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## **MODELLING OF THE CIVILIZATIONS' BREAK LINES IN CONTEXT OF THEIR FUNDAMENTAL CULTURAL DIFFERENCES**

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Given article describes a development of a methodology of world geopolitics research with the use of contemporary geopolitical paradigms based on the work of expert groups in definition of the examined objects, development the set of evaluation criteria, and quantitative estimation of the cultural differences of different objects. Current research was based on hypothesis of S. Huntington about the “clash of civilizations”.

### **INTRODUCTION**

Discovering the mankind's development laws and their subsequent studying has always been interesting for scientists, both from qualitative and quantitative points of view. Already after the Second World War in RAND Corporation (USA) these problems were studied with the use of the game theory [1] and strategy of world conflicts [2]. Jay Forrester [3] and Denis Meadows [4] continued the research of global processes on the basis of world dynamics models created at request of the Club of Rome in the early seventies.

It is worth mentioning, that at that time theories, basically, were directed at modelling and prognosticating of the bipolar world. But within the last 20 years approaches to the description of the world system dynamics have been substantially reconsidered, proceeding from the new geopolitical situation in the world. They also have been essentially improved due to the development of mathematical methods of system and scenario analysis [5] and technological calculation means. The volume of global statistics increased, which allowed to develop integrated indicators of a sustainable development and system threats for the particular countries and world regions [6, 7, 15].

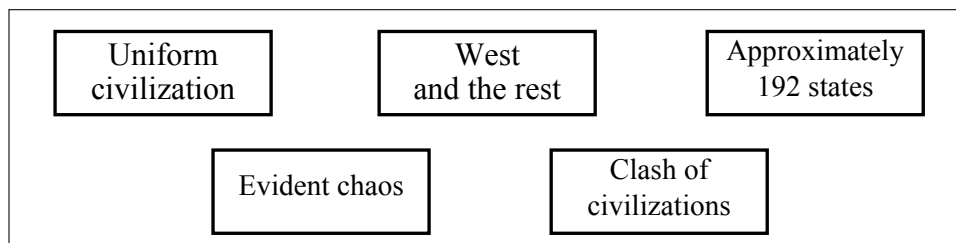
### **GEOPOLITICAL MODELS OF THE MODERN WORLD**

After the end of bipolar world era and as a result of globalisation processes, there appeared the necessity of formation of new paradigms which would most precisely reflect the existent situation in the world. As a result, at the beginning of nineties, there were formed 5 basic world cultures models, singled out in geopolitical aspect (fig. 1):

#### **a. Model “Euphoria and harmony uniting world” (The concept of a uniform terrestrial civilization)**

Supporters of this theory led by Francis Fukuyama and his well-known essay “The end of history and the last man” [8] considered that communism crash

would lead to domination of the western institutes of liberal democracy and free markets all over the world. And all the remained conflicts would be insignificant and would not be of ideological character. Several years after the fall of the Berlin wall, with an increase of the number and scope of regional conflicts, it became clear that this model little coincides with the political reality.



*Fig. 1. Geopolitical world models, which appeared after the end of the Cold War*

**b. Model “Two worlds: we and them” (or “West and the rest”)**

This model is known as «West against East», or «the rich north against the poor south», «the faithful against sceptics», and so forth. The model is very simple and does not describe any real conflicts in the world and fundamental distinctions between cultures and groups of countries. More detailed global data analysis that has been made recently resulted that a phenomenon of bipolarity and inequality gap is highly contextualized [9] therefore it cannot be used as a global model.

**c. Model “Approximately 192 states”**

In this model the assumption is made, that all states would practice exclusively pragmatic policy, would maximize their own power, search the balance of forces, and so forth. The majority of states, to certain extent, do it actively, but this model neglects cultural indications of alliances which is very essential. On the other hand, S. Huntington [10] shows that according to this "ideal" theory of forces' balance, the Western Europe should have united with Soviet Union in a fight against powerful, especially after the Second World War, United States. On the contrary, the West European governments, supposing that the Soviet Union was a threat for their way of life, concluded the alliance with the USA and generated NATO. According to Huntington, the states-nations will remain the basic players in the world politics. So, this model is useful, but it does not explain the developed distinctions between the international systems during the cold war and after its end, as the states have always pursued their own interests.

**d. Model “Evident chaos”**

This model envisages [11] that states and nations would lose their importance and eventually start to “diffuse” and even disappear. The power would be chaotically captured by small geographical subjects or even separate individuals. Racial, ethnic and religious conflicts would amplify, the weapons of mass destruction would be extended, and terrorism would increase in frequency and scale. The power of transnational corporations and mafia organizations would also increase. The Internet would become the most powerful authority in the XXI century, business elite in cyber-space would become an essential player on the world scene. The

world with the unified state would be impossible, and international regulating tools, first of all the UN, would disappear. Huntington recognizes that this “anarchy” model adequately reflects the real current processes to large extent, but it has no prospect from the point of view of relative importance of tendencies and the prognosis of various conflicts' development.

