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Sustainable development global simulation: Opportunities and treats to the planet

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[1] A system of factors (indices and indicators) and a new method named "Sustainable Development Gauging Matrix" (SDGM) culminated in a Global Simulation regarding quality of life and security of the world population are developed. The initial data for this simulation were presented by reliable international organizations. Specifically, this study focuses on applying SDGM to analysis of the Systematic Regularity of World Conflicts over the Course of Time. A prognosis is detailed of the next world conflict, labeled the "Conflict of XXI Century", and an analysis is provided of its nature and main characteristics; duration, main phases of the conflict and intensity. This prognosis details a set of basic global threats that spawn this conflict. Using cluster analysis, its influence on different countries of the world is accurately defined. Inferences are drawn from specific hypotheses as to possible scenarios occurring during the systemic conflict and after its conclusion. *INDEX TERMS:* 1600 Global Change; 6300 Policy Sciences; 6600 Public Issues; *KEYWORDS:* sustainable development, world conflicts, global simulation, noosphere.

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1. Introduction

[2] The subject of this study is based upon the concept of "sustainable development". The concept is a continuation of the theory of "noosphere" [*Vernadsky,* 1944]. The theory, in practice testifies that Vernadsky's "noosphere" doctrine at the turn of the century proves to be a necessary platform for the development of the "triune" concept of sustainable ecological, social and economic development. Hence, the new concept has united the three main components of sustainable development in society: economic, ecological and social.

[3] The economic component of the concept consists of optimizing the use of limited resources and the management of material and energy saving technologies. From an ecological perspective, sustainable development provides for the integrity of both natural biological and physical systems and ensures their viability. The global stability of the biosphere depends upon it. Special significance is attached to the ability of such systems to self reproduce and adapt to various changes, as opposed to being preserved in a static condition within a vacuum or deteriorating and losing its biological variety. The social component is oriented to human development, preserved stability of public and cultural systems, and the reduction of the amount of societal conflict.

[4] Coordinating a system comprised of these three components is a massive and complex task. Particularly, the interrelationship between social and ecological components results in the necessity of preserving identical opportunities for today's and future generations to exploit natural resources. The interaction of social and economic components compels achieving a valid distribution of material benefits amongst people and granting targeted help to poor layers of society. Finally, the interrelationship of natural protection and economic factors demands a cost assessment of the influence of technology on the environment. The solution to these problems is today's central challenge for national governments, pre-eminent international organizations and all forward thinking people of the world.

2. The Sustainable Development Gauging Matrix

[5] A fundamental assignment in embodying the concept of sustainable development is the formation of a standard of measures (indices and indicators) for reasonable quantitative and qualitative assessments of this very complicated process. The main requirements of the specified measures (gauging matrix) are their information "completeness" and

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Table 1. Set of Global Indices

Sustainable Development Dimension	Global Index	Constituents (49 indicators, 188 datasets)	Source
Economic, I_{ec}	I_c – Growth(Global) Competitiveness Index	3 indicators, 47 sets of data	World Economic Forum [www.weforum.org]
	I_{ef} – Economic freedom index	10 indicators, 50 sets of data	Heritage Foundation [www.heritage.org]
Ecological, I_e	I_{es} – Environmental Sustainability (Performance) Index	21 indicators, 76 sets of data	Yale University, USA [www.yale.edu/esi]
Social, I_s	I_q – Quality-of-life index	9 indicators	Economist Intelligence Unit [www.en.wikipedia.org]
	I_{hd} – Human development index	3 indicators	United Nation Development program [www.hdr.undp.org]
	I_{ks} – Knowledge society index	3 indicators, 15 sets of data	UNDESA, [UN, NE.04.C.1.2005]

the adequate representation of the interconnected triad of sustainable development components. Well known international organizations and numerous scientists are working in this direction, but the unequivocal coordination of these efforts has not been yet achieved.

[6] To meet this concept it is necessary to introduce a gauging matrix of sustainable development. The following sustainable development gauging matrix (SDGM) is proposed by the Institute for Applied System Analysis of the National Academy of Science of Ukraine and Ministry of Education and Science of Ukraine.

[7] Sustainable development measurements are introduced with the corresponding index (I_{sd}) (Figure 1):

[8] This index is determined by three dimensions: economic (I_{ec}), ecological (I_e) and social (I_s). Respectively, each of the indices (I_{ec}), (I_e), (I_s) is calculated by six global indices widely used in international practice (Table 1).

[9] **An index of economic dimension (I_{ec})** shall be generated from two global indices: *Growth (Global) Competitiveness Index* (further – an index of competitiveness – I_c), which was developed by the organizers of World Economic Forum. This index is annually defined for 117 economies of the world and published in the form of so-called "the Global Competitiveness Report". The report for 2005–2006 (http://www.weforum.org) was used for this paper. The index of competitiveness is comprised of three such indicators: the indicator of technological development of a country; the indicator of civil institutes and the indicator for the macroeconomic environment. In turn, these three indicators are calculated on the basis of 47 data sets including the conditions for technologies transfers and the innovational potential of a country, the level of development in information and communication technologies, the level of investment for research and development, the level of foreign direct investments, the level of government non-interference in business, the level of a country's perceived corruption, and others.

[10] *Economic Freedom Index* (I_{ef}), developed by the intellectual center of the Heritage Foundation (http://www.heritage.org/research/features/index). It is printed annually in the Wall Street Journal. The Economic Freedom Index is formed with the following ten indicators: the trade policy of country, the fiscal load on the part of government, governmental intervention in the economy, monetary policy, streams of capital and foreign investment, banking and financial activity, the policy of shaping prices and payments, the right to private property, a policy of regulation, and the informal activity of the market. These ten indicators are composed using fifty sets of economic, financial, legislative and administrative data.

[11] **Index of ecological dimension (I_e)** is generated on the basis of the well known *Environmental Sustainability Index (ESI)* designed by the Center of Ecological Legislation and Policy of Yale University (USA)

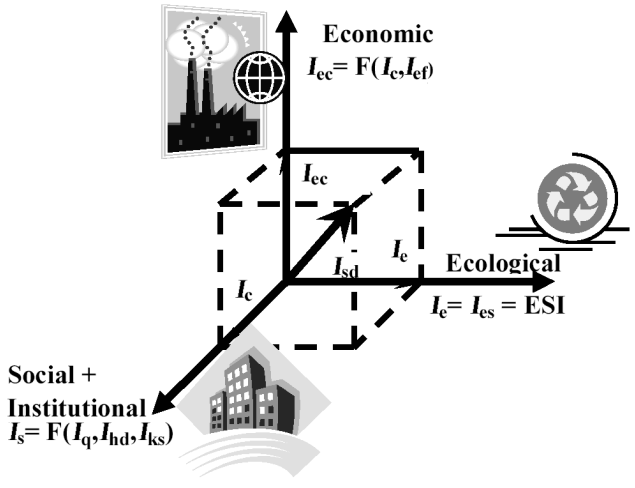

Figure 1. Global dimensions of sustainable development.

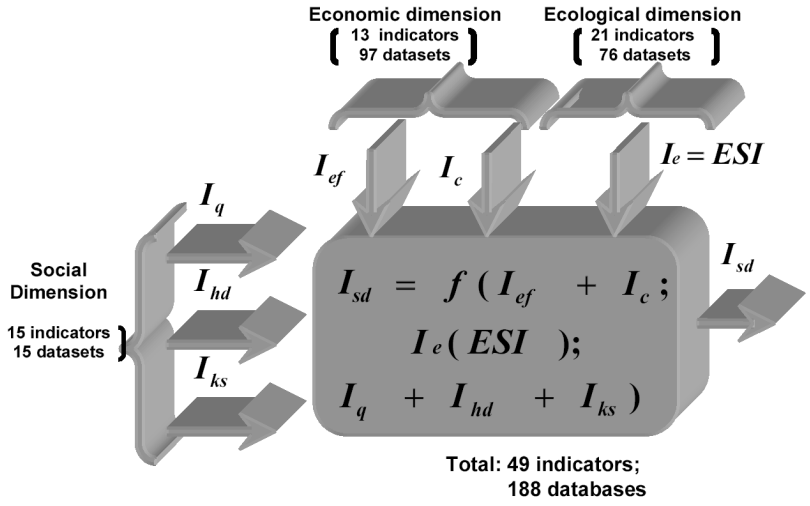

Figure 2. Mathematical model for calculation of sustainable development index (Model 1).

for 146 countries of the world (http://www.yale.edu/esi). The ESI is generated from 21 ecological indicators which, in turn, are defined by the use of 76 sets of ecological data, the level of environmental pollution in the past and presently, efforts of a country in the management of its ecological conditions, the ability of a country to improve ecological its characteristics and others.

