500
13	Норт-Хемпстед	4.0000	-0.1560	-6.4190	-1.4975	-0.6915	30.2500
14	Талса	-6.0000	0.4440	-5.9290	-1.3795	-0.2215	0.2500
15	Филадельфия	49.0000	0.0540	13.5310	2.2885	-0.4315	-9.7500
16	Мемфис	59.0000	-0.1560	-3.9390	-1.1260	-1.2415	-29.7500
17	Хопуэлл	-16.0000	0.0740	-8.2490	-1.5495	-2.7915	35.2500
18	Норфолк	-21.0000	-0.1860	-5.4790	-1.2165	-2.3215	5.2500
19	Мадисон	69.0000	-0.1560	-7.2990	-1.3675	18.2985	-44.7500
20	Южн. Милуоки	-6.0000	-0.2760	-8.2990	-1.5455	-2.7915	-9.7500
	mtans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	dispersions	776.5000	0.0689	320.7373	20.1177	20.1311	687.0875
	standart deviates	27.8657	0.2626	17.9091	4.4853	4.4868	26.2124

Таблица 7. Матрица $Y_{m6}=X_{m6}C_{66}$ Y-отклонений от нуля

№	Город	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6
1	Бирмингем	7.2594	12.7999	0.2471	-8.6445	-12.0234	1.9065
2	Окснард	29.0250	32.9127	-1.2366	-28.9169	-16.5044	2.7327
3	Салинас	-3.6162	5.4140	2.2253	-1.5100	1.6866	4.6315
4	Данбери	8.8397	14.0895	-0.6684	-9.9676	6.0348	3.9875
5	Нью-Хейвен	-9.8839	-5.5793	-0.2494	6.8775	33.6281	4.4247
6	Норуолк	-13.0828	-2.3161	1.5613	12.2290	3.5881	5.3192
7	Новый Орлеан	12.5753	11.2385	-1.1593	-10.4664	4.0707	0.1762
8	Балтимор	1.2112	-5.4838	-3.0239	5.2171	31.4259	-0.2895
9	Детройт	16.2526	0.5201	-3.9316	-7.2602	12.9318	-7.9642
10	Сент-Луис	-30.0197	-23.3263	2.2775	27.8995	9.5240	0.9031
11	Клифтон	28.1867	30.1110	-1.5159	-26.2143	-6.9902	2.6166
12	Нью-Йорк	48.8479	-46.2001	-15.1302	-8.5258	10.7510	-38.8865
13	Норт-Хемпстед	7.7376	16.3023	1.4690	-12.5935	-21.9522	2.5901
14	Талса	0.5754	5.8947	0.7188	-1.8518	4.9740	3.0983
15	Филадельфия	-22.7685	-25.7783	2.9463	21.4372	-31.4484	-6.6610
16	Мемфис	-43.8744	-24.5266	6.2631	35.0685	-23.9085	4.1515
17	Хопуэлл	20.2896	25.3796	-0.6163	-20.0135	-10.4266	3.3779

Impact Factor:

ISRA (India) = 6.317	SIS (USA) = 0.912	ICV (Poland) = 6.630
ISI (Dubai, UAE) = 1.582	ПИИЦ (Russia) = 3.939	PIF (India) = 1.940
GIF (Australia) = 0.564	ESJI (KZ) = 8.771	IBI (India) = 4.260
JIF = 1.500	SJIF (Morocco) = 7.184	OAJI (USA) = 0.350

18	Норфолк	11.3037	12.2824	-1.9901	-7.7163	12.5289	2.5259
19	Мадисон	-65.2664	-37.8024	12.1083	30.0848	-19.3404	6.2736
20	Южн.Милуоки	-3.5923	4.0681	-0.2950	4.8671	11.4503	5.0859
	mtans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	dispersions	653.8184	453.0210	23.6731	308.8686	293.2293	92.0308
	standart deviates	25.5699	21.2843	4.8655	17.5747	17.1239	9.5933

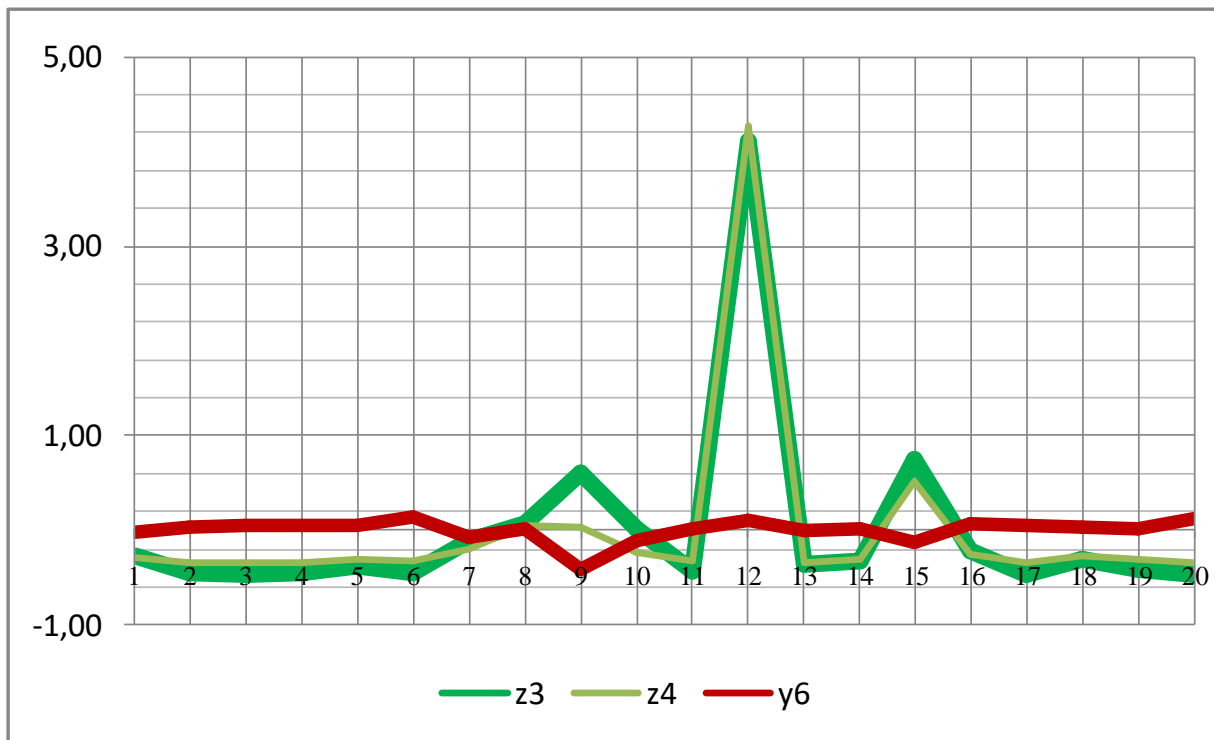


Рисунок 1. Взаимная динамика отклонений z-переменных z3,z4, влияющих на «дебиторская задолженность муниципалитета по налогам с населения и чистый общий долг» (y6)
 $y_6 = z_{10} \cdot 0.4149 + z_{20} \cdot 0.4164 + z_{30} \cdot 0.0093 + z_4 \cdot (-0.4795) + z_5 \cdot (-0.6507) + z_6 \cdot (-0.0328)$

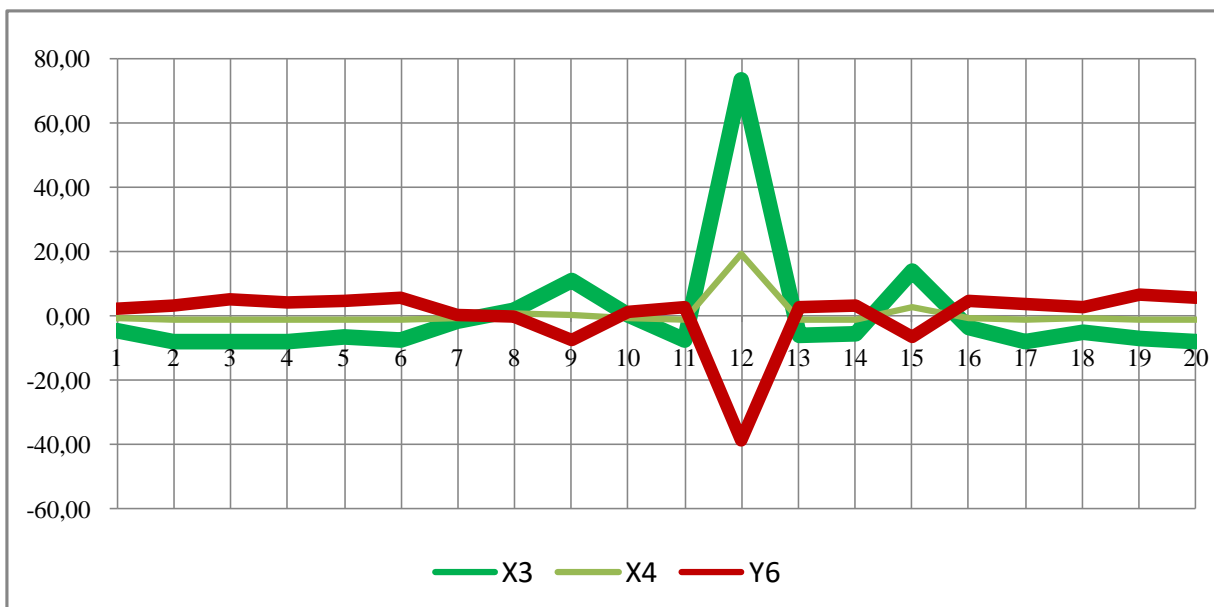


Рисунок 2. Взаимная динамика отклонений x-переменных x3,x4, влияющих на «дебиторская задолженность муниципалитета по налогам с населения и чистый общий долг» (y6)

Impact Factor:

ISRA (India) = 6.317	SIS (USA) = 0.912	ICV (Poland) = 6.630
ISI (Dubai, UAE) = 1.582	РИИЦ (Russia) = 3.939	PIF (India) = 1.940
GIF (Australia) = 0.564	ESJI (KZ) = 8.771	IBI (India) = 4.260
JIF = 1.500	SJIF (Morocco) = 7.184	OAJI (USA) = 0.350

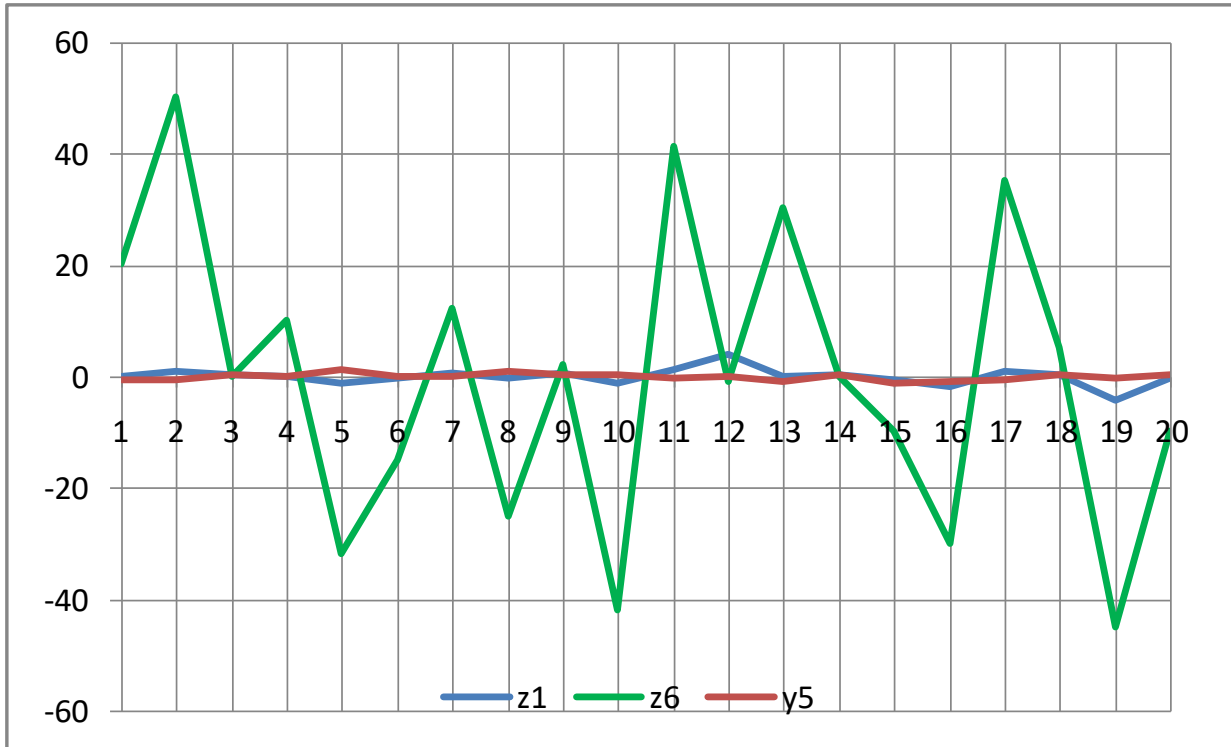


Рисунок 3. Взаимная динамика отклонений z-переменных z1,z6, влияющих на «кредиторская задолженность муниципалитета» (y5)
 $y_5 = z_1(-0.4447) + z_2(-0.3311) + z_3(0.2266) + z_4(-0.7942) + z_5(0.0951) + z_6(-0.0392)$

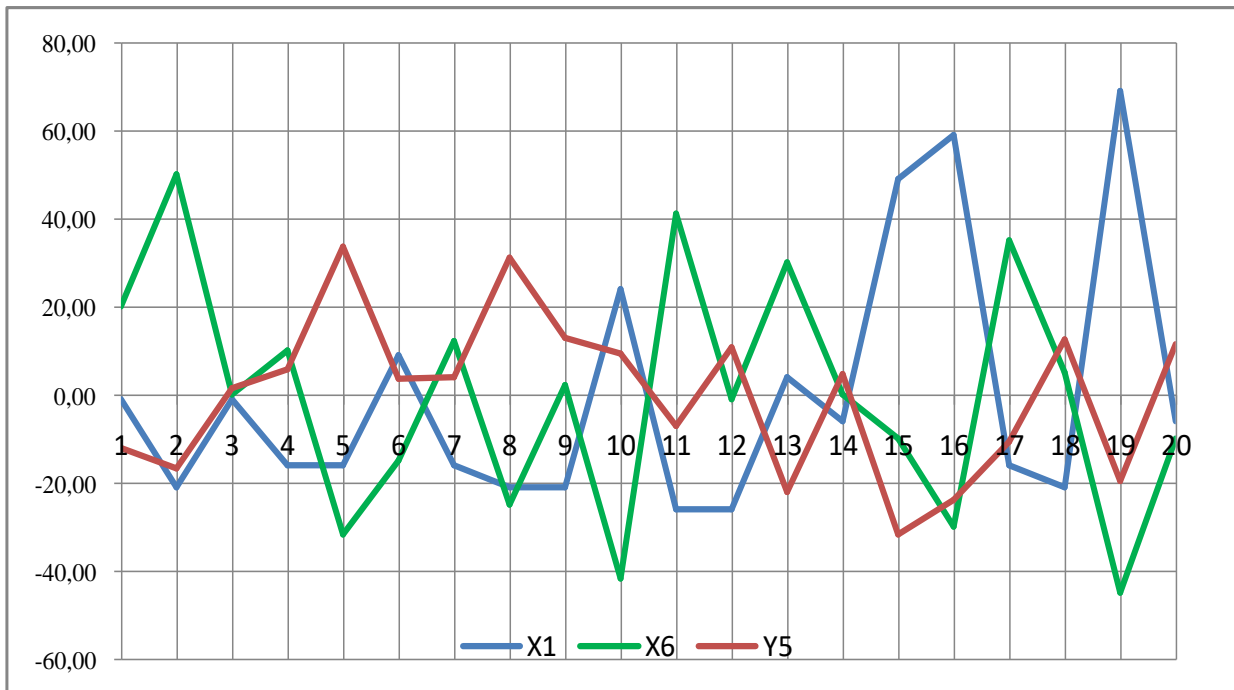


Рисунок 4. Взаимная динамика отклонений x-переменных x1,x6, влияющих на «кредиторская задолженность муниципалитета» (y5)

Impact Factor:

ISRA (India) = 6.317	SIS (USA) = 0.912	ICV (Poland) = 6.630
ISI (Dubai, UAE) = 1.582	ПИИЦ (Russia) = 3.939	PIF (India) = 1.940
GIF (Australia) = 0.564	ESJI (KZ) = 8.771	IBI (India) = 4.260
JIF = 1.500	SJIF (Morocco) = 7.184	OAJI (USA) = 0.350