**e. Model “Clash of civilizations”**

Due to the shortcomings of all the aforementioned paradigms, S. Huntington offered one more concept of the subsequent world interaction, which is based on the civilization approach. In his work [12] Huntington defined 8 basic civilizations: Western, Confucian, Japanese, Islamic, Hindu, Slavic, Latin American and African, and showed, that the subsequent world conflicts would be based not on the ideological opposition, but on the cultural distinctions between these civilizations.

**DEFINITION OF THE RESEARCH TARGET ON THE BASIS OF EXPANDED CIVILIZATION APPROACH**

It should be noted, that civilization approach has already been repeatedly used both in historical researches [13], and in the world dynamics modelling [14]. Taking into consideration the fact that we are, first of all, interested in the cultural context of system dynamics and influence of cultural distinctions on the course of world conflicts, the concept of Huntington became a base of the subsequent modelling of distinctions between civilizations.

Research objective of this section is the quantitative and qualitative analysis of distinctions between world cultures on the basis of carrying out expert estimation of pair distinctions between civilizations according to Huntington [10] by the criteria defined by experts within the limits of the conducted modelling.

During the carrying out of the above-mentioned modelling we will execute the following stages:

- a. Make specifications of the civilization distribution, suggested by S. Huntington.
- b. Develop a system of criteria for the estimation of cultural distinctions between civilizations.
- c. Develop and perform expert estimation of the cultural distinctions.
- d. Process the estimation data and calculate values of “breaks” between civilizations.

**SPECIFICATION OF THE CIVILIZATION DISTRIBUTION AND COUNTRIES' CLUSTERING ACCORDING TO THE CRITERIA OF BELONGING TO CIVILIZATIONS**

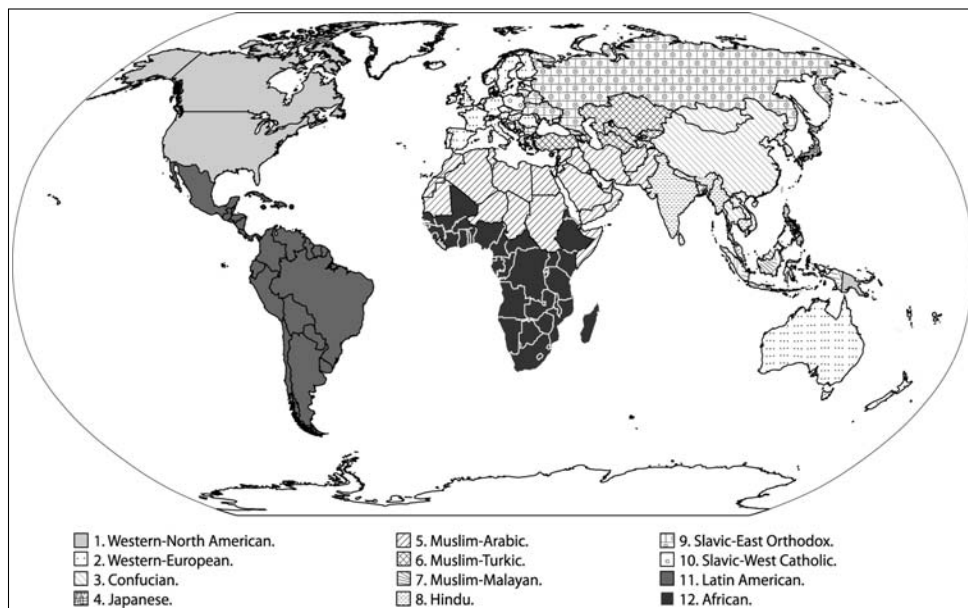
In order to avoid the subsequent ambiguous interpretation, let us give definition of the term “civilization”, which will be used in this research: civilization — human community, which during the certain period of time (process of origin, development, destruction or civilization transformation) has stable features in the socio-

political organisation, economy and culture (science, technologies, art, etc.), common cultural wealth, ideals, mentality and world-view [14].

Procedure of clustering (association of civilizations' relative criteria in groups) will be conducted on the basis of use of the expert estimation method. With that end, let us generate and organise work of several expert groups. **The first expert group** carried out the collective discussion of the offered list of civilizations and distribution of countries between them. This expert group included specialists — international affairs experts with global vision of geopolitical processes in the world. Formation of the civilization list (clusters) was conducted by the way of achieving compromise between historical and mental signs of their cultures and attempts to identify the most powerful cultural features of each civilization.

As a result, 192 countries (UN members) have been grouped in 12 civilizations, shown in fig. 2 and [15].

Using all the previous calculations of remoteness degrees of the world countries from the set of global threats, let us define average values of this remoteness degree (Table 1) for groups of countries, united on the basis of common culture (according to the specified civilization distribution of countries, suggested by S. Huntington [10]).



*Fig. 2. Map of countries' distribution by civilizations*

From the degrees of remoteness from set of global threats of civilizations given in table 1 we see, that most «successful» from the point of view of safety is the Japanese civilization, on the second place by this indicator is Western-North American, on the third — Western-European, on the fourth and fifth accordingly — Slavic-West Catholic and Slavic-East Orthodox, on the sixth — Muslim-Malayan, on the seventh — Latin American, on the eighth — Confucian, on the ninth and tenth accordingly — the Muslim-Arabic and Muslim-Turkic civilizations, on the eleventh — Hindu, and eventually on the twelfth — African.