[12] The ESI quantitatively defines the ability of any country to protect the environment both currently, and in the long-term, emerging from five criteria: the availability of a national ecological system; the ability to counteract ecological influences; the reduction of people's dependence on ecological influences; the social capabilities of a country to meet ecological challenges; the possibility to exercise global control over the ecological condition of a country. Additionally, this index may be used as a powerful tool for decision-making at an analytical level with an allowance for the social and economic measurements of sustainable development in a country.

[13] **An index of social dimension (I_s)** is generated by averaging three global indexes:

[14] *Quality of Life Index* (I_q), is developed by the international organization, the Economist Intelligence Unit (http://www.en.wikipedia.org). This index is formed with the help of the following nine indicators: the gross national product per capita calculated by the parity of purchasing capacity; the average life expectancy of the population of country; the rating for political stability and safety in a country; the quantity of the divorced families per 1000/population; the level of public activism (the activity of trade unions, public organizations etc.); the distinctions between the geographical divide given warmer and colder regions of a country; the rate of unemployment in a country; the level of political and civil freedom in a country; a ratio of an average salary of men compared to women;

[15] *Human Development Index* (I_{hd}) which is used by the United Nations Development Program (http://www.undp.org/annualreports/2005/english/). It is formed on the basis of the following three indicators: the average life expectancy of the population of a country; the level of education; the standard of life of the population of a country which is measured by gross national product per capita calculated by the parity of purchasing capacity;

[16] *Index of Knowledge Societies, or K – societies* (I_{ks}), was developed by the department of the United Nations on Economic and Social affairs – UNDESA (UN publication no. E.04. II.C.1, 2005). This index is defined by three basic indicators: the assets indicator; the advancement indicator and the foresightedness indicator, which in turn, are formed with the help of 15 data sets on a level of the involvement of youth in education and information, the investment climate in a country, the level of corruption, the inequality of the distribution of material and social benefits (GINI-index), the level of children's mortality rate, etc.

[17] As seen in Table 1, the sustainable development index (I_{sd}) is defined in terms of 49 indicators and 188 data sets. On the basis of the composition of different indicators and data sets for these three dimensions, the mathematical model as a system of linear algebraic equations (Figure 2) was developed for the calculation of the sustainable development index (I_{sd}).

[18] All data, indicators and indices which are included in the model (Figure 2) are measured in different units and have various interpretations. This is why they are reduced to the normal form in such a way that their changes and the changes of their indices themselves were in the range from 0 to 1. In this case the lowest values of the above indicators will correspond to the numerical values close to 0, and the highest – will approximate these values to 1. Such normalization allows one to calculate each of the indices I_{ec}, I_e, I_s and I_{sd} in the form of an averaged sum of its constituents with the corresponding weighted coefficients. In turn, the weighted coefficients in the calculation formula of the sustainable development index (I_{sd}) are chosen in such a way that allows one to provide the same weights of economic, ecological and social measures in this index.

[19] The SDGM can be used for various investigations of sustainable development. Let's consider some SDGM applications.

3. The Sustainable Development Global Simulation Based on Data of 2005–2006

[20] We shall fulfill calculation of an Index of Sustainable Development ($I_{\rm sd}$) using mathematical model 1 (Figure 2) and the global data for 2005–2006. The model includes complex mathematical formulas to integrate a large number of indexes and metrics measuring the development of countries. This interdisciplinary model seeks to integrate economic, ecological, and social/institutional factors into its analysis. All three areas need to be developed in harmony in order for a country to ensure "sustainable development."

[21] Sustainable development requires a balance between economic, environmental, and social/institutional development. Factoring in the dozens of data sets produced by international monitoring groups, the model can produce a numerical value for all three types of development, and also an overall development metric that takes all three into account.

[22] The model takes into account reports from various international organizations, including the United Nations, Heritage Foundation, World Economic Forum, Economist Intelligence Unit and a Yale University working group on the environment (Table 1).

[23] As a result, according to mathematical model 1 and global indices, corresponding indicators and datasets for 2006 year, the sustainable development index ($I_{\rm sd}$) is calculated for 116 countries (Table 2).

[24] In Tables 3, 4, 5, accordingly, are presented: a group of the world leaders in terms of sustainable development index, the G-8 countries and a group of the post socialist countries, positioned by the Index of Sustainable Development.

[25] According to the model, Finland is one of the most harmonized countries in the world with good scores in all three sectors. Within the last two years Finland steadily holds the leading position in the world in terms of sustainable development index, the New Zealand, Great Britain, France, USA, Czech Republic and Poland have essentially improved their positions, the sustainable development index for Estonia, Romania and Moldova has considerably decreased. Switzerland, Denmark, Sweden, Australia, Canada, Austria, Japan, Germany, Italy, Russia, Slovakia, Croatia, Bulgaria and Ukraine have remained practically on the same level of sustainable development.

4. Systematic Regularity of World Conflicts Over the Course of Time (SRWCT) and the Data Analysis of Global Threats to Sustainability in the XXI Century

[26] The analysis of the complete list of the world conflicts (http://en.wikipedia.org/wiki/List_of_wars) that took place from 2500 B.C. till now has shown that until the beginning of VII century B.C. these conflicts occurred without any permanent regularity. It looks like a stochastic process of the "white noise" type. It confirms the historic facts of permanent occurrence of conflicts at the early stages of the human civilization evolution, as a natural form of its existence. Only with the advent of higher forms of the society's formation it is possible to notice a certain periodic regularity in a sequence of data on the world conflicts. This regularity is determined and studied in the article [*Zgurovskij and Yasinsky,* 2007]. By using the specified regularity there appeared the possibility to foresee the upcoming system conflict, to analyze a set of threats generating it, to determine the impact of these threats on its development and to build scenarios of possible evolution of the society during and after the specified conflict. Certainly, it would be good to be mistaken in pessimistic prognoses, but from the scientific point of view, they are necessary in order to prevent the undesirable outcomes.

4.1. Systematic Regularity of World Conflicts Over the Course of Time (SRWCT)

[27] The succession of the world conflicts (which are taken place in the time interval – from 705 B.C. up to present time (List of wars, 2007; http://en.wikipedia.org/wiki /List_of_wars) was analyzed with the following quantizing on years:

$$\Delta T = 50 \text{ years} - 5 \text{ years} \cdot n;\ n = 0, 1, 2, \dots \ .$$

[28] The quantity of world conflicts for each sampling interval ΔT was defined as arithmetic mean of quantity of all conflicts on this time interval.

[29] At $n = 9$, $\Delta T = 5$ years, we can see a six successive evolutional waves $\{C_n\}$, $n = 1, 2, 3, \dots, 6$ (Figure 3, Table 6) of world conflicts (C_n-waves) which were defined by following characteristics:

[30] 1. Life cycle of each wave C_n generates five sequential evolutionary phases (stages) $\{C_{n,i}\}$, $i = 1, \dots, 5$:

[31] $C_{n,1}$ (ORIGINS); $C_{n,2}$ (GROWTH); $C_{n,3}$ (CULMINATION); $C_{n,4}$ (RECESSION); $C_{n,5}$ (EXTINCTION);

[32] 2. Duration of lifetime $T(C_n)$ of each following wave C_n is determined by the duration of lifetimes of two previous waves, namely:

$$T(C_n) \approx T(C_{n-2}) - T(C_{n-1})\ ; \tag{1}$$

[33] 3. Intensity of conflicts for C_n waves

$$I(C_n) = N(C_n)/T(C_n) \tag{2}$$

increases (Figure 2): $I(C_{n+1}) > I(C_n)$, due to the technological progress of the mankind, where $N(C_n)$ – number of conflicts shaping the wave C_n.

[34] The world conflicts that are uniquely determined by characteristics 1–3 we shall call C_n-waves of system world conflicts or in other words C_n-waves.