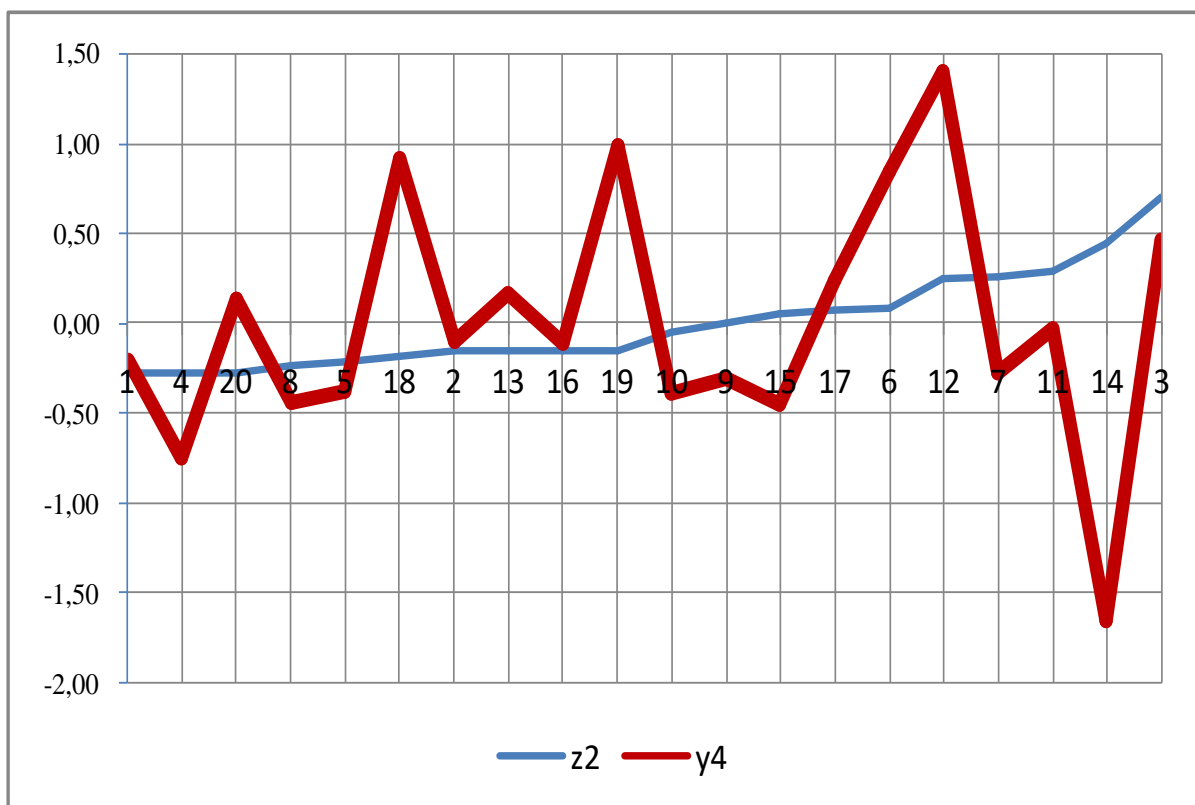


Рисунок 5. Динамика отклонений «кредиторские задолженности» (y4) при росте z-отклонений «срок платежей по вексялям» (z2) смысл(y4)= K314+K324+ K354+ K364= «кредиторские задолженности 4-х видов».

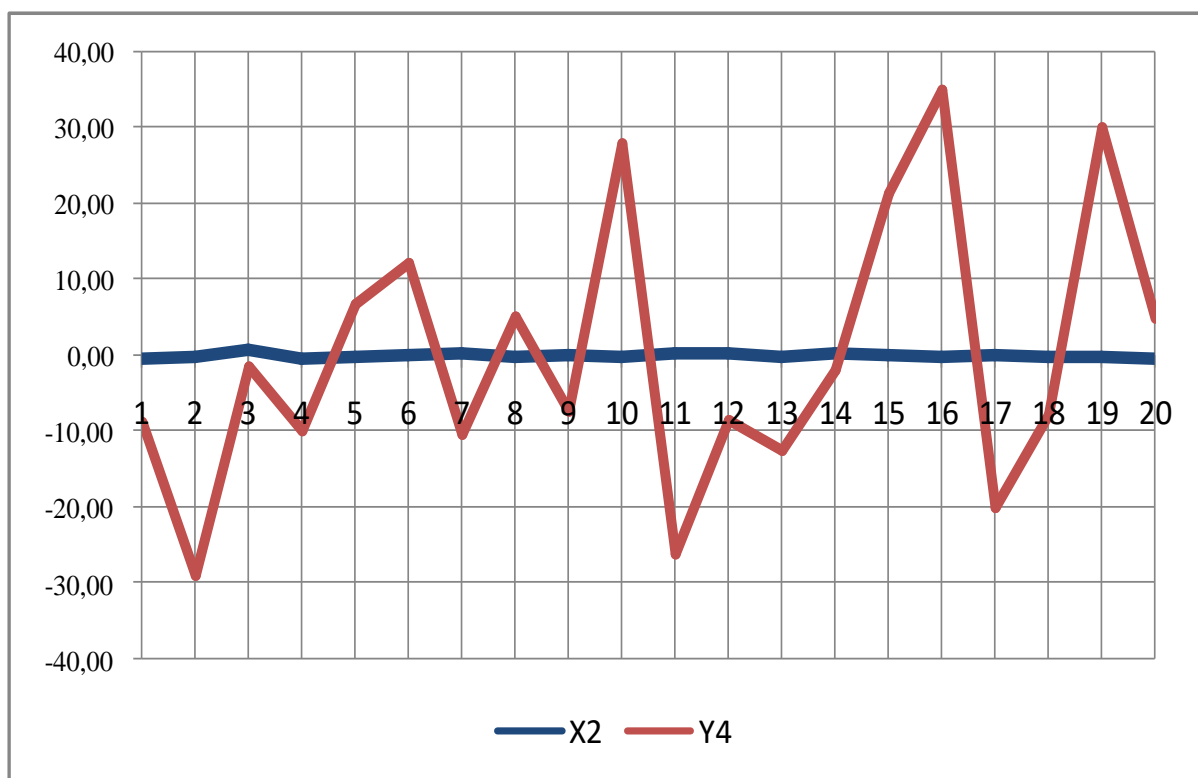


Рисунок 6. Динамика отклонений «кредиторские задолженности» (Y4) при росте x-отклонений «срока платежей по вексялям» (x2)

Impact Factor:

ISRA (India) = 6.317	SIS (USA) = 0.912	ICV (Poland) = 6.630
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GIF (Australia) = 0.564	ESJI (KZ) = 8.771	IBI (India) = 4.260
JIF = 1.500	SJIF (Morocco) = 7.184	OAJI (USA) = 0.350

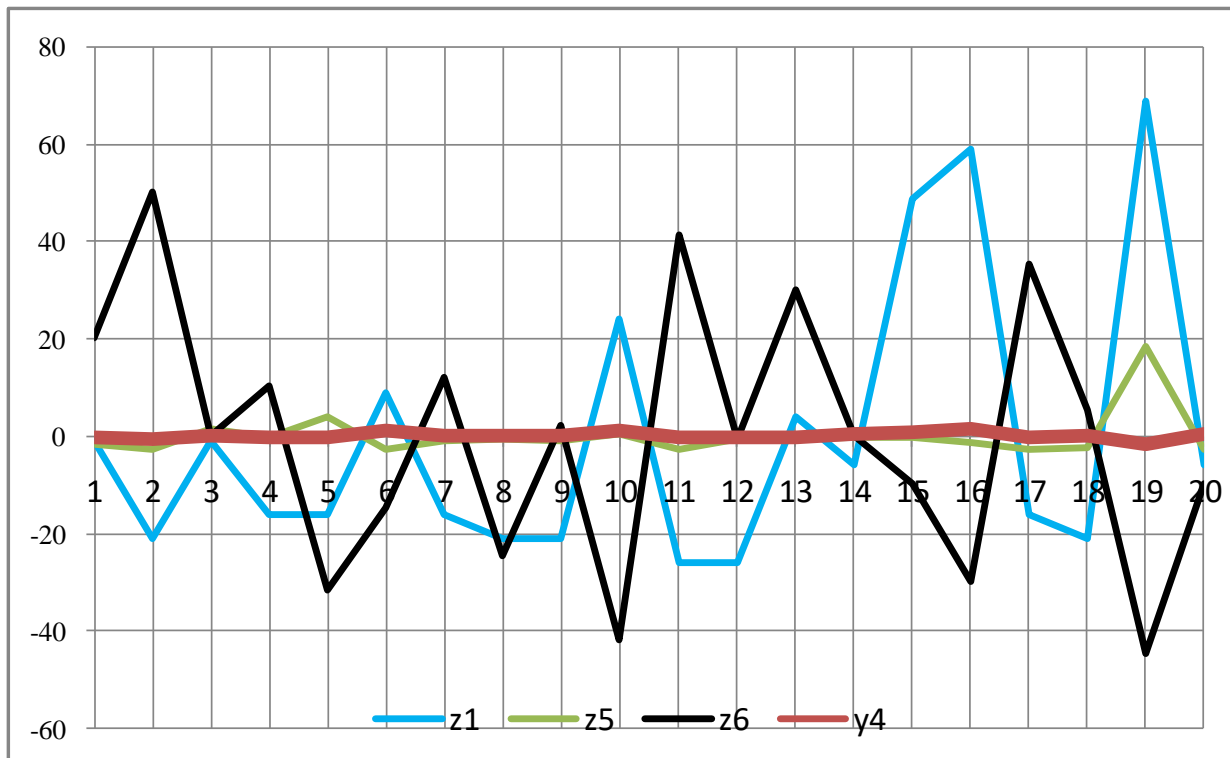


Рисунок 7. Взаимная динамика отклонений z-переменных z1,z5,z6, влияющих на «кредиторские задолженности 4-х видов» (y4)
 $y_4 = z_1(0.3918) + z_2(-0.5645) + z_3(-0.1239) + z_4(-0.0665) + z_5(-0.1000) + z_6(0.7057)$

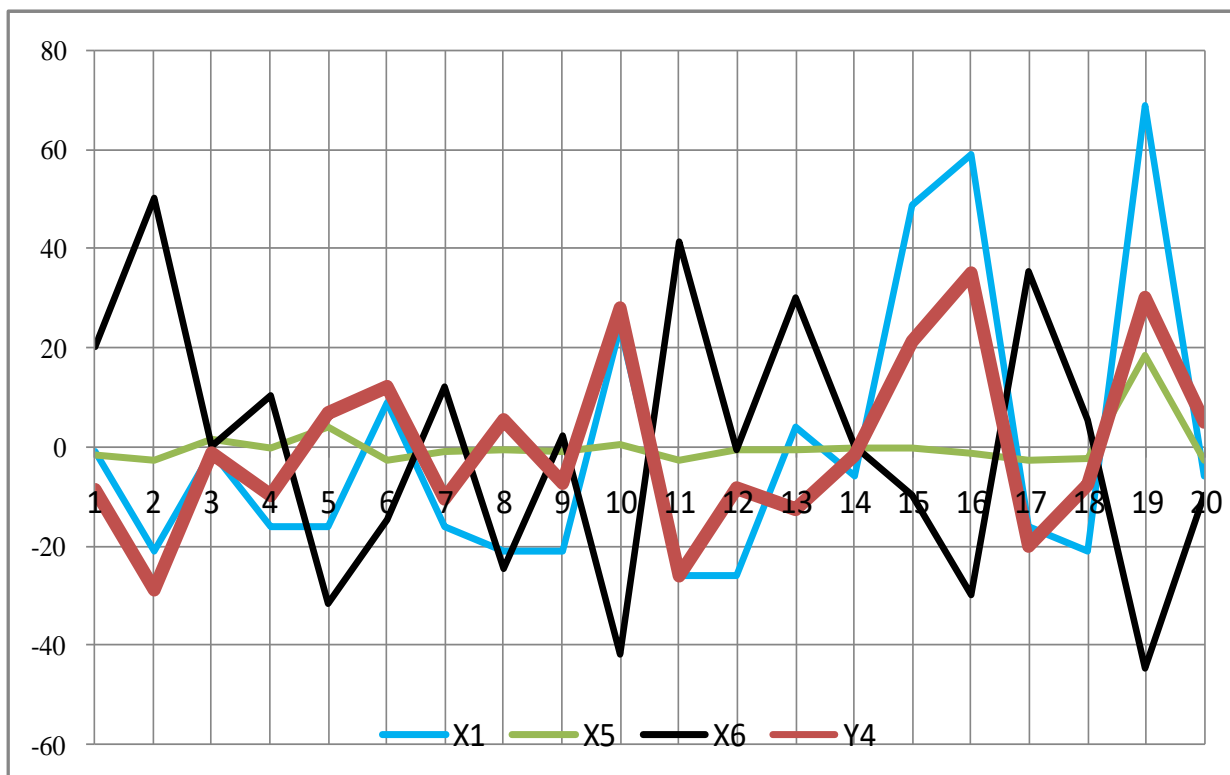


Рисунок 8. Взаимная динамика отклонений x-переменных x1,x5,x6, влияющих на «кредиторские задолженности 4-х видов» (y4)

Impact Factor:

ISRA (India) = 6.317	SIS (USA) = 0.912	ICV (Poland) = 6.630
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GIF (Australia) = 0.564	ESJI (KZ) = 8.771	IBI (India) = 4.260
JIF = 1.500	SJIF (Morocco) = 7.184	OAJI (USA) = 0.350

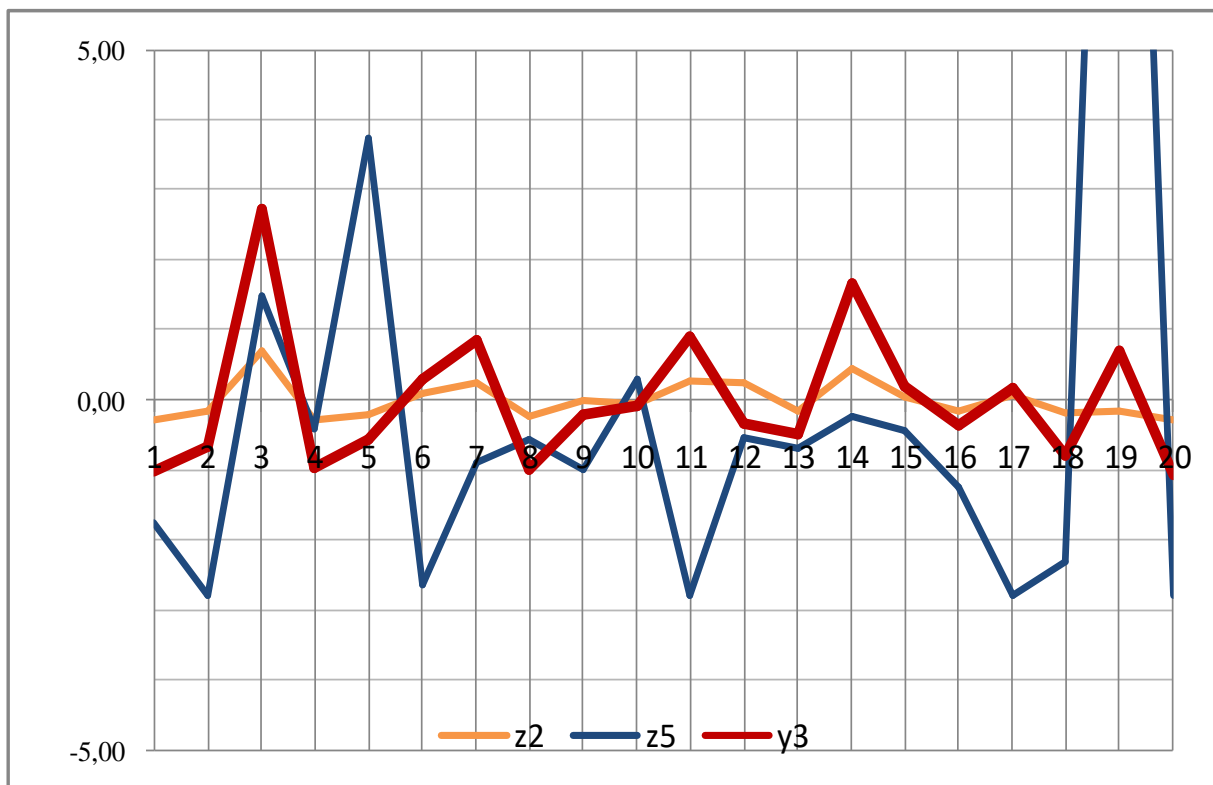


Рисунок 9. Взаимная динамика отклонений z-переменных z2,z5, влияющих на «кредиторские задолженности 4-х видов» (y3)
 $y_3 = z_1(0.3820) + z_2(-0.5719) + z_3 + z_4(-0.1372) + z_5(0.0088) + z_6(-0.0953) + z_7(-0.7064)$