**Table 1.** Remoteness degrees of civilizations from the set of global threats

Civilization / Threats	Security rating	Degree of remoteness from the set of global threats	Energetic security index	Misbalance between biosphere and people's necessities	Inequality (GINI index)	Corruption perception	Access to the drinking water	CO2 emissions	Children's mortality	Vulnerability to catastrophes	State instability	Vulnerability to global illnesses
<b>1. Western-North American</b> Canada, USA	2	<b>0,613</b>	0,419	0,679	0,633	0,795	1,000	0,323	0,974	0,999	0,960	0,742
<b>2. Western-European</b> Australia, Austria, Belgium, Denmark, Estonia, Israel, Ireland, Spain, Italy, Latvia, Lithuania, Luxembourg, Germany, New Zealand, Norway, Portugal, Romania, the United Kingdom, Finland, France, Switzerland, Sweden	3	<b>0,598</b>	0,156	0,489	0,672	0,747	0,981	0,679	0,975	0,999	0,957	0,703
<b>3. Confucian</b> Vietnam, China, Mongolia, Republic Korea, Thailand	8	<b>0,408</b>	0,068	0,124	0,629	0,350	0,830	0,853	0,903	0,962	0,712	0,562
<b>4. Japanese</b> Japan	1	<b>0,644</b>	0,012	0,394	0,751	0,750	1,000	0,670	0,984	0,995	1,000	0,815
<b>5. Muslim-Arabic</b> Algeria, Bangladesh, Bosnia and Herzegovina, Egypt, Yemen, Pakistan, Tajikistan, Tunis	9	<b>0,364</b>	0,110	0,065	0,670	0,280	0,830	0,929	0,772	0,979	0,495	0,500
<b>6. Muslim-Turkic</b> Albania, Azerbaijan, Kazakhstan, Kyrgyzstan, Turkmenistan, Turkey, Uzbekistan	10	<b>0,343</b>	0,159	0,091	0,690	0,243	0,837	0,825	0,744	0,996	0,617	0,409
<b>7. Muslim-Malayan</b> Indonesia, Malaysia	6	<b>0,438</b>	0,151	0,140	0,583	0,370	0,880	0,847	0,904	0,998	0,740	0,588
<b>8. Hindu</b> India, Cambodia, Nepal, Sri Lanka	11	<b>0,336</b>	0,242	0,049	0,617	0,280	0,740	0,983	0,695	0,991	0,430	0,513
<b>9. Slavic-East Orthodox</b> Belarus, Bulgaria, Greece, Georgia, Moldova, the Russian Federation, Ukraine	5	<b>0,463</b>	0,124	0,141	0,665	0,314	0,951	0,804	0,927	0,998	0,783	0,461
<b>10. Slavic-West Catholic</b> Poland, Slovenia, Slovakia, Croatia, the Czech republic	4	<b>0,563</b>	0,034	0,275	0,714	0,500	1,000	0,737	0,976	1,000	0,944	0,622
<b>11. Latin American</b> Argentina, Bolivia, Venezuela, Guatemala, Haiti, Dominican republic, Ecuador, Fur-tree El Salvador, Colombia, the River Kosta, Mexico, Nicaragua, Panama	7	<b>0,425</b>	0,168	0,137	0,477	0,306	0,880	0,931	0,856	0,979	0,691	0,634
<b>12. African</b> Cameroon, Nigeria, Southern African Republic, Zambia, Zimbabwe	12	<b>0,215</b>	0,273	0,060	0,502	0,288	0,682	0,920	0,420	0,999	0,360	0,271

## **FORMATION OF CRITERIA FOR ESTIMATION OF CULTURAL DISTINCTIONS BETWEEN CIVILIZATIONS**

To identify cultural distinctions between civilizations one should select a considerable number of criteria. At the same time, from the practical point of view, it is necessary to adhere to the reasonable compromise in the criteria quantity, their aggregated descriptiveness and universality. It is necessary to give each expert an opportunity to clearly differentiate distinctions between civilizations under consideration.

At the first stage those characteristics which are informative for research have been defined:

1. **Faith:** religions, views and erudition.
2. **Changes:** development, perfection, modernization and progress.
3. **Conflicts:** wars, terrorism, genocide, civil oppositions.
4. **Freedoms:** independence, democracy, rights and obligations, citizenship.
5. **Identification:** nation, nationality, ethnos, clan, group; religion; assimilation and adaptation.
6. **Judgments:** good and evil; morality, responsibility; traditionalism, politeness and intelligence.
7. **Knowledge:** scientific character and wisdom.
8. **Nature:** ecology, biosphere, sustainable development.
9. **Policy:** ideology and liberality, conservatism and neo-conservatism, fundamentalism, moderation and radicalism, “left” and “right”.
10. **Society components:** gender, family, castes and clans.