[35] We see that from 705 B.C. up to now six C_n-waves have been identified. Their so-called "structural portraits" and basic performances are shown in Table 6 and in Figure 3. Ratios $T(C_n)/T(C_{n+1})$, n=1, 2, 3, ... , 6 are shown in Table 7. As we see, they are varying around the "golden section" value – 1.618.

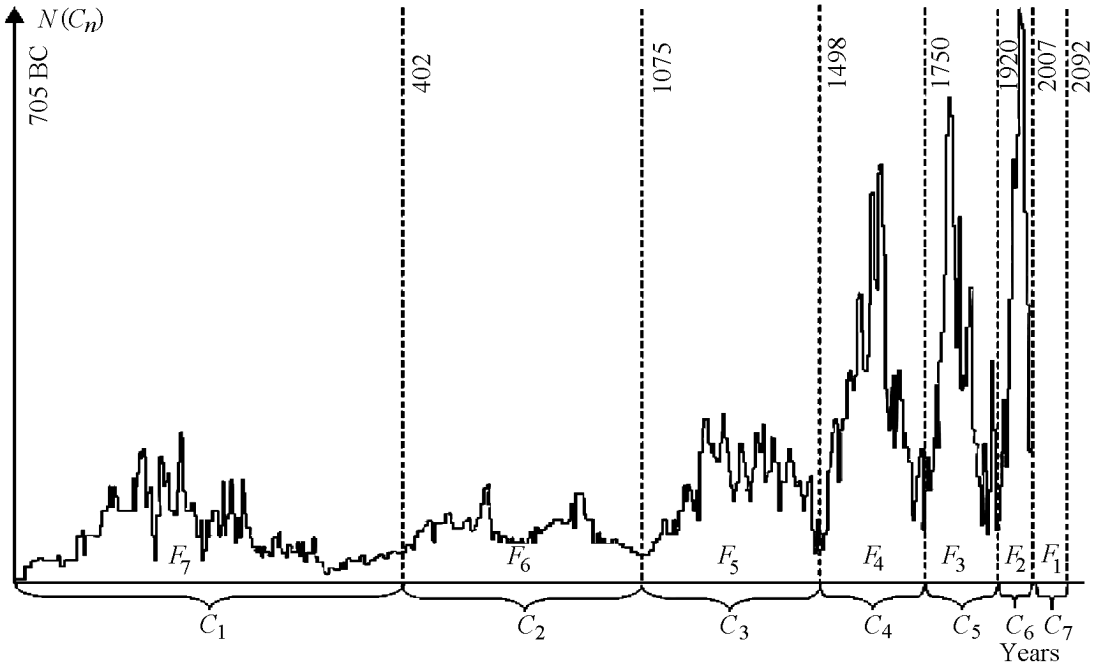

Figure 3. The "Structure Portrait" of C_n — waves of world conflicts.

[36] Therefore, we present the sequence $\{T(C_n)\}$, $n = 1, \ldots, 6, 7$ in the following form:

$$T(C_1) \approx 13k_c;\ T(C_2) \approx 8k_c;\ T(C_3) \approx 5k_c\ ;$$
$$T(C_4) \approx 3k_c;\ T(C_5) \approx 2k_c; \qquad (3)$$
$$T(C_6) \approx 1k_c;\ T(C_7) \approx 1k_c\ ,$$

where $k_c \approx 85$ years – the greatest common divisor for all values of lifetime duration $T(C_n)$ (invariant temporal quantum k_c), a row of numbers $F_s = \{13, 8, 5, 3, 2, 1, 1, 0\}$ represents an inverse sequence of Fibonacci numbers.

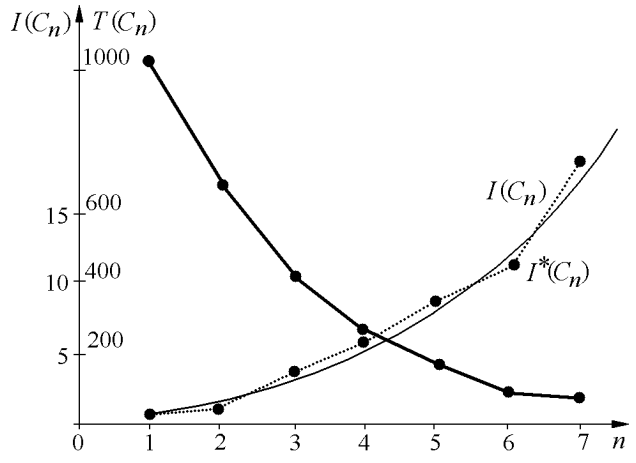

Figure 4. Duration and intensity of the sequence of world conflicts. ($n = 1, 2, 3, 4, 5, 6, 7$)

[37] Meanwhile six terms of sequence $T(C_1), \ldots, T(C_6)$ respond to the law of overmatching of units of Fibonacci series, we come up with the hypothesis, that occurrence of system world conflicts is subordinate to this law. Therefore, according to (1), the seventh (forecast) element of the sequence $\{T(C_n)\}$ should be:

$$T(C_7) = T(C_5) - T(C_6) = 1 \cdot k_c \approx 85 \text{ years}\ . \qquad (4)$$

[38] Intensity of conflicts $I(C_n)$, which depends on a level of technological evolution of the society (Figure 4), increases in time according to the hyperbolic law. We approximate this dependence with a hyperbolic function:

$$I^*(C_n) = N(C_n) \cdot \{T(C_n)\}^{-1} = N(C_n) \cdot (F_{8-n} \cdot k_c)^{-1}\ . \quad (5)$$

[39] According to (5) the intensity of the seventh (forecast) conflict is:

$$I\ (C_7) > 16\ . \qquad (6)$$

[40] Thus, relationships (3)–(6) present the systematic regularity of world conflicts over the course of time in the values of these conflicts' lifetime duration $T(C_n)$, their intensity $I\ (C_n)$ and values of Fibonacci numbers sequence (F_s).

4.2. "The Conflict of XXI Century" and the Analysis of Its Nature

[41] The element being forecast by means of (5) and (6) will correspond to the seventh wave of system world conflicts C_7. We shall call it "the conflict of XXI century". This conflict has the time span from 2008 to 2092 with the following probable phases:

Table 2. The Sustainable Development Index for 2006

Ranking	Country	GDP per Capita (PPP)	Index of Sustainable Development I_{sd}	Index of Economic Dimension I_{ec}	Index of Ecological Dimension I_{e}	Index of Social Dimension I_{s}
			Cluster 1. Very High			
1	Finland	$30,600	0.865	0.870	0.861	0.865
2	New Zealand	$24,200	0.864	0.843	0.871	0.879
3	Switzerland	$35,300	0.864	0.886	0.806	0.899
4	Denmark	$33,400	0.864	0.870	0.834	0.888
5	Sweden	$29,800	0.863	0.848	0.869	0.872
6	United Kingdom	$30,900	0.855	0.876	0.847	0.842
7	Australia	$32,000	0.851	0.860	0.793	0.899
8	United States	$42,000	0.845	0.884	0.777	0.875
9	Canada	$32,900	0.843	0.847	0.832	0.851
10	Austria	$32,900	0.843	0.806	0.843	0.878
11	France	$30,000	0.833	0.780	0.817	0.902
12	Netherlands	$30,600	0.830	0.855	0.779	0.855
13	Japan	$30,700	0.828	0.841	0.811	0.831
14	Ireland	$34,100	0.827	0.846	0.825	0.810
15	Norway	$42,400	0.822	0.809	0.794	0.864
16	Iceland	$34,900	0.822	0.842	0.813	0.812
17	Germany	$29,800	0.818	0.839	0.786	0.828
18	Luxembourg	$55,600	0.817	0.832	0.765	0.854
19	Belgium	$31,900	0.803	0.818	0.751	0.839
			Cluster 2. High			
20	Spain	$25,200	0.797	0.757	0.784	0.850
21	Czech Rep.	$18,100	0.795	0.749	0.851	0.785
22	Portugal	$18,600	0.790	0.722	0.821	0.829
23	Italy	$28,400	0.780	0.694	0.790	0.856
24	Chile	$11,300	0.780	0.801	0.781	0.757
25	Israel	$22,300	0.776	0.797	0.730	0.800
26	Cyprus	$20,300	0.769	0.733	0.776	0.798
27	Malaysia	$10,400	0.764	0.761	0.825	0.705
28	Slovenia	$21,000	0.760	0.710	0.767	0.802
29	Slovakia	$15,800	0.755	0.726	0.783	0.755
30	Greece	$22,800	0.752	0.654	0.794	0.807
31	Hungary	$16,100	0.749	0.713	0.763	0.772
32	Costa Rica	$10,100	0.735	0.684	0.808	0.713
33	Poland	$12,700	0.728	0.657	0.754	0.773
34	Croatia	$11,600	0.727	0.637	0.765	0.780
35	Panama	$7,100	0.726	0.682	0.757	0.737
36	Argentina	$13,700	0.725	0.626	0.769	0.779
37	Trinidad & Tobago	$12,900	0.717	0.697	0.761	0.693
38	Estonia	$16,400	0.717	0.823	0.576	0.751
39	Colombia	$7,100	0.713	0.644	0.796	0.698
40	Brazil	$8,400	0.704	0.645	0.762	0.704
			Cluster 3. Medium			
41	Bulgaria	$9,000	0.696	0.645	0.713	0.731
42	United Arab Em.	$29,100	0.696	0.696	0.725	0.668
43	Russia	$10,700	0.693	0.615	0.767	0.696

Table 2. Continued.