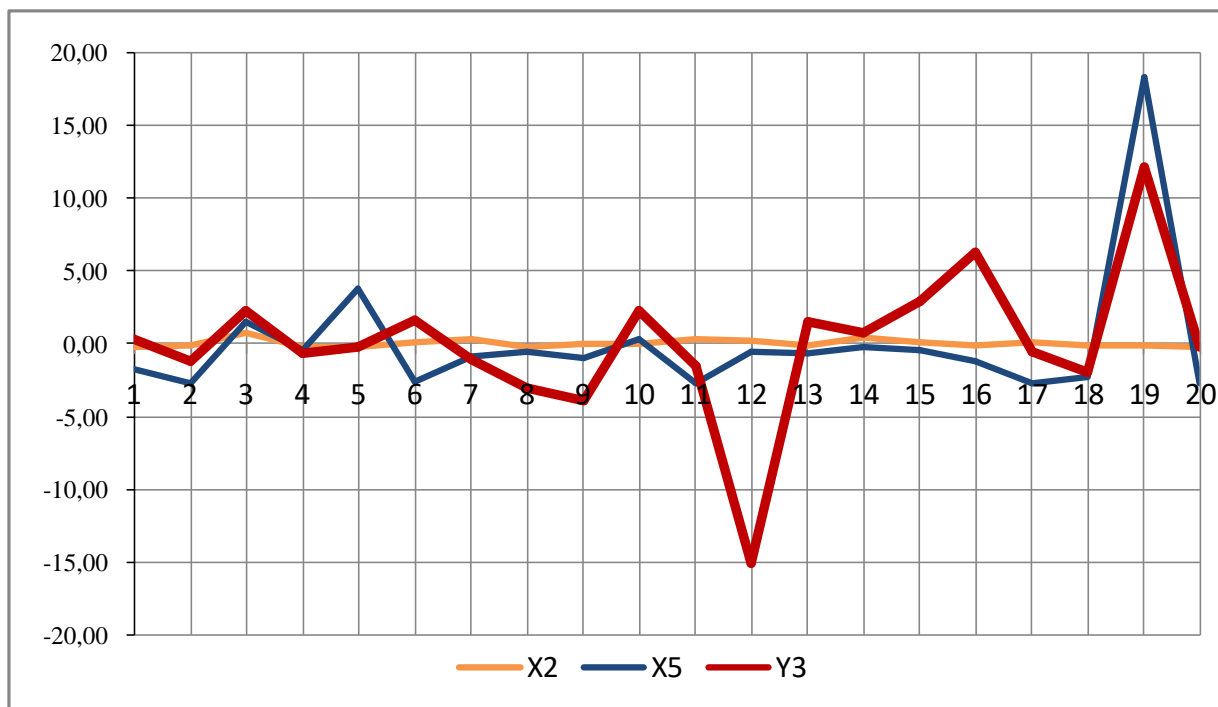


Рисунок 10. Взаимная динамика отклонений x-переменных x2,x5, влияющих на «кредиторские задолженности 4-х видов» (y3)

Impact Factor:

ISRA (India) = 6.317	SIS (USA) = 0.912	ICV (Poland) = 6.630
ISI (Dubai, UAE) = 1.582	ПИИЦ (Russia) = 3.939	PIF (India) = 1.940
GIF (Australia) = 0.564	ESJI (KZ) = 8.771	IBI (India) = 4.260
JIF = 1.500	SJIF (Morocco) = 7.184	OAJI (USA) = 0.350

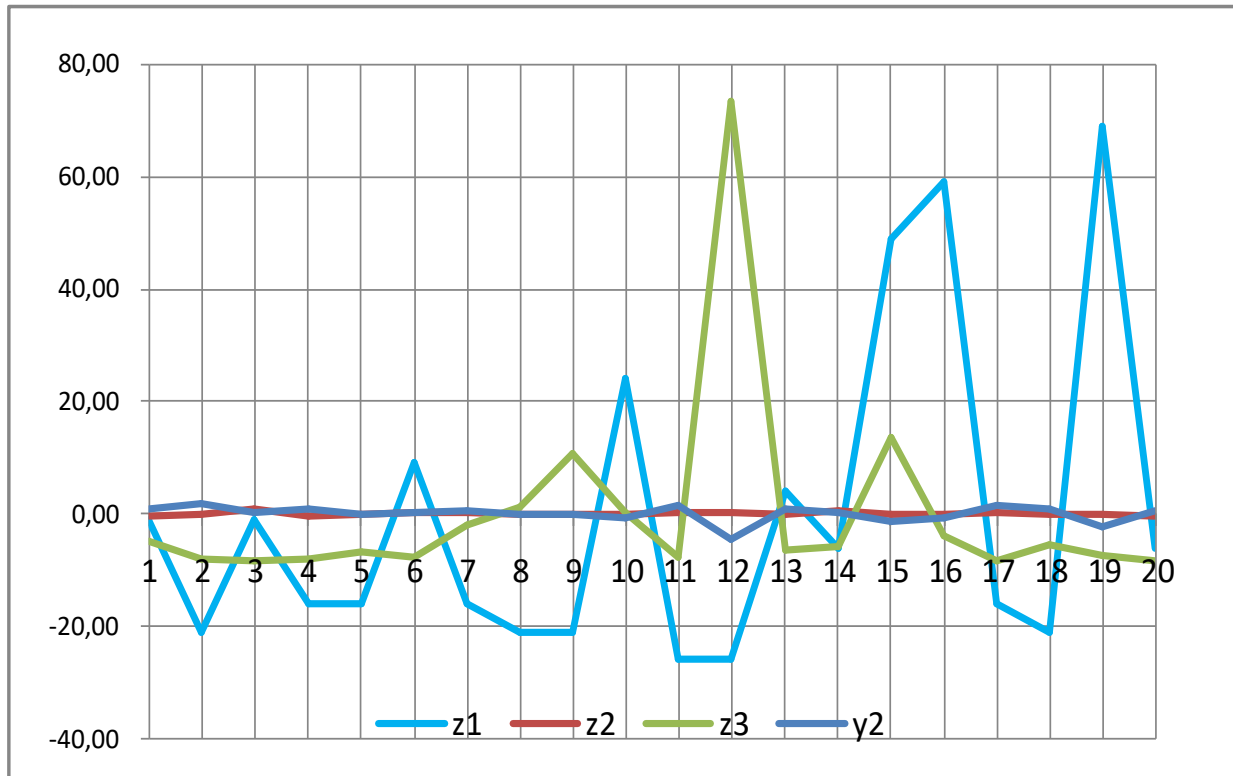


Рисунок 11. Взаимная динамика отклонений z-переменных z1,z2,z3, влияющих на пакет №2 задолженностей (y2)
 $y_2 = z_1(0.2655) + z_2(-0.0520) + z_3(0.9503) + z_4(0.1491) + z_5(0.0399) + z_6(-0.0025)$

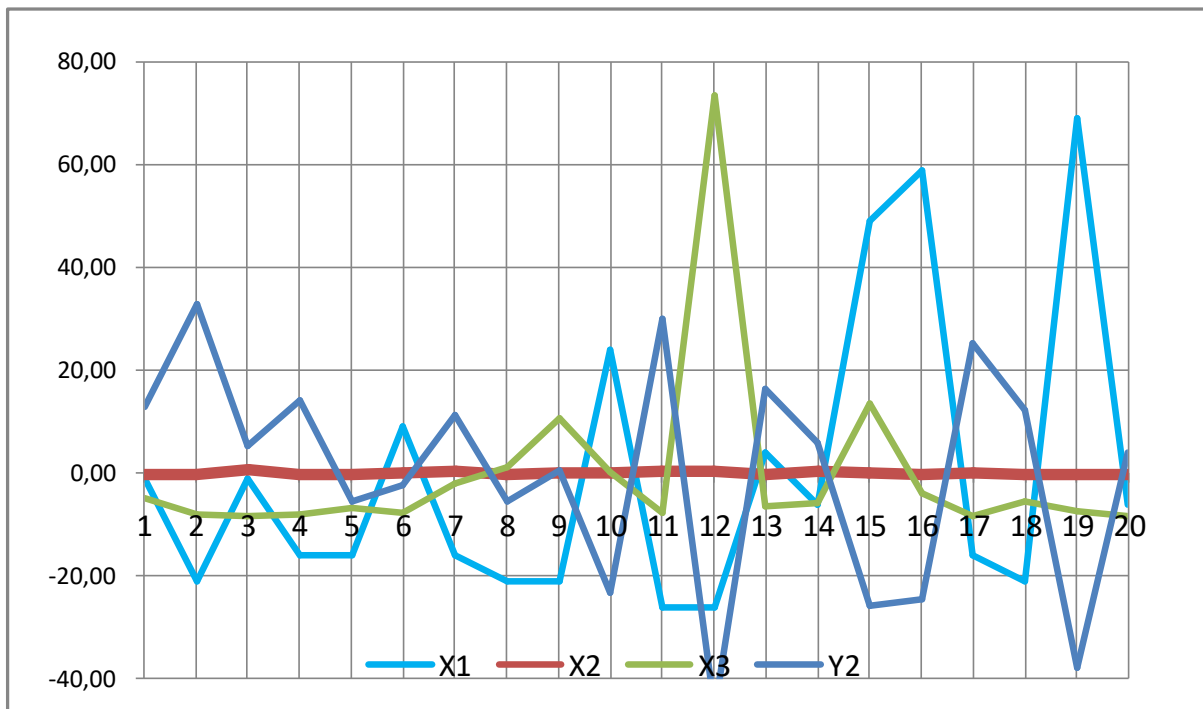


Рисунок 12. Взаимная динамика отклонений x-переменных x1,x2,x3, влияющих на пакет №2 задолженностей (y2)

Impact Factor:

ISRA (India) = 6.317	SIS (USA) = 0.912	ICV (Poland) = 6.630
ISI (Dubai, UAE) = 1.582	ПИИЦ (Russia) = 3.939	PIF (India) = 1.940
GIF (Australia) = 0.564	ESJI (KZ) = 8.771	IBI (India) = 4.260
JIF = 1.500	SJIF (Morocco) = 7.184	OAJI (USA) = 0.350

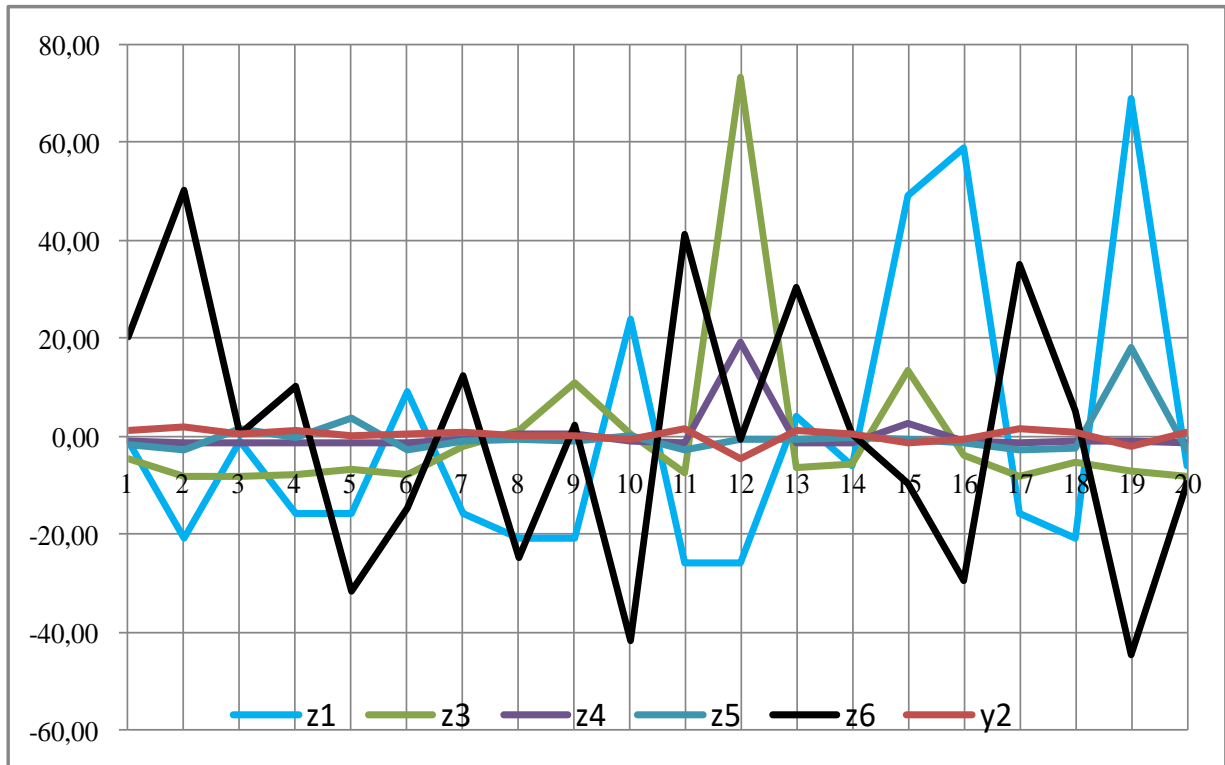


Рисунок 13. Взаимная динамика отклонений z-переменных z1,z3, z4,z5,z6, влияющих на пакет №2 задолженностей (y2)
 $y_2 = z_1(0.2655) + z_2(-0.0520) + z_3(0.9503) + z_4(0.1491) + z_5(0.0399) + z_6(-0.0025)$

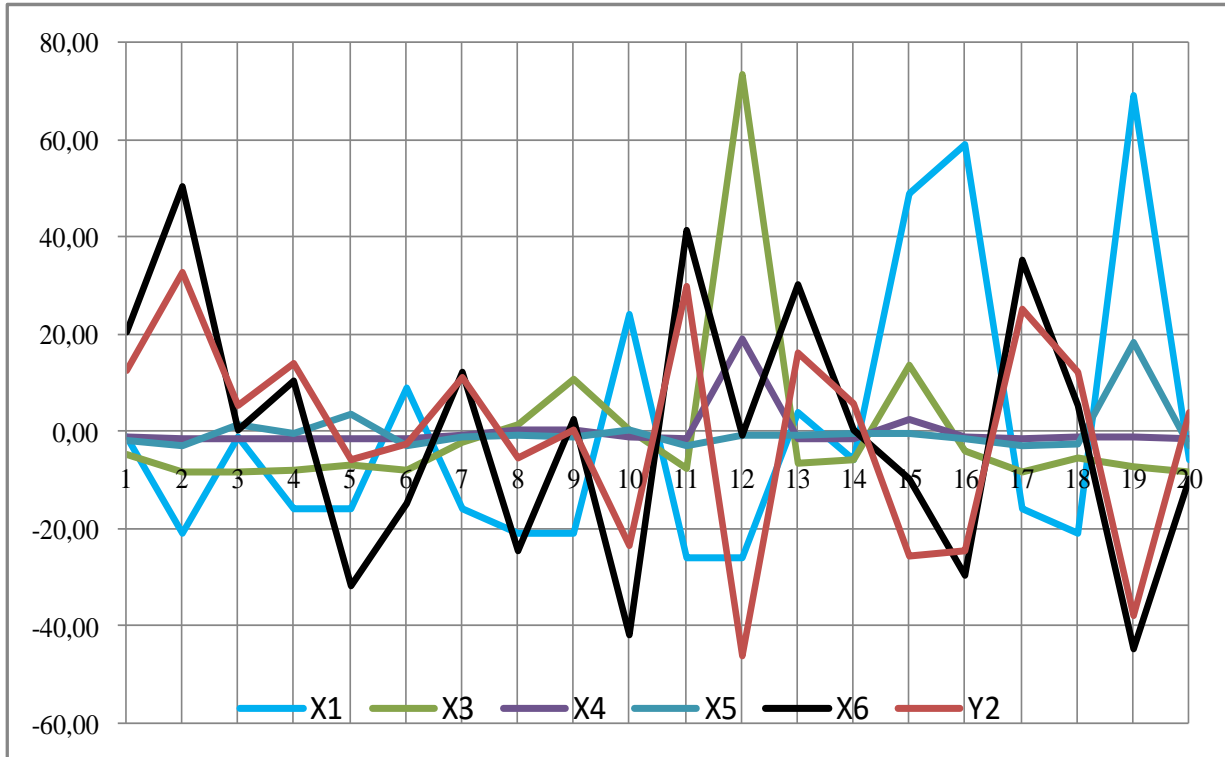


Рисунок 14. Взаимная динамика отклонений x-переменных x1,x3,x4,x5,x6, влияющих на пакет №2 задолженностей (y2)

Impact Factor:

ISRA (India) = 6.317	SIS (USA) = 0.912	ICV (Poland) = 6.630
ISI (Dubai, UAE) = 1.582	ПИИЦ (Russia) = 3.939	PIF (India) = 1.940
GIF (Australia) = 0.564	ESJI (KZ) = 8.771	IBI (India) = 4.260
JIF = 1.500	SJIF (Morocco) = 7.184	OAJI (USA) = 0.350