Following the results of **the second expert group** work, in which there were experts in sociology, culturology and international relations, 8 basic criteria were formulated, which most fully characterize cultural distinctions between civilizations, according to the experts' point of view:

1. **Value of human life.**  
Range: “Human life is worthless”—“Human life is the highest value”.
2. **Personal freedom inside society.**  
Degree of moving freedom, freedom of utterances, private life, etc.
3. **Status of woman in a society.**  
Range: “Full domination of male”—“Gender parity”—“Full domination of female”.
4. **Degree of religion penetration into public life.**  
Range: “Religious and church institutions do not influence people's life at all”—“Religious and church institutions greatly influence people's life”.
5. **Ethnic uniformity.**  
Degree of interethnic relations' tolerance inside civilization.
6. **Openness or closeness to other cultures (civilizations).**  
Degree of the civilization's openness or closeness.
7. **Traditionalism in culture and thinking (conservatism).**  
Disposition to changes in traditions and ways of thinking.
8. **Radicalism in political life.**  
Stability (constancy) of political life and speed of political courses' change.

**EXPERT ESTIMATION OF CULTURAL DIFFERENCES BETWEEN CIVILIZATIONS**

After formation of the final list of civilizations and set of estimation criteria (that is getting the first part of expert information - conceptually-notional), there appeared the necessity to specify the expert estimation procedure (getting the estimated expert information).

It is a question of considerable complexity, as experts have no possibility to give absolutely exact estimations of certain characteristics. Moreover, an attempt to make use of the existing methods of pair comparisons for getting cardinal estimations (methods of “line”, Saati and so on) was also unsuccessful owing to the fact that estimations of countries' cultural distinctions by some criteria are not subject to ordering. That is the order relation on these estimations' subspaces is impossible to maintain, even in case of partial order achievement since transitivity property is not carried out:

$$\exists k, civ \in C, \forall i, j \neg \exists R_k(civ_i, civ_j) : civ_i \prec civ_j,$$

where  $C$  — set of civilizations, which has been defined at the previous state;

$$R_k \text{ — relation in } C \times C.$$

But for each criterion experts can estimate the distance between corresponding values for each pair of civilizations:

$$\forall k, civ \in C, \forall i, j \exists d_k(civ_i, civ_j) : C \times C \rightarrow R_{[0;1]}.$$

For convenience of distances' estimation, experts used Miller's scale [5], given in table 2.

**Table 2.** Miller's scale

Qualitative difference estimation	Quantitative estimation	Distance range
Practically have no differences	1	[0; 0.1]
Very little differences	2	[0.1; 0.25]
Little differences	3	[0.25; 0.4]
Middle differences	4	[0.4; 0.6]
Big differences	5	[0.6; 0.75]
Very big differences	6	[0.75; 0.9]
Complete opposites	7	[0.9; 1]

Then the expert estimation will be as following:  $d_k(civ_i, civ_j) : C \times C \rightarrow Z_{[1;7]}$ . By imposing additional limits (that are quite sensible) to the experts' estimations  $d_k(x, z) \leq d_k(x, y) + d_k(y, z)$  (“triangle inequality”), we obtain metric  $d_k(x, y)$  (properties  $d_k(x, x) = 0$  and  $d_k(x, y) = d_k(y, x)$  will be thus evident) and set  $C$  becomes metric space.

The result of  $i$ -expert estimation will be a set  $X_i = (x_i^1, x_i^2, \dots, x_i^k, \dots, x_i^8)$ , where each criterion  $k$  has a corresponding matrix:

$$x_k^i = \begin{pmatrix} d_k(civ_1, civ_1) & \dots & d_k(civ_1, civ_m) \\ \vdots & \ddots & \vdots \\ d_k(civ_m, civ_1) & \dots & d_k(civ_m, civ_m) \end{pmatrix} = \begin{pmatrix} 0 & \dots & d_k(civ_1, civ_m) \\ \vdots & \ddots & \vdots \\ d_k(civ_m, civ_1) & \dots & 0 \end{pmatrix}.$$

To this matrix the following triangular matrix corresponds:

$$\tilde{x}_k^i = \begin{pmatrix} 0 & \dots & d_k(civ_1, civ_m) \\ \vdots & \ddots & \vdots \\ 0 & \dots & 0 \end{pmatrix}.$$

On the basis of the matrix structure, which actually should be a result of each expert's swork and using the afore-mentioned criteria of cultural distinctions between civilizations and countries classification into civilizations the following questionnaire was developed (table 3).

**Table 3.** Questionnaire for the expert estimation of distances between civilizations

		1	2	3	4	5	6	7	8	9	10	11	12
		Western-North American	Western-European	Confucian	Japanese	Muslim-Arabic	Muslim-Turkic	Muslim-Malayan	Hindu	Slavic-East orthodox	Slavic-West Catholic	Latin American	African
1	Western-North American	0											
2	Western-European		0										
3	Confucian			0									
4	Japanese				0								
5	Muslim-Arabic					0							
6	Muslim-Turkic						0						
7	Muslim-Malayan							0					
8	Hindu								0				
9	Slavic-East Orthodox									0			
10	Slavic-West Catholic										0		
11	Latin American											0	
12	African												0

For carrying out expert estimation of cultural distinctions between twelve civilizations on the basis of the above-stated eight criteria, **the third group of 14 experts** was created. These experts had experience in the international activity in countries' groups from the above-formed civilizations. Experts estimated cultural distinctions between civilizations ("breaks"/"distances") for each criterion, assigning quantitative values to these breaks, with use of estimations' system from the Miller's scale (table 2).