44	Mexico	$10,100	0.692	0.682	0.642	0.753
45	Thailand	$8,300	0.690	0.715	0.661	0.695
46	Jamaica	$4,200	0.689	0.676	0.740	0.650
47	Latvia	$13,000	0.688	0.727	0.598	0.740
48	Turkey	$7,900	0.683	0.646	0.721	0.682
49	Ecuador	$3,900	0.680	0.587	0.747	0.705
50	Bosnia and Herzegovina	$6,800	0.678	0.583	0.766	0.683
51	Ukraine	$6,800	0.668	0.595	0.705	0.705
52	Jordan	$4,800	0.664	0.679	0.653	0.658
53	Albania	$4,900	0.662	0.599	0.682	0.705
54	Armenia	$5,300	0.661	0.663	0.632	0.687
55	Venezuela	$6,500	0.658	0.550	0.734	0.690
56	Tunisia	$7,600	0.657	0.703	0.594	0.673
57	South Africa	$12,100	0.654	0.689	0.614	0.660
58	Philippines	$5,100	0.652	0.625	0.687	0.645
59	Peru	$6,100	0.651	0.643	0.647	0.662
60	Suriname	$4,100	0.648	0.554	0.723	0.668
61	Nicaragua	$2,400	0.648	0.610	0.685	0.647
	Cluster 4. Low					
62	El Salvador	$5,100	0.646	0.697	0.624	0.618
63	Honduras	$2,800	0.645	0.604	0.701	0.630
64	Guatemala	$5,200	0.645	0.636	0.682	0.615
65	Paraguay	$4,900	0.645	0.565	0.657	0.711
66	Dominican Rep.	$6,600	0.644	0.600	0.688	0.644
67	Kazakhstan	$8,800	0.644	0.656	0.630	0.645
68	Georgia	$3,300	0.644	0.658	0.608	0.665
69	Sri Lanka	$4,300	0.636	0.623	0.640	0.646
70	Morocco	$4,300	0.633	0.626	0.635	0.639
71	Algeria	$7,200	0.626	0.591	0.655	0.633
72	Bolivia	$2,700	0.625	0.567	0.628	0.679
73	Moldova	$2,100	0.621	0.610	0.623	0.631
74	China	$6,300	0.617	0.629	0.556	0.667
75	Indonesia	$3,700	0.615	0.636	0.601	0.609
76	Namibia	$8,200	0.605	0.634	0.559	0.622
77	Azerbaijan	$4,700	0.604	0.620	0.551	0.642
	Cluster 5. Very Low					
78	Egypt	$4,400	0.596	0.610	0.573	0.605
79	Kyrgyzstan	$1,800	0.590	0.578	0.599	0.592
80	India	$3,400	0.573	0.653	0.472	0.594
81	Mongolia	$2,200	0.567	0.604	0.483	0.614
82	Viet Nam	$3,000	0.563	0.579	0.538	0.574
83	Kenya	$1,200	0.561	0.598	0.558	0.525
84	Uganda	$1,700	0.556	0.586	0.602	0.481
85	Nepal	$1,500	0.551	0.545	0.596	0.513
86	Tanzania	$700	0.546	0.568	0.584	0.485
87	Tajikistan	$1,200	0.541	0.580	0.477	0.565
88	Benin	$1,100	0.540	0.558	0.578	0.484
89	Cambodia	$2,200	0.536	0.569	0.493	0.546
90	Gambia	$1,800	0.535	0.578	0.518	0.509
91	Madagascar	$900	0.528	0.583	0.481	0.519
92	Zambia	$900	0.524	0.556	0.539	0.479
93	Malawi	$600	0.524	0.536	0.559	0.475
94	Cameroon	$1,900	0.520	0.551	0.536	0.473
95	Zimbabwe	$2,100	0.508	0.434	0.624	0.466

Table 3. World leaders in terms of the sustainable development index for 2006

Country	GDP per capita	Ranking 2005	Index of Sust. Develop. (I_{sd}) 2005	Direction of changes	Ranking 2006	Index of Sust. Develop. (I_{sd})	Index of the Economic Dimension (I_{ec})	Index of the Ecological Dimension (I_e)	Index of the Sosial Dimension (I_s)
Finland	\$30,600	1	0.787	0	1	0.865	0.870	0.861	0.865
New Zealand	\$24,200	11	0.713	+9	2	0.864	0.843	0.871	0.879
Switzerland	\$35,300	5	0.737	+2	3	0.864	0.886	0.806	0.899
Denmark	\$33,400	7	0.731	+3	4	0.864	0.870	0.834	0.888
Sweden	\$29,800	3	0.774	−2	5	0.863	0.848	0.869	0.872
United Kingdom	\$30,900	17	0.674	+11	6	0.855	0.876	0.847	0.842
Australia	\$32,000	10	0.716	+3	7	0.851	0.860	0.793	0.899
United States	\$42,000	13	0.695	+5	8	0.845	0.884	0.777	0.875
Canada	\$32,900	8	0.721	−1	9	0.843	0.847	0.832	0.851
Austria	\$32,900	12	0.697	+2	10	0.843	0.806	0.843	0.878

- The 20's of XXI century – origin;
- The beginning of 20's, the end of 40's of XXI century – growth;
- 50's – of XXI century – culmination, $I\ (C_7) > 16$;
- The beginning of the 60's, the end of 70's of XXI century – RECESSION;
- 80's of XXI century – extinction.

[42] Let us study the nature of "the conflict of XXI century" on the basis of the analysis of a totality of threats generating this conflict. We will determine a degree of approach or removal of these threats for various groups of the countries.

[43] We shall analyze each of these threats [*Zgurovsky,* 2007]:

[44] **4.2.1. Global decrease of the earth energy resources.** In the first half of XXI century one of the most acute threats to the mankind is a sweeping decrease of organic fuels resources accompanied by an increase of their consumption, first of all, in India and China. According to (Alenka Burja, 2006; http://www.folkecenter.dk/en/articles /HScheer_aburja.htm) in the beginning of the 20s of the current century there will be the intersection of consumption and production curves of energy produced from oil. In other words, the "production-consumption" balance of the energy produced from oil will inverse from positive to negative (Figure 5). A similar phenomenon will be observed for the "production-consumption" balances of the energy produced from gas – in the beginning of 30's and for uranium – in the beginning of 50's, respectively (Figure 5).

[45] To quantitatively estimate a decrease of organic fuels resources for different countries we will use the parameter: "Consumption of traditional fuels percentage wise of the general energy needs of the country" (Human Development Report, 2006; http://hdr.undp.org/en/reports/global /hdr2006/).

[46] **4.2.2. The changes of demographic structure of the world.** By the end of 2007 our planet's population constitutes 6.63 billion people living in the territory of 510,072,000 square kilometers. The population annually increases by more than 74 million (Geo Hive database, maintained by Johan van der Heyden, 2007). If we proceed from the linear extrapolation method, the population of the Earth will reach 9.75 billion by 2050. Due to this the first of possible threats originates. It is connected with the fact that the population of the planet would become more than it could withstand. In opinion of Pentagon experts by 2020 the mankind shall face real problems connected with critical deficit of water and energy, which, in its turn, may lead to new conflicts on the Earth (http://www.membrana.ru/ articles/misinterpretation/2004/03/03/182200.html).