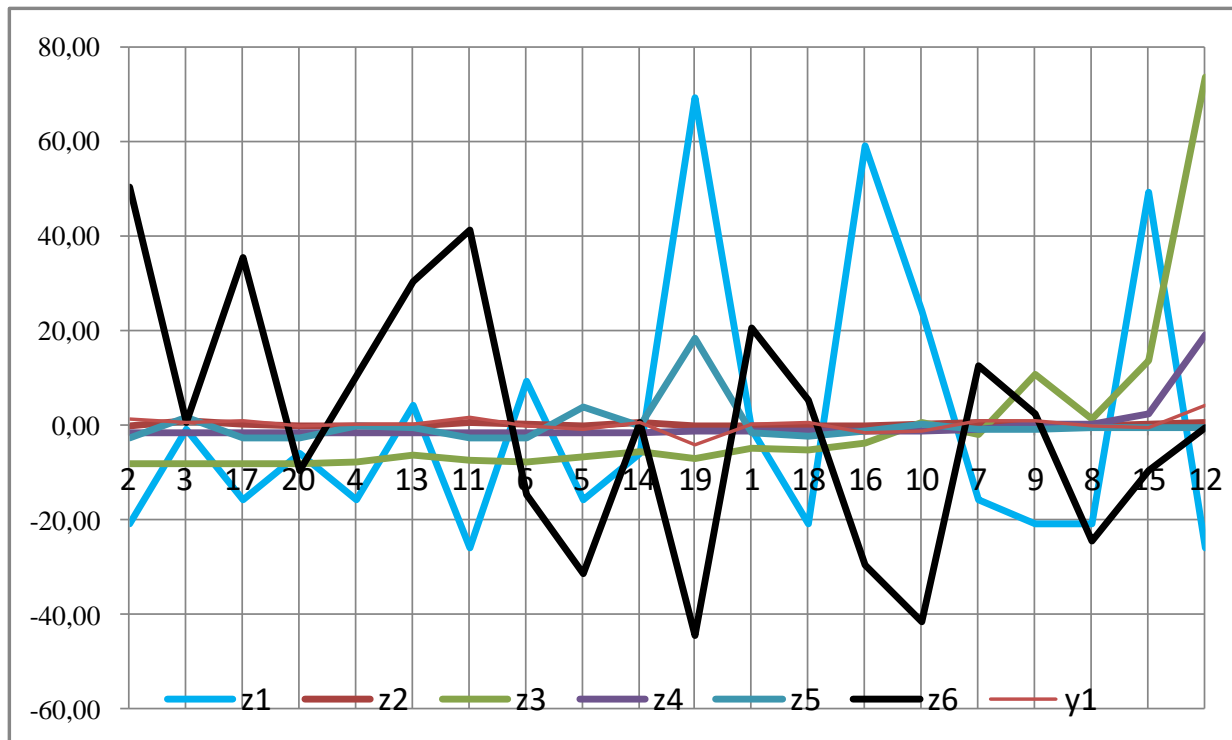


Рисунок 15. Взаимная динамика отклонений z-переменных z1,z2, z3, z4,zz5,z6, влияющих на пакет №1 задолженностей (y1)
 $y_1 = z_1(-0.5101) + z_2(-0.2618) + z_3(0.1066) + z_4(0.3356) + z_5(-0.7395) + z_6(0.0193)$

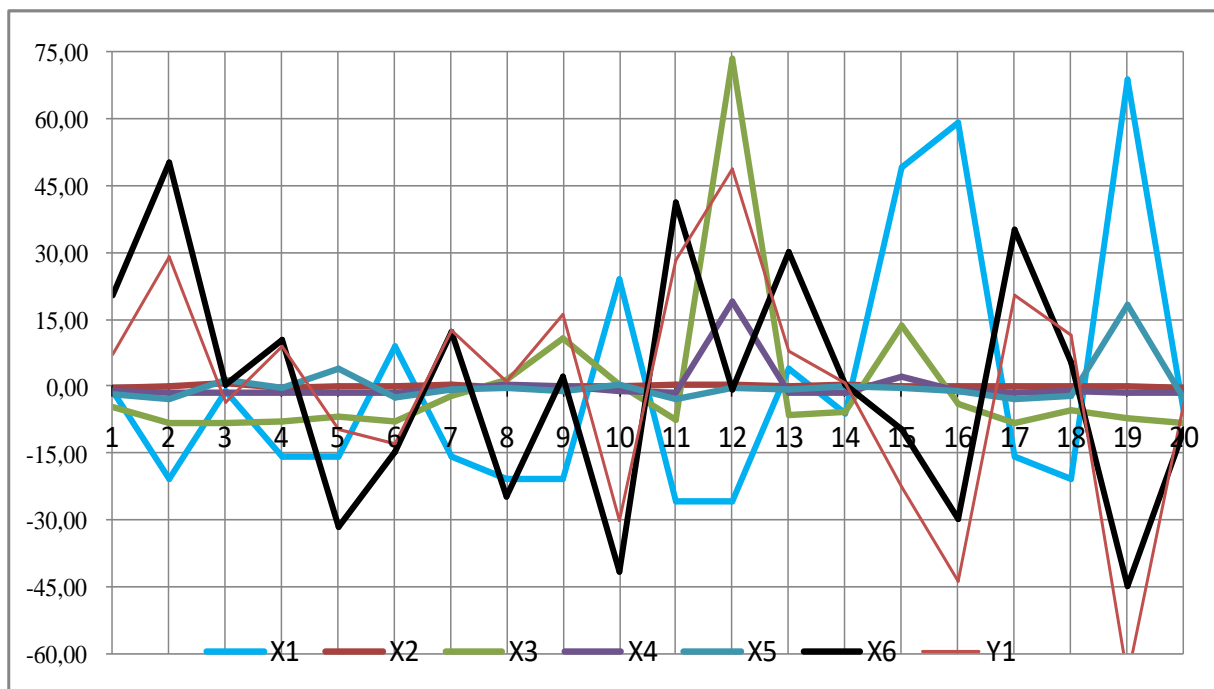


Рисунок 16. Взаимная динамика отклонений x-переменных x1,x2, x3, x4,x5,x6, влияющих на пакет №1 задолженностей (y1)

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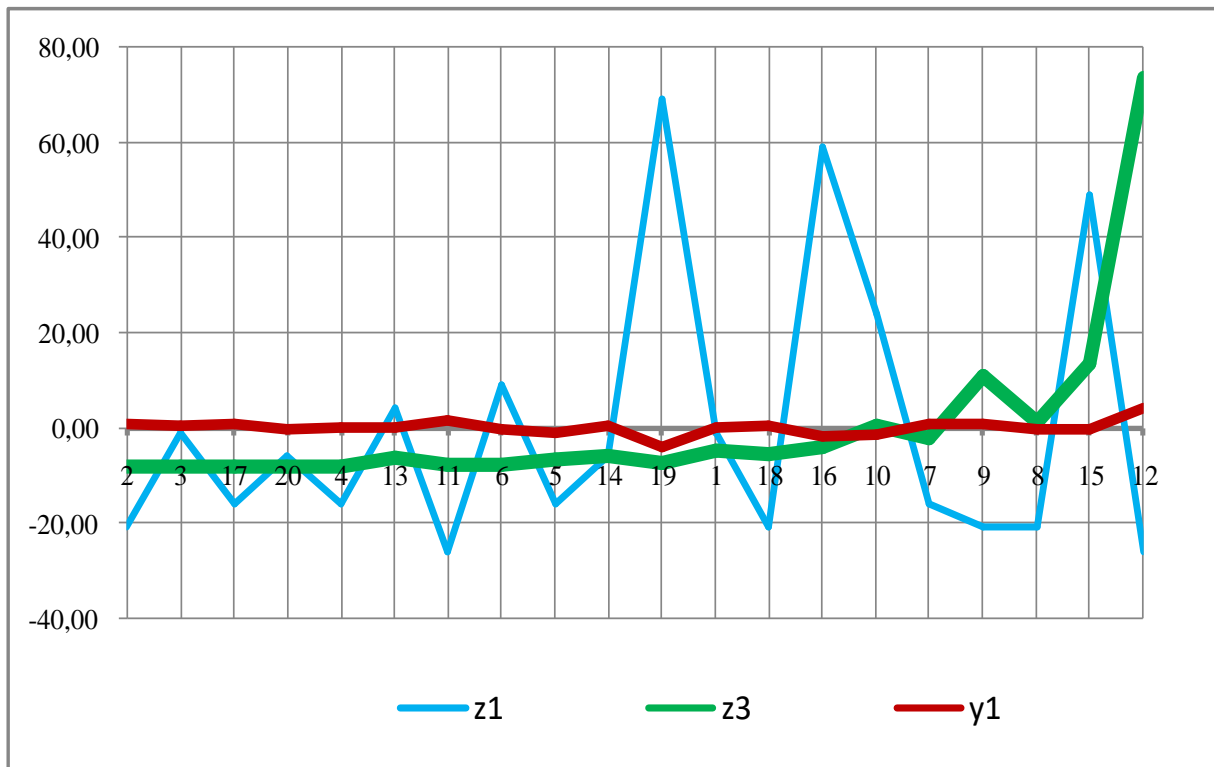


Рисунок 17. Взаимная динамика отклонений z-переменных z1, z3, влияющих на пакет №1 задолженностей (y1)
 $y_1 = z_1(-0.5101) + z_2(-0.2618) + z_3(0.1066) + z_4(0.3356) + z_5(-0.7395) + z_6(0.0193)$

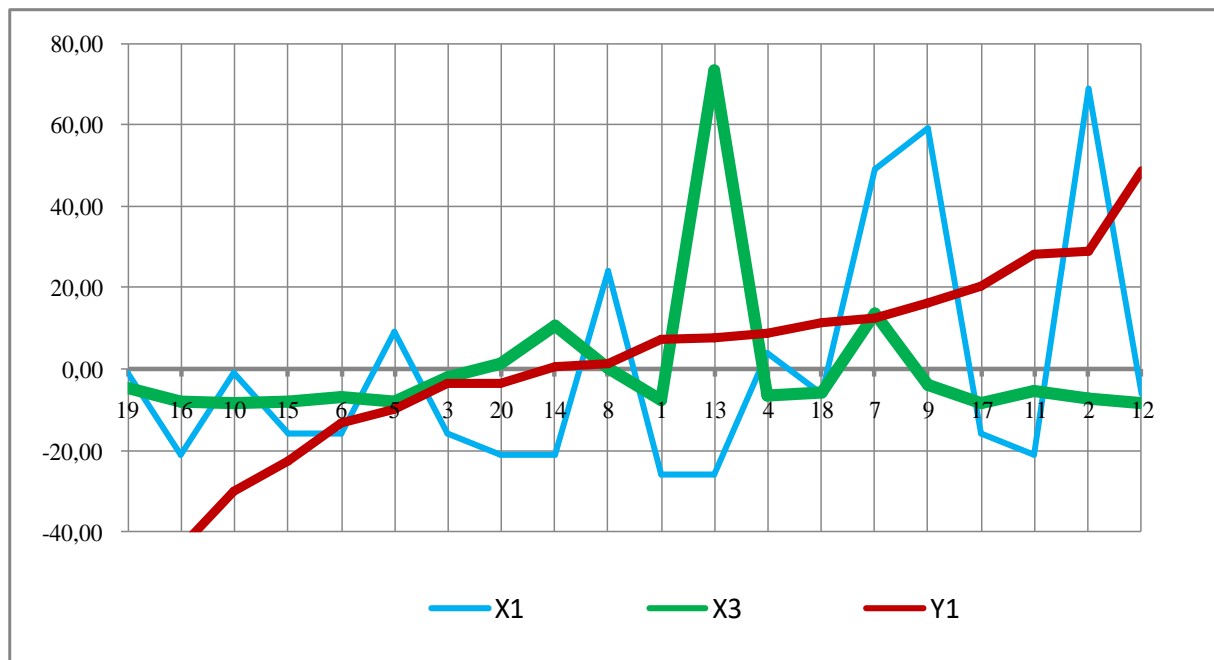


Рисунок 18. Взаимная динамика отклонений x-переменных x1, x3, влияющих на пакет №1 задолженностей (y1)

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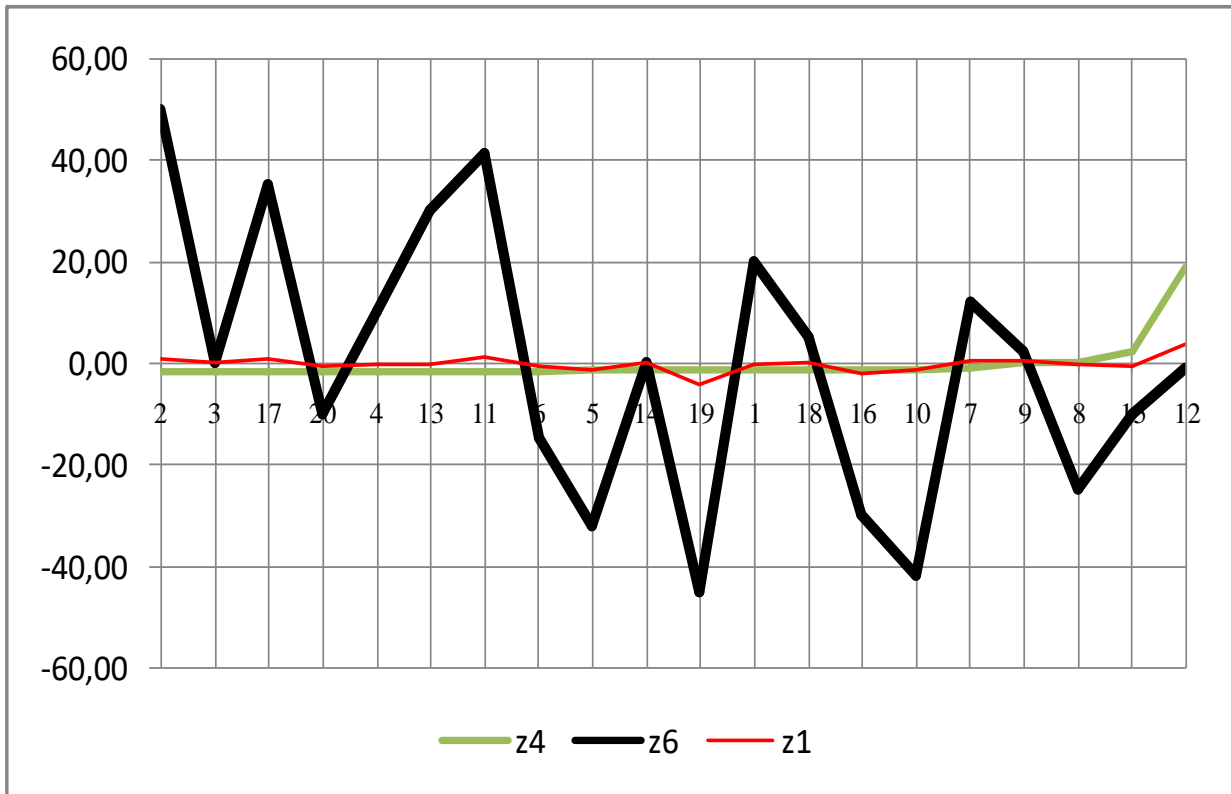


Рисунок 19. Взаимная динамика отклонений х-переменных x4, x6, влияющих на пакет №1 задолженностей (y1)
 $y_1 = z_1(-0.5101) + z_2(-0.2618) + z_3(0.1066) + z_4(0.3356) + z_5(-0.7395) + z_6(0.0193)$

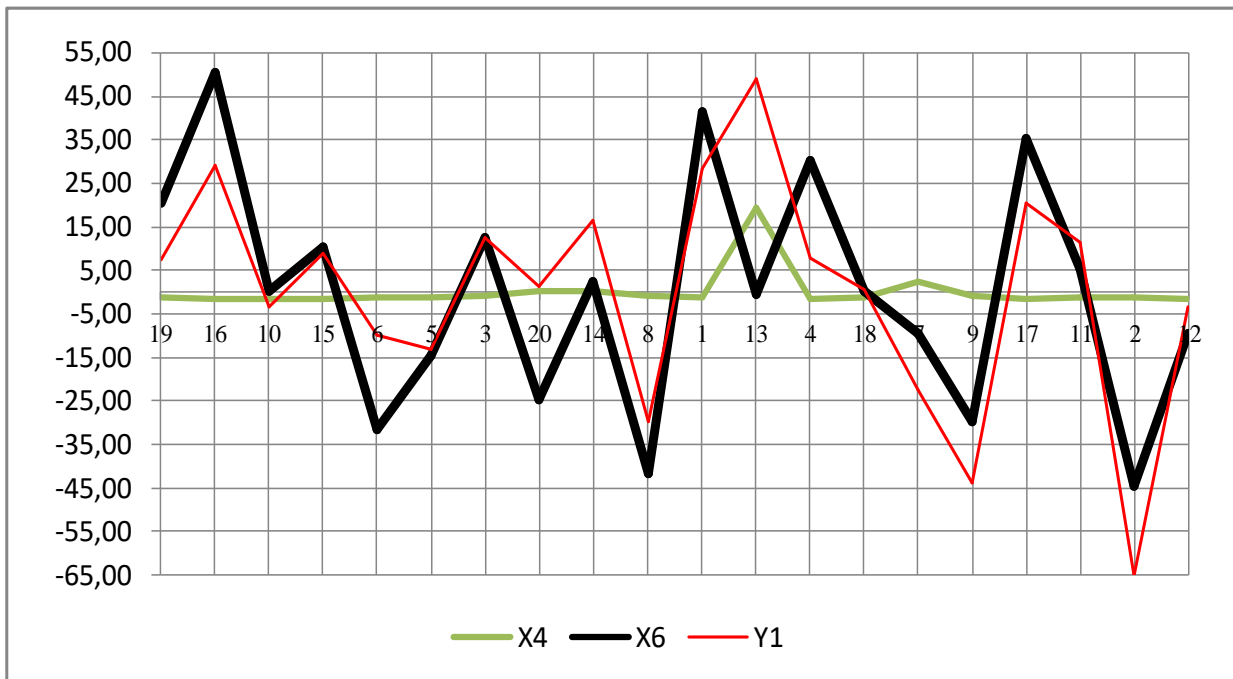


Рисунок 20. Взаимная динамика отклонений х-переменных x4, x6, влияющих на пакет №1 задолженностей (y1)

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Заклучение

Выше разработана Когнитивная модель финансовых задолженностей муниципалитетов 20 городов США об выявленных смысловых и количественных проявлениях многочисленных подтипов 2-х типов задолженностей. Удалось реализовать, обосновать их формульное [22], фразеологическое [22], визуализированное на графиках описания поведений кривых. Разработана система из 6 смысловых уравнений с $12=6+6$ семантическими переменными: $\text{смысл}(y_1), \text{смысл}(y_2), \text{смысл}(y_3), \text{смысл}(y_4), \text{смысл}(z_1), \dots, \text{смысл}(z_8)$, удовлетворяющих матричному смысловому равенству вида $\text{смысл}(Y_{m8}) = \text{смысл}(Z_{m6}C_{66})$. Этому матричному смысловому равенству соответствует матричное равенство для числовых z -, y - переменных, смоделированных в виде матриц: $Y_{m6} = Z_{m6}C_{66}$. Шесть семантические решения-знания (новые извлеченные знания), познают смыслы, парные связи, силы проявлений 12 семантических переменных. Визуализация взаимных динамик кривых (значений изменчивостей z -, y - переменных, x -отклонений из матриц (Z_{m8}, Y_{m6}) , $(X_{m6}, Y_{m6} = X_{m6}C_{66})$ Введенные в модель переменные наделены математическими и статистическими свойствами, а параметры постоянны.