Thus, after paired estimation of distances between  $m=12$  civilizations by  $k=8$  criteria for  $n=14$  experts, we obtained general estimations' spectrum

$$Z_{[1;7]}^{\frac{1}{2}(m-1)mnk}.$$

**PROCESSING EXPERT ESTIMATION DATA AND ANALYSIS OF MODELLING RESULTS**

An error of expert estimation results was defined according to the following formula:

$$\varepsilon \approx \frac{3}{2(n-2,5)} = 0,058$$

from which it follows, that the estimation error is approximately 6 %.

After performance of normalisation procedure (reduction of data to a range  $[0;1]$ ) we will get estimations' spectrum  $R_{[0;1]}^{\frac{1}{2}(m-1)mnk}$ . For the subsequent data analysis we will pass from individual experts' estimations to a group estimation:

$$x_i = \sum_{s=1}^n x_i^s c_s \quad \left( i = 1, 2, \dots, \frac{1}{2}mk(m-1) \right),$$

where  $c_s$  — factors of experts' competence, which are normalised  $\left( \sum_{s=1}^n c_s = 1 \right)$ .

With the use of obtained estimation data, factors of experts' competence were defined on the basis of the following recurrent procedure:

$$x_i^t = \sum_{s=1}^n x_{is} c_s^{t-1} \quad \left( i = 1, 2, \dots, \frac{1}{2}mk(m-1) \right),$$

$$\lambda^t = \sum_{i=1}^{\frac{1}{2}mk(m-1)} \sum_{s=1}^n x_{is} x_i^t \quad (t = 1, 2, \dots),$$

$$c_s^t = \frac{1}{\lambda^t} \sum_{i=1}^{\frac{1}{2}mk(m-1)} x_{is} x_i^t, \quad \sum_{s=1}^n c_s^t = 1 \quad (s = 1, 2, \dots, n).$$

Calculation begins with  $t=1$ . Initial values of factors are assumed to be identical and equal  $c_s^0 = \frac{1}{n}$ . Using competence factors of the first approximation, it is possible to repeat the whole process of calculations and get the second approximations  $x_i^2, \lambda^2, c_s^2$ .

According to [16], this procedure converges under condition of nonnegative definiteness and indecomposability of matrices  $B = XX'$ , where  $X = \|x_{is}\|$ . Non-negative matrices' definiteness in this case is obvious. As far as indecomposability is concerned, nonfulfilment of this property would mean that experts and objects

(civilizations × criteria) fall into independent groups, and each expert group estimates its separate group of objects. As it contradicts both the format of the conducted estimation and to the obtained data, the indecomposability property is provided. Consequently, algorithm convergence takes place.

Competence factors' vector, obtained with the help of the presented iterative procedure, coincides with matrix eigenvector, which reflects its biggest eigenvalue. Factors of experts' competence, calculated with the help of the above described recurrent procedure, are presented in fig. 3.

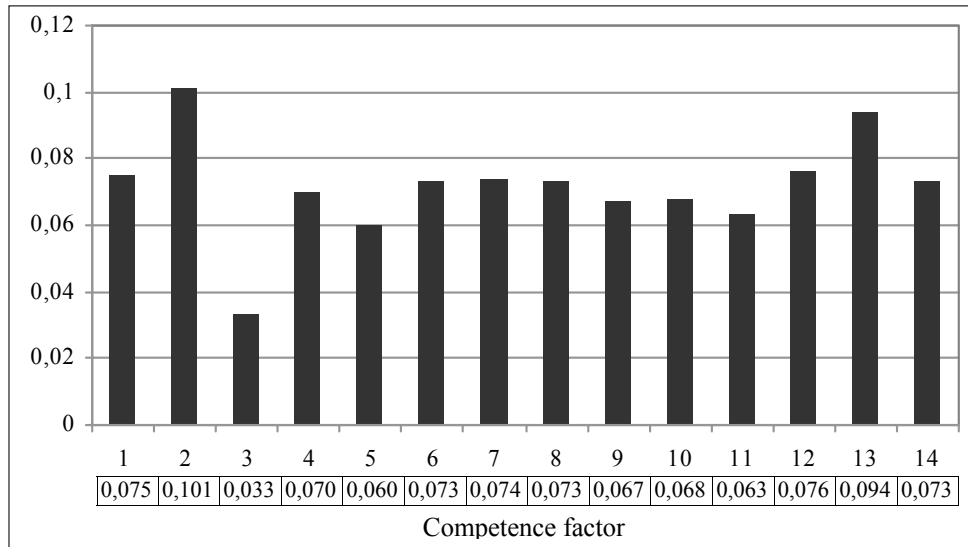


Fig. 3. Experts' competence factors

The detailed calculated group estimations are presented in [15]. On the basis of these estimations' definition, by the presented 8 criteria profiles of distinctions between civilizations were formed, “convergences” and “breaks” between them were defined, characterized by vector  $\vec{x} = (x^1, x^2, \dots, x^8)$ .