[47] Another threat is connected with changes in the population demographic structure. For example, the greatest increase in the population within the next fifty years is expected in the poorest regions of the world: in Africa it will double, in Latin America and the Caribbean basin the pop-

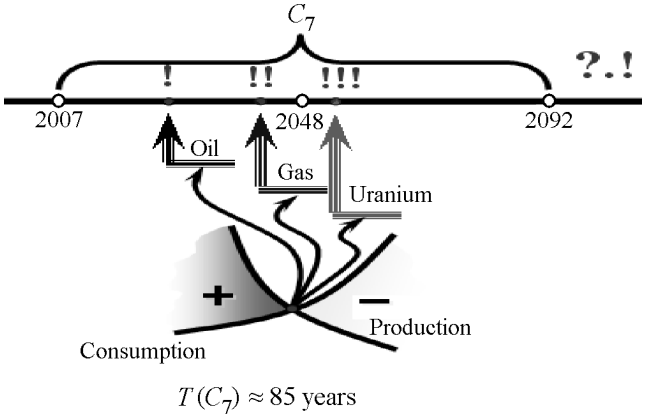

Figure 5. Turn the "production-consumption" balance to negative values for the oil, gas, and uranium.

Table 4. The sustainable development index for G-8 countries (2006 year)

Country	GDP per capita	Ranking 2005	Index of Sust. Develop. (I_{sd}) 2005	Direction of changes	Ranking 2006	Index of Sust. Develop. (I_{sd})	Index of the Economic Dimension (I_{ec})	Index of the Ecological Dimension (I_e)	Index of the Sosial Dimension (I_s)
United Kingdom	\$30,900	17	0.674	+11	6	0.855	0.876	0.847	0.842
United States	\$42,000	13	0.695	+5	8	0.845	0.884	0.777	0.875
Canada	\$32,900	8	0.721	−1	9	0.843	0.847	0.832	0.851
France	\$30,000	21	0.642	+10	11	0.833	0.780	0.817	0.902
Japan	\$30,700	16	0.680	+3	13	0.828	0.841	0.811	0.831
Germany	\$29,800	14	0.687	−3	17	0.818	0.839	0.786	0.828
Italy	\$28,400	26	0.613	+3	23	0.780	0.694	0.790	0.856
Russia	\$10,700	44	0.516	+1	43	0.693	0.615	0.767	0.696

ulation will increase by 1.5 times, while in Europe it will decrease by 0.8 times. An uncontrollable growth of the urban population in developing countries also presents a considerable threat. By 2050 it will double, and will be reaching 7 billion. It shall result in aggravation of transport, ecological and social problems, increase in crime and other consequences of uncontrolled urbanization.

[48] An important trend of the nearest decades will be impetuous changes in religious groups of the world population. Thus, within the period from 1980 to 2025 the number of Moslems will increase from 16.5% up to 30%, the number of Christians will reduce from 33% to 30%, that of Hindus will change from 13.3% to 10%, and Buddhists – from 6.3% to 5%. The total number of representatives of other religious groups will also decrease from 31.1% to 25% (Japan Vision 2050. Principles of Strategic Science and Technology Policy Toward 2020, 2005; http://www.scj.go.jp/en/vision2050.pdf). These changes will necessitate searching for new conditions of tolerant coexistence of the world population.

[49] To estimate growing threats resulting from the imbalance of the world population and the planet resources we shall use the indicator representing the ratio of the gross national product per capita to the population density of the given country. We shall use the data from the sources (Human Development Report, 2006; http://hdr.undp.org/en/reports/global/hdr2006/; and Geo Hive database, maintained by Johan van der Heyden, 2007).

[50] **4.2.3. The increasing inequality between people and countries.** According to the World Bank in 1973 the gap in profits between the richest and poorest countries was defined as 44:1, and now it is 72:1. The three richest people in the world now possess the wealth exceeding the wealth of 47 poor countries of the world, 475 richest people control over the wealth exceeding the property of a half of all mankind. The relationship between one fifth part of the world rich population and one fifth of the world poorest population is 1:75. Thirty years ago this relationship was 1:43. The assets of civilization remain unattainable for the poorest group. Its representatives earn less than 2 dollars a day. Seven hundred million of them live in Asia, four hundred million in Africa, hundred fifty million in Latin America. The gap between the richest and poorest groups in their living standards has increased almost ten times during the last

Table 5. Post socialist countries, positioned by the sustainable development index in 2006

Country	GDP per capita	Ranking 2005	Index of Sust. Develop. (I_{sd}) 2005	Direction of changes	Ranking 2006	Index of Sust. Develop. (I_{sd})	Index of the Economic Dimension (I_{ec})	Index of the Ecological Dimension (I_e)	Index of the Sosial Dimension (I_s)
Czech Rep.	\$18,100	29	0.602	+8	21	0.795	0.749	0.851	0.785
Slovakia	\$15,800	28	0.602	−1	29	0.755	0.726	0.783	0.755
Poland	\$12,700	38	0.559	+5	33	0.728	0.657	0.754	0.773
Croatia	\$11,600	31	0.596	−3	34	0.727	0.637	0.765	0.780
Estonia	\$16,400	18	0.662	−20	38	0.717	0.823	0.576	0.751
Bulgaria	\$9,000	39	0.549	−2	41	0.696	0.645	0.713	0.731
Latvia	\$13,000	24	0.618	−23	47	0.688	0.727	0.598	0.740
Ukraine	\$6,800	47	0.486	−4	51	0.668	0.595	0.705	0.705
Romania	\$8,400	43	0.532	−19	62	0.646	0.646	0.563	0.730
Moldova	\$2,100	45	0.506	−29	74	0.621	0.610	0.623	0.631

Table 6. The main characteristics of C_n-waves of world conflicts

C_n-waves	Time interval of C_n-wave	The duration of C_n-wave	The number of conflicts, which form the C_n-wave	The intensity of conflicts for C_n-wave	The correspondence of C_n-waves to Fibonaccy numbers F_s
C_1	705 B.C.–401 A.C.	1106	1218	$I(C_1)$=1.101	F_7=13
C_2	402–1074	674	756	$I(C_2)$=1.122	F_6=8
C_3	1075–1497	422	1680	$I(C_3)$=3.981	F_5=5
C_4	1498–1749	252	1543	$I(C_4)$=6.123	F_4=3
C_5	1750–1919	170	1485	$I(C_5)$=8.735	F_3=2
C_6	1920–2007	87	1035	$I(C_6)$=11.897	F_2=1
C_7 (Forecasting wave)	2008–2092	85	>1400	$I(C_7) > 16$	F_1=1

twenty years. This threat is rather serious from the point of view of growing number of conflicts in the world, spreading of corruption, terrorism, crimes, worsening of education, ecology and health care.

[51] To estimate the inequality in distribution of economic and social assets for each of the considered countries we shall use Gini index (Human Development Report, 2006; http://hdr.undp.org/en/reports/global/hdr2006/) representing these characteristics.

[52] **4.2.4. Spreading of human immunodeficiency virus (HIV), tuberculosis, malaria.** Among new threats to the mankind World Health Organization (WHO) points out such dangerous infectious diseases, as HIV/AIDS, tuberculosis and malaria, first of all, in connection with their dramatic consequences and also their global spreading.

[53] According to the data of the international organization UNAIDS only during 2004–2006 the number of HIV-infected people in the world has increased from 36.9 to 39.5 million. This general tendency with minor variations is observed in all regions of the world.

[54] Despite of the successes achieved in combating tuberculosis, annually in the world there are 8 million new morbid events causing 2 million of fatal outcomes. In countries with a high level of HIV/AIDS spreading, the number of those suffering from tuberculosis has 3–4 times increased for the last 15 years (http://www.who.int/gb). 80% of them have been registered in Africa, South East Asia and the Western part of coastwise of the Pacific Ocean.

[55] Malaria is traditionally widespread in Africa and Latin America. For the last five years malaria incidence has 2–3 times increased in Afghanistan, Ghana, Papua New Guinea, Pakistan, Uganda; 30 times in Mozambique and Democratic Republic of Congo; threatening morbidity rates (70 times growth) are registered in Mali. In other countries where cases of malaria are recorded, the morbidity rates are varying within the limits of ±50% for the last 5 years.