В статье впервые предлагается определять количество и применять величины недоминирующих собственных чисел из спектра корреляционной матрицы. До настоящего времени применялись величины ℓ доминирующих собственных чисел. Количество ℓ удовлетворяло одному из 4 критериев, зависящих от цели анализа данных и от состава значений элементов спектра. Автор часто определял доминирующие собственные числа из спектра и конструировал содержательные смыслы соответствующих им главных компонент (y -переменных). в диссертации [9] были собраны 20 примеров спектров Λ_{mn} корреляционной матрицы, применявшихся исследователями при анализе

реальных многомерных данных из разных предметных областей. Доля недоминирующих дисперсий мала, но их количество намного превышает количество ℓ . Выше мы извлекли много знаний из $n-\ell=6-2=4$ смысловых уравнений. Теория систем многосмысловых уравнений с семантическими переменными основанное на смысловом матричном равенстве (в данном случае: $\text{смысл}(Y_{m6}) = \text{смысл}(Z_{m6}C_{66})$) позволяет добывать скрытые новые знания из реальных многомерных данных.

Вместо КЗ, ДЗ уместно применить термин БКЗ, БДЗ, значимость будущих КЗ, ДЗ показана в статье [11] на примере «истории Детройта: «город, некогда бывший «автомобильной столицей» США, оказался на грани разорения и вымирания (дефицит городского бюджета составляет 300 млн долл., а долг городских властей – 14 млрд долл.). Губернатор штата Мичиган был вынужден назначить в Детройт внешнего кризисного управляющего, которому поручено за год привести городские финансы в порядок. Однако это почти нереально, отмечает В. Злобин, учитывая, что город находится в глубоком кризисе [2]. Автомобильная индустрия в нем медленно умирает – американские автогиганты давно перенесли большинство производственных мощностей за рубеж, туда, где дешевле рабочая сила. И постепенно Детройт пришел в упадок: население за последние полвека сократилось с 2 млн чел. до 700 тыс. чел., причем безработица среди них превышает 18 % (при среднем уровне по стране 7,7 %). Пустеют целые кварталы, растет преступность. Город давно не в состоянии выполнять свои обязательства по пенсионному обеспечению и страховым выплатам, бюджет города уже десять лет сводится с растущим дефицитом. Так что рано или поздно его банкротство все же произойдет [23]».

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Article



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EQUIPMENT AND MATERIALS FOR DRILLING WELLS BY ELECTRIC DRILLING

Abstract: The article considers the analysis of the selection, recommendations, as well as instructions for the use of equipment and materials for drilling wells by electric drilling in the Western part of the oil and gas fields of Turkmenistan for the purpose of trouble-free well drilling of vertical and directional wells. To analyze the selection of equipment and materials for well wiring, materials from previously drilled wells, operating instructions and a guidance document "Guidance document for the construction of wells by electric drilling" were used.

This paper presents a detailed analysis of the selection and recommendations for the use of equipment and materials for electric drilling, as well as recommendations for their operation of different types of downhole tools. The work can be used to fulfill the tasks set during the construction of oil and gas wells in areas with abnormally high reservoir pressures.

Key words: telemetry system, axial load, reactive torque, relative humidity, specific gravity, resistance, error, voltage, hydrocarbon, cable coupling.

Language: English

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Introduction

The telemetry system - STE TP-190UHL5 is designed to measure the axial load of the bit, the reactive moment of the body of the deep device, the

pressure in the annular space, the pressure in drill pipes, the difference between the in-pipe and annular pressure during drilling of vertical and directional wells with electric drills [1, 2, 3, 4] (Figure 1).

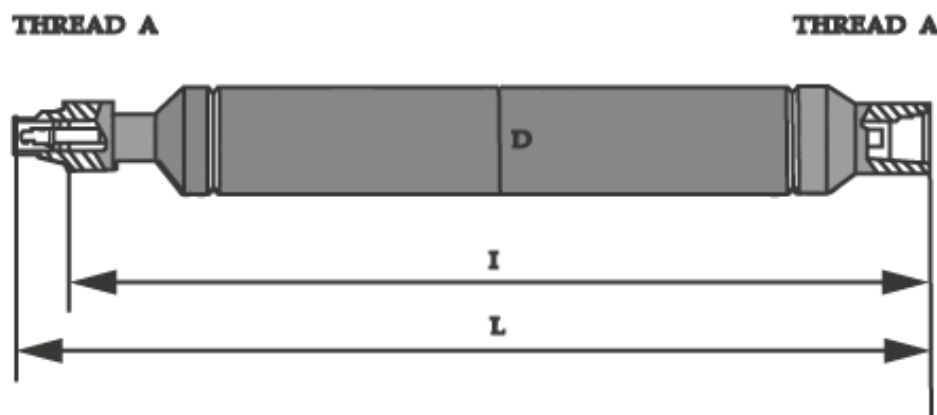


Figure 1. Telemetry system STE TP-190UHL5

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The technical data of the system correspond to those given in Table 1.

The deep measuring device (DMD) is operated:

- when the temperature of the air or other agent is from 0 to 110 °C;

- relative humidity up to 80 (at 20 °C). [5, 6, 7].

Table 1. Technical data of the system

Name of parameters	Measurement limits	The limit of the permissible value of the basic error	
		by digital output	by analog output
Axial load	from minus 50 to minus 10 from 10 to 350	+18	+0,25
Reactive torque of the DMD body, m	From 0 to 5000	+250	+0,25
Pressure in the annular space, MPa	from 20 to 110	+3,3	+0,15
Pressure in drill pipes, MPa	from 20 to 110	+3,3	+0,15
The difference between the in-pipe and annular pressure, MPa	- from minus 5 up to plus 15	+0,23	+0,75

The ground measuring device (GMD) is operated in an air environment at a temperature from 5 to 40 °C, relative humidity up to 80 (at 20 °C) and at

a supply voltage (220 + 40) V, frequency (50 + 2) Hz [8, 9, 10].

Continuation of Table 1

The limit of the permissible value of the basic error of the electrical resistivity of the drilling mud, Ohms.m	+0,015
The limit of the permissible value of the basic error of temperature, drilling mud, °C	+0,55
The limit of the permissible value of the basic error on the analog output, V	+0,55
Power consumption, max., no more, W	20

Notes:

1. Additional reduced error of ground control (GC) from changes in ambient temperature (for every 10 seconds) from the nominal value +0.2% [11, 12, 13].

2. Additional reduced error of GC when the supply voltage changes (by +40V from the nominal value of 220 V) +0,1% [14, 15, 16]. The design parameters of the system must meet the requirements of Table No. 2.

Table 2. Design parameters of the system

Name of parameters	Parameter value
Device for monitoring the isolation (DMI):	
Length, mm	4087+300
Diameter, mm	190 minus 10
Weight, kg	574+25
GC:	
Dimensions, mm no more, Weight, kg	500 x 490 x 178

The deep device is operated:
- in the medium of drilling mud, which is an alkaline medium with a hydrogen index (pH) from 7 to 12 and containing hydrocarbons with a gas-liquid factor of 0.5 m³/m³;

- at a hydraulic pressure of no more than 110 MPa;

- at an upper environment temperature of 110 °C [17, 18, 19].

The ground-based device is operated in an air environment in accordance with the climatic design of the UHL and placement categories 3 according to GOST 15150-69 at a supply voltage (220 +40)V, 50 Hz.

The reverse resistance measured between the large ring of the cable coupling and the housing must be at a temperature of (20 +5) C - at least 10 ohms [20-23].

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The layout scheme of the bottom hole assembly (BHA) using these telesystems.

Table 3. Characteristics of the layout of the bottom hole assembly (BHA)

Name of parameters	Norms	
	DMD	GMD
Device layout of the telemetry system		
Length, mm	4779+400	
Diameter, mm	190 minutes 10	
Weight, kg	600+30	
Dimensions, mm, no more		500x490x178
Weight, kg no more		15
Connecting filter-2		
Dimensions, mm, no more		320x230x100
Weight, kg, no more		5

The telemetry system STE GP-190UHL5 is designed to measure the electrical resistivity and temperature of the drilling fluid in the annulus during the drilling of wells with electric drills, as well as the

insulation resistance and winding of the electric drill and power supply during the descent and lifting operations [24-28]. The technical data of the system must correspond to Table 4.

Table 4. Technical data of the system

Name of parameters	Norms
The operating current of the DMI, A	from 0 to 150
The measurement limit:	
Electrical resistivity of drilling mud in annular space annular space, Ohms.m	from 0.1 to 3.0 from
The temperature of the drilling fluid in the annular space, deg.C	20 to 110
The limit of the permissible value of the basic error:	
electrical resistivity of drilling mud, Ohms.m	+0,15 +2,8

A list of special structures for guidance in electric drilling, installation of electric drill relays, a list of fishing tools and technical data of the complete

device (UZEB-80U2) is given in Tables 5-8, as well as the set of the device (UZEB-80U2) is shown in Fig.2.

Table 5. The list of special structures that should be guided by electric drilling

No. n/a	Title	Designation year of manufacture	Organization who issued the instruction
1.	A complex method of classification of rocks of geological section, dividing them into characteristic bundles of rocks and selecting rational types and designs of ball bits for effective drilling of oil and gas fields	RD 39-2-52-78	VNIIBT
2.	Operating instructions for roller bits when drilling oil and gas wells	RD 39-2-51-78	VNIIBT
3.	Instructions for drilling oil and gas wells, diamond drilling tools	RD 39-2-77-78	VNIIBT
4.	Instructions for drilling directional wells	RD 39-2-810-83	VNIIBT
5.	Manual for the repair of electric drilling equipment	OTSCH.410.010. 1970 year	SKTBPE VNPO "Potential"
6.	Instructions for the preparation and operation of drill pipes and cable sections of the electric drill current supply	OTSCH.466.010.	The same

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7.	A device for monitoring the isolation and position of the diverter. Technical description and operating instructions	OTSCH.140.025TO. 1977 year	The same
8.	The device is a deep measuring telemetry system of the electric drill of the STE-185 UZ series. Technical descriptions and operating instructions	ZTSCH.789.030-02T0	SKTBPE VNPO "Potential"
9.	Instructions for the care and operation of the current collector of the TZ series	OTSCH 140.026, 1981 year	The same
10.	The mechanism of curvature of electric drills. Brief description and installation and operation instructions	OTSCH.466.039, OTSCH 466.036, 1975 year	-!-
11.	Technical description and operating instructions of the complete control and protection device for electric drills UZEB-65MU2 (UZEB80-39A2U2)	46x606.014T0, 1974 year.	-!-
12.	Technical description and operating instructions for gearboxes-inserts (GI)	OTSCH.466.063, 1978 year	
13.	Instructions for the device and operation of the grounding of the installation of an electric cord powered by the system "two wires-pipe"	IZ – 4 1981 year	SKTBPE VNIITB
14.	Electric drills. General technical conditions.	GOST 15880 – 76SKTBPE	
15.	Electric drills with a capacity of up to 210 kW. Technical conditions	GOST 17287 – 77	The same
16.	Rules of technical operation of electrical installations of consumers and safety rules for the operation of electrical installations of consumers	1971 year	Gosenergonadzor

Table 6. Installation of electric drill relays

Electric drill	Rated data of the electric drill			Drilling depth, m.	Types of protection, settings of the electric circuit protection relay		
	power kW	voltage	current strength		short circuit protection (instantaneous), Relay (1RM 2RZHRT40/20)		
					installation current A	connection of coils	cut-off current, A
E240 - 8	210			0-1000	6,6	parallel	530
E240 - 8	210	1700	144	1000-2000	6,0	parallel	530
E240 – 8R				2000-3000		parallel	480
E185 – 8 (E190) E185 – 8 s PB (E190 – 8R)				3000-4000	5,5	parallel	440
GI=2, GI=3)	125	1300	125	0-3000	4,7	series	380
(E 185 – 8P with a double GI =2x2)	125	1300	125	0-3000	3,1	series	250

Continuation of table 6. Installation of electric drill relays

Electric drill	Types of protection, settings of the electric circuit protection relay					
	from jamming (time exposure 2c) RMZ(RT 40/10)			overload protection (time delay-12 s>-Relay RMP (RT 40/6)		
	Installation current, A	connection of coils	cut-off current, A	Installation current, A	connection of coils	cut-off current, A
E240 - 8	3,2	parallel	252	2,2	parallel	174

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E240 - 8	3,16	parallel	252	2,2	parallel	174
E240 – 8R E185 – 8 (E190) E185 – 8 s PB (E190 – 8R)						
GI=2, GI=3)	2,5	series	200	1,8	series	150
(E 185 – 8P with a double GI =2x2)	1,7	series	240	1,7	series	140

Table 7. List of fishing tools for electric drilling

No n/a	Name	Appointment	Diameter of wells	Note
1.	Bell-cutter	To capture the body of the electric drill 3164, 3190, 3240, 3290	188;190,5 215,9 269,9; 295,3 394,3	
2.	Bell-gauge-milling machine	To capture the electric drill by the nipple of the upper and lower connecting housing and for catching an electric drill together with a spindle for diameters 3164, 3190, 3240, 3290	188;190,5 215,9 269,9; 295,3 394,3	
3.	Tap with centering devices	To capture the spindle shaft of electric drills 3164, 3190, 3240, 3290	188; 190,5 215,9 269,9; 295,3 394,3	The tap must have a set of heads, directions and funnels for the specified electric drills and wells
4.	Tap-gauge	To capture the body of the electric drill 3164, 3190, 3240, 3290	188;190,5 215,9 269,9; 295,3 394,3	Including the reducer-inserts in the presence of the remaining crown of the gear coupling RF 164, GI185, RF 190, GI 240, GI 290
5.	Bell-gauge-milling machine	To capture the bodies of the STE-164 telemetry system	188;190,5 215,9 269,9; 295,3 394,3	
6.	Tap-calibrator-milling machine	To capture the bodies of the STE-164 telemetry system	188;190,5 215,9 269,9; 295,3 394,3	
7.	Bell-gauge	To capture the pipes H140 annular thread	269,9;295,3	Connecting thread Z-161 nipple
8.	Bell-gauge	To capture the drill pipes H140 annular thread	269,9;295,3	Connecting thread Z-140
9.	Bell-gauge	To capture the HI40 drill pipes by the ZU-185 lock housing followed by a lapel	269,9;295,3	Connecting thread Z-161 nipple
10.	Tap-gauge with centering device	To capture drill pipes -N 140 annular thread of the lock coupling ZU-185 – N114, B127 - annular thread of the lock coupling ZU-155	243;269,9 190,5;215,9	Connecting thread 3-161 nipple Z-133, nipples

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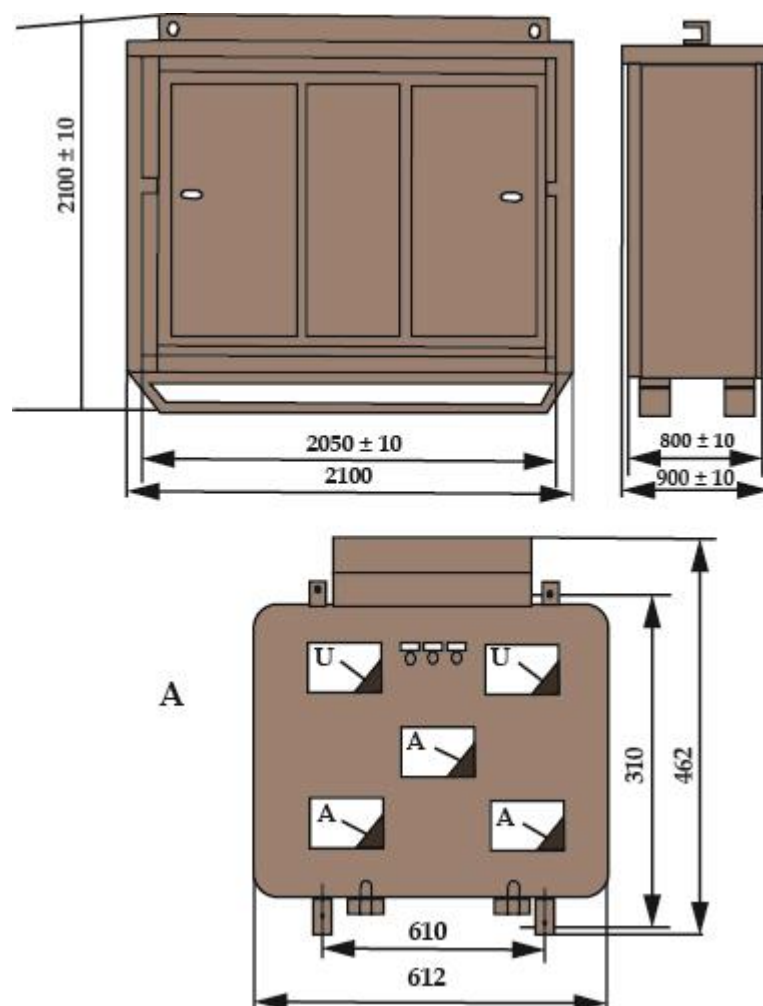


Figure 2. Complete device (UZEB-80 U2)

Table 8. Technical data of the complete device (UZEB-80 U2)

Designation	Name of the object	Main circuit		Control circuit	Overall dimensions, mm	Weight, kg
		UI	U			
A	Electric drill control and protection station	3000	200	330	2100x2050x800	1000
B	Control cabinet with measuring instruments	100	5	220	612x462x290	25

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Article



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OPERATION OF ELECTRIC DRILLS FOR DRILLING OIL AND GAS WELLS UNDER CONDITIONS OF ABNORMALLY HIGH RESERVOIR PRESSURES

Abstract: The article discusses the analysis and recommendations, as well as instructions for the operation of electric drills for drilling oil and gas wells in conditions of abnormally high reservoir pressures in the fields of Turkmenistan in order to accelerate the completion of the constitution of wells provided for by the project.