It also allowed making reverse estimation of a system effectiveness of the suggested criteria and experts' work efficiency characterized by the statistical data given in table 4.

**Table 4.** Statistical characteristics of estimations by various criteria

Characteristics	Criteria							
	1	2	3	4	5	6	7	8
$E[X]$	0,589	0,643	0,596	0,590	0,631	0,619	0,624	0,611
$D[X]$	0,055	0,053	0,052	0,054	0,050	0,049	0,054	0,040

Average criteria correlation among themselves made up 89 %. High correlation value testifies the possible presence of 2 factors:

- a) there is the interdependence of characteristics taken as the principle criteria. This factor can be eliminated through the specification of criteria system by carrying out future researches with attraction of the factorial analysis toolkit;
- b) insufficient quality of experts' recognition of characteristics, which were subject to estimation, which can be eliminated by attracting specialised experts to estimation of the corresponding criteria groups.

Let us execute clustering of the calculated distances with the help of k-means method, having put clusters' number  $n = 3$ . The clustering results are given in table 5.

**Table 5.** Clustered distances between civilizations (number of clusters  $n = 3$ )

Western-North American	Western-European	Confucian	Japanese	Muslim-Arabic	Muslim-Turkic	Muslim-Malayan	Hindu	Slavic-East Orthodox	Slavic-West Catholic	Latin American	African	
3	1	2	1	1	1	1	2	3	2	1	Western-North American	
3	1	2	1	1	1	1	2	3	2	1	Western-European	
1	1	3	2	2	2	2	2	1	2	2	Confucian	
2	2	3	2	2	2	2	2	2	2	1	Japanese	
1	1	2	2	3	3	2	1	1	2	2	Muslim-Arabic	
1	1	2	2	3	3	2	1	1	2	2	Muslim-Turkic	
1	1	2	2	3	3	3	1	1	2	2	Muslim-Malayan	
1	1	2	2	2	2	3	1	1	2	2	Hindu	
2	2	2	2	1	1	1	1	3	2	1	Slavic-East Orthodox	
3	3	1	2	1	1	1	1	3	2	1	Slavic-West Catholic	
2	2	2	2	2	2	2	2	2	2	2	Latin American	
1	1	2	1	2	2	2	2	1	1	2	African	

The greatest distances fell into the first cluster, they actually correspond to breaks between civilizations, to the second cluster — average distances, to the third cluster — the shortest distances corresponding to civilizations' approaching.

The important result of research is the definition of quantitative breaks' indicators. As sets of vectors  $\vec{x} = (x^1, x^2, \dots, x^8)$ , characterizing “breaks” between  $i$  and  $j$  civilizations according to all eight criteria are already defined, we will pass to definition of aggregation function:

$$u(X) = u(x^1, x^2, \dots, x^8)$$

by which a set of group estimations by various criteria is brought into accord to general distance, which will be an integral indicator of distinctions between two civilizations. Having chosen the additive form of this integral indicator, we will obtain the following form of function  $u$ :

$$u(x_{ij}) = \sum_{h=1}^k \omega_h x_{ij}^h, \quad (i, j = 1, 2, \dots, 12),$$

where  $\omega_h$  — weight of  $h$  criterion.

Assuming that  $\omega_i = \frac{1}{k} = \frac{1}{8}$ , we will get matrix  $D$  of general breaks between civilizations (table 6) which consists of 12 vectors:

$$d_i = \begin{pmatrix} x_{1,i} \\ \vdots \\ x_{i-1,i} \\ 0 \\ x_{i+1,i} \\ \vdots \\ x_{12,i} \end{pmatrix}, \quad D = (d_1, \dots, d_i, \dots, d_{12}),$$

where vector  $i$  corresponds to the breaks of civilization  $i$ .

**Table 6.** Matrix of the general breaks between civilizations

	Western-North American	Western-European	Confucian	Japanese	Muslim-Arabic	Muslim-Turkic	Muslim-Malayan	Hindu	Slavic-East IOrthodox	Slavic-West Catholic	Latin American	African	
Western-North American	0	0,7	0,65	0,96	0,92	0,89	0,78	0,55	0,33	0,56	0,85		Western-North American
Western-European	0	0,7	0,64	0,94	0,93	0,89	0,78	0,48	0,25	0,55	0,85		Western-European
Confucian	0,7	0,7	0	0,17	0,52	0,52	0,51	0,4	0,64	0,7	0,62	0,66	Confucian
Japanese	0,65	0,64	0,17	0	0,59	0,58	0,57	0,5	0,66	0,68	0,66	0,75	Japanese
Muslim-Arabic	0,96	0,94	0,52	0,59	0	0,1	0,12	0,41	0,74	0,86	0,68	0,55	Muslim-Arabic
Muslim-Turkic	0,92	0,93	0,52	0,58	0,1	0	0,15	0,41	0,77	0,85	0,66	0,59	Muslim-Turkic
Muslim-Malayan	0,89	0,89	0,51	0,57	0,12	0,15	0	0,34	0,76	0,86	0,65	0,58	Muslim-Malayan
Hindu	0,78	0,78	0,4	0,5	0,41	0,41	0,34	0	0,72	0,79	0,63	0,63	Hindu
Slavic-East Orthodox	0,55	0,48	0,64	0,66	0,74	0,77	0,76	0,72	0	0,37	0,52	0,79	Slavic-East Orthodox
Slavic-West Catholic	0,33	0,25	0,7	0,68	0,86	0,85	0,86	0,79	0,37	0	0,5	0,84	Slavic-West Catholic
Latin American	0,56	0,55	0,62	0,66	0,68	0,66	0,65	0,63	0,52	0,5	0	0,61	Latin American
African	0,85	0,85	0,66	0,75	0,55	0,59	0,58	0,63	0,79	0,84	0,61	0	African