[56] We used the data on the indicated diseases presented by the World Health Organization (http://www.who.int /healthinfo/statistics/programme/en/index.html).

[57] **4.2.5. Corruption growth.** Corruption poses a formidable obstacle to economic growth and social evolution. It undermines any positive transformations. Corruption has become not only the major reason for poverty, but also the main impediment of overcoming it. Although corruption is rooted in ancient times, its "explosion" occurred at the end of XX, the beginning of XXI centuries in the course of the sweeping globalization. Corruption in one country has begun negatively affect development of other countries. Moreover, countries with the highest level of corruption now are not confined by the so-called "third world": liberalization in the former socialist countries in 1990-s was accompanied by scandalous official abuses. In its issue of 31 December 1995 "Financial Times" called 1995 "the year of corruption". The following years were marked by this negative phenomenon penetrating almost into all countries of the world, and, thus, corruption has gained global, international character.

[58] High living standards did not become the necessary precondition of successful eradication of corruption. The analysis of the long-term trends revealed by the international organization "Transparency International" shows that for the last twelve years the corruption level has decreased in some countries with low levels of income, such as Estonia, Colombia, and Bulgaria. In the same time, in rich countries, for example, in Canada and Ireland a noticeable growth of corruption level is observed. Such risk factors as the opac-

Table 7. "Golden section" coefficients for the sequence of world conflicts $\{C_n\}$, n=1, 2, 3, 4, 5, 6, 7

C_n	C_1	C_2	C_3	C_4	C_5	C_6	C_7
$T(C_n)$, years	1106	674	422	252	170	87	85
$F = T(C_n)/T(C_{n+1})$	1.641	1.597	1.675	1.482	1.954	1.023	–
F_{8-n}	13	8	5	3	2	1	1
F_{8-n}/F_{8-n-1}	1.625	1.6	1.667	1.5	2	1	–

ity of state institutions, excessive impact of some oligarchic groups, violations in financing political parties, etc. exist both in rich and in poor countries; and, unfortunately, in the majority of countries the tendencies towards the growth of corruption still remain.

[59] To estimate effect of corruption on social, economic and spiritual evolution of the world we shall use "an index of corruption perception" which is defined by the international organization "Transparency International" (http://www.transparency.org.ru).

[60] **4.2.6. Limited access to clean potable water.** According to World Health Organization (WHO) and Children's fund of the United Nations (UNICEF), one more danger is connected with diminishing access of people to clean potable water and sanitary means. The fifth part of mankind (more than 1.1 billion people) has no access to potable water, and 2.4 billion are not provided with minimum sanitary conditions. In this connection 2003 was declared by the General Assembly of the United Nations the International year of fresh water, and the period from 2005 to 2015, starting from the International day of water resources, 22 March 2005, the International decade of "Water for life" actions.

[61] Especially critical is the situation in urban regions of poor countries where due to the rapid growth of population this problem quickly becomes aggravated. The indicated negative factors especially affect the children's health. As estimated by WHO, in 2005 1.6 million children under 5 years of age (on the average, 4500 children daily) died of aftereffects of the usage of unsafe water and because of inadequate hygiene. In the course of the world population growth and especially that in less developed regions of the world, the struggle for control over fresh water resources will become bitter, which represents one more global threat to the mankind.

[62] Limited access to clean potable water will be estimated by the inverse magnitude to the indicator of access to the clean potable water presented in the WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation, 2005 (http://www.wssinfo.org/en/welcome.html).

[63] **4.2.7. Isolation or "inverse globalization".** Considering globalization as an objective phenomenon that has its economic basis and is associated with growing interdependency of people on the Earth with the purpose of common use and sharing the best achievements of mankind, we assume that its opposite – "isolation" being an artificial process and having political basis presents one more global threat.

[64] Isolation or "inverse globalization" – is a sign of the "other side of a medal" of globalization, being an evidence of insufficient development of democratic institutes of the country, its deviation from methods of competitive struggle in the global markets. In that case the power and wealth in this country are concentrated within a small group of people, separating the remaining society from democratic norms of using the public rights and resources. The opacity which is characteristic for the isolated societies generates the highest level of political corruption, suppression of healthy competition mechanisms, leads to a decrease of competences of people, financial and public institutes. Such status of a society is unbalanced and sooner or later comes to the ended with a collapse for those political and financial circles, who are striving to maintain this order.

[65] We shall estimate the isolation by means of inverse magnitude to an index of globalization [*Dreher,* 2006]. In this connection we shall also call isolation "inverse globalization".

[66] **4.2.8. Global warming.** Global warming is the process of gradual rise of average annual temperature of the Earth atmosphere and the World Ocean. As stated by the United Nations Interstate commission of experts on climate changing (ICECC), and national academies of sciences of G-8 countries, the average temperature on the Earth has risen by 1°C from the end of XIX century, and "major part of the warming observed in the last 50 years is caused by human activity", first of all, it is due to emissions of the gases causing greenhouse effect, such as carbon dioxide (CO_2) and methane (CH_4) (http://ru.wikipedia.org/wiki/).

[67] The estimations obtained on climatic models referred to by ICECC, show that the average temperature of the Earth may raise from 1 up to 15°C between 1990 and 2080 (in different regions, or on the average on the Earth). Predictably, warming will lead to other climatic changes, including a rise of the World Ocean level by 0.1–5 meters (it is probable in 30–40 years), and to changes in the quantity and distribution of atmospheric precipitation. As a result, natural cataclysms, such as flooding, droughts, hurricanes, etc., would become more frequent, the harvests would become poorer and many biological species may disappear. The struggle for control over diminished natural resources, both between the countries, and between separate groups of the population may become aggravated, which also would provoke new global conflicts.

[68] Taking into consideration, that emissions of carbon dioxide considerably exceed those of methane, we shall estimate the threat of global warming by the amount of carbon dioxide (CO_2) emission (Human Development Report, 2006; http://hdr.undp.org/en/reports/global/hdr2006/).

4.3. The Impact Analysis of the Totality of Global Threats on the Sustainability in the XXI Century

[69] We shall define the summarized impact of the totality of global threats (1–8) on different countries of the world. Being grounded on data on specified threats we shall use the method of cluster analysis with the purpose of selecting groups of the countries with "close" characteristics of summarized threats. We shall perform this procedure on the basis of application of Vard clusterization agglomerative hierarchical algorithm. For each country j we shall put the corresponding vector $\mathbf{Tr_j}$, with the elements describing the degree of corresponding threats (Table 8).

$$\mathbf{Tr_j} = (HIV, TB, WI, CINI, CP, \mathrm{CO_2}, TFC)$$

where HIV – number HIV-infected people (percentage of the population in the age of 15–49 years); TB – degree of