To select the operating mode of electric drills for the purpose of drilling wells, materials of previously operated wells, literary and Internet materials, geological and operational characteristics of deposits and the guidance document "Operating instructions for electric drills for drilling oil and gas wells" were used.

This paper provides a detailed analysis of the operation of electric drills for drilling oil and gas wells and provides recommendations and instructions for choosing the operating modes of different types of electric drills (downhole motors). This work can be used when drilling directional oil and gas wells and field development in order not to seal the development grid.

Key words: pipe carrier, drill pipe, hydraulic weight indicator, spindle, oil tanker, pressure gauge, stabilizer, phase, defect, cable section, oil.

Language: English

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Introduction

Drilling with electric drills requires slightly more labor costs and a more qualified approach than with other drilling methods. Therefore, drilling crews have an additional number of workers - one electrician in each watch.

When transported on a pipe carrier, the electric drill is placed by the spindle on the front support and the stator housing on the rear support of the pipe carrier.

In order to avoid excessive stresses in the threaded connections, the electric drill is laid on the support beam of the trailer of the pipe so that the departure from the support beam to the end of the electric drill is 1/4 of its length. In order to prevent longitudinal and transverse movements during transportation, the electric drill is fixed with special clamps or cables in the places of the

supports. Electric drills with a diameter of 164 mm are allowed to be transported only in a special transport case. It is strictly forbidden to dump an electric drill from a pipe carrier [1, 2]. When unloading the electric drill on the racks, the pipe carrier must drive sideways to the racks so that the elevator translator is directed towards the entrance to the drilling.

When transporting an electric drill on a tractor sled, it is allowed to unload it on the ground right in front of the receiving bridge of the drilling rig. In this case, in order to prevent its damage, it is mandatory to use special rolls with a length of at least 3 m.

When loading drill pipes onto a pipe carrier and unloading them onto the receiving bridge of the drilling rig, the safety of protective cups in the nipples of locks and cable sections mounted in the pipes must be

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ensured. When transported on a pipe carrier, drill pipes are laid with a lock nipple on the trailer.

When dragging drill pipes to the receiving bridge of the drilling rig and to the rotor, a protective cap must be screwed onto the lock spindle. It is forbidden to use the eye of the protective cap to pull the drill pipe.

Each electric drill entering the drilling rig must be provided with a trip passport. The passport is an acceptance document for both drilling and rolling and repair facilities. It is inserted into a sealed cartridge attached to the contact rod of the cable entry.

The electrician is obliged to fulfill all the points of the trip passport after each one way. The operating time of the electric drill is recorded based on the readings of the diagrams of the hydraulic weight indicator or a special electric clock that turns on when the "Start the electric drill" button is pressed. At the end of the work of the electric drill, the trip passport signed by the drilling foreman is sent together with the electric drill to the rolling and repair base [3, 4, 5].

Before screwing the bit onto the electric drill shaft, the axial lift of the spindle shaft is checked. To do this, the suspended electric drill is placed on the rotary table and at the time of setting, the mixing value of the shaft relative to the spindle body is measured.

The displacement of the shaft should not exceed 1.5 mm. The presence of oil in the compensators of the motor and spindle and the condition of the threaded connections are also checked. The threaded connections are checked by an external inspection, the tightness of the connections between the motor housings, spindle, compensator, as well as in the places of plug installations is checked. In case of detection of oil leaks and mobility of threaded connections, if it is impossible to correct defects on the spot, the electric drill must be sent to the workshop.

The oil pressure inside the electric drill is measured by a device that is a pressure gauge with a scale of 51:10 kgf / cm² and a tip with a thread M10 x 1 and a needle. The tip with a nanometer is screwed into the valve thread, the needle squeezes the ball and the pressure gauge shows the oil pressure, which should correspond to the values specified in the electric drill's trip passport [6, 7].

Pumping transformer oil into the engine on the drilling rig is carried out through the calapans in the upper part of the engine by a special oil tanker, which is a small manual piston pump with an oil capacity. At the same time, it is recommended to use a device for pumping oil, which allows you to simultaneously monitor its pressure inside the electric drill. It is a tee to which the hose tip from the oil tanker is connected, one of the fittings with the M10 x 1 thread is screwed into the engine valve, and a pressure gauge is screwed into the other. Before pumping transformer oil into the engine, it is necessary to visually check the purity of the oil in it, the absence of impurities of clay solution [8, 9, 10].

Transformer oil is transported and stored on the drilling rig only in an oil tanker with constant heating for winter conditions and a selikogel filter. Regardless of the oil consumption from the oil tank, it must be replaced with a new one every 3 days.

The presence of oil in the spindle compensators, gearboxes and other mechanisms mounted between the engine and the spindle is determined by measuring the oil pressure through check valves.

Air oil is pumped through valves located in the upper part of the spindle and other mechanisms using a manual oil tanker.

It is recommended to pump oil into the engine and spindle after each one way.

Before each descent of the electric drill into the well, it is necessary to check the value of the insulation resistance of the motor winding relative to the housing. In this case, it is necessary to pre-rinse and clean the contact rod with castor oil. The insulation resistance is measured by a magnetometer (at a voltage of 500 or 1000 V). The engine delivered from the workshop must have at least 50 mOhm at a temperature of +20 -25 C, the one lifted from the well must have at least 30 mOhm at a body temperature of +50 C. With a sharp decrease in the insulation resistance of the electric motor, the electric drill must be sent for repair [11].

Drill pipes with cable sections delivered to the drilling site must be subjected to (on the drilling site) preventive inspection, checking of cable section fasteners in drill pipes and checking the insulation resistance with a magnetometer for a voltage not lower than 500 V.

The measured insulation resistance between the phases and each phase relative to the ground should be at least 2000 mOhm.

Pipes with defects in cable sections, as well as pipes with sections attached without spring washers, are not allowed to be drilled.

Data on insulation resistance, oil pressure in the engine, spindle and gearbox, and on the oil pumps produced must be recorded in the trip passport and the electrician's log.

Before lowering the electric drill into the well, it is necessary to check the direction of rotation of its shaft. This is done every time there are circumstances in which it is possible to change the direction of rotation of the shaft.

The direction of rotation of the shaft is checked before the electric drill is lowered into the newly drilled well. The inspection is performed over the wellhead visually. The rotation should be clockwise when viewed from above [12, 13, 14].

It is allowed to check the direction of rotation of the shaft of the electric drill lowered into the wellhead in the direction of the action of the reactive moment. The driving rod at the moment of switching on the electric cord should move in the direction of reverse rotation of the shaft.

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It is forbidden to check the direction of rotation of the shaft of an electric drill with an unfastened translator and a bit at the wellhead and above the open rotary shaft.

After building up the next pipe, when turning on the electric drill, you should also make sure that the direction of rotation of the electric drill is correct. At the same time, the direction of rotation is judged only by the action of the reactive moment [15].

At a significant depth of the well, when the action of the reactive moment on the working rod is no longer transmitted, it is necessary to check the phasing of the cable sections of all drill pipes, without exception, prepared for the build-up.

Upon completion of electrical installation work at substations, electric lines, cables and high-voltage switchgears feeding the transformer of the electric drill, it is also necessary to check the direction of rotation of the electric drill. At the same time, it is recommended to pay attention to the direction of rotation of the ground engines installed on the drilling rig.

When changing the current collector and the current supply cable, before switching on the electric cord, it is necessary to check the phasing of the current supply, starting from the contact coupling of the drive rod to the control station tires, and make sure that the phasing has not changed.

The contact rod and coupling, before screwing the drill pipes into the column, should be cleaned with brushes and lubricated with heated castor oil. Dust or dried dirt from the working surfaces of the contact joints must be removed before cleaning with castor oil.

It is forbidden to use unheated, contaminated and moistened castor oil, as this leads to an electrical breakdown of the insulation (overlap) between the contact rings and the failure of the contact connection [16, 17].

Castor oil should be heated in a special tank for heating castor oil.

When lowering the drill pipe string after screwing each plug, it is necessary to control the insulation resistance of the current supply circuit and the motor winding of the electric drill relative to the "ground". The insulation resistance of the "current supply-electric drill" system relative to the "ground" is controlled by a lamp megometer supplied complete with an electric drill control device. To do this, the noise of the tube megohmmeter is applied to one of the contact rings of the rod. As the well deepens, the insulation resistance of the "current supply-electric drill" system may decrease [18, 19].

A sharp decrease in the insulation resistance of the "current supply-electric drill" system after the build-up of the next candle indicates a defect in the cable section of the screwed candle. Such a candle must be removed, check the insulation resistance of its cable section and, if a defect is detected, send it for repair or change of the cable section.

In case of insulation breakdown, the place of damage is found using a tube megohmmeter when lifting drill pipes after flushing the contact rod of the pipe located on the elevator with water. To do this, the probe of the lamp megohmmeter is applied to each of the copper rings of the contact rod. If, after lifting one candle, the insulation resistance has sharply increased, then the breakdown, as a rule, turns out to be in the cable section of the last unscrewed candle.

Prevention of current supply on the drilling rig during operation is carried out as follows:

- at each lifting of the drill string, all contact rods in the working connectors of the candles are thoroughly washed with water, and after installing each candle on the candlestick, the contact coupling of the lower pipe is also washed with water using a flushing tube;

- at each descent of the drill string, the electrician must carefully inspect the contact couplings and rods in the drill pipes. If mechanical damage to the contact connections or other damage is detected, the drill pipe with the cable section must be replaced;

- if a thickened and contaminated castor oil film is found on the contact rings and on the rubber surface of the contact joint, it must be cleaned, rinsed with "Galosha" gasoline, then with water and re-lubricated with clean, heated castor oil;

- to prevent damage to the contact connections in non-working connectors, it is advisable to change the place of the connector in the spark plugs of drill pipes after 1-2 months;

- it is recommended at least once during the drilling period, and during deep drilling after 3-4 months of operation of the current supply, to carry out its preventive inspection, paying attention to the condition of fastening the current supply supports to the crackers in the nipples and couplings of drill locks [20, 21, 22].

At the end of drilling, the pipes together with the current supply are thoroughly washed with water until the remains of the washing liquid are completely removed from all contact connections, crackers, supports and bolts of cable sections.

Drill pipes from the drilling rig should be sent to the pipe base for preventive maintenance. It is allowed to send drill pipes directly to the next drilling rig, where they must be laid out on the receiving bridge and subjected to mandatory prevention before being introduced into further work.

The insulation of the cable sections of individual pipes is checked with a 2500 V megohmmeter with a scale of 10000 mOhm. The insulation resistance between the phases and each phase relative to the pipe body must be at least 2000 mOhm.

The cable section with low insulation resistance should be removed from the pipe and replaced with a new one.

To prevent overflow of the washing liquid when building up the next pipe, it is recommended to use the check valve KOSH-140 - with pipes H140 or KOSH-

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114 - with pipes H114 and B127. The valve must be installed on the first spark plug under the drive rod. During the build-up, the valve moves down and at the end of the roundtrip it must be returned to its original position [23].

It is possible to turn on the electric drill located in the well only if there is a circulation of the washing liquid and without applying an axial load on the bit. It is forbidden to start the electric cord under load.

In order to protect electric drills from breakdowns during overloads caused by the jamming of the bit, especially when it is worn out and the tool feed rate is inappropriate, protection is applied, which is triggered after a certain time after the start of the overload.

The complete device provides:

- switching on and off of the electric drill using a push-button station from the driller's console;
- high-speed protection of the current supply-electric circuit system from short-circuit current;
- protection of the electric drill with a time delay of 2 seconds when the bit is jammed;
- overload protection with a time delay of 10 s;
- prohibition of re-activation of the electric cord after an emergency shutdown in case of a short circuit in the current supply system-electric cord;
- the possibility of sending a signal from the complete device to the remote drill for permission to start the electric drill;
- a mechanical lock between the door of the high-voltage cabinet and the disconnecter prohibiting the disconnecter from being turned on when the door is open and the door from opening when the disconnecter is turned on;
- mechanical blocking between the disconnecter and the high-voltage contactor, prohibiting disconnecter disconnection when the contactor is switched on and contactor shutdown when the disconnecter is disconnected [24, 25, 26];
- electrical blocking of the disconnecter drive with a high-voltage contactor, prohibiting the

activation of the high-voltage contactor when the disconnecter is disconnected and disconnecting the high-voltage contactor when the disconnecter is disconnected:

- electrical interlocks that prohibit the inclusion of the drilling transformer when the doors are open.

The complete device includes:

- control panel;
- cabinet with measuring instruments SHGS 5105-00B2;
- two push-button stations.

The operation of electric drills is economically effective for cluster drilling (construction) of wells mainly directional with mobile drilling rigs, the mouths of which are grouped at a close distance from each other from a common limited site, and the faces reveal the productive horizon at specified points in accordance with the development grid [27, 28]. The experience of work in different regions of the world demonstrates the success of the technology of cluster drilling of production wells with an electric drill with mobile drilling rigs.

In the modern period of development of the oil and gas industry, thanks to the improvement of electric drilling technologies, the development and production of new drilling equipment, chemicals and technologies, it has become possible to use innovative, previously little-known methods and techniques of well construction [29]. With the use of these advanced technologies, there are currently all possibilities for drilling directional wells with different trajectories and multi-barrel. The experience gained during the construction of an inclined-directional exploration well in southwestern Turkmenistan allowed us to conclude that it is possible to conduct prospecting and exploration work on the site of this field located in the shallow waters of the Gulf of the Caspian Sea, using inclined-directional wells with a deviation of the bottom a long distance from the vertical using electric drilling.

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Article



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UNIVERSAL DEMOCRATIC PRINCIPLES IN NEW UZBEKISTAN ARE AN IMPORTANT FACTOR IN THE UNDERSTANDING OF THE NATIONAL IDENTITY

Abstract: *In the process of understanding the national self, universal democratic principles play an important role. Serious attention is paid to the formation of the national self-awareness of the multinational people of Uzbekistan, relying on universal democratic principles in the renewing Uzbekistan, the creation of good neighborliness and an atmosphere of mutual trust, friendship and respect between the countries living in the Central Asian region. This article will focus on the macro works carried out in the new Uzbekistan in this area.*

Key words: *New Uzbekistan, Central Asia, region, independent state, universal democratic principles, friendship, respect, mutual trust, understanding of national identity.*

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Introduction

According to Article 13 of the Constitution of the Republic of Uzbekistan: "democracy in the Republic of Uzbekistan is based on universal principles, according to which a person, his life, freedom, honor, dignity and other inviolable rights are of high value.

Democratic rights and freedoms are protected by constitutions and laws". It is also a structural structure and an important factor in the perception of the national self.

Universal values and principles form the basis of democracy. Nationalism and generalism are required to be harmonious in the perception of the national self, and thus universal democratic principles have a defining significance in the perception of the national self.

Universal democratic principles are criteria that apply to the life of mankind, guarantee democratic progress, serve to correctly express the essence of the perception of the national self.

They simultaneously serve the development of the convergence, progress of all national values, the realization of the national identity of peoples.