The closing stage of the given research is the definition of norm in space of breaks' vectors, allowing to estimate the size of a "break", that is to calculate quantitative value of cumulative differences of the given civilization from the rest of the world. The choice of aggregation norm to significant extent influences adequacy of end results of the developed model, that is very important at reception of

integral estimation [16, 17]. In this connection the decision was accepted to choose norm from the following family of Gyolder's norms ( $\|x\|_p = \sqrt[p]{\sum_i |x_i|^p}$ ,  $p \geq 1$ ):

a. 1-norm (“Manhattan” norm)  $\|x\|_1 = \sum_i |x_i|;$

b. 2-norm (“Euclid” norm)  $\|x\|_2 = \sqrt{\sum_i |x_i|^2};$

c.  $\infty$ -norm (“Chebyshev” norm)  $\|x\|_\infty = \max |x_i|.$

It is known, that these norms are equivalent on finitely-measured vector space  $R^n$ . Proceeding from the physical content (for example if there is a conflict at least with one civilization, then it significantly influences the common civilization' position in the world) we will take the  $\infty$ -norm (“Chebyshev” norm), which will allow to consider adequately all components of breaks' vectors and is the least by modulus ( $\|x\|_\infty \leq \|x\|_2 \leq \|x\|_1$ ).

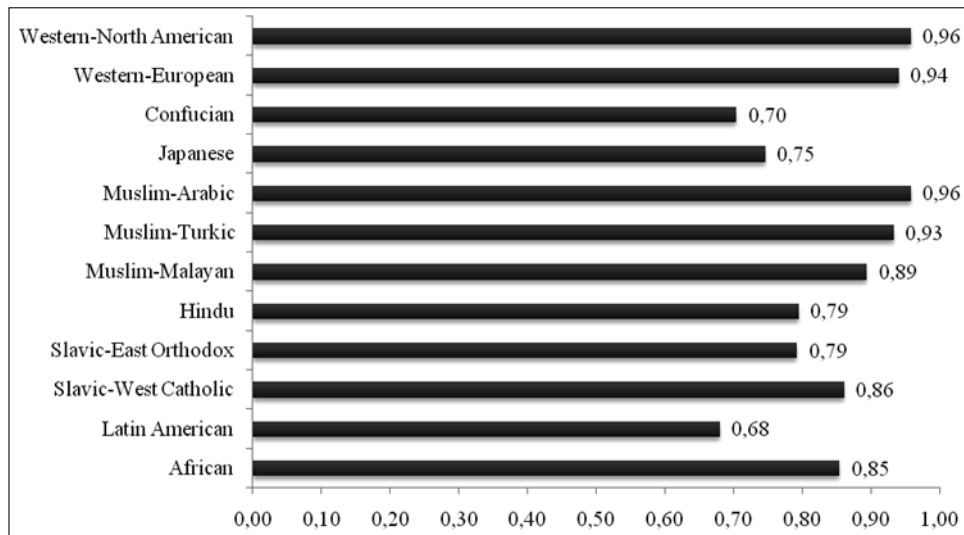


Fig. 4. Cumulative differences of civilizations from the rest of the world

The calculated values of cumulative differences of civilizations from the rest of the world are presented in fig. 4.

Actually cumulative differences of a separately taken civilization from the other world characterize, on the one hand its propensity to conflicts with other civilizations, and on the other hand — its attractiveness for the other civilizations.

**THE ANALYSIS OF THE OBTAINED RESULTS**

The obtained results show the existing cultural distinctions between different civilizations. Potential conflicts may take place between civilizations, first of all along the break lines, quantitative values of which are the biggest. And on the

contrary: potential civilizations' associations can take place along the break lines, quantitative values of which are the least. Using results of distances' clustering, numerical values of the common breaks between civilizations and cumulative civilizations' distinctions, we shall construct the list of possible associations and conflicts between world cultures.