Table 8. The degree of remoteness from the totality of global threats

		Global Treats									
		(TFC)	(DI)	(GINI) Index	(HIV)	(TB)	(CP)	(GI)	(WI)	(CO_2)	
No	Country (GDP per capita, PPP, USD)	Consumption of traditional fuels (% of total power consumption in the country)	Demographic status (GDP/population density)	(Income inequality)	HIV/AIDS (15–49 years, %)	Tuberculosis (Number of patients per 100,000 population)	Corruption Perception	Inverse Globalization	Limited access to clean potable water (%)	CO_2 emission (metrictons)	($\|\mathbf{Tr_j}\|$) Degree of remoteness from the totality of global threats
1	2	3	4	5	6	7	8	9	10	11	12
					Cluster 1 (Very High)						
1	Australia ($32,000)	7.10	12.038	35.2	0.1	6	8.700	0.833	0.00	18.3	0.893
2	Canada ($32,900)	4.30	9.838	33.1	0.3	4	8.500	0.932	0.00	18.2	0.891
3	Sweden ($29,800)	20.40	1.485	25	0.1	3	9.200	0.969	0.00	6.2	0.851
4	Norway ($42,400)	6.10	2.970	25.8	0.1	4	8.800	0.785	0.00	9.3	0.849
5	Denmark ($33,400)	11.80	0.263	23.2	0.2	6	9.500	0.884	0.00	9.9	0.842
6	Finland ($30,600)	22.00	1.975	26.9	0.1	7	9.600	0.892	0.00	13	0.833
7	Netherlands ($30,600)	1.40	0.077	30.9	0.2	6	8.700	0.958	0.00	11.3	0.827
8	Switzerland ($35,300)	5.80	0.193	33.1	0.4	6	9.100	0.903	0.00	6.2	0.822
9	Austria ($32,900)	13.20	0.337	31	0.3	11	8.600	0.995	0.00	8.5	0.821
10	Germany ($29,800)	2.70	0.129	28.3	0.1	6	8.000	0.857	0.00	10.6	0.816
11	Great Britain ($30,900)	0.60	0.124	36.8	0.2	9	8.600	0.960	0.00	9.5	0.812
12	France ($30,000)	4.60	0.258	32.7	0.4	10	7.400	0.936	0.00	6.9	0.808
13	United States ($42,000)	3.10	1.343	45	0.6	4	7.300	0.832	0.00	20.1	0.794
14	Spain ($25,200)	3.70	0.314	32.5	0.7	20	6.800	0.857	0.00	7.5	0.791
					Cluster 2 (High)						
15	Hungary ($16,100)	5.00	0.150	26.9	0.1	30	5.200	0.837	1.00	8.3	0.783
16	Czech ($18,100)	3.00	0.140	27.3	0.1	11	4.800	0.887	0.00	12.5	0.783
17	Slovakia ($15,800)	2.20	0.142	25.8	0.1	23	4.700	0.707	0.00	7.8	0.773
18	Israel ($22,300)	0.00	0.072	34	0.1	7	5.900	0.681	0.00	10.5	0.759
19	Japan ($30,700)	1.20	0.091	38.1	0.1	39	7.600	0.581	0.00	9.5	0.750
20	Estonia ($16,400)	17.10	0.564	33	1.1	49	6.700	0.700	0.00	12.6	0.743
21	Jordan ($4,800)	1.30	0.073	36.4	0.1	5	5.300	0.589	3.00	3.1	0.741
22	Bulgaria ($9,000)	6.50	0.136	29.2	0.1	36	4.000	0.601	1.00	6.1	0.737
23	Croatia ($11,600)	6.20	0.146	29	0.1	65	3.400	0.658	0.00	4.6	0.737

Table 8. Continued

		Global Treats									
		(TFC)	(DI)	(GINI) Index	(HIV)	(TB)	(CP)	(GI)	(WI)	(CO_2)	
No	Country (GDP per capita, PPP, USD)	Consumption of traditional fuels (% of total power consumption in the country)	Demographic status (GDP/population density)	(Income inequality)	HIV/AIDS (15–49 years, %)	Tuberculosis (Number of patients per 100,000 population)	Corruption Perception	Inverse Globalization	Limited access to clean potable water (%)	CO_2 emission (metrictons)	($\|\mathbf{Tr_j}\|$) Degree of remoteness from the totality of global threats
1	2	3	4	5	6	7	8	9	10	11	12
		Cluster 3 (Middle)									
24	Chili ($11,300)	11.50	0.525	57.1	0.3	16	7.300	0.667	5.00	3.9	0.696
25	Egypt ($4,400)	9.40	0.055	34.4	0.1	35	3.300	0.429	2.00	2.1	0.696
26	Ukraine ($6,800)	1.60	0.089	29	1.4	151	2.800	0.545	4.00	6.2	0.695
27	Malaysia ($10,400)	6.50	0.138	49.2	0.4	133	5.000	0.756	1.00	6.3	0.689
28	Tunis ($7,600)	8.60	0.121	40	0.1	24	4.600	0.394	7.00	1.9	0.686
29	Jamaica ($4,200)	17.00	0.017	37.9	1.2	9	3.700	0.561	7.00	4.2	0.684
30	Russia ($10,700)	2.70	1.292	40.5	1.1	160	2.500	0.667	3.00	10.3	0.676
31	Latvia ($13,000)	46.50	0.372	35	0.6	71	2.600	0.542	1.00	3.3	0.674
32	Argentina ($13,700)	4.10	0.941	48.3	0.7	53	2.900	0.580	4.00	3.7	0.670
33	China ($6,300)	4.60	0.046	44	0.1	221	3.300	0.597	23.00	2.2	0.669
34	Algeria ($7,200)	6.40	0.514	35.3	0.1	54	3.100	0.298	15.00	3	0.661
35	Costa Rica ($10,100)	29.60	0.125	46.5	0.6	15	4.100	0.442	3.00	1.4	0.648
36	Morocco ($4,300)	6.10	0.057	40	0.1	105	3.200	0.411	19.00	1.3	0.646
37	Romania ($8,400)	12.40	0.090	28.8	0.1	188	3.100	0.568	43.00	5	0.636
38	Mexico ($10,100)	13.00	0.183	54.6	0.3	43	3.300	0.449	3.00	4.3	0.628
39	Colombia ($7,100)	15.80	0.182	53.8	0.7	75	3.900	0.401	7.00	1.4	0.621
40	Ecuador ($3,900)	18.70	0.080	42	0.3	196	2.300	0.434	6.00	2.1	0.620
41	India ($3,400)	19.80	0.010	32.5	0.9	312	3.300	0.362	14.00	1.1	0.619
42	Venezuela ($6,500)	2.50	0.228	49.1	0.7	52	2.300	0.423	17.00	6.5	0.616
43	Thailand ($8,300)	17.70	0.066	51.1	1.5	208	3.600	0.470	1.00	3.3	0.610
44	Indonesia ($3,700)	15.90	0.030	34.8	0.1	275	2.400	0.386	23.00	1.3	0.606
45	Black Friar Republic ($6,600)	26.90	0.034	47.4	1.7	118	2.800	0.392	5.00	3	0.601

Table 8. Continued

		Global Treats									
		(TFC)	(DI)	(GINI) Index	(HIV)	(TB)	(CP)	(GI)	(WI)	(CO_2)	
No	Country (GDP per capita, PPP, USD)	Consumption of traditional fuels (% of total power consumption in the country)	Demographic status (GDP/population density)	(Income inequality)	HIV/AIDS (15–49 years, %)	Tuberculosis (Number of patients per 100,000 population)	Corruption Perception	Inverse Globalization	Limited access to clean potable water (%)	CO_2 emission (metrictons)	($\|\mathbf{Tr_j}\|$) Degree of remoteness from the totality of global threats
1	2	3	4	5	6	7	8	9	10	11	12
					Cluster 4 (Low)						
46	Brazil ($8,400)	29.10	0.376	56.7	0.7	77	3.300	0.511	10.00	1.8	0.599
47	Panama ($7,100)	28.50	0.171	56.4	0.9	45	3.100	0.481	10.00	2.1	0.596
48	Sri Lanka ($4,300)	60.40	0.013	34.4	0.1	91	3.100	0.361	21.00	0.5	0.593
49	Pakistan ($2,400)	23.50	0.012	41	0.1	329	2.200	0.402	9.00	0.7	0.590
50	Peru ($6,100)	24.70	0.273	49.8	0.5	216	3.300	0.474	17.00	1.1	0.589
51	El Salvador ($5,100)	46.30	0.015	52.5	0.7	74	4.000	0.488	16.00	1.1	0.586
52	Guatemala ($5,200)	72.10	0.044	48.3	1.1	107	2.600	0.366	5.00	0.9	0.549
53	Philippines ($5,100)	33.20	0.017	46.6	0.1	463	2.500	0.502	15.00	1	0.547
54	Bolivia ($2,700)	18.80	0.325	60.6	0.1	290	2.700	0.353	15.00	1.3	0.537
55	Paraguay ($4,900)	55.00	0.299	56.8	0.5	107	2.600	0.371	14.00	0.7	0.536
56	Honduras ($2,800)	63.60	0.042	55	1.8	97	2.500	0.427	13.00	0.7	0.532
57	Nicaragua ($2,400)	69.30	0.055	55.1	0.2	80	2.600	0.391	21.00	0.7	0.520
58	Nepal ($1,500)	93.20	0.007	37.7	0.5	257	2.500	0.144	10.00	0.1	0.503
					Cluster 5 (Very low)						
59	Cameron ($1,900)	86.30	0.050	44.6	6.9	227	2.300	0.235	34.00	0.4	0.440
60	Republic of South Africa ($12,100)	11.60	0.335	59.3	21.5	670	4.600	0.554	12.00	7.4	0.431
61	Madagascar ($900)	81.90	0.027	47.5	1.7	351	3.100	0.177	50.00	0.1	0.420
62	Burundi ($600)	95.70	0.002	33.3	6.0	564	2.400	0.000	21.00	0	0.407
63	Uganda ($1,700)	93.50	0.013	43	4.1	646	2.700	0.283	40.00	0.1	0.384
64	Nigeria ($1,000)	82.90	0.007	50.6	5.4	531	2.200	0.411	52.00	0.3	0.377
65	Mali ($1,000)	86.70	0.103	50.5	1.9	578	2.800	0.251	50.00	0	0.375
66	Malawi ($600)	82.90	0.005	50.3	14.2	501	2.700	0.272	27.00	0.1	0.369
67	Zambia ($900)	87.20	0.059	52.6	16.5	707	2.600	0.393	42.00	0.2	0.305
68	Zimbabwe ($2,100)	67.20	0.067	56.8	24.6	673	2.400	0.216	19.00	1.2	0.294