In the process of building a new Uzbekistan from national revival to national revival in independent Uzbekistan, special attention is paid to the introduction of the universal democratic principle into life and the growth of national identity awareness.

Indeed, in the conditions of today's globalization, such factors as complex situations arise all over the world, terrorism, extremism and radicalism, constant vigilance and alertness in the current conditions of increasing ideological and ideological struggle, strengthening independence, ensuring a peaceful life of our people, universal democratic principles such as interethnic harmony, mutual cooperation, interreligious tolerance play an important role in

As noted in the speech of the president of the Republic of Uzbekistan Shavkat Mirziyoev at the 75th session of the UN General Assembly on September 23, 2020, a policy of openness is underway in the new Uzbekistan. "As a result of our large - scale measures for the political, social and economic modernization of society, a new Uzbekistan is being formed. Today, democratic changes in our country have become irreversible."

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Loyalty to humanitarian ideals, democracy, striving for social justice to be sustainable everywhere, preventing human rights from being violated, protecting the struggles of all peoples and nations for national independence, respecting national customs and values, not interfering with the development of their understanding of national identities, helping to introduce justice, the rule of law into life, encouraging people to friendship, cooperation and, trying to make a decision of tranquility are aspects of universal values based on universal democratic principles that are gaining importance in the context of today's globalization.

According to the researchers, "these values also consist in new aspects of the development of human-acquired relations of science, technology, culture, social production, achievements in the stabilization of democracy, legislation, justice, the rational use of which contributes to the fact that our country is among the developed countries and our people perceive the national self more terribly". It should be remembered that in this regard, it is important not to recognize universal democratic principles, to allow any retreats, national restrictions and calandimagin lead to great losses.

Democracy cannot be formed as a positive reality, beyond or contrary to the historical-cultural paradigm, the people, the nation, the traditions, norms and values that have been created and revered for centuries. For this reason, universal democratic principles are an important structure for the perception of the national self, which contributes to its formation.

It is necessary that the perception of the national self corresponds to universal democratic principles. They are:

- 1) national self-awareness recognition of the inviolability of human life;
- 2) it is necessary to respect human freedom, rights and interests;
- 3) an important criterion in the understanding of the national self is that a person is the highest value;
- 4) achieving the commonality of universal interests in the understanding of the national identity of different nations forms and strengthens mutual joint feelings;
- 5) it is important that democracy has equal opportunity (conditions), the rule of law in the realization of the national identity of representatives of different nationalities;

Humanization (humanism) is a universal value. It essentially means humanizing society, life, socio-political being.

All the reforms carried out in the new Uzbekistan, including socio-political and spiritual ones, in essence, imply the orientation of social relations to human interests, the formation of high spiritual and moral qualities in it. Humanity, as a universal democratic principle and a high spiritual value, brings humanistic traditions, views and norms

into the socio-political processes, the management of the state and society. In this way, it enriches the socio-political sphere with humanistic values and acts as an important factor in the perception of the national self.

In the national consciousness of each people there are fundamental aspects that are unique and appropriate to this people, historically formed, that represent the psyche, mentality, character, uniqueness of this people, and they leave their mark on the social system of the country. Important features of the national identity are manifested. It would be appropriate to note that this situation is manifested today in the socio - economic, scientific, cultural - spiritual, national and religious relations of the peoples of Central Asia, including the peoples of Kazakhstan and Uzbekistan, and also in the life of these peoples.

In this regard, we think that the international scientific and practical online conference "model'nazarbaeva: Strategicheskoe sotrudnichestvo I global'niy dialogue", planned by the library of the first president of Kazakhstan – elbasi, dedicated to the Independence Day of Kazakhstan, will be a great gift to the independence of the peoples of Central Asia in December 2020. There is no doubt that this conference will help bring the peoples of the Central Asian region closer together.

Such conferences show that democracy in World Development as a universal value is a manifestation of a style of management that is embedded, recognized and correspondingly embedded in the thinking and way of life of different peoples, nations. The second side of the law, which is currently analyzed at the conference, is also related to the existence of the way of life, mentality of each people, the feature of feeling, understanding, understanding and following democracy. Democracy, no matter how universal democratic principles acquire universal meaning and value, is the basis of it, "nationalism", "national psyche", "national identity", which gives it spiritual strength, enriches it, ensures its colorfulness. Universal democratic principles, on the other hand, are an important factor in the perception of the national self.

Interethnic harmony occupies an important place in the understanding of the national identity of peoples, along with national identity, in an important link of universal democratic principles. Instructive work is being carried out in Uzbekistan on the implementation of interethnic harmony and religious tolerance. As noted in the speech of the head of our state at the 75th session of the UN General Assembly, "further strengthening of interethnic harmony and religious tolerance is an important task for us."

The fifth priority of the strategy of action on the introduction of universal democratic principles into the life of the peoples of Uzbekistan, which is being more broadly updated, and its use in the cultivation of national identity, was also set the most important tasks

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in the field of ensuring interethnic harmony and religious tolerance. 138 national cultural centers play a big role in developing ethnic identity and further harmonizing interethnic relations in our country.

Universal democratic principles serve to determine the culture of peoples of different nationalities, the commonality of nationwide interests in language, consciousness and worldview in the rise of national self-awareness. According to the researchers, "changes in the areas of social life create the necessary space for this law to follow". It is gratifying that the democratic changes that are taking place in New Uzbekistan today, the help provided through the Centers of Public Service, increase mutual integration about people of different nationalities.

The rise of the awareness of the national identity increases the sense of the common homeland of different nations. Strengthens tolerance even more.

There are problems contrary to the universal democratic principles of national self-realization, which are: missionary, religious extremism and fundamentalism; equating religion with "false Islamic ideas"; nationalism; chauvinism, etc. Each of these listed, together with a certain threat to the security of the country, the stability of our country and Central Asia in the region, the realization of the national identity of our people, does not serve to effectively form a nationwide idea in our country and make it a necessary spiritual factor that directs society to the prospect.

It is a nationalism from problems contrary to universal democratic principles.

It is necessary to note that the concept of "nationalism" as a phenomenon inherent in this lack of understanding of the national self, there are cases of its different interpretation. For example, under the former Union, the concept of nationalism was deliberately falsified, nationalism and any manifestation of nationalism were judged as "nationalism". In some current studies, opinions are expressed on the content differentiation of the concepts of "nationalism".

In particular, nationalism is interpreted as denying the equality of nations, putting one's own nation above other nations, striving to create privileges for it, prostrating one's own nation, not giving it an impartial assessment, not noticing its shortcomings and flaws, and nationalism as recognizing the equality of nations, treating all races and nationalities equally, not indifferent to one's own nation, its language, culture. Professor S.Otamuratov's view, "nationalism means elevating, improving the potential of a nation, ensuring its dignity and pride".

Nationalism is a characteristic characteristic of all nations. However, it is necessary to take into account that it manifests itself more strongly in a small number of nations.

There are also different opinions about nationalism.

In our opinion, nationalism is one of the most challenging factors for the prosperity of a nation. Because, in fact, the nationalist will move his nation away from other nations, the world community, sluggish the prosperity of the nation. Does not base or acknowledge universal democratic principles. From this point of view, in our opinion, nationalism is contrary to the perception of the national self and does not fall into its structure.

The main reason for causing interethnic conflicts is aggressive nationalism and chauvinism. The fact that there are still forces in the world trying to organize a "crusade" against the idea of new fascism, bolshevism, chauvinism, racist ideas, interethnic harmony, solidarity requires us all to be vigilant and do practical things in preventing the spread of such harmful ideas.

Today, when ideological struggles intensified in the world, it is gratifying that good neighborly relations have been achieved between the peoples of the countries of the Central Asian region. This was properly emphasized in the speech of the president of the Republic of Uzbekistan Shavkat Mirziyoyev at the 75th session of the UN General Assembly, "at the moment there are fundamental changes in the Central Asian region. We have achieved good neighborliness and an atmosphere of mutual trust, friendship and respect among the states of the region."

Contrary to the universal democratic principles of national self-realization, there are also some problems, in particular, national separatism (separatism), unhealthy ideas that resent national harmony, situations of nonlinear interpretation of the lives, value and culture of some, national selfishness (egoism) chauvinism and the Prevention of aggressive nationalism, which are encountered in some countries. These problems contradict universal democratic principles and interfere with the formation of the national identity of peoples.

In general, in the new Uzbekistan, all-democratic principles in the understanding of interethnic harmony, interreligious tolerance, national identity fully correspond to the universal democratic principles of the national identity of the multiethnic people of Uzbekistan and serve the purpose of building a democratic society in the country.

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Article



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PATRIOTISM IS A SPIRITUAL FORCE THAT MOBILIZES SOCIETY FOR DEVELOPMENT

Abstract: This article aims to analyze the process of instilling in the upbringing of the younger generation the patriotic spirit of our Motherland, which identifies the spiritual and educational power of the development of society. We also consider some of the tasks of implementing this issue at different stages of the history of our Homeland regarding hidden socio-political and historical events.

Key words: Homeland, patriotism, independence, basis and foundation, life position, faith, idea, ideology, spirituality, devotion and bravery.

Language: English

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Introduction

There is such a great word in the world that it is always begged, like the divine light in the heart of man, that the coin radiated thereby gives strength, pleasure to the soul, and a lifetime of prosperity to the life of man. This is undoubtedly the Homeland. Homeland is the golden cradle of man, in this cradle we grow up with the love of mother and father and grow up and fall in love with our homeland. This kindred ground in which we live has been the mother of our ancestors, who have raised many children for several thousand years, is also the mother of us, and will remain the mother of our future generations.

The last decade of the 20th century brought profound changes in quantity and quality to the world political map that we have today. This, in turn, put on the agenda the assessment in the development of society, not only of the basis, but also of our relationship to the concept of an abstract Homeland, which has settled on consciousness and consciousness for more than 70 years, passing through the prism of the heart again as the highest value. Because the role, importance in the emergence of specific lifestyles, spiritual and spiritual values, political – economic freedom and activism in the social space, in which the new formation of superstitious relations is necessary,

is extremely salient. Everyone living in society serves the motherland with their faith, purpose and interests, tirelessly striving for its great future. In this sense, one of the important principles that serve tremendous progress is undoubtedly the sense of patriotism in humans. Undoubtedly, during the years of independence, "in order to form a strong life position and a high sense of responsibility for the fate of our motherland in the hearts of the growing young generation, a unique system was created in the field of patriotic education according to the focus of Essence, and a wide range of the population of our country was covered within it".

It is well known to all of us that patriotism is the spiritual basis of the life of every state and has manifested itself as the most important mobilizing moral force in relation to the comprehensive development of society, and it is beyond doubt that it will remain so. "Both for the heart, for the deep feeling of the motherland, and to show the patriotic models of the people, the people are obliged the Motherland independent," the authors of the book "The feeling of the motherland" argue. As long as independence is in our hands today, we must honor it, appreciate it, strengthen it step by step.

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In the socio-philosophical literature, many definitions of the concept of patriotism are given. For example, professor Q. Nazarov wrote in his book "Philosophy: a comprehensive dictionary "that" patriotism is the realization of responsibility and duty to the fatherland", while the author of the educational manual "Ethics" is the poet and scientist A. Sher describes it as "a moral concept that represents a person's love for his homeland, his passion for preserving it". On another page of the dictionary, we read the opinion that "patriotism is the social and spiritual –moral qualities, qualities of a person who expresses his love for the land, the ground, where he was born and grew up, matured."

Dedication and courage are considered the chief signs of patriotism. Dedication can be said to the strengthening of the Republic of Uzbekistan as an independent state, its economic, spiritual and cultural development, the tireless work and search for workers to achieve a faster prosperous life. Dedication begins with devotion to the motherland. It is possible to show a sense of patriotism in the desired area. The conservation of nature, the collection, study, avarice and promotion of the cultural heritage left by our ancestors are also considered patriotic. Courage, on the other hand, is a high spiritual and moral quality for one's homeland and countrymen, which manifests itself in their own interests, and if necessary, in their souls. Courage can be inappropriate both in the long work done for the protection of the motherland and in emergency situations that require self-sacrifice, for the prosperity of the people, the prosperity of science and culture. Historian scholars B.Aminov and T.Rasulovs write in his book "Motherland – a jewel in the heart": "it should be noted that the history of the people should be studied only by its educated, that is, not by its intelligentsia, but by a single letter-literate and mind-conscious, know the necessary information, historical events, and educate the younger generation in the spirit of love for such Mother-Motherland history. Because every human child loves his homeland with faith, he receives wisdom, signs and strength from the life of generations-ancestors."

For some reason, patriotism is a high manifestation of the social and spiritual-moral qualities, qualities of people. After all, on the basis of them lies the love of the land inherited from the ancestors, the preservation of customs, values, sincerely working for the prosperity of el yurt, protecting the motherland from enemies, freeing it from any dependence, and even, if necessary, not sparing its life for its freedom and independence. Patriotism means serving the interests of el yurt, placing the interests of el yurt above personal interests. It is understood from this that patriotism is a quality inherent in a person who has a deep respect for the history and fate of the motherland, the people, is able to show examples of self-sacrifice in the interests of the motherland.

Respect for the motherland, the people, love, a sense of trust are formed on the basis of certain common interests, goals, take a deep place in the hearts of people, influence their activities and mobilize them to perform responsible tasks. The supreme manifestation of patriotism is courage. Courage is a high spiritual and moral quality for a person's homeland and compatriots, which manifests itself in his own interests, if necessary, even in his soul. Ordinary Shepherd Shirok, betimsol representative of the struggle against the Mughal invaders Jaloliddin Manguberdi, Amir Temur, Mirzo Babur and thousands of other defenders of the Fatherland who ended their names in golden letters in the Chronicle of Eternity are seen by the children of today's years of independence on the example of their lives.

At different stages of historical, social, political, spiritual progress, new facets of patriotism are discovered. The upbringing of current youth in the spirit of patriotism is one of the tasks that is extremely, complex, responsible and urgent to solve in the same place. The large - scale reforms carried out in our country will entail a further strengthening of the work of educating the population, including young people, in the spirit of patriotism.

After all, the scale and complexity of the tasks set in the field of development of our society requires youth to work with perseverance, perseverance for a bright future, and mobilize all the strength and opportunities in acquiring modern knowledge. Such complex tasks can be performed only by competent people, in whose hearts the feeling of the Motherland is deeply rooted, ready for any tests for its future.

"As we all know well, patriotism is the spiritual basis of the life of every state and manifests itself as the most important mobilizing force in relation to the comprehensive development of society. That is why we are obliged to take concrete measures to form a strong immunity to harmful influences that are completely alien to us in our citizens and to strengthen the sense of responsibility for the fate of our Motherland" the president noted Sh.Mirziyoev. It is known that from time immemorial young people gained attention as the driving force behind reforms. But it is typical of them to give way to haste, to give in to emotion, when there is a lack of life experience, to act with contemplation and restraint. Their shortcomings with a lack of life experience have been exploited by political forces fighting for group interests. Warning us of the shortcomings encountered in the way of overcoming such shortcomings in working with young people, they said: "if we regularly engage in youth education, as the honorable Islam Abduganievich said, and do not put this issue in place, it may be late tomorrow. Why do we say that our children will either bring us anxiety tomorrow or bring us interest. But what we are doing is not yet enough

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for our children to be true patriots, to be eloquent, helpful to us tomorrow."

When loving the motherland, forming patriotic feelings, it is necessary to pay attention to the following tamans. These include serving in the military to protect the motherland, looking at the enemies and traitors of the motherland with hatred, putting the interests of the motherland above all else, recognizing the symbols of the Motherland, the country as sacred, knowing and proud of the history of the motherland, appreciating all compatriots and uniting with them in the interests of the serving for the motherland is an honorable duty of every patriotic person. Patriotism is a unique phenomenon that embodies mature moral components. It is formed and developed on the basis of a certain national culture, ideology, beliefs. The sacred memory of our people keeps in its pages examples of patriotism raised to the level of a symbolic emblem that can serve as an example for later generations. They were Queen Tumaris, who took the field against King Cyrus of Iran, the yovqur Shepherd Shiroq, who led the army of countless Darius to the Karakum steppes, opposed the army of Alexander Macedonski, who invaded Byzantium, Asia Minor, Vavilonia, Mesopotamia and the Iranian States, but was the victim of a local traitor ploy – Spitamen, named after the Sogdian tiger, whose life and path of struggle to this day remains the subject of various controversies, hoki Ash, whose spirit has turned into light, the symbol of the mercenary struggle against the Arab conquerors Muqanna, Temur Malik, Mahmud Torobiy, Jaloliddin Manguberdi, Amir Temur and finally Gurbanjan, who chose the path of mercenary struggle against the invasion of Chor Russia, the acquittal of the names of hundreds of leaders and participants in the National Liberation Movement, whose names were unjustified for many years by Dukchi Eshon and finally by the supreme court of the Republic, showed the unreasonableness of the accusations cast against them.

It is necessary for young people to realize that patriotism is a feeling and value of special importance for every common sense person. After all, a person relies primarily on his loved ones, his country and homeland, from which he receives life force. In addition to creating conditions for the formation of a person as a person, the motherland also bears responsibility and responsibility. "The stronger the sense of patriotism in young people, the stronger their need for spiritual perfection, the more stable. Patriotism is the spiritual basis of the life of society, it becomes inadequate as an internal force that develops society, mobilizes the individual to serve his homeland as a self-sacrifice. As a social phenomenon, it is the main factor that ensures the development of any nation and state," writes R. Akhunov.