Let us calculate civilizations' predispositions  $i_1, \dots, i_t$  to alliance  $p_u(A_{i_1}, \dots, \dots, A_{i_t})$ , by putting values of these predispositions inverse to the maximal distances between civilizations, which are in this block:

$$p_u(A_{i_1}, \dots, A_{i_t}) = 1 - \max[d(civ_a, civ_b)], \quad a, b \in i_1, \dots, i_t, \quad a \neq b.$$

Let us similarly define predispositions of civilizations to confrontations:

$$p_c(A_{i_1}, \dots, A_{i_t}) = \min[d(civ_a, civ_b)], \quad a, b \in i_1, \dots, i_t, \quad a \neq b.$$

Probable alliance and conflict civilizations' areas are given in tables 7 and 8, accordingly.

**Table 7.** Predisposition of civilizations to alliances

#	Block name and participating civilizations	$p_u(A)$
1.	<b>Western block</b> Western-North American, Western-European	1
2.	<b>Muslim block</b> Muslim-Arabic, Muslim-Turkic, Muslim-Malayan	0,85
3.	<b>Confucian-Japanese block</b> Confucian, Japanese	0,83
4.	<b>West-Catholic block</b> Western-North American, Western-European, Slavic-West Catholic	0,67
5.	<b>Malayan-Hinduistic block</b> Muslim-Malayan and Hindu	0,66
6.	<b>Slav block</b> Slavic-East Orthodox, Slavic-West Catholic	0,63

We see that the Western block possesses the greatest predisposition to association inside itself. High enough predisposition to internal association is observed in the Muslim block, the Confucian-Japanese block, at Malayan-Hinduistic block, and at the same time Slavs' internal association is hardly probable. Association of Western-North American, Western-European, Slavic-West Catholic civilizations under the factor of uniform Catholic religion is probable enough.

As far as oppositions are considered, the greatest propensity towards them have Western and Muslim civilizations' blocks. Western and Slavic blocks have big breaks with Islamic, Hinduistic and African civilizations. It is necessary to note the existing propensity of the Catholic block to opposition with Confucian civilization. This opposition is now observed not only in a cultures context, but also in a context of economy. Propensity to opposition between African and Hinduistic civilizations can be explained by the current strong influence of such phenomena, as racism and segregation.

**Table 8.** Predisposition of civilizations to confrontations

#	Confrontation name and participating civilizations	$p_c(A)$
1.	<b>Muslim and West</b> 1) Western-North American, Western-European 2) Muslim-Arabic, Muslim-Turkic, Muslim-Malayan	0,89
2.	<b>Africa and West</b> 1) Western-North American, Western-European 2) African	0,85
3.	<b>Slav and Africa</b> 1) Slavic-East Orthodox, Slavic-West Catholic 2) African	0,79
4.	<b>West and Hinduism</b> 1) Western-North American, Western-European 2) Hindu	0,78
5.	<b>Africa and Japan</b> 1) Japanese 2) African	0,75
6.	<b>Muslim and Slav</b> 1) Muslim-Arabic, Muslim-Turkic, Muslim-Malayan 2) Slavic-Eastorthodoxal, Slavic-Westcatholic	0,74
7.	<b>Slav and Hinduism</b> 1) Slavic-East Orthodox, Slavic-West Catholic 2) Hindu	0,72
8.	<b>Muslim and West</b> 1) Western-North American, Western-European 2) Muslim-Arabic, Muslim-Turkic, Muslim-Malayan	0,7

It is worth mentioning, that the most neutral civilization was found to be the Latin American, the manifestation of which is also its minimal cumulative difference from other civilizations, which is equal to 0,68 (fig. 4). It is least threatened by the oppositions with other civilizations. Further by these parameters there are countries of the Far East — Confucian (0,7) and Japanese (0,75) civilizations, then Slavic-East Orthodox and Hinduistic civilizations (both 0,79). The countries of Western (North American — 0,96, European — 0,94) and Muslim (Arabian — 0,96, Turkic — 0,93, Malayan — 0,89) blocks have the greatest propensity to oppositions. This value is also big enough for the Slavic-West Catholic civilization (0,86).

## CONCLUSIONS

The proposed approach and criteria system for the estimation of the cultural distinctions between civilizations can be used in the analysis of any geopolitical situation. In particular, quantitative values of civilizations' cultural distinctions according to separate criteria can be used for prognosticating formation of various associations and world countries' alliances (military, trading, religious, and so forth). Also it is possible to use the results in behavior and development modeling of the separate world countries. For example, it is possible to use indeclinability to oppositions of the Latin American civilization at performance of the SWOT-analysis of Brazil and scenario creation of its economic growth.

But it should be noted that, to get high quality results of studying this class of systems it is necessary to attract a lot of highly skilled experts possessing a wide vision of geopolitical processes. In addition, experts in particular panels should be involved - economy, culture, security, etc.

The obtained results substantially coincide with the modern situation in the world and enable us to speak about the adequacy of the constructed model at the first approximation. The subsequent researches are possible in several directions, in particular:

- the model's modification considering countries' clustering with the use of indistinct clusters;
- use of various estimation techniques, that most fully correspond to the research objective in one modelling;
- accounting of historical dynamics, in particular, the history of world confrontations;
- creation of simulation models for the prognosis of dynamics of civilizations development;
- comparison of various models and estimation of their adequacy.

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