tuberculosis spreading (number of patients per 100000 population); GI – an index of inverse globalization (it is calculated as 1/index KOF); WI – index of limited access to clean potable water (percentage of the population in the country not having access to potable water); CP – corruption perception index (varies from 0 up to 10, where 0 is maximum level of corruption, 10 – minimum); $GINI$ – index of inequality in distribution of allocation of material and social assets (varies in the range of 0–65, where 0 is minimum inequality, 65 is maximum inequality); DI – demographic status (it is estimated by the ratio of gross national product per capita in the country to the population density in the country); CO_2 – carbon dioxide emission (it is measured in metric tons); TFC – consumption of traditional fuels (it is measured in percentage of the total power consumption in the country).

[70] Initial data on each threat are normalized, so that its values vary over the range (0–1). Thus, 0 will correspond to maximum threat, 1 – to minimum. In other words, after such normalization any of threats becomes "closer" for the concrete country to the extent its numerical value is closer to zero, and "more distant" for the country, if its value is closer to 1.

[71] For example, normalization for HIV and TB is fulfilled by using relationships:

$$HIV^0 = 1 - \frac{HIV - HIV_{\min}}{HIV_{\max} - HIV_{\min}} \ ;$$

$$TB^0 = 1 - \frac{TB - TB_{\min}}{TB_{\max} - TB_{\min}} \ .$$

[72] Similarly the normalization for all other threats is fulfilled. As a result, we have a vector of the normalized threats:

$$\mathbf{Tr_j^0} = (HIV^0, TB^0, WI^0, GINI^0, CP^0, DI^0, {CO_2}^0, TFC^0) \ . \quad (7)$$

[73] Let us correlate with each j-th country some number $\|\mathbf{Tr_j}\|$, which is the Minkovsky norm of the vector $\mathbf{Tr_j}$ consisting of normalized threats at $p = 3$:

$$\left\|\mathbf{Tr_j}\right\| = \sqrt[3]{\sum_{l=1}^{n} (\mathbf{Tr_{jl}})^3} \ , \quad (8)$$

where $\|\mathbf{Tr_j}\|$ is the threats vector norm for j-th country. Let us identify the norm of vector $\|\mathbf{Tr_j}\|$ as a degree of remoteness from the totality of threats.

[74] On the basis of the computed norms of the vector of threats $\|\mathbf{Tr_j}\|$ for each country j let us introduce relationship of order between countries' clusters (Table 8).

$$K_k \pi K_j \Longleftrightarrow \left\|\mathbf{Tr_k}\right\| \leq \left\|\mathbf{Tr_j}\right\| \ . \quad (9)$$

[75] From Table 8 it follows that cluster 1 includes a group of "the most satisfactory countries", from the point of view of safety, for which the degree of remoteness from the totality of threats is highest. Moreover the world leaders in terms of sustainable development index for 2006 (Finland, Switzerland, Denmark, Sweden, United Kingdom, Australia, United States, Canada, Austria, Table 4) also belong to cluster 1 (Table 8) as the most satisfactory countries, from the safety point of view.

[76] And, on the contrary, cluster 5 includes the countries most vulnerable in this respect. For them the remoteness degree from the totality of threats is minimal. The comparison of cluster 5 of Table 3 and cluster 5 of Table 8 shows that the countries with the lowest values of sustainable development index (like Cameroon, Madagascar, Uganda, Malawi, Zambia, Zimbabwe) at the same time are most vulnerable in respect of safety.

[77] Ukraine, China, Russia, India, Romania, Egypt, Mexico, Argentina and a number of other countries belongs to cluster 3 with the average remoteness from the totality of global threats. The most dangerous global threats for Ukraine are the level of spreading HIV/AIDS and tuberculosis which is one of the highest in the world and a very high level of corruption.

4.4. Possible Scenarios Generated by "The Conflict of XXI Century"

[78] Since from relationship (3) and Table 6 it follows that at $n > 6$ for C_n – waves the inverse Fibonacci series $\{F_s\}$ is degenerated, there is a natural question what should happen with the world civilization in the course of "the conflict of XXI century" and after 2092, in particular, in XXII century? Maybe, there is a closing cycle of some evolutionary chain:

$$C_7 \rightarrow C_6 \rightarrow C_5 \rightarrow C_4 \rightarrow C_3 \rightarrow C_2 \rightarrow C_1?$$

[79] The answer to this question can be found in the works of two outstanding scientists of the past century – V. I. Vernadsky: "In the geological history of biosphere human beings will have great future, if they realize it and do not use their mind and labor for self-destruction" [*Vernadsky,* 1944] and N. N. Moiseyev: "If the mankind is not going to radically change its behavior on the Planetary scale, then in the middle of XXI century there may appear conditions under which people cannot exist" [*Moiseyev,* 2000]. Taking into consideration that the statistical data on the world conflicts (presented in (List of wars, 2007; http://en.wikipedia.org /wiki/List_of_wars) for the time span from 2500 B.C. up to now) corresponded to the constant paradigm of the mankind existence "to meet people's own interests", then according to [*Vernadsky,* 1944] and [*Moiseyev,* 2000] with the persistence of this paradigm on the Planetary scale, already in the middle of XXI, it would not be possible for people to exist.

[80] If we assume that the mankind will change the paradigm of its existence on the Planetary scale for another, for example, for the paradigm of "harmonious coexistence", then the systemic regularity of world conflicts over the course of time determined for the previous paradigm corresponding to the Fibonacci series, obviously, will lose its validity. Thus, the mankind will find new prospects for prolongation of its mission on the Planet.

5. Conclusions

[81] 1. The new Sustainable Development Gauging Matrix (SDGM) was developed and argued. SDGM as a sys-

tem analysis model uses mathematical formulas to integrate a large number of indices and metrics measuring the sustainable development of countries. This interdisciplinary model seeks to integrate economic, ecological, and social/institutional factors. All three areas should be developed in harmony in order for a country to have "sustainable development".

[82] 2. The model takes into account reports from well known international organizations and institutions, including the United Nations, the World Economic Forum, Heritage Foundation, Economist Intelligence Unit, Transparency International, Yale University working group on the environment and others. This model allows carrying out the global simulation of sustainable development processes for different specific applications.

[83] 3. Based on the analysis of data pertaining to global conflicts taking place from 705 B.C. till now, the regularity of their occurrence is determined. It is shown that a sequence of life cycles of system world conflicts is subordinate to the law of the Fibonacci series, and the intensity of these conflicts, depending on a level of technological evolution of the society, builds up under the hyperbolic law. By using the determined regularity we attempt to foresee the upcoming world conflict, called "the conflict of XXI century", and analyze its nature and the principal characteristics – duration, main phases of its flow and intensity.

[84] 4. We analyze a set of basic global threats that generate "the conflict of XXI century", and by using the cluster analysis identify the impact of these threats on different countries of the world. The examples of the threats to the future of the planet identified by the model are: population growth rates in less developed countries, the spread of HIV/AIDS, tuberculosis, corruption, CO_2 emissions, and projected shortfalls in the production of energy resources, such as oil, gas, and uranium. The model also analyzes the periodicity of conflicts, and presents a model for predicting future conflicts. Then, a number of possible scenarios are built regarding the world community evolution during and after the specified system conflict.

[85] 5. In such a way the created mathematical model has political implications and could become a method for politicians to measure their country's progress. The model can serve as the basis for providing informed and accurate analysis to politicians for developing some recommendations regarding the ways of improving the standards of quality and safety of life in particular countries and regions of the world by the global computer simulation of sustainable development and security of world population.

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