But young people fall into a narrow sense that the duty to the motherland consists in protecting them from internal and external threats. In fact, a person's duties before the motherland are obedience to the law, respect for the rights and freedoms, honor and dignity of other people, avaricious preservation of historical and cultural heritage, careful treatment of the environment, payment of taxes and local fees established by law. Raising a spiritual and physical harmonious generation to adulthood, forming a sense of national pride and dedication to the motherland in their minds, faithfulness to faith, ancestral heritage and pandemics, upbringing in the spirit of the ideology of national independence is an urgent task of the current era.

The information about the great siymos, which left a bright mark on the history of our motherland, serves as an important program in the love and preservation of the motherland of our young generation, which has sprung up in the new XXI century, for its bright future, fame and prospects, in their response with Enlightenment against thought, ignorance alien to our national interests and goals.

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STUDY OF HEAT AND MASS TRANSFER IN A CHANNEL WITH TPMS RIBBING

Abstract: The paper presents a study of heat and mass transfer in a channel, where triply periodic minimal surfaces (TPMS) are used to intensify heat transfer. TPMS are surfaces that have minimal mean curvature, have no self-intersections, and periodic in all directions of the Cartesian coordinate system. Their use in heat exchange devices can significantly increase the efficiency of the heat transfer. There are many types of TPMS. To determine the TPMS topology most suitable for intensification, a series of computational experiments were carried out in ANSYS Fluent. The results of the study demonstrate that TPMS ribs promote the formation of vortices in the fluid flow and increase heat transfer.

Key words: minimal surface, ANSYS, CFD modeling, heat and mass transfer, TPMS.

Language: Russian

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ИССЛЕДОВАНИЕ ТЕПЛОМАССОПЕРЕНОСА В КАНАЛЕ С TPMS ОРЕБРЕНИЕМ

Аннотация: В работе представлено исследование теплообмена в канале, где для интенсификации теплообмена применяются трижды периодические минимальные поверхности (TPMS). TPMS – это поверхности, которые обладают минимальной средней кривизной, не имеют самопересечений и периодичны во всех направлениях декартовой системы координат. Их применение в теплообменных устройствах может значительно повысить эффективность теплообмена. Существует множество видов TPMS. Для определения наиболее подходящей для интенсификации TPMS топологии проведена серия вычислительных экспериментов в ANSYS Fluent. Результаты исследования демонстрируют, что TPMS-оребрение способствует образованию завихрений в потоке жидкости и увеличивает теплоотдачу.

Ключевые слова: минимальная поверхность, ANSYS, CFD-моделирование, теплообмен, TPMS.

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Введение

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Разработка эффективных методов интенсификации процессов теплопереноса является важным направлением науки и инженерии. Как правило, увеличение эффективности теплообменного оборудования достигается за счет использования следующих подходов: оребрение поверхностей теплообмена, турбулизация потока, фазовые переходы, улучшение тепловой изоляции и т.д. [1-3]. Однако, данные методы интенсификации можно отнести к классическим. Они давно известны и их развитие достигло такой степени, при которой новые открытия в данной области не приносят значительной прибавки к эффективности теплообменного оборудования. В связи с этим в настоящей работе затрагивается вопрос создания совершенно новой конструкции теплообменных устройств, основанной на трижды периодических минимальных поверхностях (TPMS, от англ. triply periodic minimal surface) [4].

TPMS – это поверхности, имеющие кристаллическую симметрию, а также обладающие наименьшей средней кривизной среди всех поверхностей, который могут быть вписаны в один и тот же контур. Существует

множество работ, посвященных исследованию свойств трижды периодических минимальных поверхностей [5-9]. Особенно интересны механические свойства TPMS. Например, в работе [6] выполнено исследование прочности при сжатии напечатанных на 3D принтере образцов TPMS. Также стоит отметить, что большая площадь поверхности и необычная форма TPMS может способствовать турбулизации потока и значительному увеличению эффективности теплообмена [10-12].

Существует множество видов трижды периодических минимальных поверхностей, каждый из которых обладает своей особенной геометрией. В связи с этим возникает необходимость в определении наиболее эффективной TPMS для использования в теплообменном оборудовании. В настоящей работе проводится исследование влияния различных TPMS на температуру и гидродинамику потока жидкости в канале с квадратным сечением.

Постановка задачи

В статье рассматривается 5 видов TPMS, а именно: Schwarz Primitive, Neovius, Schoen's I-WP, Fischer-Koch S Surface, Schoen's O,C-TO (см. рис. 1).

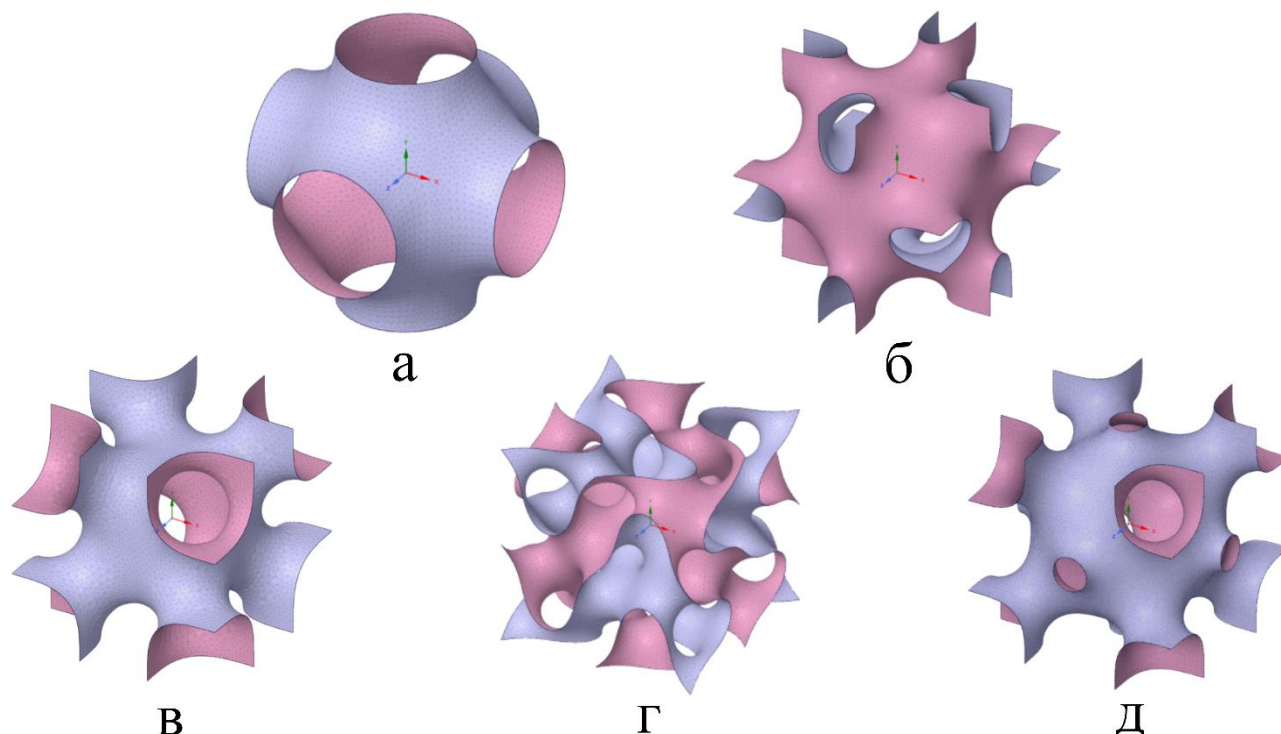


Рисунок 1. Трижды периодические минимальные поверхности: а) Schwarz P; б) Neovius; в) Schoen's I-WP; г) Fischer-Koch S Surface; д) Schoen's O,C-TO

Все исследуемые TPMS обладают кубической симметрией, то есть могут быть

идеально вписаны в куб с длиной ребра a . Каждой TPMS придается определенная толщина δ путем

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построения эквидистант к исходной поверхности (см. рис. 2).

На рис. 2 изображена твердотельная модель трижды периодической минимальной поверхности Шварца Р. Определяющим параметром в данном исследовании является пористость структуры, которая принимается одинаковой для всех исследуемых типов TPMS, и определяется следующим выражением:

$$\phi = \frac{V_k - V_{TPMS}}{V_k} \quad (1)$$

где V_k – объем куба, в который вписана TPMS; V_{TPMS} – объем твердотельной TPMS.

Примем постоянной длину ребра куба $a = 5 \text{ мм}$ и пористость $\phi = 0.9$ для каждого типа TPMS и построим расчетную геометрию для задачи тепломассопереноса (см. рис. 3).

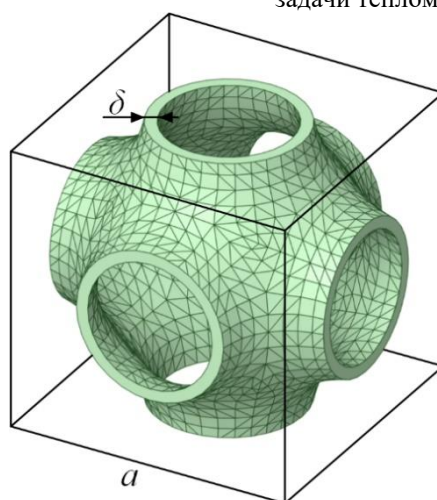


Рисунок 2. Твердотельная модель TPMS Шварца Р

Решение задачи течения жидкости через TPMS канал осуществляется методом конечных элементов в модуле Fluent программного комплекса ANSYS. На входе в канал задается скорость потока жидкости $v = 0.05, 0.1, 0.15 \text{ м/с}$ и

температура $T_0 = 5 \text{ }^\circ\text{C}$. К твердотельной TPMS, расположенной в центре канала, присоединена пластина, на поверхности которой задается граничное условие первого рода $T_{ст} = 70 \text{ }^\circ\text{C}$

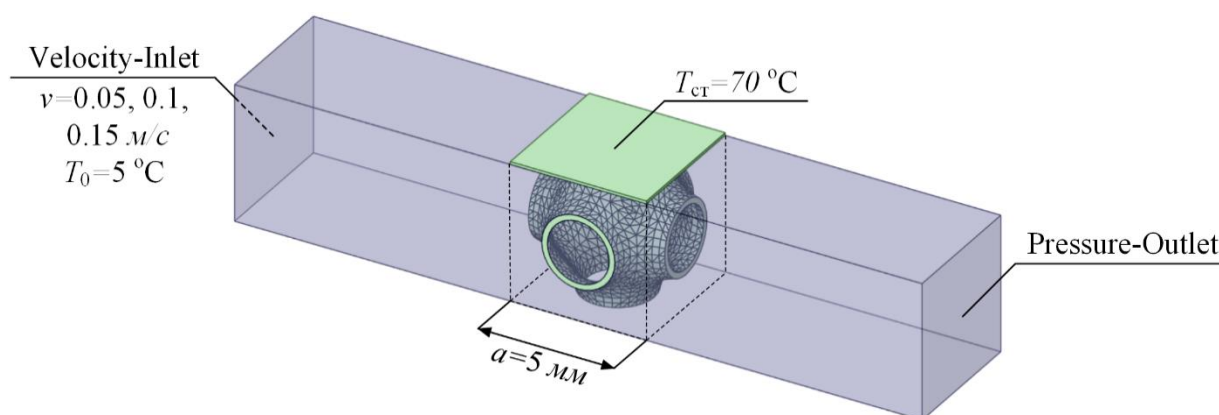


Рисунок 3. Схема задачи.

Твердотельной части геометрии присваивается материал алюминий с коэффициентом теплопроводности $\lambda = 202.4 \text{ Вт/(м}^\circ\text{C)}$, теплоемкостью $c_p = 871 \text{ Дж/(кг}^\circ\text{C)}$ и плотностью $\rho = 2719 \text{ кг/м}^3$. В качестве жидкости, протекающей в канале, используется вода с теплопроводностью $\lambda = 0.6 \text{ Вт/(м}^\circ\text{C)}$,

теплоемкостью $c_p = 4182 \text{ Дж/(кг}^\circ\text{C)}$, плотностью $\rho = 998.2 \text{ кг/м}^3$ и вязкостью $\mu = 0.001003 \text{ кг/(мс)}$. Стоит отметить, что все указанные свойства в данном исследовании приняты постоянными и не зависящими от температуры.

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Результаты

На рисунке 4 в качестве примера представлены, полученные в ходе численного решения, контуры распределения скорости и температуры в канале с TPMS Neovius. Из анализа рисунка видно, что вблизи стенок трижды периодической минимальной поверхности

образуются завихрения потока, которые способствуют интенсификации теплообмена. Подобная картина характерна для всех исследуемых видов TPMS, однако количество теплоты, передаваемой от нагретого каркаса к холодному потоку жидкости, будет отличаться у разных TPMS.

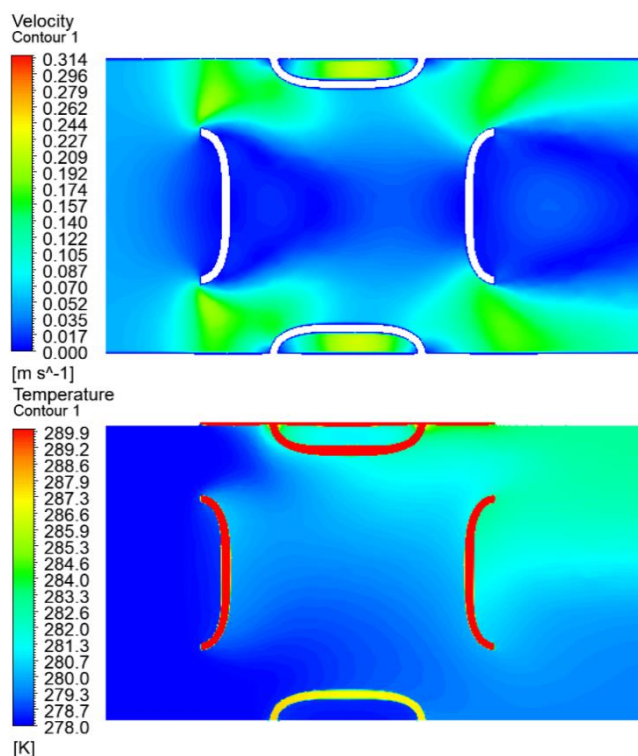


Рисунок 4. Контуры скорости и температуры в исследуемом канале.

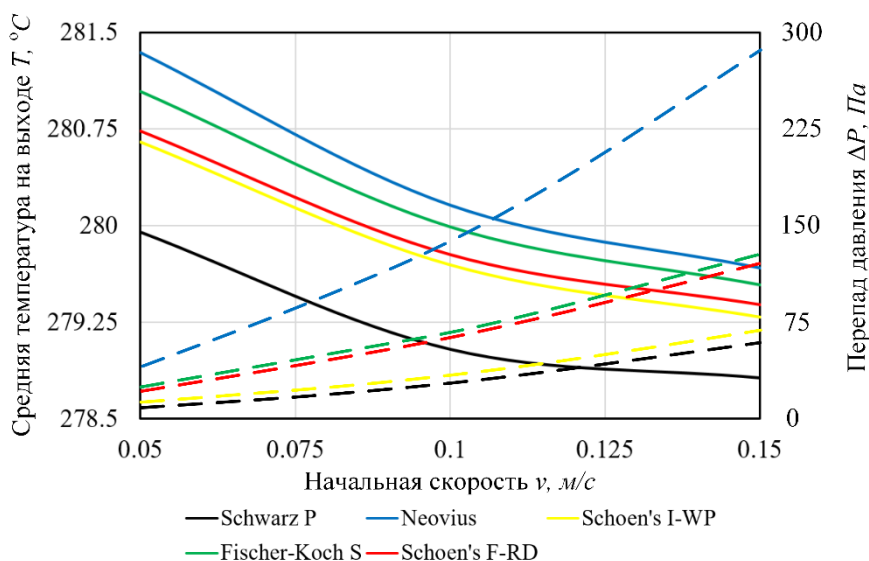


Рисунок 5. График зависимости температуры на выходе и перепада давления от начальной скорости.

Для более детального сравнения эффективности использования различных TPMS в

теплообменнике построим графики зависимости средней температуры на выходе из канала в

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зависимости от начальной скорости потока (см. рис. 5). Также нанесем на данный график зависимость перепада давления от начальной скорости. Из анализа графика можно заключить, что наиболее эффективной с точки зрения теплоотдачи является TPMS Neovius. Однако, при течении жидкости через данную TPMS наблюдаются наибольшие потери давления. Хуже всего себя показала трижды периодическая минимальная поверхность Schwarz P, которой соответствует наименьшая эффективность теплоотдачи.

График на рис. 5 позволяет выбрать наиболее оптимальную топологию TPMS для задачи интенсификации теплообмена, что может быть полезно в различных отраслях промышленности, а также при проектировании теплообменного и другого оборудования.

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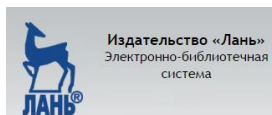
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